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Land Use Planning Material for second year students

Chapter 5. Land use problems identification

5.1. Establishing goals and terms of reference

- The planning effort is launched by discussions between those who want the plan (land users and government) and the planners. This crucial first step should be a mutual exchange of ideas and information. The decision-makers and representatives of the people of the planning area have a brief discussion to the planner about the problems of the area and what they want to achieve.
- The planner has to make clear how a land-use plan might help. A reconnaissance field trip, during which representatives of the people concerned are met, can be especially useful. The following tasks may be included in this first step of planning. Some of them will be repeated in more detail in Steps 3 and 4.

✓ *Define the planning area.*

✓ *Contact the people involved.*

✓ *Acquire basic information about the area.*

✓ ***Establish the goals.*** The goals may arise from local problems (e.g. low crop yields, food shortages) or from national policy and development priorities (e.g. crops for export). At any particular level, the goals may have been derived from higher levels (from national to district and local) or lower levels (by the amalgamation of local needs) top-down and bottom-up planning, respectively.

✓ List the problems of the area and the benefits required; distinguish between long-term goals and those that can be achieved in the planning period; separate those goals of higher-level plans that apply to the area and those that do not.

✓ Identify the problems and opportunities

✓ Identify limitations to implementation

✓ Establish the criteria by which land-use decisions will be made

✓ Set the scope of the plan

✓ Set the planning period

✓ Agree on the content and format of the plan

✓ Decide operational questions

Basic information about the area

- ✓ *Land resources*
- ✓ *Present land use*
- ✓ *Present infrastructure*
- ✓ *Population*
- ✓ *Land tenure*
- ✓ *Social structure and traditional practices*
- ✓ *Government*
- ✓ *Legislation*
- ✓ *Non-governmental organizations (NGOs)*
- ✓ *Commercial organizations*

Terms of reference and budget

- Step 1 is the foundation of the land-use plan. Misunderstandings arising at this stage may be difficult to clear up later. In particular, it is essential to develop close working relationships between the land users, the decision-makers, the planning team and other participants of the planning process.
- A major requirement of this step is to identify the main components of the planning project. From these, the terms of reference should be defined broadly enough to allow flexibility in finding solutions to the land-use problems identified while staying within the limits of the time and resources available.
- The output from this step will be a project document (or similar statement) giving the terms of reference of the planning exercise, including its goals, specific objectives, time required and the necessary budget.

5.2. Organize the work: what the work plan prepares? Why it is needed? How it is done?

What the work plan prepares

- This step transforms the general planning procedure from Step 1 into a specific program of work. It says what needs to be done, decides on the methods, identifies who will do it, specifies the responsibilities of each team member, schedules personnel and activities and allocates resources for the following steps in the planning process.

Why is it needed?

- Coordination of the very diverse activities involved in land-use planning is important because:

- ***Many tasks have a long lead time*:** For example, gathering information must begin as early as possible - some surveys take many months to complete.
- ***Supporting services must be organized*:** for example, transport, labor, cartography, and printing. These must be scheduled so they are available when needed, to make the best use of staff as well as to avoid unnecessary costs.
- ***Supplies and materials must be obtained*:** Security permission may be required for maps, air photographs and satellite imagery.
- ***Training, travel, review meetings and consultancies must be scheduled* months ahead.**

How is it done?

- First, list the major planning tasks and activities. For each task, outline what needs to be done as well as the skilled personnel and other resources required. Identify the people and organizations that will be responsible for each task and others who will contribute.
- A checklist of jobs and responsibilities is importance. Everyone needs to know what is expected of them and to whom they are responsible. Specify the time needed to complete each task, which tasks need to be completed before others can be started and the deadlines. Allocate money and equipment. Draw up budgets for each activity and list the resources (e.g. transport, equipment) that will be needed.

5.3. Analyze the problems:

1. Collect data on the existing situation

- In Step 1, some basic facts about the area were assembled. Now it is necessary to gather information on the existing situation in much more detail, to provide the factual basis for all subsequent steps, up to implementation. Much of this information should be shown on maps.
- Assuming that data on the administrative structure, legal framework and interested organizations has been gathered in Step 1, the information now needed includes:
  - ***Population*.** Analyze the numbers, age and sex structure, population trends and distribution. Plot these data - towns, villages and dispersed rural settlements - on the base map.
  - ***Land resources***. Obtain, compile or, where necessary, survey land resource data relevant to the planning task. This may include landforms, climate, agro-climatic regions, soils, vegetation, pasture resources, forests and wildlife.
  - ***Employment and income*.** Summarize data by area, age, social and ethnic groups.

- ***Present land use*.** Existing information will often be out of date or unreliable. Make an up-to-date land-use map. This is an essential basis for planning changes.
- ***Production and trends*.** Organize production data; graph production trends and economic projections for the planning period. This information should be as quantitative as possible.
- ***Infrastructure*.** Plot roads, market and service centers on the base map.

- Most of this information will be obtained from existing sources, supplemented by field reconnaissance to check how up to date and reliable these are. Gaps of importance may need filling in by methods of rapid rural appraisal, remote sensing and field surveys as well as talking with people who know the area, e.g. agricultural or forestry extension staff.

2. Identify and map land unit and land use systems

- To analyze the present situation, it will be necessary to break the area down into *land units*, areas that are relatively homogeneous with respect to climate, landforms, soils and vegetation. Each land unit presents similar problems and opportunities and will respond in similar ways to management.
- The next step is to identify the more common *land-use systems*, areas with similar land use and economy. These may be *farming systems* or systems based on forestry, etc. Land-use systems are frequently defined in terms of dominant crops, e.g. a maize/tobacco system.

3. Identify problems of land use

- **Symptoms of land-use problems**
    - ✓ Migration to towns
    - ✓ Low rural incomes
    - ✓ Lack of employment opportunities
    - ✓ Poor health and nutrition
    - ✓ Insufficient survival production
    - ✓ Shortage of fuel and timber
    - ✓ Shortage of grazing land
    - ✓ Low, unreliable crop yields
    - ✓ Desertion of farmland
    - ✓ Encroachment on forest and wildlife reserves

- ✓ Conflicts among farming, livestock and non-agricultural uses
- ✓ Visible land degradation, e.g. eroded cropland, silted bottomlands, degradation of woodland, salinity in irrigation schemes, flooding

- **Underlying causes related to land use**
  - ❖ **Social problems**
    - ✓ Population pressure on land resources
    - ✓ Unequal distribution of land, capital and opportunities
    - ✓ Restrictions of land tenure and landownership
  - ❖ **Natural hazards and limitations**
    - ✓ Inadequate water supply and distribution
    - ✓ Irregular relief
    - ✓ Drought-prone soils
    - ✓ Poor drainage, Diseases
  - ❖ **Mismatch between land use and land suitability**
    - ✓ Inadequate water control
    - ✓ Clearance of forest on steep lands
    - ✓ Inadequate soil conservation practices
    - ✓ Inadequate periods of bush fallow
  - ❖ **Related rural planning problems**
    - ✓ Inadequate power
    - ✓ Lack of fertilizer and pesticides
    - ✓ Lack of markets, unsatisfactory price structure
    - ✓ Lack of finance
    - ✓ Inadequate transport
    - ✓ Lack of technical support

Problems of land use

To define a problem, it is necessary to establish the present situation, judge ways in which it is unsatisfactory and identify ways in which it might be made better. Apart from when planning new settlements on unoccupied land, this stage of diagnosis of problems is of the highest importance. Without identifying problems and analyzing their causes, one is in no position to plan for improving the situation. Three closely related methods, any of which can be used at this stage, are *farming systems analysis, diagnosis and design* and *rapid rural appraisal*

The fundamental field survey method may be summarized as:

- ✓ talk to the people;
- ✓ look at the land

"People" include the farmers and other land users, local leaders, extension staff and agencies active in the area. Where time allows, a set of interviews should be conducted with farmers sampled from each land-use system. Identify which are considered to be the most important - by the farmers, by local agencies and by the planning team. At the same time, diagnose the causes of the problems identified. For example, a fodder shortage may be caused by cultivation encroaching on former grazing land, coupled with a lack of rotational grazing and/or control of livestock numbers on the latter. The effects may be indirect: a labor shortage on farms at a critical period might be made worse by the fact that women have to travel long distances to collect fuel wood or water. Field observation is complementary to interviews. Ask to be shown around farms and travel about the area. This will reveal physical problems such as soil erosion, overgrazing and forest degradation.

Taking present land use as the basis, ask:

- ✓ How is the land managed now?
- ✓ What will happen if the present management continues unchanged?
- ✓ Why is it the way it is?
- ✓ Is it the best available system of land use or is it followed because of tradition, insufficient labor, lack of capital, a need for staple food, a need for cash, a need for time for communal activities and leisure, a desire to retain landownership, a lack of skill or technical knowledge or poor planning?

4. Problem statements

This stage can be summarized by a set of *problem statements* which, for each problem, give:

- ✓ its nature and severity with respect to land units and land-use systems;
- ✓ its short-term and long-term effects;
- ✓ a summary of its causes: physical, economic and social.

Chapter 6: Identify opportunities for change

- Now that the problems needing attention are known, the next step is to consider what can be done to solve or ameliorate them. This requires interaction between the planning team, which devises and presents its alternative opportunities for change, the land users, who comment on these opportunities and may offer their own solutions and the decision-makers, who choose which alternatives are to be analyzed further.
- Seek a variety of solutions in the first instance, and then select those that seem most promising. All reasonable solutions should be considered in Step 4 because it becomes increasingly difficult to follow new directions as planning progresses. It is important for the land users, planners and decision-makers to reach a consensus about what the priorities are, and this entails both public involvement and wide-ranging executive discussion.

6.1. Identification of opportunities/ options for solving a problem

- Planning involves seeking and appraising opportunities for closing the gap between the present situation and the goals. Opportunities are presented by untapped human and land resources, new technology and economic or political circumstances such as:

    a) The people present opportunities

    b) The land

    c) Improved technology

    d) Economic opportunities

    e) Government

- At this stage, the opportunities considered need not be specified in great detail but should be wide-ranging to include all possibilities that appear realistic (a process sometimes called "brainstorming").

