MANAGING WATERSHED ENVIRONMENT

Shared Control of Natural Resources, SCOR Project
International Irrigation Management Institute

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The need for Internalizing Environmental Considerations into Agricultural Decision Making

In many countries there is an urgent need for more intensive but environmentally appropriate utilization of the natural resources base, particularly, land and water, for profitable and sustainable production in agriculture industry and other uses. In these countries, more and more farmers, even those with small holdings, make production responses to the economic environment within which they carry out their farming activities. *These responses are influenced by the degree of control the users can exercise over their means of production, availability of productive, sustainable and appropriate technology, availability of information about market conditions and opportunities and the necessary support services.*

The typical processes used for environmental protection in the industrial sector--establishment of environmental standards, monitoring of impacts, and enforcement of rules--can be effective because most of the practices with environmental impacts can be identified with the individual producer. In the agriculture sector, particularly in farming, adverse impacts are usually the result of the ***cumulative*** effects of the actions of many and are difficult to identify with individuals against whom corrective actions can be taken. These problems, typically of a *non-point source,* cannot be effectively dealt with using the point source control mechanisms. *These cumulative effects*, such as erosion resulting from inappropriate cultivation practices, pesticide and nitrate contamination of groundwater and nitrate or phosphorous eutrophication of tanks and streams, *are the results of decisions made in the normal course of farming. Unless the actors are informed by the knowledge of potential impact, and unless profitable alternatives exist for these cultivation practices and the management of these chemicals, environmentally inappropriate decisions will continue to be made.* (SCOR Project paper)

Other environmental impacts may be the result of failure to use appropriate protection practices because they are technically too difficult or too expensive. Erosion control practices that require physical structures are an example.

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[1]Paper presented to the "Watershed Management Forum", University of the Philippines, Los Banos, 4-6 October, 1995.

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While most agricultural environmental impacts are from non-point sources, some, such as those resulting from inappropriate irrigation or accelerated erosion resulting from inappropriate (or illegal) cutting of trees on fragile lands can be identified with individuals. In these cases, more often than not, penalties are proposed to generate corrective action. *However, understanding of alternate use, incentive structures (for example, usufructuary rights for users for environmentally sound production in "Government-owned" stream/irrigation canal reservations), and reduction in pressures to use environmentally fragile lands through participatory protection of natural resources are usually much more effective in internalizing environmental considerations into agricultural decision making.*

SCOR CONCEPTS AND STRATEGIES

SCOR is a *participatory action-research project aimed at developing and testing a holistic interdisciplinary approach to integrate environmental and conservation concerns with production goals in the watershed context.* The "conservation" strategy being tested in SCOR is different from traditional approaches. SCOR hypothesize that a *package* of measures (type of vegetation, land water saving and conservation practices, appropriate land and water management practices and related user rights) should be selected in consultation with (or jointly with) the users and both production and conservation 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 to motivate her/him to protect natural resources.

SCOR concepts and strategies were developed through a unique participatory project design process spearheaded by a core group of experts, including senior government officials, who are closely associated with the management of land and water resources of Sri Lanka. The process was designed and facilitated by IIMI and financed by USAID. The three-month design process included a review of experiences in the management of natural resources in Sri Lanka and elsewhere, a series of consultations and project development workshops with a cross section of resources users, government officials at various levels, development banks and representatives of nongovernmental organizations (NGOs).

A participatory analysis of constraints to the potential for sustainable increases in productivity in the watersheds paved the way to SCOR. Four types of major constraints have been identified in relation to environmentally appropriate increases in production.

(a) The lack of a *production environment* (including profitability, security of tenure and local control of resources) that motivates the resources user to effectively manage the combination of resources essential to optimize economic production while conserving land and water resources.

(b) The lack of an effective combination of technology, skills, incentives and (mechanisms to enforce) penalties that encourage *internalization of environmental considerations into management decisions.*

(c) The lack of adequate information about land and water resources management at appropriate levels.

(d) Institutional and organizational constraints, including inadequate coordination between projects/activities of land and water resources development.

The SCOR strategy is based on: the need for understanding the hydrological, socio-economic, and other interactions between different segments of watersheds; the experience in group economic and natural resources management efforts--notably of the water user groups associated with irrigation; and (c) the assumptions related to tenurial security, usufructuary rights, state-user partnerships and other shared control mechanisms in natural resources management.

SCOR Project concepts, strategies and activities are summarized and illustrated in Figures 1 & 2. Figure 3 is a schematic presentation of pre-project status of degraded watershed. Figure 4 illustrates the expected developments approaching and "ideal" situation.

Objectives of SCOR Participatory Action Research

to develop and test strategies to optimize the **watershed-wide macro efficiencies in land and water resources use with due regard to the environment;**

- To develop and test strategies to improve the *incentive* and *institutional* context in which land- and water-related activities are undertaken in watersheds through appropriate *modes of production and state-user partnerships* to ensure both the productivity and the sustainability of these resources.

To get resources user groups and managers to consider environmental implications of land and water use more explicitly and to *internalize environmental considerations* in decision making and implementation at all levels.

To enhance *information and the understanding* (of the government, groups and individuals) about potentials of and prospects for the natural resources (land and water) base for production and conservation.

To *strengthen the capacity* of the Provincial/Divisional level government authorities in planning for land and water resources utilization in an integrated manner, gradually transforming the *strategy of development of land and water resources from a "project" mode to a "program mode."*

Watershed as the Basic Planning, Coordinating and Implementation Unit

The focus on watersheds as the basic planning, coordinating and implementation unit is an important feature of SCOR. The term watershed is defined as the area of land surface that

drains water into a common point along a stream or river[3]. The rationale for using the watershed as the basic unit for integrated planning of (land and water) resources utilization is clear. The watershed is a physical entity geographically defined by an important natural resource, water; the ways in which the water in the upper parts of the watershed are used affect the ways in which it can be used downstream, and they affect the associated land resource.

SCOR participatory action-research program considers the total utilization and management of water resources and associated land in a watershed. The project aims at optimizing watershed - wide water use efficiency. For example, in Figure 5 a unit of water in the upstream (w_1) may be characterized by a quantity/volume of v_1 and a quality level of q_1. The potential productivity of that unit will depend (in addition to type & method of utilization) on v_1 & q_1. As illustrated in Figure 1, at the point, a portion of v_1 may be "lost" due to evapo-transpiration, percolation etc. However, part of this "loss" may re-appear number of times later in the watershed, (v_2, v_3, v_4, ... V_n). Therefore, computations of water use efficiencies, using only the volumes applied to irrigation commands need to be adjusted considering the re-use patterns. Depending on upstream (agri. and non-agri.) land and water use, quality of water may also change (q_2, q_3 ...). The potential use at a given point will depend on the qualitative & quantitative aspects of water use in the upstream, terrain & soil characteristics, vegetation cover, methods employed in re-capturing etc. Hence, the characterization of the geographic space of the landscape systematically by appropriate unit of analysis (sub/micro watershed, farm plot etc.) based on supply characteristics of water (quality and quantity over time) and land (capability & fertility levels, drainage quality, depth etc.) is useful in a watershed management effort. Based on such information and socio economic (including market potential) and environmental considerations, different land & water use options can be evaluated in a participatory mode.

Moreover, various parts of the watershed are physically and operationally linked in important ways, and the potential benefits from integrated use can be large. For example, the SCOR Huruluwewa watershed contains about 220 small tanks (in addition to the major reservoir). Most of these small tanks are in series of clusters or in cascades. In addition, ground water extraction from the weathered rock up to a depth of about 10 m in the dry and intermediate zones of Sri Lanka 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 drawdown of water in the well while pumping from adjoining wells in progress. This situation has limited the "on-demand" nature of some wells. Moreover, in certain locations, farmers, after excavating to depths exceeding 6-7m and spending about Rs. 40,000 - 50,000 (US$800-1,000) per well, have found out that the water yields are not satisfactory. Some of them continued their efforts by driving tubewells from that point up to the underlying deep rock. In addition, the negative consequences of the proliferation of agro-wells include the lowering of the water table and associated problems such

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[3] According to this definition there can be sub watersheds depending on the order of streams. Hence, the river basin can be considered as the highest order watershed.

as moisture deficits in rainfed farming areas, threats to domestic wells, and income disparities. According to SCOR Project's participatory resource mapping, there are about 1000 agro-wells within the command area of the reservoir and associated highlands. Most of these have been constructed over the past 2-4 years. Moreover, recent monitoring of rainfall at several points within the watershed shows a significant "microscale variation". *The challenge to SCOR is to study the spatial and temporal variations of: rainfall, and other sources of water available to the agricultural production system and to assist users in distributing and using those supplies rationally (among various users) and 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 is clear from the above discussion that different combinations of various sources of water can be used. An in-depth analysis of supply (e.g., water balance) and demand options (e.g., conjunctive use, diversified cropping, water conservation measures) is being conducted for this purpose. Temporal and spatial dimensions also considered in such an analysis.

In addition, the people in the different components of the watershed having access to different aspects of the natural resources base may be engaged in different economic activities, and may be of different social and/or cultural backgrounds. For example, people in the upper catchment areas may have very different environmental, economic and social conditions from those in associated irrigated commands and those in downstream areas of the irrigated areas. Thus, the personal and economic interests in the different areas do not necessarily coincide, introducing problems for planning and implementation.