Options for change

- There is usually more than one way to tackle a problem. Alternatives may be needed to give due attention to the interests of competing groups and serve as a starting point for negotiations.
- The plan that is finally accepted may include aspects of more than one option. The options developed in this step will depend on the goals, the strategy pursued to reach

these goals, opportunities and problems presented by the people and the land and the finance and other resources available. For example, problems of food production will demand agricultural or economic action; opportunities for tourism will depend on ways of attracting and accommodating tourists.

Options can be described in terms of ways and means:

- ✓ Non-land-use planning options
- ✓ Allocations of land use
- ✓ New land uses
- ✓ Improvements to land-use types

- Assume that existing situation are chronic food shortage, and accelerating degradation of grazing land. To solve the problem improve land use by increase rural income and arrest land degradation. There is no fixed procedure for selection of alternatives for change. Some courses of action will be suggested by farmers, others by extension staff or people with an interest in the area, while the planners may develop still others from the information obtained in Step 3. What is essential is to keep all interested people informed and seek their views.

Some guidelines are as follows:

a) Focus on questions regarding what action can be taken within the plan

b) Consider alternative land-use strategies

c) Identify a range of possible solutions

d) Develop options within the extremes

e) Public and executive discussion of problems and alternatives

- The alternatives are presented to representatives of the local people, government officials and other interested agencies. A basic decision is whether, in the light of work to date, the original goals still appear to be attainable. Assuming this to be so, two choices must now be made: which problems are to be given priority and which are the most promising alternatives for further study.
- Finally, the decision-maker can draw attention to action needed at other levels of land-use planning (e.g. at the national level, arising from a district-level plan) and action desirable outside the scope of land-use planning. Following these decisions, targets for this subsequent work must be specified. A partial reiteration of Step 2 may now be necessary,

planning subsequent steps more specifically than before. If necessary, an additional or revised budget and time schedule must be prepared.

6.2 Evaluate land suitability

6.2.1 Why land evaluation?

- ✓ Land evaluation is concerned with the assessment of land performance when used for specified purposes. It involves the execution and interpretation of basic surveys of climate, soils, vegetation and other aspects of land in terms of the requirements of alternative forms of land use. To be of value in planning, the range of land uses considered has to be limited to those which are relevant within the physical, economic and social context of the area considered, and the comparisons must incorporate economic considerations.
- ✓ Land evaluation is a process for matching the characteristics of land resources for certain uses using a scientifically standardized technique. The results can be used as a guide by land users and planners to identify alternative land uses.
- ✓ Land evaluation may be operated either for a specific kind of use (maize, potatoes) or for a more general utilization (agriculture, grazing) and is then referred to as land suitability or land capability evaluation respectively. Land evaluation may be qualitative or quantitative.
- ✓ Land evaluation assesses the performance of land based on a more or less systematic analysis of the physical land conditions and on the impact, these have on present and alternative land use systems. Land evaluation is a tool or a technique to compare the various use potentials and benefits that can be obtained from the land, taking into consideration the current and expected social and economic contexts.
- ✓ Land evaluation is only part of the process of land use planning. Its precise role varies in different circumstances.
- ✓ Land evaluation plays a major part in stages iii, iv and v of the above sequence, and contributes information to the subsequent activities. Thus, land evaluation is preceded by the recognition of the need for some change in the use to which land is put; this may be the development of new productive uses, such as agricultural development schemes or forestry plantations, or the provision of services, such as the designation of a national park or recreational area.

- ✓ Recognition of this need is followed by identification of the aims of the proposed change and formulation of general and specific proposals. The evaluation process itself includes description of a range of promising kinds of use, and the assessment and comparison of these with respect to each type of land identified in the area. This leads to recommendations involving one or a small number of preferred kinds of use. These recommendations can then be used in making decisions on the preferred kinds of land use for each distinct part of the area. Later stages will usually involve further detailed analysis of the preferred uses, followed, if the decision to go ahead is made, by the implementation of the development project or other form of change, and monitoring of the resulting systems.
- ✓ In the present context it is sufficient to represent the land use planning process by the following generalized sequence of activities and decisions:

  i. recognition of a need for change;

  ii. identification of aims;

  iii. formulation of proposals, involving alternative forms of land use, and recognition of their main requirements;

  iv. recognition and delineation of the different types of land present in the area;

  v. comparison and evaluation of each type of land for the different uses;

  vi. selection of a preferred use for each type of land;

  vii. project design, or other detailed analysis of a selected set of alternatives for distinct parts of the area;

  This, in certain cases, may take the form of a feasibility study.

  viii. decision to implement;

  ix. implementation;

  x. monitoring of the operation.

- ➢ Almost every activity of man uses land and, as human numbers and activities have multiplied, land has become a scarce resource. The amount of cultivable land in the world is finite, and land that has been degraded is almost irreversibly lost for production. As long as the populations who use this land remain small in number, they are able to live in harmony with their natural environment.

✓ This brings a decision to a change in the use of a land. But the decision may lead to a great loss or benefit in:

- ✓ Economic terms (e.g. not returnable investment, etc.)
- ✓ Physical resources (land degradation, conservation)
- ✓ Social or political benefits

✓ **Land varies greatly in topography, climate geology, soil and vegetation** cover. This difference then leads to a rational utilization of land. Therefore, land evaluation concerns these opportunities and limits and attempts to translate the available information about land into a form usable by a practical man-farmer, forester, fisher, engineer, etc. Ex what a farmer can in this yield?

The aims of land evaluation

- ✓ The principal objective of land evaluation is to select the optimum land use for each defined land unit, taking into account both physical and socio-economic considerations and the conservation of natural resource for future use.
- ✓ Land evaluation may be concerned with present land performance. Frequently however, it involves change and its effects: with change in the use of land and in some cases change in the land itself.
- ✓ Evaluation takes into consideration the economics of the proposed enterprises, the social consequences for the people of the area and the country concerned, and the consequences, beneficial or adverse, for the environment. Thus, land evaluation should answer the following questions:
    - ✓ How is the land currently managed, and what will happen if present practices remain unchanged?
    - ✓ What improvements in management practices, within the present use, are possible?
    - ✓ What other uses of land are physically possible and economically and socially relevant?
    - ✓ Which of these uses offer possibilities of sustained production or other benefits?
    - ✓ What adverse effects, physical, economic or social, are associated with each use?
    - ✓ What recurrent input e are necessary to bring about the desired production and minimize the adverse effects? What are the benefits of each form of use?

- The evaluation process does not in itself determine the land use or land use changes, but provides data on the basis of which land use decisions and options can be taken. In other words, land evaluation helps individual land owners, regional development agencies or countries to make rational choices between land use alternatives.

6.2.2 The basic principles of land evaluation

Certain principles are fundamental to the approach and methods employed in land evaluation. These basic principles are as follows:

I. Land suitability is assessed and classified with respect to specified kinds of use

- This principle embodies recognition of the fact that different kinds of land use have different requirements. As an example, an alluvial flood plain with impeded drainage might be highly suitable for rice cultivation but not suitable for many forms of agriculture or for forestry.
- The concept of land suitability is only meaningful in terms of specific kinds of land use, each with their own requirements, e.g. for soil moisture, rooting depth etc. The qualities of each type of land, such as moisture availability or liability to flooding, are compared with the requirements of each use. Thus, the land itself and the land use are equally fundamental to land suitability evaluation.

ii. Evaluation requires a comparison of the benefits obtained and the inputs needed on different types of land

- Land in itself, without input, rarely if ever possesses productive potential; even the collection of wild fruits requires labour, whilst the use of natural wilderness for nature conservation requires measures for its protection. Suitability for each use is assessed by comparing the required input, such as labour, fertilizers or road construction, with the goods produced or other benefits obtained.

iii. A multidisciplinary approach is required

- The evaluation process requires contributions from the fields of natural science, the technology of land use, economics and sociology. In particular, suitability evaluation always incorporates economic considerations to a greater or lesser extort. In qualitative evaluation, economics may be employed in general terms only, without calculation of costs and returns. In quantitative evaluation the comparison of benefits and inputs in economic terms plays a major part in the determination of suitability.

- It follows that a team carrying out an evaluation require a range of specialists. These will usually include natural scientists (e.g. geomorphologists, soil surveyors, ecologists), specialists in the technology of the forms of land use under consideration (e.g. agronomists' foresters, irrigation engineers, experts in livestock management), economists and sociologists. There may need to be some combining of these functions for practical reasons, but the principle of multidisciplinary activity, encompassing studies of land, land use, social aspects and economics, remains.

iv. Evaluation is made in terms relevant to the physical, economic and social context of the area concerned

- Such factors as the regional climate, levels of living of the population, availability and cost of labour, need for employment, the local or export markets, systems of land tenure which are socially and politically acceptable, and availability of capital, form the context within which evaluation takes place. It would, for example be unrealistic to say that land was suitable for non-mechanized rice cultivation, requiring large amounts of low-cost labour, in a country with high labour costs.
- The assumptions underlying evaluation will differ from one country to another and, to some extent, between different areas of the same country. Many of these factors are often implicitly assumed; to avoid misunderstanding and to assist in comparisons between different areas, such assumptions should be explicitly stated.

v. Suitability refers to use on a sustained basis

- The aspect of environmental degradation is taken into account when assessing suitability. There might, for example, be forms of land use which appeared to be highly profitable in the short run but were likely to lead to soil erosion, progressive pasture degradation, or adverse changes in river regimes downstream. Such consequences would balance the short-term profitability and cause the land to be classed as not suitable for such purposes.
- This principle by no means requires that the environment should be preserved in a completely unaltered state. Agriculture normally involves clearance of any natural vegetation present, and normally soil fertility under arable cropping is higher or lower, depending on management, but rarely at the same level as under the original vegetation. What is required is that for any proposed form of land use, the probable

consequences for the environment should be assessed as accurately as possible and such assessments taken into consideration in determining suitability.

vi. Evaluation involves comparison of more than a single kind of use

- This comparison could be, for example, between agriculture and forestry, between two or more different farming systems, or between individual crops. Often it will include comparing the existing uses with possible changes, either to new kinds of use or modifications to the existing uses. Occasionally a proposed form of use will be compared with non-use, i.e. leaving the land in its unaltered state, but the principle of comparison remains.
- Evaluation is only reliable if benefits and inputs from any given kind of use can be compared with at least one, and usually several different, alternatives. If only one use is considered there is the danger that, at the same time as the land may indeed be suitable for that use, some other and more beneficial use may be ignored.

6.2.3 Levels of intensity and approaches in Land Evaluation

Certain groups of activities are common to all types of land evaluation. In all cases evaluation commences with initial discussions, concerned with the objectives of the evaluation, assumptions and constraints, and the methods to be followed. Details of subsequent activities and the sequence, in which they are carried out, vary with circumstances. These circumstances include the level of intensity of the survey and which of two overall approaches is followed.

6.2.3.1 Levels of Intensity

Three levels of intensity may be distinguished in land evaluation. These are reconnaissance, semi-detailed and detailed evaluation. These are normally reflected in the scales of resulting maps.

- **Reconnaissance** surveys are concerned with broad inventory of resources and development possibilities at regional and national scales. Economic analysis is only in very general terms, and land evaluation is qualitative. The results contribute to national plans, permitting the selection of development areas and priorities.
- **Surveys at the semi-detailed, or intermediate,** level are concerned with more specific aims such as feasibility studies of development projects. The work may include farm surveys; economic analysis is considerably more important, and land evaluation is usually

quantitative. This level provides information for decisions on the selection of projects, or whether a particular development or other change is to go ahead.

- The **detailed** level covers surveys for actual planning and design, or farm planning and advice, often carried out after the decision to implement has been made.

6.2.3.2 Two-stage and parallel approaches to land evaluation

The relationships of resource surveys and economic and social analysis, and the manner, in which the kinds of land use are formulated, depend on which of the following approaches to land evaluation is adopted (Fig. 1):

-A two-stage approach in which the first stage is mainly concerned with qualitative land evaluation, later (although not necessarily) followed by a second stage consisting of economic and social analysis;

-A parallel approach in which analysis of the relationships between land and land use proceeds concurrently with economic and social analysis.

The two-stage approach is often used in resource inventories for broad planning purposes and in studies for the assessment of biological productive potential. The land suitability classifications in the first stage are based on the suitability of the land for kinds of land use which are selected at the beginning of the survey, e.g. arable cropping, dairy farming, maize, tomatoes. The contribution of economic and social analysis to the first stage is limited to a check on the relevance of the kinds of land use. After the first stage has been completed and its results presented in map and report form, these results may then be subject to the second stage, that of economic and social analysis, either immediately or after an interval of time.

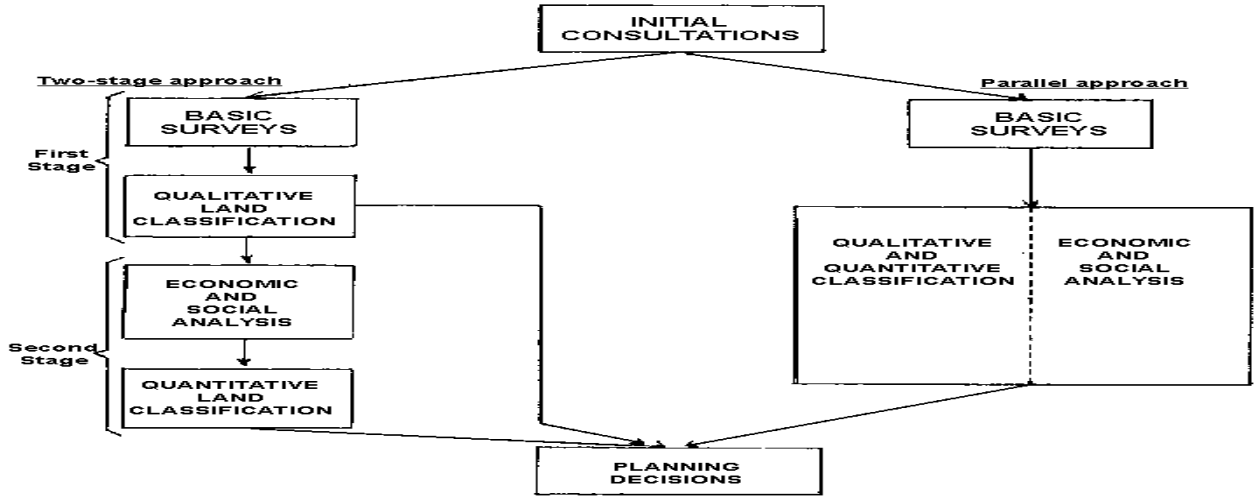

Fig. 1 Two-Stage and Parallel Approach to Land Evaluation

In the parallel approach the economic and social analysis of the kinds of land use proceeds simultaneously with the survey and assessment of physical factors. The kinds of use to which the evaluation refers are usually modified in the course of the study. In the case of arable farming, for example, this modification may include selection of crops and rotations, estimates of the inputs of capital and labor, and determination of optimum farm size. Similarly, in forestry it may include, for example, selection of tree species dates of thinning and felling and required protective measures. This procedure is mostly favored for specific proposals in connection with development projects and at semi-detailed and detailed levels of intensity. The parallel approach is expected to give more precise results in a shorter period of time. It offers a better chance of concentrating survey and data-collection activities on producing information needed for the evaluation.

However, the two-stage approach appears more straightforward, possessing a clear-cut sequence of activities. The physical resource surveys precede economic and social analysis, without overlap, hence permitting a more flexible timing of activities and of staff recruitment. The two-stage approach is used as a background in the subsequent text except where otherwise stated.

6.2.4. Procedures of land evaluation

The main activities in a land evaluation are as follows:

- ✓ Initial consultations, concerned with the objectives of the evaluation, and the data and assumptions on which it is to be based
- ✓ Description of the kinds of land use to be considered, and establishment of their requirements
- ✓ Description of land mapping units, and derivation of land qualities
- ✓ Comparison of kinds of land use with the types of land present
- ✓ Economic and social analysis
- ✓ Land suitability classification (qualitative or quantitative)
- ✓ Presentation of the results of the evaluation

6.3 Types of land classifications

6.3.1 Land capability classification

- ➢ Land capability classification is an internationally recognized means of land classification, used to evaluate the capability of land to support a range of land uses, on a long-term sustainable basis. Land Capability may be defined as a ranking of the ability of land to sustain a range of agricultural land uses without degradation of the land resource.

It is an exercise for interpretative grouping and grading of soils according to their potentialities and limitations. The land use capability (LUC) classification is a system of arranging different kinds of land according to its capacity to support long-term sustained production after taking into account the physical limitations of the land.

- Land capability assessment takes into account the physical nature of the land (e.g. geology, soils, and slope) plus other factors (e.g. climate, erosion hazard, and land management practices) which determine how that land can be used without destroying its long-term potential for sustainable agricultural production. It also takes into account limitations that might affect agricultural use, e.g. Stoniness, drainage, salinity or flooding. Land capability assessment is therefore based on the permanent biophysical features of the land (including climate), and does not take into account the economics of agricultural production, distance from markets, social or political factors.
- Land capability assessment should not be confused with land suitability assessment which, in addition to the biophysical features, does take into account economic, social and/or political factors in evaluating the 'best' use of a particular area of land. Land capability classification gives a grading of land for broad scale agricultural uses, whereas land suitability is applied to more specific, clearly defined land uses, such as land 'suitable' for single crop.
- The terms suitability and capability have often been confused or even regarded as synonymous. There is a distinction between suitability for a single clearly defined, reasonably homogenous purpose is practices, (e.g. carrot production or mole drainage) and capability for a broader use such as agriculture development. Thus, suitability assessment has a sharp focus, looking for sites possessing the positive features associated with successful production or use, whereas capability, is a vaguer term and it is often defined in terms of negative limitations, which hinder or prevent some or all of the individual activities being considered. “Suitability is largely a matter of producing high yields with relatively low inputs (Vink A.P.A, I960).”
- There are two stages in finding out the land that is suited to a specific crop. Firstly, the requirements of the crop need to be known, or alternatively it should be known as to what soil and site attributes adversely influence the crop. The second stage is to identify and to delineate land with the desirable attributes, but without the undesirable ones.

6.3.2 Land capability Classification types

The foundation of land capability classification lays in land resource inventories starting with the geological surveys during the 19th c. Following these different types of classification has been developed in the different countries. Majority of these classification types include: -

- The American (USDA's) land capability classification type
- The FAO land capability classification
- The Canadian method of capability classification
- The Britain capability classification etc.

6.3.3 Principles of land capability classification

1. LCC is an interpretative classification based on permanent qualities and characteristics of the land. Existing vegetation (including shrubs, trees, or stumps) is not considered a permanent characteristic.
2. Land with a class is similar in the severity of limitations, but not necessarily in the kind of limitation or in the management practices required, so that for example, there may be quite different soils in the same class.
3. LCC is not a productivity rating for specific crops, though the ratio of input to output may help determine the class.
4. A moderately high level of management is assumed.
5. The system does not, in itself, indicate the most profitable use that could be made of the land.
6. Where removal of limiting factors is feasible or has been carried out (e.g. drainage, irrigation, and stone removal) the land is assessed according to the limitations remaining after the improvements have been made. The cost of such improvement does not affect the assessment.
7. The land capability assessment of an area may be changed by major reclamation projects that permanently change the nature and/ or extent of limitations, e.g. a large-scale drainage, irrigation, or flood prevention schemes.
8. Capability groupings are subject to change as new information about the behavior and responses of the soils become available.

9. Distance to markets, kinds of roads, size and shape of the soil area, locations within fields, skill or resource of individual operators, and other characteristics of the land ownership patterns are not criteria for capability groupings.

- The arable soils are grouped according to their potentialities and limitations for sustained production of the common cultivated crops that do not require specialized site conditioning or site treatment.
- Non- arable soils are grouped according to their potentialities and limitations for the production of permanent vegetation and according to their risk of soil damage if mismanaged.

6.3.4 Major categories of land capability groupings

The capability classification provides three major categories of soil grouping: classes, subclasses and units.