This implies that socioeconomic and institutional factors too influence the linkages between "upstream and downstream." For example, the interrelationships between ***chena*** (shifting, slash and burn cultivation) in the catchment areas of reservoirs in the watershed (mainly in the upstream of watersheds) and rice farming in the irrigated commands and drainage areas (downstream) are influenced by socioeconomic factors. Similarly, there exist significant socioeconomic relations among tank systems within a "minor tank cascade." Such factors as land tenure, power structure, village institutions, community traditions, etc. can influence land and water use patterns within tank systems as well as within river basins/watersheds. As people are the final decision makers regarding the use of land and water resources, they not only influence these linkages and relationships but also can change the production potential of land and water resources either favorably or adversely.

Thus, any conservation or environment management approach should consider those physical, socioeconomic, and institutional linkages that exist between upstream and downstream of a river basin/watershed, and between systems within watersheds (such as the variations within and between micro watersheds/basins like the tank cascade systems). It should also consider the role of users both in "production and conservation." *In other words, sustainable agricultural development in the broad context of rural development in these areas requires a watershed-based integrated approach which not only optimizes the production, but also ensures the protection of the natural resources or production base with active participation of the users concerned.*

Potential benefits from such an integrated participatory watershed management effort can be large.

Moreover, the physical boundaries of the watershed are rarely congruent with the boundaries of the administrative or constituent political entities. This situation complicates the processes of planning and implementation.

An integrated participatory approach is useful to overcome these problems, the Project emphasizes an integrated participatory approach, and makes a substantial effort in linkage and coordination. Experience in the major irrigated commands in many countries has shown that the combination of the use of catalysts, sharing of information, and reasonable administrative and political support can bring divergent groups into successful cooperative activity. While the process will be more difficult in the context of the full watershed, *there is a reasonable probability of success, and the potential for major benefits.*

User-oriented/participatory

The strategy is designed to be user-oriented and participatory. This means that much of the emphasis and activity of the Project will be at the field level in the selected watersheds. The approach will be to increase the **share of control of the natural resources of the watershed by the users and to support them as they attempt to intensify, expand or move into new economic activities. To achieve economies of scale, and to utilize group solidarity to promote responsible behavior, the Project is based upon group action as a primary vehicle for Project implementation.**

As constraints to group activities are identified, the Project assists in the removal of the constraints. When the constraints are the result of policies, rules, regulations, or actions of a higher level, the Project works at those levels to achieve the purposes of the Project. **Demand-driven changes** are likely to be more expeditiously addressed than recommendations for change from above. The Project structure, including Steering Committees in each of the provinces and at the national level facilitates the process of inducing change.

The Project's participatory mode, starting with the design process, in which officials, resources user group representative and others from the national, provincial, district and divisional levels played important roles, through to implementation should facilitate both the identification of problems and constraints and their solutions.

Shared Control of Resources

SCOR aims at <u>sustaining</u> productivity of land and water resources within watersheds through shared control by local user groups and the government involving formal agreements and joint management. In the Sri Lankan situation, such a process should clearly increase the share of users' control over land and water resources.

SCOR makes a different interpretation of the property rights defining it in the context of individual and communal ownership of resources based on culture, local values and local market conditions. For example, instead of exclusive individual property rights (in this case a complete transfer of ownership of state land to individuals) concept of **shared control**, usufructuary rights, longer term lease arrangements, **state-user partnerships** are being tested in pilot watersheds. It is hypothesized that such alternatives to exclusive individual property rights may provide the Sri Lankan natural resources user a sense of ownership.

A Proper Mix of Technology, Organizations/Institutions, Policy and Resources

SCOR assumes that the "sense of ownership" is a necessary condition but not a sufficient condition for motivation to undertake sustainable practices. Therefore, the sense of ownership should be backed by **technology, organizations/institutions, policy and resources.** The project activities, classified under four themes, aimed at this:

i. Strengthening the Capabilities of Resources User Groups

a) Survey of Existing Local Organizations (in pilot areas)
b) Participatory constraints Analysis (in pilot areas)
c) User Group Creation (in pilot areas)
d) Legal Status and Powers for User Groups including formal agreements between user groups and state
e) Skill Development and Training for User Groups and Trainers
f) Environmentally sound Economic Opportunities for User Groups
g) **Appropriate technologies and techniques aimed at balancing production and protection: eg: selection of crops, cropping patterns and practices, inter and intra segment management of water, conservation farming, water saving techniques, conjunctive use of water aquaculture agro-forestry.**
h) Supporting Services and Facilities for User Groups
i) Establish Production Companies (for advanced user groups)

ii. Improving Land and Other Resources Tenure Arrangements

a) **Regulatory and Legal Mechanisms including land & water rights**
b) Resources Access and Tenurial Arrangements
c) Policy and Process Reform (long term)
d) Land Titling
e) Consolidation of fragmented land holdings

iii. Strengthening Government, NGO and Private Sector Capacities to Support User Groups through Participatory Land and Water Management, Training and Skill Development

a) Information Systems
b) National Departments and Agencies

c) Provincial Councils and Staffs
d) Divisional Offices and Line Agency Staffs
e) Strengthening of NGOs
f) Strengthening of the Private Sector and Banks

iv. Improving Coordination and Linkage for Land and Water Resource Management

a) Coordination among Projects, Programs and Activities
b) Coordinate and Improve Provincial and Divisional Planning and Implementation
c) Coordinate the activities of different Government Agencies and Donors
d) Administrative and Coordination Mechanisms for Watersheds (in pilot areas)
e) Multi-Level Planning (in pilot areas)
f) User Group Federations in Watersheds (in pilot areas)
g) Establishment of Information System

APPLICATIONS AT MULTIPLE LEVELS

The appropriateness of the SCOR approach is being tested and demonstrated in two pilot watersheds of Sri Lanka, namely, Huruluwewa (HW) in the North Central Province and Nilwala (NW) in the Southern Province. These watersheds were chosen for their differing social, agricultural and environmental characteristics. In these pilot areas, 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 tenurial arrangement and state-user partnership. **Integrated planning and improved co-ordination of land and water related projects, programs and activities on a watershed basis will be an integral component of the SCOR project. Moreover, based on watershed and field level experiences, relevant policy changes will be formulated and programs designed to spread the benefits from SCOR through replication by other agencies. Hence SCOR will be operational at multiple levels.**

While the Project focuses the majority of its activities at the local level, with the watershed as the basic unit, other activities will take place at the divisional, district, provincial and national levels. The specific activities at the intermediate levels will be determined in the process of dealing with the problems and constraints identified in the selected watershed. It is anticipated that these activities will be those that strengthen the ability of the government and others to more adequately provide supporting services to the user groups, and to assist in the reorientation of the government agencies to a client-centered mode.

At the **National level**, the primary emphasis is on strengthening the capacity to deliver appropriate information on natural resources to the broad community that can benefit from that information. In addition, primarily based on the results of the Projects action-research activity, certain policy and process reforms are being promoted at this level.

Inter-Project/Activity Co-ordination

In the pilot watersheds, SCOR project takes the leadership in bringing the activities (projects, programs, etc.) based on land and water resources into closer co-ordination. The project will strengthen the capacity of the provincial and Divisional Secretariats in integrated planning for the utilization of land and water resources in the watersheds. The institutionalization of such an approach will shift the strategy of development of land and water resources (in the watersheds) from an uncoordinated "project mode" to a well co-ordinated "program mode".

Integrating Agro-forestry and Inland Fisheries into Watershed Management Strategies

Linkages have been established with Forest Department to implement the participatory agro-forestry program and with the Ministry of Aquaculture to implement and inland fisheries program using participatory modes. The initial emphasis in the latter will be on minor tanks or village tanks.

Upstream-Downstream Linkages

Remarkable achievements have been already achieved in linking "Upstream & Downstream", institutionally as well as in terms of surface water sharing:

a) Organized groups of farmers in the "downstream" (irrigation command) areas had initiated negotiations with the farmer organizations in the "upstream" (catchment) areas[4].

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[4] 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 60 mile-long feeder canal the first five miles falls within the jurisdiction of the Mahaweli authority. The balance part comes under the control of the Irrigation Department. The main canal is a trans-basin canal taking water to several systems, including Huruluwewa. it is about 25 miles long and bifurcates to convey water to Huruluwewa (through a feeder canal - 150 cusecs) and to some other major irrigation systems. Some selected issues relevant to SCOR efforts are listed below:

I. The feeder canal was constructed in 1976 cutting across the catchments of several minor tank systems thus depriving some (**not all**) of the present "illegitimate users" of the water rights they would have enjoyed before the canal was cut.

II. Legal measures to stop illegitimate syphoning of water have proved a failure.

III. Irrigation Management Division of the Ministry of Irrigation had attempted to establish contact with these upstream users. In fact, IMD has formed several farmer organizations in this area.

IV. **Land productivity in this "illegal area" is high. However, water is freely syphoned out and therefore, water productivity is low.**

b) Watershed-level farmers council has been formed with the federated farmer organizations of the upstream & downstream areas.

c) They held pre-season cultivation meetings jointly, decided on a mutually beneficial water allocation and cropping schedules. **IIMI researchers provided hydrological and other related information, based on research studies.**

In the water deficit dry season, the irrigated area was divided equally among all the farmers and soya bean was cultivated instead of paddy. In the upstream catchment areas farmers decided to cultivate only half an acre each. The major crop in this area was onion.

d) A "task force" has been created, consisting of farmer leaders, local government authorities and irrigation and land settlement agencies to design and implement a land and irrigation management program to solve the problem of illegal cultivators/"encroachers" in the catchment area.