1. Capability Classes (The Highest Class)

- Capability classes are groups of land units that have the same degree of hazard or limitation. The risks of soil damage or limitation become progressively greater from class I to class VIII. By convention Roman numerals are used to designate classes.
- The capability classes are useful as a means of introducing the map user to the more detailed information on the soil map. The classes show the location, amount and general suitability of the soils for agricultural use. Only information concerning general agricultural limitations in soil use are obtained at the capability class level. The soil conservation service of the U.S. Dept, of Agriculture classified lands into eight Capability classes on the basis of the topographic situations which are as follows:

Table 1: Land capability classes, their description and land use systems

Class	**characteristics and recommended land use**
I	deep, productive soils, easily worked, on nearly level land; not subject to overland flow; no or slight risk of damage when cultivated; use of fertilizers and lime, cover crops, crop rotations required to maintain soil fertility and soil structure. ➢ They can be cultivated safely with ordinary good farming methods. ➢ They are very good.
II	productive soils on gentle slopes; moderate depth; subject to occasional

overland flow; may require drainage; moderate risk of damage when cultivated; use crop rotation, water control systems or special tillage practices to control erosion.

- They are good soils.
- They can be cultivated with easily applied practices.

- Soils in class II differ from class I in number of ways. They differ mainly because of they have gentle slopes a subject to moderate erosion, are of moderate depths are subject to occasional overflows, and are in need of drainage.

III Soils of moderate fertility steep slopes, subject to more severe erosion; subject to severe risk of damage, but can be used for crops provided adequate plant cover is maintained; hay or other sod crops should be grown instead of row crops.

- They are moderately good soils.
- They can be used regularly for crops, provided they are planted according to good rotations and given the proper treatment.
- They are inherently low in fertility.

IV good soils on steep slopes, subject to severe erosion; very severe risk of damage, but may be cultivated occasionally if handled with great care; keep in hay or pasture but a grain crop may be grown once in five or six years.

- The soils are fairly good.
- Soils in class IV have unfavorable characteristics.
- They are restricted in their suitability for crop use.
- low in fertility and on moderate slopes.

V Land is too wet or stony for cultivation but of nearly level slope; subject to only slight erosion if properly managed; should be regulated to prevent plant cover from being destroyed.

- Soils in class V should be kept in permanent vegetation.
- They should be used for pasture or forestry.
- Cultivation is not feasible, however, because of wetness or other limitations.
- Grazing should be regulated so that plant cover is maintained.

- It is subject to only slight erosion by wind or water, if properly managed.

VI Shallow soils on steep slopes; use for grazing and forestry; grazing should be regulated to preserve plant cover; if the plant cover is destroyed, use should be restricted until cover is re-established.

- Class VI land is capable of producing forage or woodland products when properly managed.
- As a rule, class VI land is either steeper or more subject to wind erosion than class IV.

VII Steep, rough, eroded land with shallow soils; also includes droughty and swampy land; severe risk of damage even when used for pasture or forestry; strict grazing or management must be applied.

- They are either fair or poor for grazing or forestry and must be handled with care.
- Where rainfall is ample, land should be used for woodland.

VIII Very rough land; not suitable even for woodland or grazing; reserve for wildlife, recreation or watershed conservation.

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2. Capability Subclasses

It is a grouping of capability units having similar kinds of limitations are recognized and the symbol given for each is used as suffix to the concerned land capability class?

(a) Erosion and runoff (including risk of erosion and post erosion damage) -e,

(b) Excess of water (wetness, high water-table, problem of drainage, overflow)-w,

(c) Root zone limitations (Shallow depth, low water holding capacity, salinity or alkalinity) -s and

(d) Climatic limitations- c. Where soils have two kinds of limitations and both can be indicated the dominant one being used first. Where two kinds of limitations are essentially equal priority is to be given to e, followed by w and then s. Land capability sub-classes have been used widely in many parts of the world with slight modifications mostly incorporating local hazards.

- Indicates the kind of limitation for agricultural use.

- Capability subclasses are defined on the basis of major conservation problems, such as e, w, s, c.
- A suffix notation was introduced for the four major kinds of limitation,
- The capability subclass provides information as to the kind of conservation problem or limitation involved.
- Class and subclass together provide the map user information about both the kind of problem involved and the degree of this limitation.

3. Capability unit

- A capability unit is a subdivision of subclasses on the basis of potential productivity.
- All soils within a sub-class having comparable potential productivity belong to the same capability unit.

It is a grouping of one or more individual soil-mapping units having similar potentials and continuing limitations or hazards.

❖ This means that soils in a capability unit are sufficiently uniform to:

(a) Produce a similar kind of cultivated crops and pasture plants with similar management practices;

(b) Require similar conservation treatment and management;

(c) Have comparable potential productivity.

Thus, the capability unit condenses and simplifies soils information for planning individual tracts of land, field by field. Capability units with the class and sub-class furnish information about the degree of limitation kind of conservation problems and the management practices needed.

6.4.Factors of Land Capability Classification

Climatic Limitations

- Climatic limitations (temperature and moisture) affect capability. Extremely low temperatures and short growing seasons are limitations, especially in the very northern part of continental United States and at high altitudes. Limited natural moisture supply affects capability in sub humid, semiarid, and arid climates. As the classification in any locality is derived in part from observed performance of crop plants, the effects of the interaction of climate with soil characteristics must be considered. In a sub humid climate, for example, certain sandy soils may be classified as class VI or class VII,

whereas soils with similar water-holding capacity in a more humid climate are classified as class III or IV.

- The moisture factor must be directly con- sidered in the classification in most semiarid and arid climates. The capability of comparable soils decreases as effective rainfall decreases. In an arid climate the moisture from rain and snow is not enough to support crops. Arid land can be classed as suited to cultivation (class I, II, III, or IV) only if the moisture limitation is removed by irrigation. Wherever the moisture limitation is removed in this way, the soil is classified according to the effects of other permanent features and hazards that limit its use and permanence, without losing sight of the practical requirements of irrigation farming.

Wetness Limitations

- Water on the soil or excess water in the soil presents a hazard to or limits its use. Such water may be a result of poor soil drainage, high water table, overflow (includes stream overflow, ponding, and runoff water from higher areas), and seepage. Usually soil needing drainage has some permanent limitation that precludes placing it in class I even after drainage. Wet soils are classified according to their continuing soil limitations and hazards after drainage.
- In determining the capability of wet areas emphasis is placed on practices considered practical now or in the foreseeable future. The vast areas of marshland along the seacoast or high-cost reclamation projects not now being planned or constructed are not classified as class I, II, or III. If reclamation projects are investigated and found to be feasible, the soils of the area are reclassified based on the continuing limitations and hazards after drainage. These places the classification of wet soils on a basis similar to that of the classification of irrigated, stony, saline, or overflow soils. Some large areas of bottom land subject to overflow are reclassified when protected by dikes or other major reclamation work.
- There are examples of these along streams where levees have been constructed. Land already drained is classified according to the continuing limitations and hazards that affect its use. Needs for initial conditioning, such as for clearing of trees or swamp vegetation, are not considered in the capability classification. They may be of great importance, however, in making some of the land-management de cisions. Costs of drainage, likewise, are not considered directly in the capability classification, although they are important to the land manager.

Toxic Salts

- Presence of soluble salts or exchangeable sodium in amounts toxic to most plants can be a serious limiting factor in land use. Where toxic salts are the limiting factor, the following ranges are general guides until more specific criteria are available:
- Class II—Crops slightly affected. In irrigated areas, even after salt removal, slight salinity or small amounts of sodium remains or is likely to recur. Class III—Crops moderately affected. In irrigated areas, even after salt removal, moderate salinity or moderate amounts of sodium remains or is likely to recur.
- Classes IV-VI—Crops seriously affected on cultivated land. Usually only salt-tolerant plants will grow on non-cultivated land. In irrigated areas, even after leaching, severe salinity or large amounts of sodium remains or is likely to recur. Class VII Satisfactory growth of useful vegetation impossible, except possibly for some of the most salt-tolerant forms, such as some Atriplexes that have limited use for grazing.

Slope and Hazard of Erosion

Soil damage from erosion is significant in the use, management, and response of soil for the following reasons:

1. An adequate soil depth must be maintained for moderate to high crop production. Soil depth is critical on shallow soils over nonrenewable substrata such as hard rock. These soils tolerate less damage from erosion than soils of similar depth with a renewable substratum such as the raw loess or soft shale that can be improved through the use of special tillage, fertilizer, and beneficial cropping practices.

2. Soil loss influences crop yields. The reduction in yield following the loss of each inch of surface soil varies widely for different kinds of soil. The reduction is least on soils having little difference in texture, consistence, and fertility between the various horizons of the soil. It is greatest where there is a marked difference between surface layers and sub- soils, such as among soils with claypans. For example, com yields on soils with dense, very slowly permeable subsoils may be reduced 3 to 4 bushels per acre per year for each inch of surface soil lost. Yield reduction is normally small on deep, moderately permeable soils having similar textured surface and subsurface layers and no great accumulation of organic matter in the surface soil. **3**. Nutrient loss through erosion on sloping soils is important not only be-cause of its influence on crop yield but also because of cost of replacement to maintain crop yields. The loss of plant nutrients can be high, even with slight erosion.

4. Loss of surface soil changes the physical condition of the plow layer in soils having finer textured layers below the surface soil. Infiltration rate is reduced; erosion and runoff rates are increased; tilth is difficult to maintain; and tillage operations and seedbed preparation are more difficult.

5. Loss of surface soil by water erosion, soil blowing, or land leveling may expose highly calcareous lower strata that are difficult to make into suitable surface soil.

6. Water-control structures are damaged by sediments due to erosion. Maintenance of open drains and ponds becomes a problem and their capacity is reduced as sediment accumulates.

7. Gullies form as a result of soil loss. This kind of soil damage causes reduced yields, increased sediment damage, and physical difficulties in farming between the gullies. The steepness of slope, length of slope, and shape of slope (convex or concave) all influence directly the soil and water losses from a field. Steepness of slope is recorded on soil maps. Length and shape of slopes are not recorded on soil maps; however, they are often characteristic of certain kinds of soil, and their effects on use and management can be evaluated as a part of the mapping unit. Where available, research data on tons of soil loss per acre per year under given levels of management are used on sloping soils to differentiate between capability classes.

Soil Depth

- Effective depth includes the total depth of the soil profile favorable for root development. The soil depth includes the total depth of the soil to a contrasting layer significant for soil conservation requirements (rooting depth, presence of hard pan, hard sub-soil, and others).
- Use a soil auger or look at profiles near edges of footpaths, gullies, and ask farmers their view. In general, observe and measure soil depth at least every 100 meters in most terrains,
- Where the effect of depth is the limiting factor, the following ranges are commonly used: Class I, 36 inches or more; class II, 20-36 inches; class III, 10-20 inches; and class IV, less than 10 inches.
- These ranges in soil depth between classes vary from one section of the country to another depending on the climate. In arid and semiarid areas, irrigated soils in class I are 60 or more inches in depth. Where other un- favorable factors occur in combination with depth, the capability decreases.

Previous Erosion

- On some kinds of soil previous erosion reduces crop yields and the choice of crops materially; on others the effect is not great. The effect of past erosion limits the use of soils

  (1) where subsoil characteristics are unfavorable, or

  (2) where soil material favorable for plant growth is shallow to bedrock or material similar to bedrock.

In some soils, therefore, the degree of erosion influences the capability grouping.

Water Logging

- Waterlogging is the major obstacle for sustainable agriculture. Plants subjected to waterlogging suffer from substantial yield losses. Under natural environmental conditions, plants often get exposed to transient or permanent waterlogging.
- It affects a number of biological and chemical processes in plants and soils that can affect crop growth in the short and long term. The rate of oxygen depletion in saturated soil is affected by the temperature and rate of biological activity in the soil.
- A study has determined what are the most important causes of waterlogged soils. Waterlogging is caused by a combination of excess rainfall (for the site), poor external drain- age (runoff), poor internal drainage (water movement in the soil profile) and the inability of the soil to store much water.
- It refers to the saturation of soil with water. Soil may be regarded as waterlogged when the water table of the ground water is too high to conveniently permit an anticipated activity, like agriculture. Crops need air to a greater or lesser depth in the soil.
- It is the saturation of soil with water. Soil may be regarded as waterlogged when it is nearly saturated with water much of the time such that its air phase is restricted and anaerobic conditions prevail.

Infiltration

- Infiltration is defined as the entry of water from the surface into the subsurface.
- Introduction Infiltrated water may originate from rainfall; irrigation; water bodies such as ponds, rivers, and lakes; or other anthropogenic activities. The terms infiltration and percolation are frequently interchangeably used even though they represent two different processes.
- Infiltration describes the entry from the surface to the subsurface, whereas percolation focuses on the flow of water through soil and porous media. The amount of water

percolation that reaches the groundwater represents the groundwater recharge. When the soil surface is exposed to rainfall or submersion, infiltrated water fills the interstices between soil grains of the upper layers of the soil.

- The soil profile may contain a saturated horizon that extends a few millimeters in depth, called the saturated zone. Water continues to penetrate into the subsurface forming a transmission zone. The water content in this zone varies with depth, and the water flow is essentially vertical and driven by gravitational forces.
- Soil water infiltration is controlled by soil physical properties, slope, vegetation, surface roughness, and the rate and duration of water application. Infiltration capacity is commonly determined by hydrograph analysis and infiltrometer experiments.
- Soil infiltration refers to the ability of the soil to allow water to move into and through the soil profile. Infiltration allows the soil to temporarily store water, making it available for use by plants and soil organisms. The infiltration rate is a measure of how fast water enters the soil, typically expressed in inches per hour.

Surface Stoniness/Rockiness

- Surface Stoniness/Rockiness is a % coverage of stones and rocks on the land unit's surface.
- This extent of stones and rocks coverage on the surface of a land units hinders development unless removed by the developer even if other conditions are conducive for cropping and other uses.

6.5.Land suitability evaluation

- Land suitability classification relates to specific uses. In other words, it refers to the fitness of the land for a specific kind of land use, whether it be agricultural or non-agricultural uses. Land Suitability is the degree of appropriateness of land for a certain use. Land suitability could be assessed for present condition (Actual Land Suitability) or after improvement (Potential Land Suitability).
- Actual Land suitability is a land suitability that is based on current soil and land conditions, i.e. without applying any input. The information is based on physical environment data generated from soil or land resources surveys. The information is based on soil characteristics and climate data related to growth requirements of crops being evaluated.
- Potential Land Suitability is the suitability that could be reached after the land is improved. The land to be evaluated can be natural (conversion) forest, abandoned or unproductive lands, or land currently used for agriculture, at a sub-optimal level of

management in such a way that the productivity can be improved by changing to more suitable crops.

Basic principles of land suitability are:

(a) Land suitability is assessed for specified kinds of use.

(b) Evaluation requires a comparison of benefit obtained with inputs needed.

(c) Suitability is for use on a sustained basis, i.e. the use must not bring about severe or progressive degradation.

(d) Land suitability orders, which reflect kinds of suitability.

(e) Land suitability classes, which reflect degrees of suitability within orders.

(f) Land suitability sub-classes, which reflect kinds of limitation or the main kinds of improvements required within classes.

(g) Land suitability units, which reflect minor differences within sub-classes in the required management.

6.4.1 Structure of the suitability classification

The framework has the same structure, i.e. recognizes the same categories, in all of the kinds of interpretative classification (see below). Each category retains its basic meaning within the context of the different classifications and as applied to different kinds of land use. Four categories of decreasing generalization are recognized:

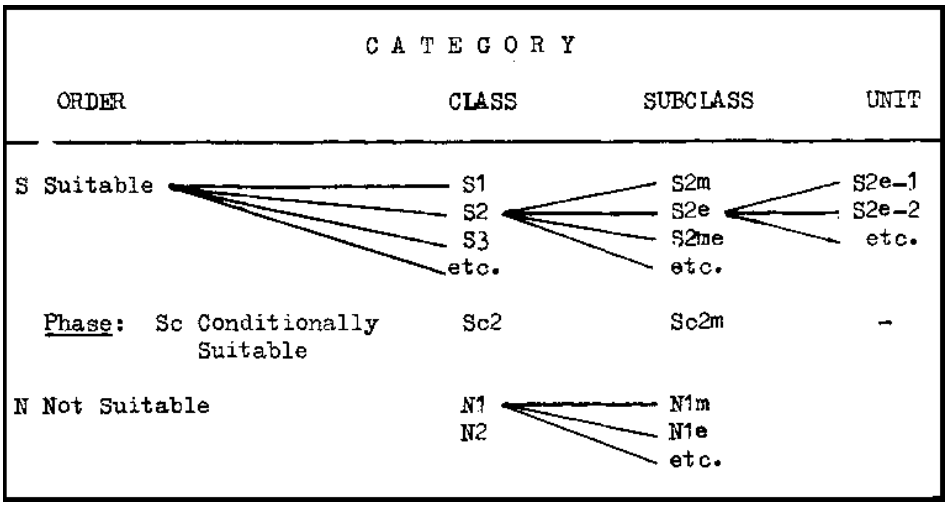
i. Land Suitability Orders:	Reflecting kinds of suitability.
ii. Land Suitability Classes:	Reflecting degrees of suitability within Orders.
iii. Land Suitability Subclasses:	Reflecting kinds of limitation or main kinds of improvement measures required, within Classes.
iv. Land Suitability Units:	Reflecting minor differences in required management within Subclasses.

Table *- Land suitability classes*

Order	**Class**	**Description**
Suitable	S1 (Highly suitable)	➢ Land having no significant limitation to a sustained application of a given use or only

		minor limitations will not significantly reduce productivity or benefits and will not raise inputs above an acceptable level.
	S2 (Moderately suitable)	➢ Land having minor limitations to the given type of use ➢ It will reduce productivity or benefits and increase required inputs to the extent that the overall advantage to be gained from the use, although still attractive, will be appreciably inferior to that is expected from class S, land.
	S3 (Marginally suitable)	➢ Land having moderate limitations to the given type of use ➢ The soils reduce productivity or benefits or increase required inputs, that this expenditure will be only marginally justified.
Not suitable	N1 (Currently not suitable)	➢ Land having limitations, which may be surmountable in time, but which cannot be corrected with existing knowledge at currently acceptable cost; the limitations are so severe as to preclude successful sustained use of the land in the given manner.
	N2 (Permanently not suitable)	Land that have so severe limitations that are very difficult to be overcome

Table - Structure of the Suitability Classification



6.5.2 The range of classifications

The Framework recognizes four main kinds of suitability classification, according to whether it is qualitative or quantitative, and refers to current or potential suitability. Each classification is an appraisal and grouping of land units in terms of their suitability for a defined use.

6.5.2.1 Qualitative and Quantitative Classifications

- A qualitative classification is one in which relative suitability is expressed in qualitative terms only, without precise calculation of costs and returns.
- Qualitative classifications are based mainly on the physical productive potential of the land, with economics only present as a background. They are commonly employed in reconnaissance studies, aimed at a general appraisal of large areas.
- A quantitative classification is one in which the distinctions between classes are defined in common numerical terms, which permits objective comparison between classes relating to different kinds of land use.
- Quantitative classifications normally involve considerable use of economic criteria, i.e. costs and prices, applied both to inputs and production. Specific development projects, including pre-investment studies for these, usually require quantitative evaluation.
- Qualitative evaluations allow the intuitive integration of many aspects of benefits, social and environmental as well as economic. This facility is to some extent lost in quantitative evaluations. The latter, however, provide the data on which to base calculations of net benefits, or other economic parameters, from different areas and different kinds of use. Quantitative classifications may become out of date more rapidly than qualitative ones as a result of changes in relative costs and prices.

6.5.2.2 Classifications of Current and Potential Suitability

- A classification of current suitability refers to the suitability for a defined use of land in its present condition, without major improvements. A current suitability classification may refer to the present use of the land, either with existing or improved management practices, or to a different use.