Land & Water Management at Sub-Watershed Level

The selected sub-watersheds for SCOR action-research are contiguous areas of manageable size, having characteristic profiles of ecological, socio-economic and environmental features similar to that of the respective main watersheds. Size of these selected pilot sub-watersheds ranges from about 200-1000 ha. One such sub-watershed is used here to illustrate the SCOR participatory action research process aimed at testing hypotheses and developing models for integrated land and water development. Hydrological characteristics of this sub-watershed, namely Maha Meegaswewa (MM), is shown in Figure 6. Action is being taken through a participatory process to learn, test and demonstrate on "ideal" land use pattern with due emphasis on production and conservation. This participatory approach of developing methodologies for combining technology, organizations and resources would illustrate the various production-conservation elements with their intimate relationships, that will have to be incorporated in the management of watersheds or tank ecosystems in a sustainable manner. Micro concentration on **contiguous areas** or tank ecosystems within which "every inch of surface" is carefully planned and monitored for the impacts of participatory research interventions is a unique characteristic of SCOR.

V. Hence there are lot of "new comers" - some of them operate on large illegal holdings. This has become a politically sensitive issue at present.

VI. The upper contours of the area are being encroached and soil erosion is substantial.

VII. The soils in this area are generally well-drained and there is potential for increasing water use efficiency if a non-paddy cropping pattern could be introduced; without sacrificing user income.

Participatory Appraisal of Sub watersheds/Tank ecosystems

In the selected sub-watersheds, participatory appraisal of the characteristics of resource uses and users as well as mapping of **current** resource use were done by groups comprising of resource users/farmers, local officials of government agencies such as Irrigation, Agriculture, Forestry and Agrarian Services departments, IIMI-SCOR professional and catalysts. The catalysts took the lead role in preparing the resource use maps and recording information. General objectives of this Participatory Rapid Appraisal were to:

a) Prepare a **detailed** map of the sub watershed or tank ecosystem indicating: the land use pattern of **individual holdings** in the entire tank ecosystem/sub-watershed (catchment, command areas, homesteads, drainage areas etc.), cropping/vegetation patterns, type and quality of cropping/vegetation cover, tank and the natural drainage system, road network, residential pattern.

b) Develop a database, including basic data such as: type and membership of user organizations, land fragmentation, ownership and tenurial patterns, cropping patterns and intensities (current and in the recent past), slop category, apparent degree of soil erosion, conservation practices, cultivation practices, input use of agriculture, production and productivity, and constraints to production and conservation, yield performance, profits derives from different holdings in different zones. Social organizations including farmers organizations, conflicts, assistance from government support services and NGOs.

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

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

For this purpose, each group was provided with a line diagram/sketch map of 1:3000 scale with land marks indicating roads and streams for guidance. The groups collected data and mapped each land plot of a village. Refining of the map to maintain accuracy to scale was done subsequently by the draftsman supporting the group and the *map was used for participatory planning of resources management of the village.* Land and water use as well as other information collected through the participatory mapping exercise have been incorporated into the SCOR spatial database using a Geographic Information System (GIS). This was repeated for each village in selected sub-watershed system and for all selected sub-watersheds. For example, Figure 7 shows the pre-project land use (as of January 1994) by individual plot of one such sub-watershed, in this case a tank system namely Maha Meegaswewa, MM. For this village, a participatory resource management "mini project" was formulated with an investment of Rs. 1.2 million (US$ 24,000). The project aims to change the present *land and water use pattern to a more profitable and diversified resource use combining production and conservation using appropriate technologies/ techniques, novel shared control arrangements and resource*

augmentation. New commercial enterprises and conservation practices in a typical sub-watershed in the Huruluwewa Watershed include: integrated wet and dry season water management in command areas (eg: water saving techniques to improve cropping intensity and introducing short duration commercial crops in the dry season, cultivation of medicinal plants, fruits and vegetables in chena (shifting cultivation areas), processing industry for medicinal plants, stabilized cropping patterns for chena and highlands, contour bunds to cover the entire area, water harvesting techniques, etc.

This means that the villages in such pilot sub-watersheds have "action plans" that guide them along a path to the planned future from the current status of resource use. The planned future land use pattern is illustrated in Figure 8 while the land use pattern as of February 1995 is illustrated in Figure 9. Contour bunds and drains are being established to cover the entire extent shown in this map as well as in several other pilot areas.

Components of Conservation Farming and organic matter management (adopted by users) in selected tank ecosystems include:

a) mulching (crop or weed residues) to increase soil moisture retention and to effectively use the limited rainfall and irrigation water. Promising results have been achieved in all sites: farmer managed to increase irrigation interval from 3 to 6 in chillies and from 8 to 16 in beans; time take to reach wilting point was significantly higher when compared to areas without mulch; branches, leaves, flowers and pods per plant were significantly higher and consequently high crop yields have been achiever;

b) adoption of contour bunds and drains and stabilization by biological means - as water harvesting/saving technique and for soil conservation.

c) combination of agriculture and forestry eg: through alley cropping, home gardening (forest gardens), growing seasonal and perennial between contour bunds in the uplands,

d) green manuring,

e) mixed cropping and integration of livestock,

f) integrated pest management

Novel modes of state-user partnerships in land and water resources use have been arranged. The banks have agreed to provide loans for the user organization. A Colombo-based company offered a forward contract to the user organization to purchase most of the expected produce under the "mini-project".

A leadership emerged from the community with leaders of groups, organizations and

companies aimed at production and conservation (Figure 10) and volunteer catalysts representing each production zone in the village, which is the correct basis for selecting mobilizers without considerations of party politics. They have access to information from outside and knowledge gained from their own experiments in their own farms with the support of the government officers and others who extend such support to them. They can mobilize resources to carry out their plans and finally become shareholders of their own company will control over the production process, which is a productive way of small farmers to gain and share prosperity in an open economy.

SCOR Management Information System, and Monitoring and Evaluation

A continuous flow of information is required to enrich the SCOR participatory process facilitating interaction, debate and resolution. The prudent use of information technology (IT) in the generation, process and analysis of information needed is crucial to support the planning, implementation and evaluation processes. For this, SCOR will use a Management Information System (MIS) and a rigorous monitoring and evaluation (M&E) activity through a participatory procedure involving user groups, government and other project participants. It reviews the progress and employs a feedback/correcting mechanism to ensure that project inputs, work schedules, targeted outputs and other related actions are proceeding according to plan. This mechanism also provides data for continuous and periodic evaluations to determine systematically and objectively the relevance, efficiencies, effectiveness (and impact) of project activities.

MIS and M&E of SCOR monitor and evaluate *project activities* or inputs as well as the *achievement of specific objectives of the project*. These two are related to each other and will eventually lead to *project's impacts*.

Figure 11 lists the basic data requirements to gain knowledge on the watershed and Figure 12 illustrates the Management Information Systems and the Operation of the Monitoring and Evaluation System of SCOR.

It should be noted that SCOR M & E database is not separated from its research database. As much as possible, a common data collection program and a database will be used to compute M&E indicators as well as the indicators used for special research studies and indepth analyses.

Data for establishing "benchmark" and follow-up M&E will come from three sources:

a) Data base maintained by farmer/user groups using simple indicators - Self M&E:-
This can be expected only after organizing user groups and at the intervention phase. For example, a minimum set of indicators would include:
- no. of current members of the group;
- quantity/extent of new production/conservation activities undertaken during the month/quarter such as:
- length of contour bunds established;

- length of organic bunds established;
- group tree planting, group nursery established; etc.
- no. of interactions had with government officers on project activities;
- no. of members received training;
- no. of meetings held;
- no. of conflicts recorded and mode of resolution;
- group investments (cumulative) by activity;
- change of (legal) status of the group.

b) Data collected by educated volunteers employed by IIMI/universities or other research institutes e.g.: students in the community, teachers, others:-
Such data/indicators may include:
- farm inputs: labor, chemicals, seed, power (as & when necessary);
- crop yields, profitability and productivity;
- water flow measurements, water use efficiency, water productivity;
- salient features of meetings;

c) Data collected by agency officials or specially employed Research Assistants:-
Data/indicators covered by this group would include:

a) in the catchments: - rainfall, run-off, soil moisture, soil fertility, soil loss/sediment transportation, moisture retaining capacity and infiltration, trees/plants by type, investments, water quality;

b) in the irrigated command: - extents irrigated, adequacy of supply, reliability of supply, equity in supply, agency/user participation in O&M, adequacy of maintenance activities, user-agency conflicts;

c) in both areas: - crop yields through crop cuts, incomes, tree/crop density, re-use patterns of water, user interactions between watershed and command areas.