- A classification of potential suitability refers to the suitability, for a defined use, of land units in their condition at some future date, after specified major improvements have been completed where necessary. Common examples of potential suitability classifications are found in studies for proposed irrigation schemes. For a classification to be one of potential suitability it is not necessary that improvements shall be made to all parts of the land; the need for major improvements may vary from one land unit to another and on some land units none may be necessary.
- In classifications of potential suitability, it is important for the user to know whether the costs of amortization of the capital costs of improvements have been included. Where these are included, the assumptions should state the extent to which input e has been costed and the rates of interest and period of repayment that have been assumed.
- The distinction between qualitative and quantitative classifications, and between current and potential suitability, do not fully describe the nature of a classification. Two further considerations of importance are treatment of the location factor and amortization of capital costs, but these by no means exhaust the range of possibilities. They are not distinguished as further specific types of classification. A suitability classification needs to be read in conjunction with the statement of the data and assumptions on which it is based.

6.5.3 Land suitability analysis procedure

This step forms the central part of land evaluation, a procedure which answers the following questions: -

- ✓ For any specified kind of land use, which areas of land are best suited?
- ✓ For any given area of land, which kind of use is best suited?

In simplified form, the procedure for land suitability analysis is:

- ✓ describe promising land-use types;
- ✓ for each land-use type, determine the requirements, e.g. for water, nutrients, avoidance of erosion;
- ✓ conduct the surveys necessary to map land units and to describe their physical properties, e.g. climate, slope, soils;

- ✓ Compare the requirements of the land-use types with the properties of the land units to arrive at a land suitability classification.

Land cannot be graded from "best" to "worst" irrespective of the kind of use and management practiced because each kind of use has special requirements.

For example: -

- ✓ Rice has high water requirements and most varieties grow best in standing water; no other cereal crop will tolerate water logging during its period of active growth.
- ✓ Tea, sugar cane and oil-palm need efficient transport to processing plants; but most crops grown for subsistence do not.
- ✓ For mechanical operations, stones and rock outcrops are limiting; with oxen or hand implements, cultivation can work round these obstacles.

6.5.3.1 Description of land-use types

A land-use type is a kind of land use described in terms of its products and management practices. For reconnaissance surveys at the national level, highly generalized descriptions may be sufficient, e.g. "sorghum production", "conservation forestry". At the district and local levels, it is necessary to specify the use in more detail. For example, will the sorghum production be mechanized or based on animal traction? Will fertilizer be used? Will the conservation forests be managed by the government forestry service or by local communities? Such descriptions serve two purposes:

- ✓ First, they are the basis for determinating the requirements of a use.
- ✓ Second, the management specifications can be used as a basis for extension services and for planning necessary inputs.

The land-use types will be based on the promising improvements identified in Step 4. They may be modifications of existing uses, such as incorporating fodder trees or soil conservation measures, or something new to the area, such as the introduction of a new cash crop.

- ➢ Make provisional description of the land use types in terms of:
  - ➢ Market orientation
  - ➢ Capital intensity
  - ➢ Labor intensity
  - ➢ Land tenure
  - ➢ Material input

- Define the requirements for successful growth and development.
- For each land use type, it is necessary to establish:
    - The conditions which are best in its operations.
    - The range of conditions which are less optimal but still acceptable.
    - Conditions which are unsatisfactory.
- The land use requirements are latter matched with land qualities to determine the suitability of a particular land unit for a particular land use type.
- Examine the land use requirements (LUR) in terms of:
    - **Physical requirement like:**
        - ✓ Energy
        - ✓ Temperature
        - ✓ Moisture
        - ✓ Oxygen
        - ✓ Nutrient availability
        - ✓ Rooting condition etc.
    - **Management requirements like:**
        - ✓ Land preparation
        - ✓ Soil workability
        - ✓ Crop rotation
        - ✓ Access with production zone etc.
    - **Conservation requirements:**
        - ✓ Requirements for the hazard of soil degradation like:
            - ✓ Erosion and
            - ✓ Soil degradation

6.5.3.2 Selection of land qualities and land characteristics

Land-use requirements are described by the land qualities needed for sustained production. A land quality is a complex attribute of land that has a direct effect on land use. Examples are the availability of water and nutrients, rooting conditions and erosion hazard. Most land qualities are determined by the interaction of several land characteristics, measurable attributes of the land. For example, the quality "availability of water" is determined by the

balance between water demand and water supply. The demand is the potential evaporation from the surface of the crop and the soil; the supply is determined by rainfall, infiltration, storage of water in the soil and the ability of the crop to extract the stored water.

- What should be done to reach on factor rating?
  - ✓ Select LQs relevant for consideration.
- A land quality (LQ) is significant for suitability assessment and can be employed when the following three conditions are fulfilled;
  - ✓ The quality has a known effect upon the crops or kinds of land use (LU) under consideration.
  - ✓ Critical values of the quality such as management adversely affect the use.
  - ✓ There is some practicable means of collecting information for its measurement or estimation.

How can we assess the significance of land qualities (LQs)?

1. Effect upon the uses
   - ✓ Large: - when the land use is particularly affected by the quality.
   - ✓ Moderate: - the quality can have substantial effect upon the use.
   - ✓ Slight: - the quality has no substantial known effect upon the use.
2. Occurrence of critical values within the study area
   - ✓ Frequent: critical values such as a substantial effect on the suitability for use are believed to occur over at least 5% of the area.
   - ✓ Infrequent: - critical values cover less than 5% of the area
   - ✓ Rarely / never: - critical values never occur in the area
3. Practicability of obtaining information
   - ✓ Obtainable
   - ✓ Unobtainable

- Thus, the qualities used in an evaluation are stated with reference to both the considered land use type and the nature of land units in the study area.

6.5.3.3 Factor rating

- Factor ratings are sets of values which indicate how well each land use requirement is satisfied by a particular condition of the corresponding land qualities on the crops or land utilization types.

- Factor ratings are made in terms four classes:
    1. s1 – Highly suitable
    2. s2 – moderately suitable
    3. s3 – Marginal suitable
    4. n – not suitable
- These ratings refer to the effects of individual land quality on a specified land use requirement.

Examples: rating the land use requirements for sorghum.

Land use requirements			**factor ratings**			
Land quality	**Diagnostic factor**	**Unit**	**Highly**	**Mild**	**Marginal**	**None suitable**
Rooting condition	Effective depth	Cm	>100cm	50 – 120cm	30 – 50cm	<30cm
Oxygen availability	drainage	class	Well drained to moderately drained	Moderately drained	Importantly drained	Poorly drained
Nutrient availability	Soil reaction	pH	5.5- 7.5	4.8- 5.5 & 7.5- 8.0	4.5 – 4.8 & 8.0 – 8.5	<4.5 & > 8.5

- Each factor rating may be assessed in two ways
    - ✓ In terms of reduction in yields.
    - ✓ In terms of inputs or additional costs needed to avoid such reduction by counter acting the deficiency.

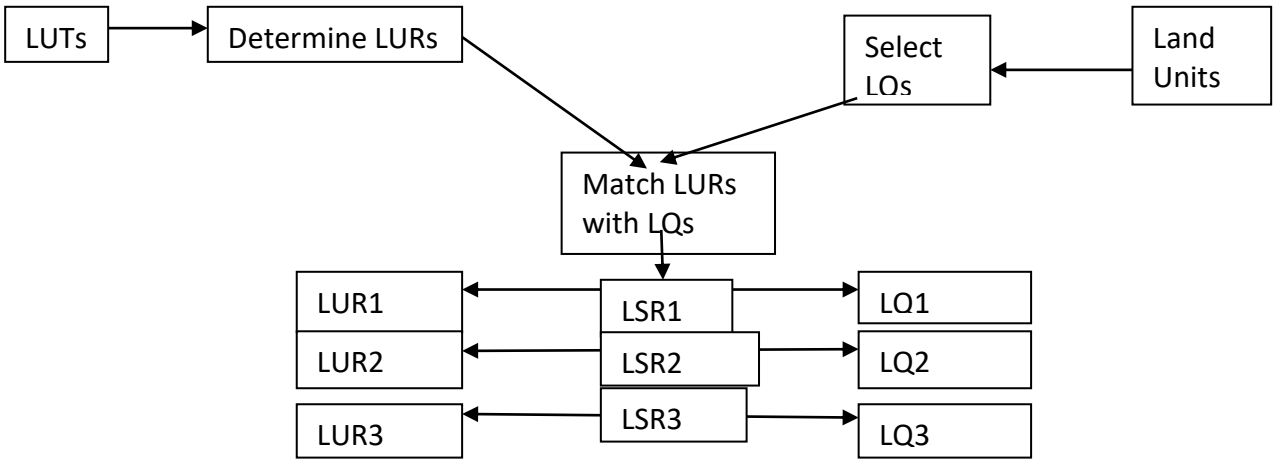
Factor rating class	**Definition in terms of yield**	**Definition in terms of input**

s1- highly suitable	>80%	None
s2-moderately suitable	40-80%	Inputs needed are productive and economical
s3-marginally suitable	20-40%	Inputs needed are practical but only has economical value
n- not suitable	<20%	Limitations can never be overcome by inputs or management practices

6.5.3.4 Matching land use requirements with land qualities

- Matching is the process of comparing land use types with the qualities of a specific land units.
- Matching answers how well do the qualities of the land satisfy the requirements of the land use.
- The answers levels to the first approximation of land suitability class based on the physical criteria.

Chain of Matching LURs with LQs



Where LUTs = Land Use Types

LURs = Land Use Requirements

LQs = Land Qualities

LSR = Land Suitability Rates

◎ These simple ratings are combined in a table by using two general methods.

6.5.3.5 Methods of combination

- There are two methods of combination of suitability ratings.

1. Limiting condition

1. If there are five important or significant LQs rated respectively as s1, s1, s3, s2 and s1 the overall suitability rating is taken as S3.
2. The decision is made based on the principle of "**law of minimum**" in agriculture which states that crop yield will be determined by the factor in the lowest supply.

Example: - land suitability rating by limitation method single land unit for different land use system.

Land Use Requirements	**Land use types**	
	Maize	**Sorghum**
Temperature regime	s1	s1
Moisture availability	s2	s1
Oxygen availability	s1	s1
Nutrient availability	s3	s1
Rooting condition	s2	s1
Land suitability class	**S3**	**S1**

Example: - land suitability rating of different land units for a single land use type.