Outputs:

Major outputs of M&E and Research studies will be the assessment of SCOR Project based on specific indicators. Major indicators are listed below :

- Targeted hectares under improved production and conservation techniques

- Value of targeted investment by the resource users in environmentally sound production practices

- Government policy decisions initiated

- Targeted land area covered by new agreements between GSL and user groups

(Extent now under conservation and production practices expecting user rights)

- Farm households using improved environmental techniques
- Number of Natural Resource Groups Operating
    - farmer/user acceptance and participation
    - Technology adoption
    - User-agency relations
    - extents irrigated
    - Erosion coefficients
    - vegetative cover by type of vegetation
    - soil and water conservation improvements
    - rainfall: run-off ratio
    - cropping intensity improvements
    - water use efficiency (macro/watershed and micro)
    - water productivity
    - land productivity
    - income/investment levels by users
    - equity
    - profitability

Few examples of specific research outputs are given below.

Research Publications and Progress Reports

The project is designed to innovate novel approaches to watershed management through participatory methods. Hence, proper documentation, dissemination of information and sharing of international experiences should be planned for. In addition, most of the special studies will be conducted directly by IIMI staff and the data for most of these studies will come from SCOR M&E program. Allocation for special study/research contracts in the proposed budget will be utilized to study specific aspects related to watershed management. Universities/other research institutions will also be contracted for this purpose. Such institutions are collaborating with IIMI in a participatory mode. The topics for IIMI and contract research include: watershed-wide land & water use efficiency, Watershed water balance, integrated water management, competing users and uses, shared control and organizational development in watersheds, impact on environment, social conflicts, and agri-business, etc. Based on such studies several research publications, journal articles, conference papers, etc. will be produced. Few examples of such research outputs are listed in Annex 1.

Annex 1

Special Research Studies :

a. **Integrated water management in basin watersheds**

a.1 Rainfall trends and surface water balance in Sub-watersheds - The Mahameegaswewa sub watershed.

a.2 Analysis of planning of water allocation and distribution and water use efficiency in major and minor tanks (surface water) in the Huruluwewa watershed.

a.3 Agro-well and groundwater management in Huruluwewa watershed.

a.4 Water balance models for Huruluwewa watershed.

a.5 Re-use patterns and Macro water use efficiency in watersheds.

b. **Soil and Water Conservation and Conservation farming in highlands**

b.6 Environmental impact of soil and water conservation interventions in Huruluwewa and Nilwala watersheds.

b.7 Stabilization of shifting cultivation (Chena) areas.(agro-forestry and conservation farming).

b.8 Production and conservation in homesteads with emphasis on women's groups (Huruluwewa watershed).

b.9 Environmentally Sound Tea Cultivation in the Upper Nilwala Watersheds

b.10 Evaluation of technology adoption in balancing production and conservation in Nilwala & Huruluwewa watersheds.

b.11 Spatial & Temporal Changes in Water Quality in Nilwala and Huruluwewa Watersheds.

c. **Integrated planning and coordination (involve A & B)**

c.12 Participatory mapping as a tool for planning and M & E.

c.13 Process documentation of SCOR

c.14 Integrated planning of watershed resources management strategies and processes

d. Development of User Organizations and participatory approaches in watershed management (involves A and B).

d.15 Development and sustainability of user organizations in watershed management in Nilwala & Huruluwewa watersheds.

e. Tenurial Security and Shared control of watershed management.

e.16 Impact of Land Tenure on Production and Conservation.

e.17 Land consolidation in minor tank command areas.

e.18 Policy research related to organizational and business modes for production and conservation, ranging from informal groups to production/processing/service companies.

e.19 Policy research related to different modes of partnerships and legal recognition of joint control modes.

f. Land Use and Socio-economic impact of Production and Conservation Interventions.

f.20 Biodiversity of medicinal and other tree species in the Huruluwewa Watershed with emphasis on their economic utility.

f.21 Review of land use and preparation of land use maps for Huruluwewa and Nilwala Watersheds.

f.22 Socio-economic analysis of SCOR interventions : conservation, resources management, production, crop-livestock yields, productivity and profitability.

f.23 Potential for improving labour, water and land productivity in tea small holdings.

f.24 Evaluation of profitability and productivity of Onions, Tomato and Rice under different irrigation and technology regimes.

f.25 Analysis of Experiential training of SCOR - strategies and methods.

f.26 Monitoring and Evaluation systems for Natural Resources Management.

f.27 Sustainable Natural Resources Management in minor tank Eco-systems.

f.28 **General :**

- Watershed Management - A methodological framework for Socio-economic and Environmental Analysis.

- A Regional Development strategy based on Water Resources Management.

Progress & other special reports will include the following:

1) Periodic progress reports/seasonal reports (including for phase I)
2) Integrated workplans for a 5-year implementation programme.

* Annual reports assessing the progress and problems encountered with the formation and operation of resource user groups;

* Special reports on impacts and problems encountered with implementation and operation of various interventions designed to promote shared control of resources or increased of tenure to the resource user;

* Reports on the cost benefit to the resource user of different conservation practices or production practices introduced or promoted by the project.

The SCOR Project will help to introduce improved mechanisms for planning for resource conservation and use at three levels: national and/or provincial; watershed; and community of farm level. As a part of field interventions, the project will test new production and conservation techniques and evaluate their effectiveness, with special reference to their cost: benefit to resource users and their social acceptability. IIMI will use agricultural economists and other specialists related to conservation practices. SCOR Project self-evaluation of activities is essential to the refinement of natural resource management models. Assessment of the effectiveness and cost:benefit of individual interventions is necessary to select interventions that are replicable and sustainable.

Figure 1 Integrated Land & Water Resources Management in a Watershed Context

STRATEGIES / CONCEPTS:

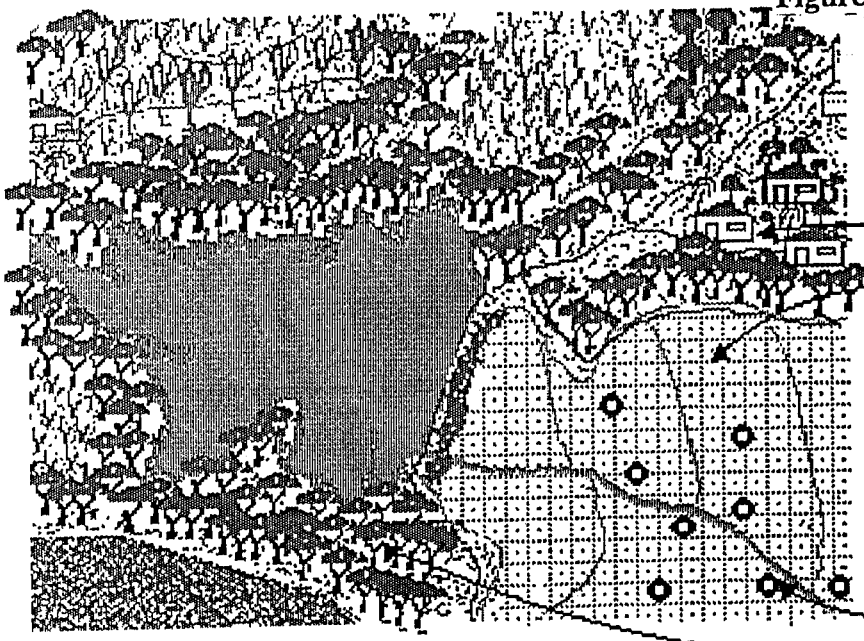
- Integrating Conservation Concerns with Production Goals: Balancing Production and Conservation;
- Proper Mix of Technology, Organizations and Resources;
- Watershed Focus : Manage Re-use & improve watershed-wide water & land use Efficiency;
- Participatory Action-Research : A Learning Process;
- Shared Control : State-User Partnerships;
- Integrated Planning : Institutional & Organizational;
- Building Local Capacities;
- Policy and Institutional Interventions.

↓ Combined Effect on Activities

ACTIVITY AREAS:

- Improve Cropping Intensity, Water Use Efficiency (crop yields) in irrigation command areas;
- Stabilized conservation farming instead of slash & Burn
- Conservation Farming in Homegardens;
- Soil and Water Conservation in other Associated Highland;
- Value - Added Production to Enhance Value Product of Land, water etc;
- Non-Production Incentives for Conservation : eg: Micro-Hydropower Generation Coupled with Catchment Conservation;
- Integrated Water Management : Rational Mix (Time & Space) of Rainfall, Tank Storage, Groundwater, River diversion

Figure 2–PARTICIPATORY WATERSHED MANAGEMENT
– Action Research to Develop Strategies to Reconcile Conservation Concerns with Production Goals –



- Appropriate policy
- Land and water rights,
- State user - partnerships
- Shared control
- User groups, Organizations & companies

Field trials
NARS

FARMER

NARS = National Agricultural Research Centres
AG = Agriculture
AS = Agrarian Services
FO = Forestry
Irrig. = Irrigation
IMD = Irrigation Mgt.
LIV = Livestock
PS = Private Sector
NGO = Non Governmental Org.
o = Agro well

Line Agencies AG, AS, FO, Irrig., IMD, LIV	PS	NGO	Banks

Production & Conservation Technology, Support services, and Business partnerships: Selection of trees and crops, cropping patterns and practices (including conservation farming), pests and disease control, timing of cultivation, watershed-wide water mgt., planned re-use, matching crop and irrigation scheduling. Post harvest technology, value added production, crop-livestock mix, marketing, credit, banking, managerial skills, other support services.

Catalyzing ↑ ↓ Learning

IIMI
* Catalyze the process
* Learn from action on-site, M&E
* Analyze and evaluate the learning process approach through research and feedback
* Synthesize and define strategies

Catalyzing ↑ ↓ Learning

Task Forces: Watershed Resources Mgt. Team (WRMT), Sub WRMT, Provincial and National Steering Committees.

Figure 3 A Typical Degraded Status of Watershed Resources Use - Before Intervention January 1994

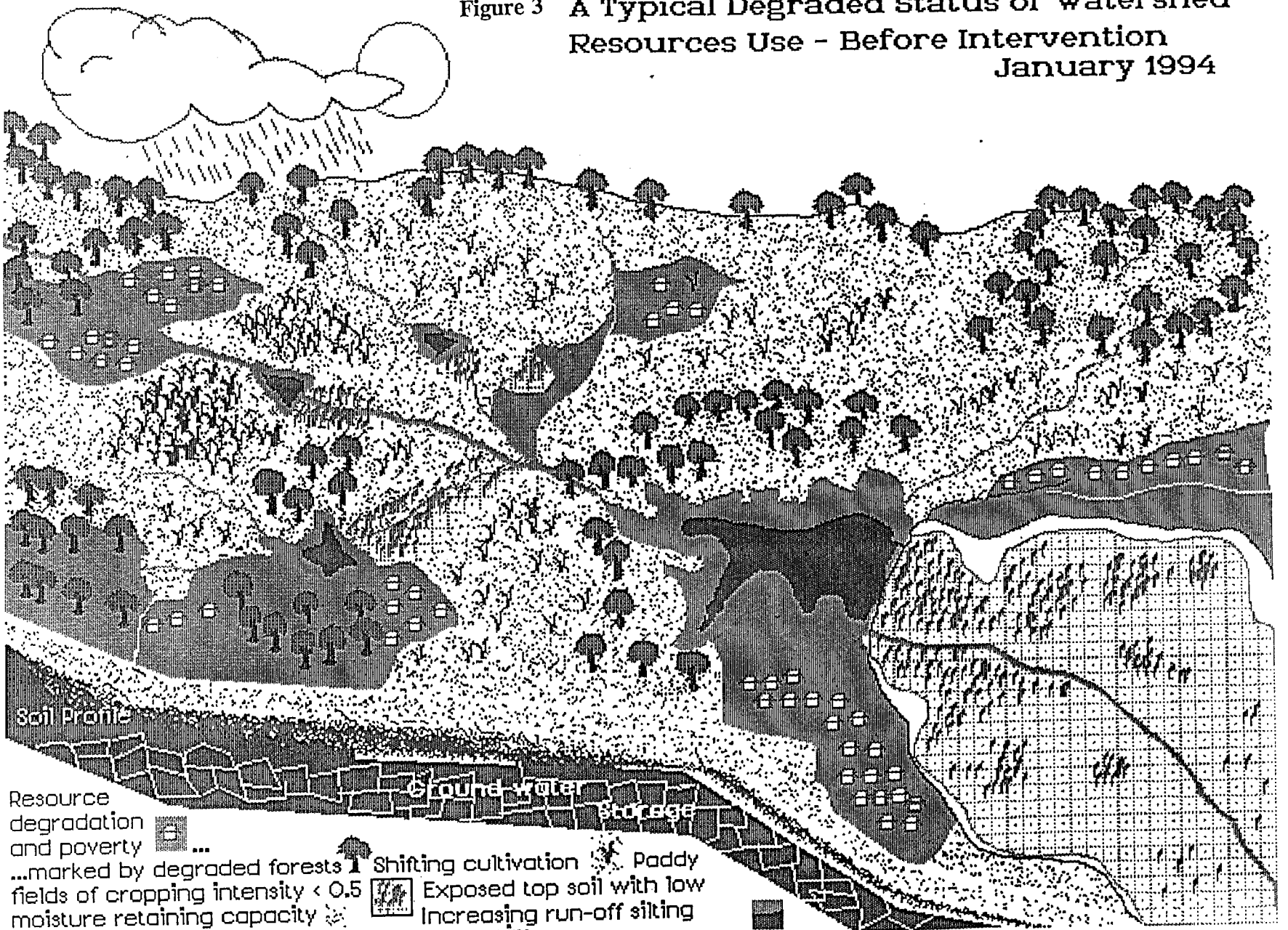
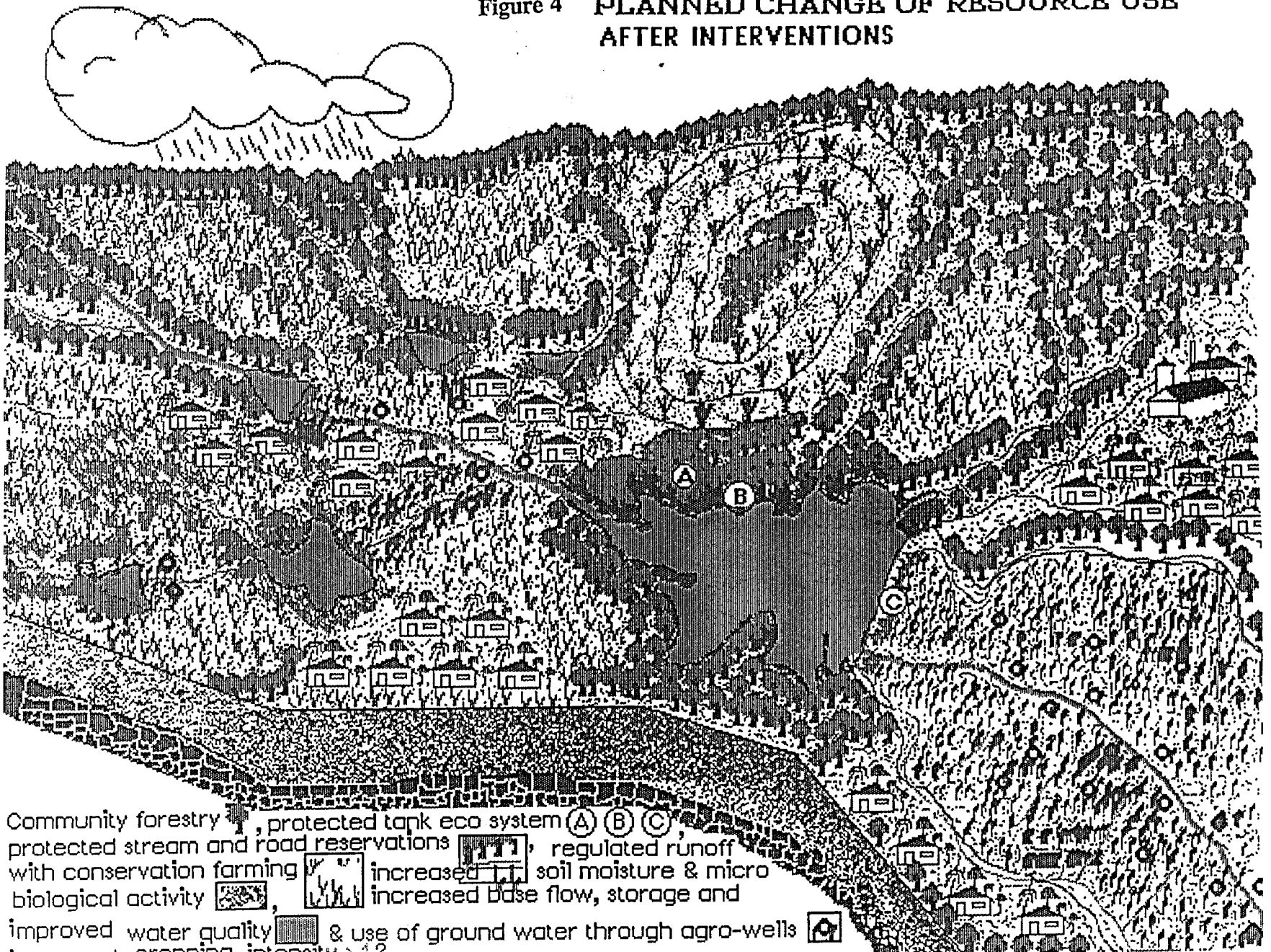


Figure 4 PLANNED CHANGE OF RESOURCE USE AFTER INTERVENTIONS



Community forestry , protected tank eco system (A) (B) (C), protected stream and road reservations , regulated runoff with conservation farming increased soil moisture & micro biological activity , increased base flow, storage and improved water quality & use of ground water through agro-wells increased cropping intensity > 1.2.