Land use requirements	**Land units**		
	A	**B**	**C**
Temperature regime	s1	s1	s1
Moisture availability	s1	s1	s1

- Land use type: sorghum

Oxygen availability	s1	N	s1
Nutrient availability	s1	s2	s2
Rooting condition	s1	s2	s1
Suitability class	**S1**	**N**	**S2**

2. **Arithmetic supply method**
   - ✓ The individual assessments which are expressed numerically can be combined by multiplication as follow.
   - ✓ Each suitability class is assigned a value varying from 1.0 to 0.0 accordingly the following suggestions are given;
   - ✓ **S1** = 1.0, S**2** = 0.8, **S3** = 0.5, and **n** = 0.0
   - ✓ These values will be multiplied for all moderately or very important LQs.

➢ These products will be converted back to an overall suitability in accordance with the seal of the crop yield of the table which is;

- » 0.8 to 1 = S1
- » 0.4 to 0.8 = S2
- » 0.2 to 0.4 = S3
- » 0.0 to 0.2 = S4

Example: - Determine the overall suitability if

Land quality no = 1, 3, 5, 7, 9

Significance = 2, 1, 2, 1, 2, 3

Suitability = s2, s2, s1, s3, s2

• Overall suitability = 0.8 * 0.8 * 1.0 * 0.5 * 0.8 = 0.26 = S3

The outputs from Step 5 are: -

- ✓ **Land suitability maps**, showing the suitability of each land unit for each land-use type;
- ✓ **Descriptions of these land-use types.**

The descriptions of land-use types are given in a degree of detail appropriate to the level of planning. At the national level, only outline descriptions of major kinds of land use may be needed. At district and local levels, land-use type descriptions should specify the management, inputs (e.g. seeds, fertilizer, and fuel) and estimated production. Such information will later be needed to make provision for the supply of inputs and for storage, distribution and marketing.

In this step the planning team is responsible and must be able to:

- ✓ Describe land-use types in sufficient detail for subsequent analysis.
- ✓ Select land qualities and land characteristics to be used in comparisons of land-use requirements with land.
- ✓ Map the land units and determine their relevant land characteristics and qualities.
- ✓ Set limiting values to land-use requirements, to be used for determining class limits for land suitability. Take into account sustainability and the ratio of benefits to inputs.
- ✓ match land use with land:
  - compare land-use requirements with land qualities or characteristics to determine provisional land suitability classes;
  - consider modifications to land-use types, in order that they become better suited to the land;
  - consider land improvements that could make the land better suited to the land use.
- ✓ Map land suitability for each land-use type.
- ✓ Plan for research, needed: additional surveys, research by outside agencies or within the land-use plan.

6.6 Appraise the alternatives: Environmental, economic and social analysis

- ➢ The evaluation carried out so far has been essentially in terms of physical suitability. An assessment has been made of whether different kinds of land use can be undertaken on a sustained basis.
- ➢ In step 6, the effects of each alternative use are appraised in environmental, economic and social terms. Obviously, these aspects have not been ignored: they generally guided the

identification of promising options at Step 4. Now, those that passed this first test are formally apprised against the selected criteria.

6.6.1 Environmental impact assessment

The land suitability evaluation has already classified as "not suitable" any land use that continually degrades the land. An analysis of environmental impact goes further. It compares what will happen under each alternative system of management in terms of the quality of life of the whole community and takes account of effects both within and beyond (off-site effects) the planning area.

Following are examples of the environmental effects to be considered:

a) **Soil and water resource:** hazard of soil erosion, landslides and sedimentation; security of water supply and water quality within and beyond the planning area.

b) **Pasture and forest resources:** degradation of rangelands, clearance or degradation of forests.

c) **quality of wildlife habitat:** structure and composition of forests, grasslands and wetlands; critical areas needed to maintain wild plant and animal communities.

d) **Scenic and recreational value for tourism and leisure industries:** tolerance of the disturbance associated with leisure, and compatibility with other land uses.

6.6.2 Economic and financial analysis

- In step 5, land suitability is expressed either in qualitative terms (highly, moderately and marginally suitable or not suitable) or in quantitative physical terms (e.g. crop or timber yield). By comparing the production and other benefits with inputs in terms of money, an extra quantitative measure of land suitability is provided.
- An underlying assumption of financial and economic analysis is that market prices, established in competitive markets, reflect social values. Where there is no competitive market for a resource, which is often the case with renewable land resources and family labor, some other measure of worth has to be found.
- Financial analysis looks at profitability from the point of view of a farmer or other private investor, by comparing the producers' revenues with their costs. Farmers will not practice a land use unless, from their point of view, it pays.

Financial analysis can answer some immediate, practical questions:

- ✓ Is this crop, or land use, the most profitable option?
- ✓ Where can this crop be grown, or land use practiced, most profitably?

Finally, costs and prices can change within a few years and projections of their future levels are risky. For example, it may be found that oil-palm is a more profitable crop shall rubber at present-day costs and prices but, by the time these crops are producing, the position may have reversed. There is no easy solution to this problem. For perennial crops or forestry, it may prove better to adopt land uses that perform best in physical terms, rather than seeking short-term price advantages. Economic calculations must be updated periodically during the planning period.

6.6.3 Social impact

Social impact analysis studies the effects of proposed changes of land use on different groups of people. Particular attention should be given to effects on women, ethnic minorities and the poorest sections of the community. There are no fixed procedures for assessing the social impact of a proposed change of land use. The social purpose of the land-use plan should be laid down at the outset and the impact of each system of land use can be judged against this goal.

Examples of social factors that might be considered are:

Population: its projected size, distribution and age structure; the desirability or otherwise of migration.

Basic needs: food security, lessening of risk (e.g. in planning subsistence production as compared with cash cropping)

Employment and income opportunities: for example, mechanization may have been considered as a means of achieving lower production costs but this could lead to unemployment.

Land tenure and customary rights: for example, grazing and water rights.

Administrative structure and legislation with in which planning must operate.

6.7 Choose the best option

- At the point of decision, the roles of the planner and the decision-maker must interact. The planner has to assemble and summarize the facts needed to make an informed decision - namely the results obtained from the previous steps. The decision-maker has to choose the land-use option that best meets the goals.
  - It may be obvious which option is best, or else the choice may involve careful judgment. In simple cases, a good decision may be made by weighing the evidence

that has been built up through the previous steps of planning. A set of policy guidelines, for example;

- a minimum acceptable production of staple foods and fuel wood;
- the preferred location within range of existing services and a limited amount of development capital;

❖ The decision-maker must take into account a variety of practical considerations, including:

- ✓ the expressed preferences of the local people;
- ✓ the interests of minority groups;
- ✓ national policies;
- ✓ constraints, e.g. of land tenure and availability of inputs;
- ✓ the maintenance of environmental standards;
- ✓ practicability - potential implementing agencies should be consulted;
- ✓ Costs and the availability of funding.

In the final analysis, most land-use decisions will be taken by the thousands of individual land users, all making decisions from their own points of view. Therefore, it is advisable to: -

1. See every available means to achieve public involvement - through meetings, posters, the press, broadcasts and government agencies.
2. Allow adequate time for reviews and comments, as determined by the decision-maker or planning regulations, and fix a deadline for the receipt of comments.
3. Review comments and resolve conflicts. Since the comments may be numerous, a systematic process for dealing with them must be adopted. The planners can:
   - ✓ group the comments according to land use, land users or products;
   - ✓ assign comments by subject area to a member of the planning team for responses;
   - ✓ list proposed changes in the draft plan;
   - ✓ Submit comments, responses and proposed changes to the decision-maker.

4. The decision-makers must decide:

- ✓ whether the responses to the comments are adequate;
- ✓ Which, if any, changes should be made to the draft plan.

Not everyone will be satisfied with the plan. Whatever compromises or adjustments are made, there will still be people who disagree. But resolve conflicts. The critical point in Step 7 is reached with selection of the option that is judged to be the best. This forms the basis for subsequent preparation of the plan. The data and evaluation of other options are not discarded, but recorded in the report, since they may be needed for later revision. Finally, the decision-maker must authorize subsequent steps; that is, the preparation of the chosen plan.

In this step the planning teams be able to:

- ✓ Set out a series of options for the allocation or recommendation of land-use types to land units. Also state their evaluation in terms of land suitability and environmental, economic and social analysis.
- ✓ Set out the consequences of these options in terms of the goals and planning objectives.
- ✓ Present the options and their consequences in a way that is appropriate for review.

Both the planning team and decision-makers

- ✓ Make arrangements for consultations with the communities affected as well as with the implementing agencies; obtain views about feasibility and acceptability.
- ✓ Assemble and review the comments received. In the light of these, make any necessary changes to the options.

Decision-makers must

- ✓ Decide if the response to comments is adequate.
- ✓ Consider the options in terms of goals and policy criteria.
- ✓ Choose the best option.
- ✓ Authorize preparation of the plan.

6.8. Prepare the land-use plan

At this point, a report is written which has two major functions:

- ✓ to present the plan that is now recommended, with reasons for the decisions taken - that is, to summarize the results from Steps 1 to 7;
- ✓ To prepare for implementation.

Three elements in the plan that is now prepared are:

1) **What should be done?** - The selected changes to land use and where they should be applied or recommended.,

2) **How should it be done?** - Logistics, costs and timing.

3) **Reasons for the decisions taken.**

Writing the plan

Format of the plan

One of the main difficulties in drafting a land-use plan is the wide range of readership that needs to be informed. This ranges from senior government ministers, who have time only to read outline summaries of what is to be done, to technical staff responsible for implementation and the field extension staff who will have to apply the findings to local areas. To meet the needs of these different users, it has frequently been found useful to divide the plan into the following sections:

1) **Executive summary**: Written for non-technical decision-makers; a summary of the land-use situation, its problems, the opportunities and the recommendations for action, i.e. the focal point. Reasons for decisions taken are given, but only briefly. Clear, concise writing is of the highest importance. This section should include at least one key map, the (master) land-use plan and possibly other maps at small scales. It is typically 20 to 50 pages long at the most.

2) Main report: Explains the methods, findings and factual basis of the plan. Written for technical and planning staffs who want to know details, including reasons for decisions taken.

3) Preparation of maps: An integral part of the main report, presented separately for convenience of binding.

- Land-use planning is critically concerned with what should be done, where. The planning procedure so far has been based on the fact that land conditions are highly variable and so land-use types that will be sustainable and economically viable on one land unit will fail, in either or both of these respects, on other kinds of land. Hence, maps form a key element in the presentation of results.
- Several sets of maps have been prepared as part of the planning procedure: base maps, summaries of available data and possibly maps based on original surveys (Steps 3 and 5); land suitability maps (Step 5); and allocations or recommendations of land use to areas of land. These are now drawn up and printed so that they can be used as a basis for implementation and revision. These maps will be used in the field and in the office by a variety of people - executive, technical and administrative.

For the maps to be useful, the following points should be observed:

- The **base-map** detail (roads, tracks, settlements, administrative boundaries) should be clear; users will constantly need to find where they are and what should be done, where.
- At the same time, the features shown in the maps (e.g. land-use types, soils, water resources) should be easy to see; a good quality of cartography, normally using color, is essential.
- The legend (key) must be an integral part of the maps.
- The maps should be printed in sufficient quantities to supply all implementing agencies with copies for several years. The map showing land-use allocations and recommendations is the focal point of the land-use plan.

4) Appendixes: Give the technical data that support the main report. These may run to several volumes. They include the results from original surveys conducted as part of the plan, e.g. soil surveys, forest inventories, records of river flow.

In this step the planning teams is responsible and be able:

- ✓ Prepare maps - the basic or master land-use plan and supporting maps.
- ✓ Set out the land-use allocations and recommendations, based on the preferred option selected in Step 7. Give descriptions of land-use types, including management recommendations on each kind of land.
- ✓ Set targets for achievement, by land-use type, area and agency. Specify how they will be reached. Check that they are within the capabilities of the agencies and infrastructure.
- ✓ Draw up logistic preparations, specifying the capital works, recurrent inputs and responsibilities for implementation.
- ✓ Establish mechanisms for monitoring progress and revising the plan (Step 10).
- ✓ Make arrangements for research needed to support the plan.
- ✓ Determine the finance needed for each operation and determine sources of funds.
- ✓ Write the report - executive summary, main report, maps and appendixes.
- ✓ Establish mechanisms for communication with, and the participation of, all institutions involved.
- ✓ Prepare public relations material.

Chapter 7. Implement the plan

The objective of the entire land-use planning exercise so far has been to identify and put into practice beneficial land-use changes. Hence, implementation is included as a "step" in the planning process, even if a step of a different nature. The responsibility for putting the plan into effect rests with the decision-makers, the implementing agencies and the people of the area.

7.1 Land use plan Implementation Strategies

- Mixing Measures
- Direct Implementation
- Indirect Implementation
- Decentralised Implementation
- Participatory Implementation
- Sectoral Implementation
- Implementation Management
- Know-how of the Participants involved in the Implementation
- Concerted Action
- Local Controlling Mechanisms
- Conviction and Voluntary Action
- Minimum Legal Framework

❖ Implementation involves a wide range of practical activities. The following refer specifically to roles that the planning team may undertake.

- ✓ Ensure that the changes recommended in the plan are correctly applied in the plan; be available for technical consultations; discuss with implementing agencies any suggested modifications.
- ✓ Help to maintain communications between all people and institutions participating in or affected by the plan, i.e. land users, sectoral agencies, government, non-governmental organizations, and commercial organizations.
- ✓ Assist in coordination of the activities of the implementing agencies.
- ✓ Assist in institution-building by strengthening links between existing institutions, forming new bodies where necessary and strengthening cooperation.
- ✓ Focus on the participation of the land users; ensure adequate incentives.

- ✓ Organize research in association with the plan; ensure that results from research are communicated and, where appropriate, incorporated into the plan.
- ✓ Arrange for education and training of project staff and land users.

7.2. Monitor and revise the plan

- ➢ Now the planning process comes full circle. Information is needed on how well the plan is being implemented and whether it is succeeding, so that the implementation agencies can improve the way in which the plan is being applied and so that the planning team may learn from experience and respond to changing conditions.

In this step it is necessary to know:

- ✓ Are the land-use activities being carried out as planned?
- ✓ Are the effects as predicted?
- ✓ Are the costs as predicted?
- ✓ Have the assumptions on which the plan was based proved to be correct?
- ✓ Are the goals still valid?
- ✓ How far are the goals being achieved?

Monitoring

- ➢ Monitoring may involve observations at key sites, regular extension visits and discussions with officials and land users. A checklist and periodic meetings in the planning area may serve the purpose. Those responsible for plan implementation should list the tasks needed to correct problems as they arise and should also take action.

7.3 Review and revision

- ➢ By analysis of the data collected, compare what has been achieved with what was intended. Identify problems in the implementation of the plan, or in the data or assumptions on which the plan is based.

In this step planning team is able to

- ✓ List the goals and criteria achievement agreed in Step 1. Add any that emerged later in the planning period.
- ✓ Gather data relevant to each criterion of attainment: physical, economic and social.
- ✓ Compare what has been achieved with what was planned. Identify elements of success and failure.
- ✓ Seek explanations for failures. Were they caused by:

- Incorrect assumptions of the plan?
- Changed economic or political circumstances?
- Logistic problems of implementation?
- Problems of communication and participation?

✓ Review the goals: are they still valid?

✓ initiate modification or revision of the plan:

- Minor modifications through action by implementing agencies;
- larger revisions by the preparation of proposals and reference back to decision-makers.

Chapter 8: Framework of general conditions for land use planning

8.1 Impact of the General Conditions on Land Use Planning

- The framework of general conditions influences the whole process of land use planning and implementation. Changes to the framework conditions constitute one of the reasons why land use planning cannot be carried out according to fixed working steps. It is aniterative process allowing countless instances of backtracking, learning from experience and new findings.
- General conditions vary in nature, context and country. They are composed of natural, economic, political, legal, institutional-, organisational and socio-cultural factors, which also influence each other. The following aspects are particularly significant for land use planning.

Land law and land order: Uncertainty about land tenure and rights of use restrict the scope for action in decision-making by the land users. There is little willingness to make high investments for long-term and sustainable forms of land use.

The present situation concerning the natural resources: When resources appear to be intact, there is often little concern for protective measures. If resources are already degraded, often the funds are not available for carrying out measures to improve them.

Differences in interests specific to gender and age: Due to the existing system of splitting responsibilities in rural families, men and women, young and old people, often have different priorities concerning the planning of land use.

The economic potential of the (smallholder farming) population: The need for daily survival does not enable the poor rural population to invest long-term in improvements to resource management, unless this also leads in the short-term to an increased income.

Equipment of the responsible organisations in terms of personnel and materials: Without external support, many organisations are overwhelmed by their tasks in land use planning.

Traditional authorities and mechanisms of settling conflicts: Existing traditional authorities and mechanisms of settling conflicts are an important element in land use planning. External support is especially necessary when traditional mechanisms of regulation in the field of land use planning fail.

8.2 Possibilities of Dealing with the General Conditions

- Well-founded knowledge of the framework of general conditions sets the scope for action and finds the limits of LUP to be determined. The assumptions and risks in achieving the project objectives and results can be defined more realistically. They are particularly helpful in checking the potential for self-help. This knowledge forms an important basis for creating awareness and public relations work. In the long run, a precise analysis is a prerequisite for examining which of the conditions can be influenced and which cannot.
- In addition to data sets and evaluations of existing materials and statistics, informal information and findings by key people are of major importance. Informal sources of information often has a higher clarification content, are more up-to-date and closer to the situation of the participants.
- The open discussion processes on existing patterns of behaviour and regulations usually have consequences. A problem is identified, e.g. why existing legal regulations do not have an effect, due to those being too rigid and do not fit into the regional situation. This can be the case when there is a general limit on land use, because of the slope; or the political will for implementation is lacking.
- It is possible to use political pressure on the decision-makers, aiming at legal changes or keeping of existing regulations. This can be done through press reports on the appropriate meetings. The participants are encouraged to change their behaviour and might consider, for example, the introduction of new agricultural techniques. Even traditional regulation mechanisms can be revitalised and developed further.
- In addition to developing new mechanisms and institutions, many projects aim specifically at maintaining existing laws (agricultural reform, nature conservation, etc.), in order to influence the general conditions in this way. Authorities are encouraged to become active in implementing laws concerning their field of activity.

Strategies for this are as follows:

- Support by the project for appropriate requests from the population. Often, stakeholder representatives only get access to the authorities thanks to the project;
- Empowering representatives of authorities and of target groups to deal with activities which are necessary to enforce laws;
- The project finances or temporarily fulfils tasks, which are actually those of the government. Such financial support should, however, have only a temporary nature. Taking on additional tasks is only appropriate if these are taken back by the institutions responsible after a short time;

- Other incentives such as further education, supporting the interests of the organisation or encouraging the establishment of independent means of control;
- Lobbying and public pressure, as far as possible by different people and groups according to agreements fixed in theproject contract.

8.3 Limits in Practicing Land Use Planning

The extent to which land use planning can actually contribute to solving problems depends on many prerequisites and conditions. Some of these limits are

It makes no sense to practice land use planning if:

- the political will is lacking;
- it cannot be guaranteed that planning will have a binding character
- there is no guarantee for the implementation of the plan;
- other problems have priority to be solved e.g. refugee problems;
- unfair land distribution practices;
- natural catastrophes;
- general conditions which cannot be changed do not allow LUP, e.g.
- if in an ecologically extreme climate zone (desert) “the available scope for action is too small“;
- the political or security situation allow neither the freedom of speech nor the freedom of assembly;
- a minimum security for long-term rights of the plots in the planning area is not guaranteed and cannot be established;
- there is no possibility of raising the willingness in the population to talk about questions and/or problems concerning land use;
- the existing institutions and organisations have very rigid structures which allow no changes

Technicaly Practising land use planning is not appropriate if:

- it is impossible to create the prerequisites for LUP at the intervention levels of the project, e.g. due to –economic processes in the world;
- it is beyond the financial or personnel capacities of the project to implement LUP;
- LUP requires expenses, which are not appropriate (costbenefit- ratio);

- LUP with the partners is not feasible or is politically inopportune.