Figure 5 TOTAL UTILIZATION AND MANAGEMENT OF WATER RESOURCES IN A WATERSHED

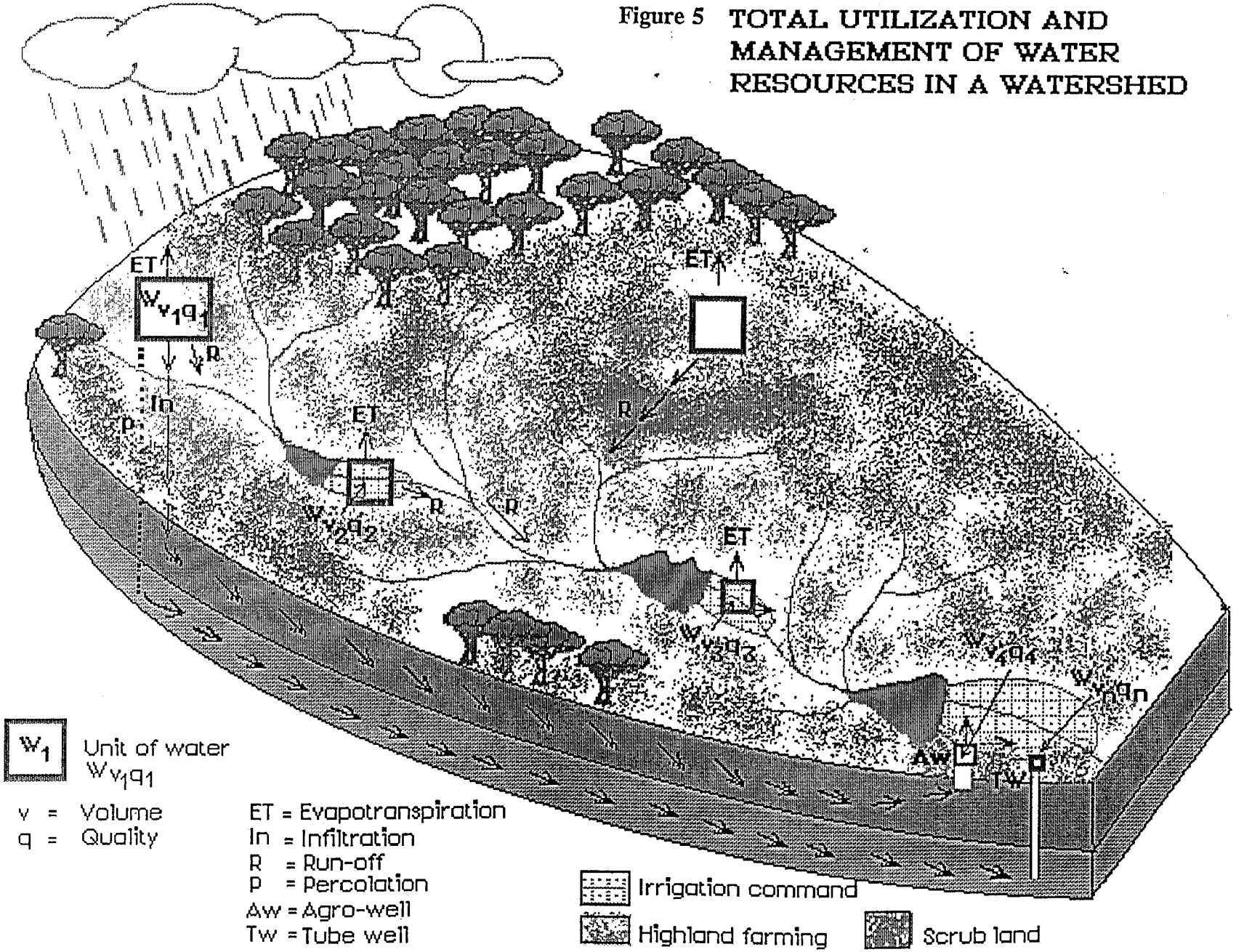
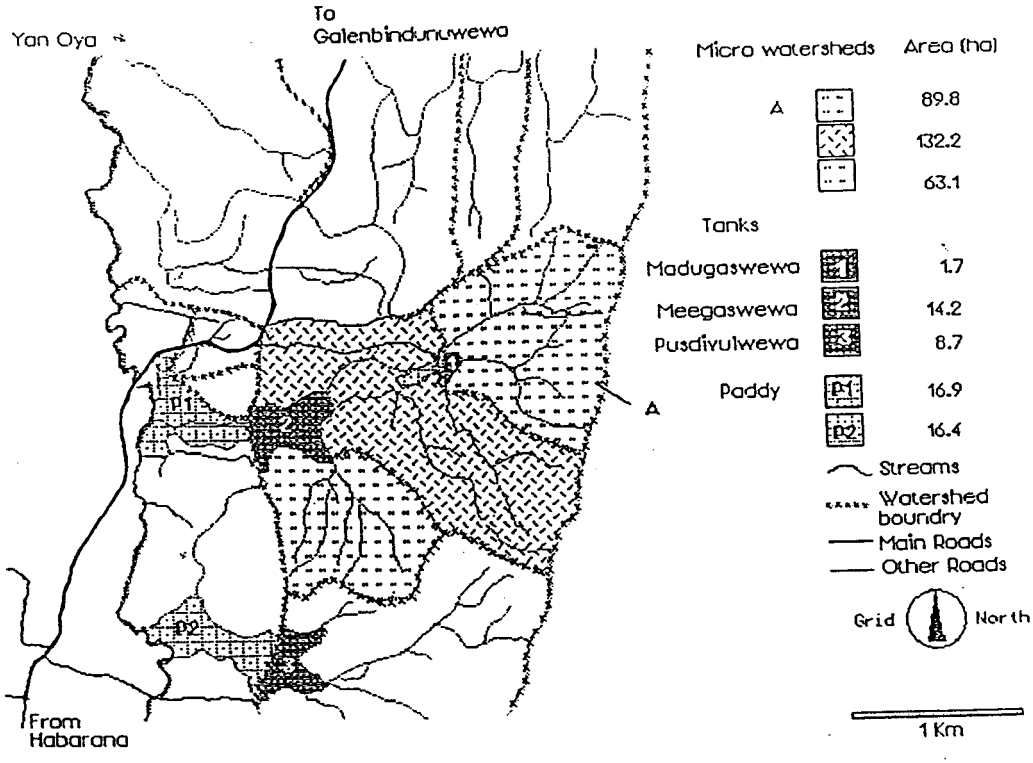


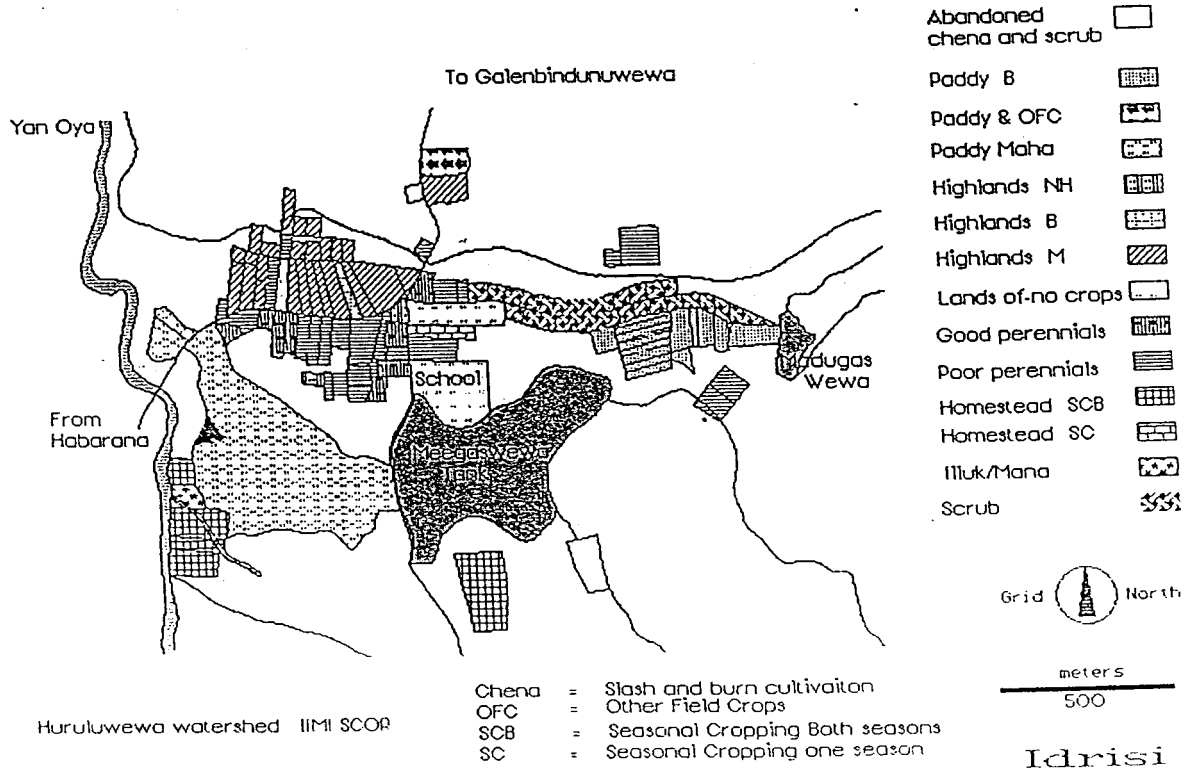
Figure 6 MAHA MEEGASWEWA MICRO WATERSHEDS



IIMI-SCOR March 1995 Mahameegaswewa Tank Catchment Area - 285 ha.

Figure 7

MAHAMEEGASWEWA LAND USE - JANUARY 1994



Huruluwewa watershed IIMI SCOR

Chena = Slash and burn cultivaiton
OFC = Other Field Crops
SCB = Seasonal Cropping Both seasons
SC = Seasonal Cropping one season

Figure 8 PLANNED FUTURE LANDUSE FOR MAHAMEEGASWEW

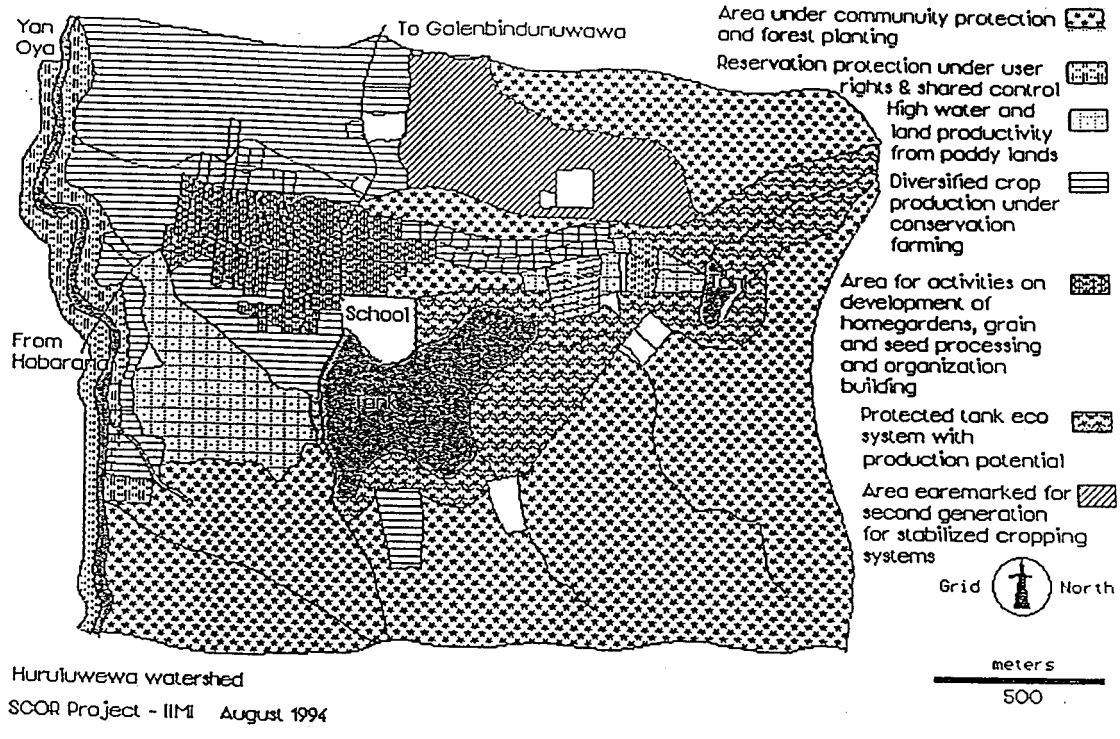


Figure 9

MAHAMEEGASWEWA LAND USE - FEBRUARY 1995

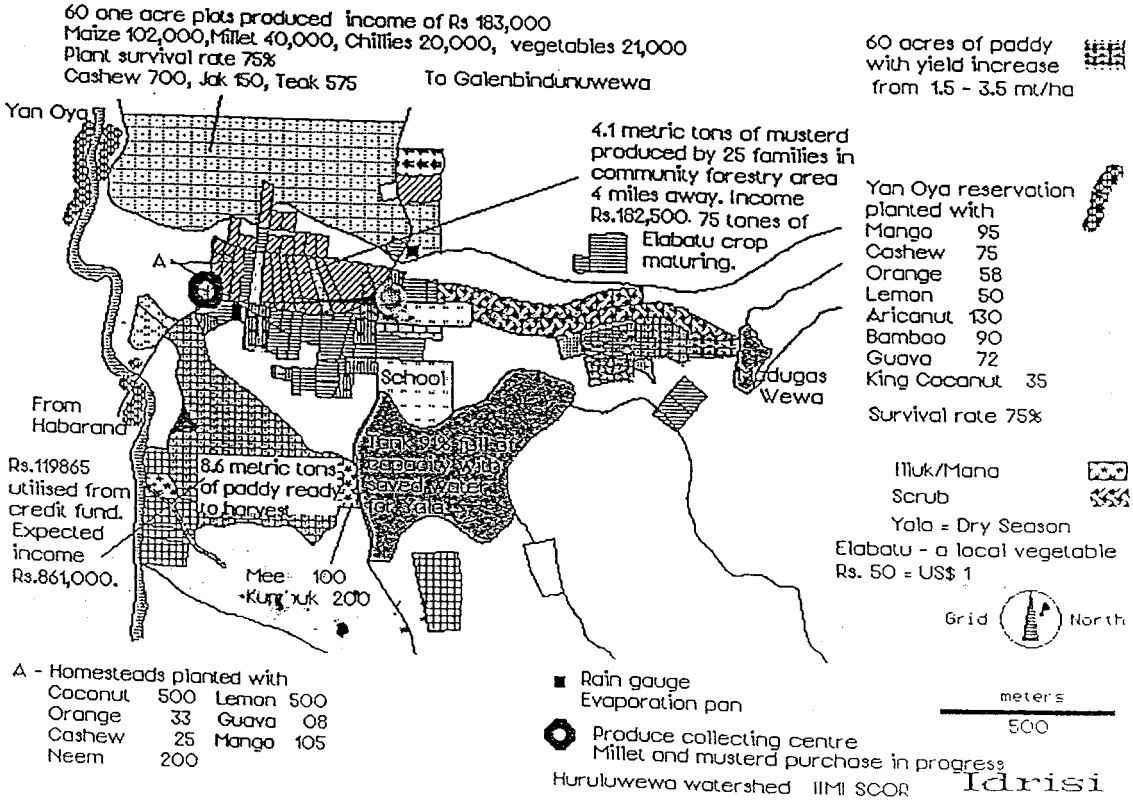


Figure 10 A SCHEMATIC PRESENTATION TO ILLUSTRATE GROUP, ORGANIZATIONS AND (...) FORMATION IN A SUB WATERSHED

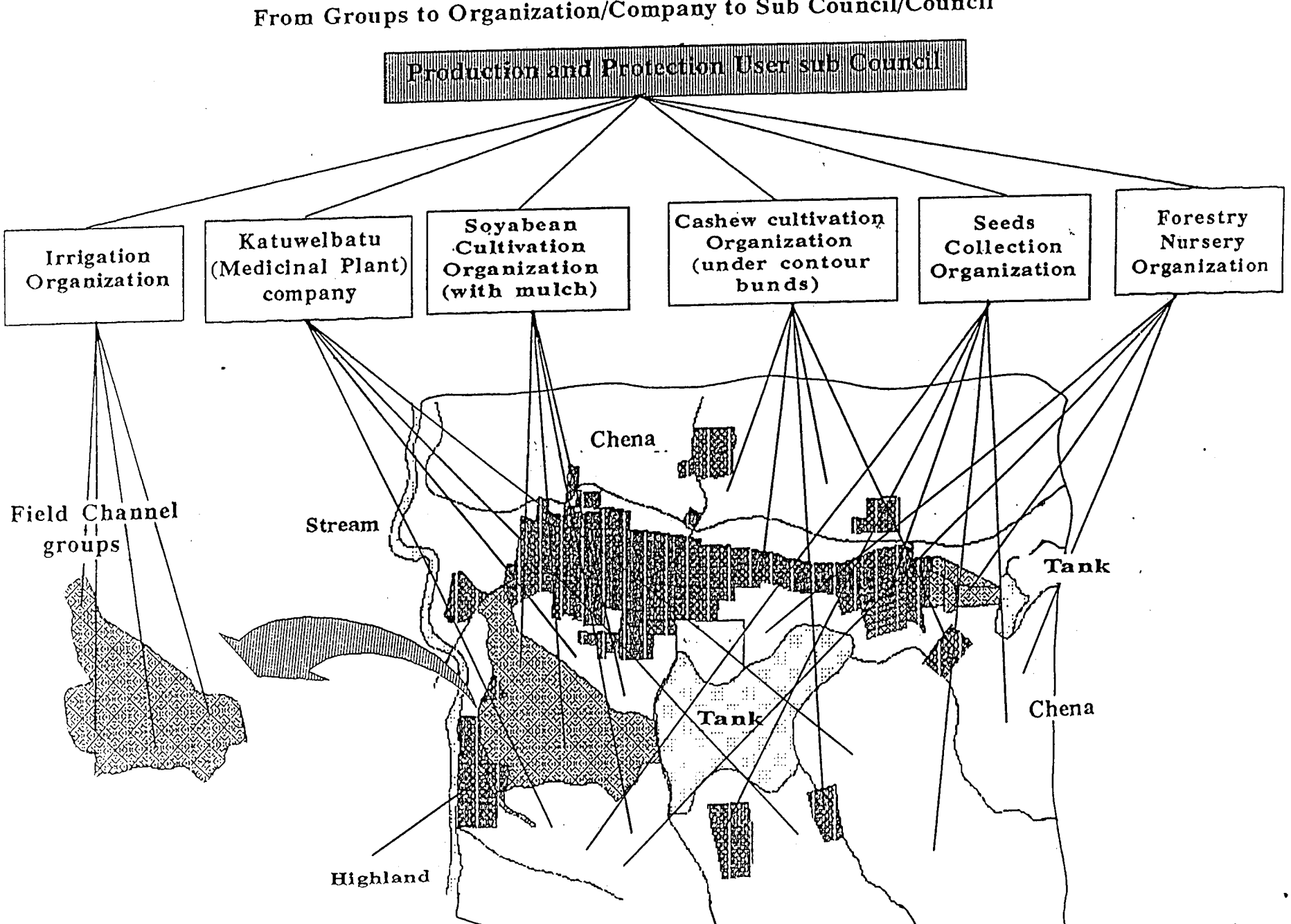
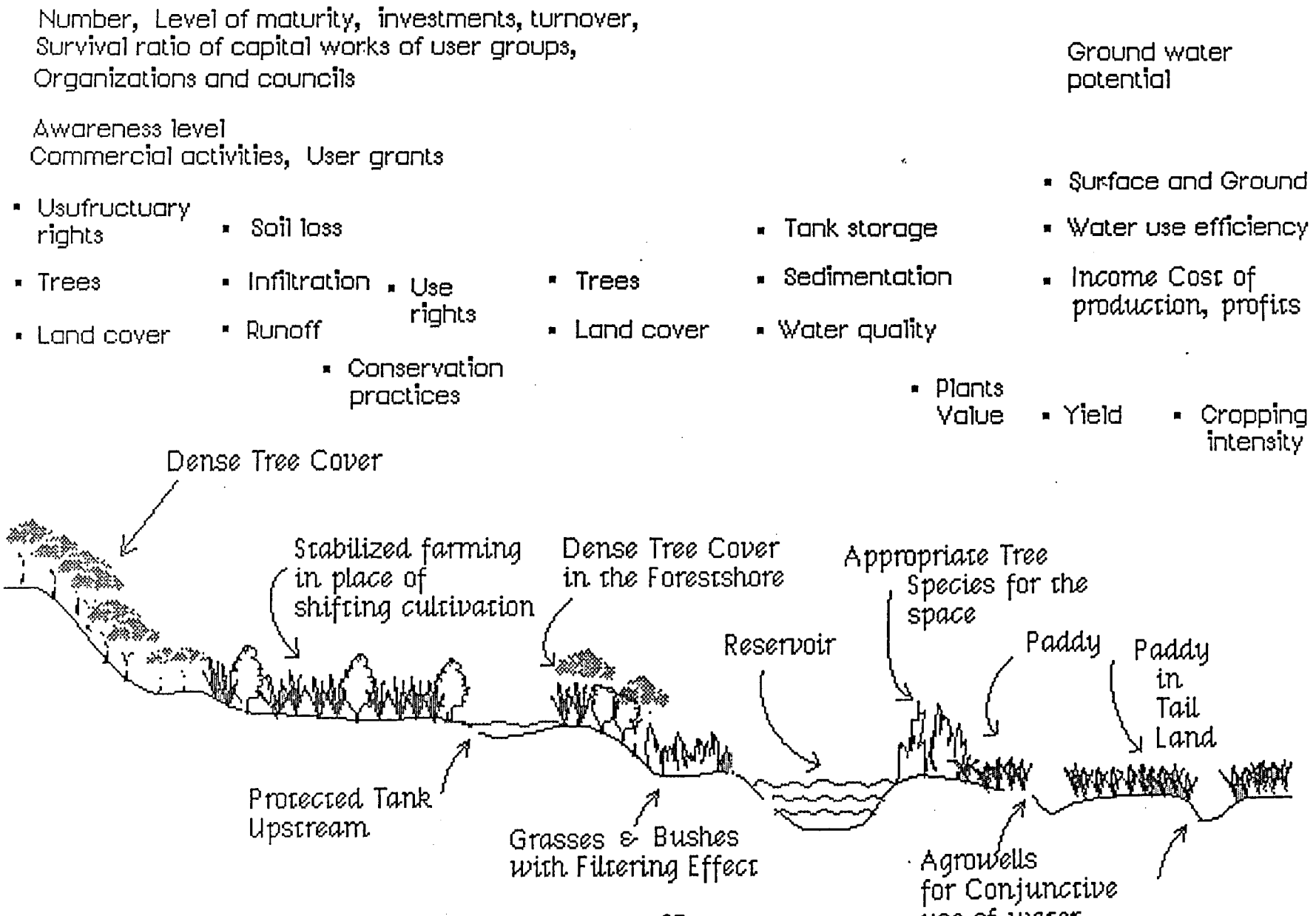
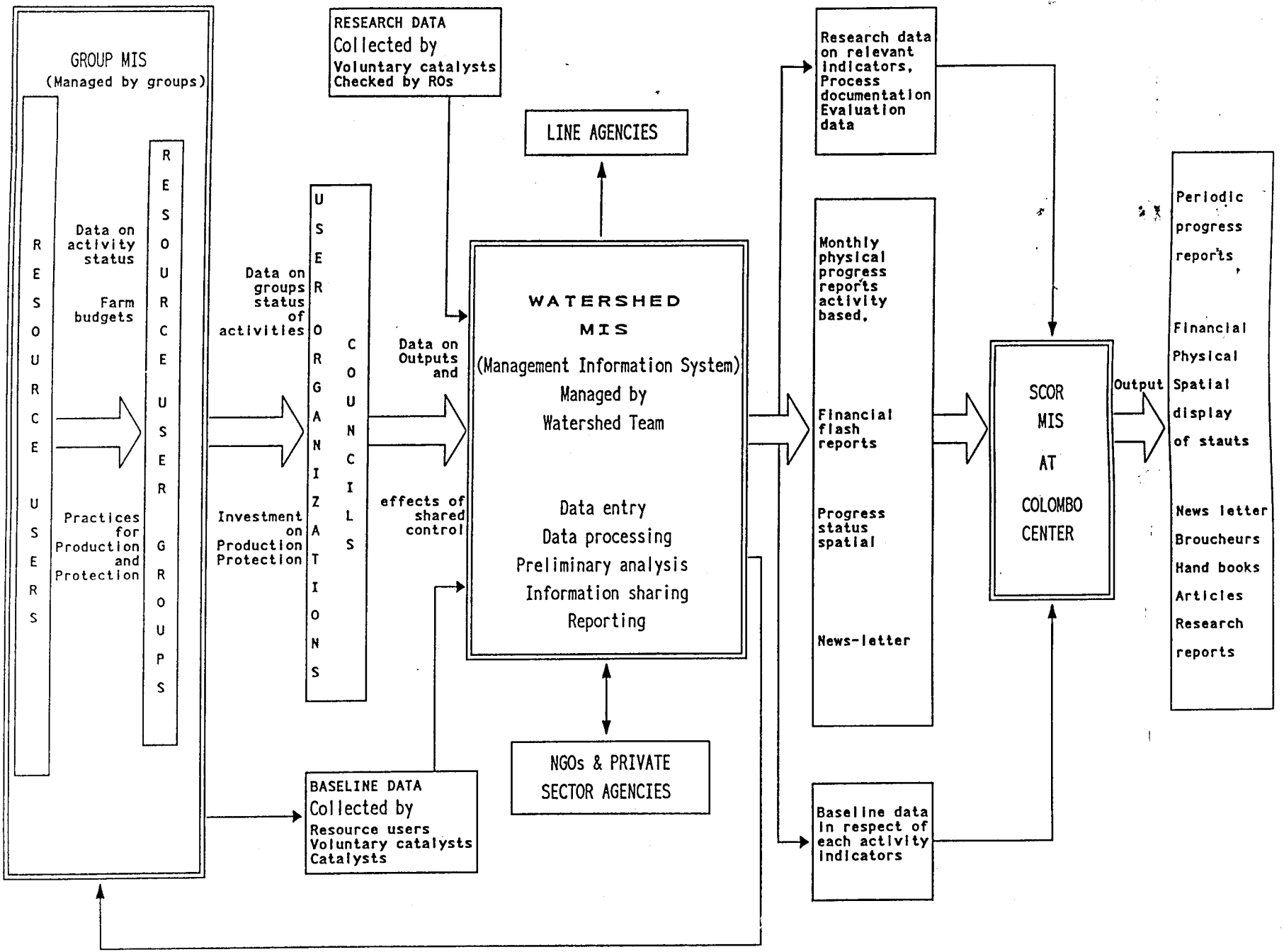


Figure 11 – INDICATORS FOR MONITORING AND EVALUATION SCOR PROJECT




GROUP MIS
(Managed by groups)
RESOURCE USERS
Data on activity status
Farm budgets
Practices for Production and Protection
RESOURCE USER GROUPS
RESEARCH DATA
Collected by
Voluntary catalysts
Checked by ROs
Data on groups status of activities
Investment on Production Protection
USER ORGANIZATIONS
COUNCILS
Data on Outputs and
effects of shared control
LINE AGENCIES
WATERSHED MIS
(Management Information System)
Managed by
Watershed Team
Data entry
Data processing
Preliminary analysis
Information sharing
Reporting
NGOs & PRIVATE SECTOR AGENCIES
BASELINE DATA
Collected by
Resource users
Voluntary catalysts
Catalysts
Research data on relevant indicators, Process documentation Evaluation data
Monthly physical progress reports activity based,
Financial flash reports
Progress status spatial
News-letter
Baseline data in respect of each activity indicators
SCOR MIS AT COLOMBO CENTER
Output
Periodic progress reports
Financial
Physical
Spatial
display of stauts
News letter
Broucheurs
Hand books
Articles
Research reports