CHAPTER 2

RANGE ECOSYSTEM

In order to understand the philosophy and basics of Range Management and Improvement, it is important to have some insight of Range Ecosystem, its components, functioning and various constraints on its productivity.

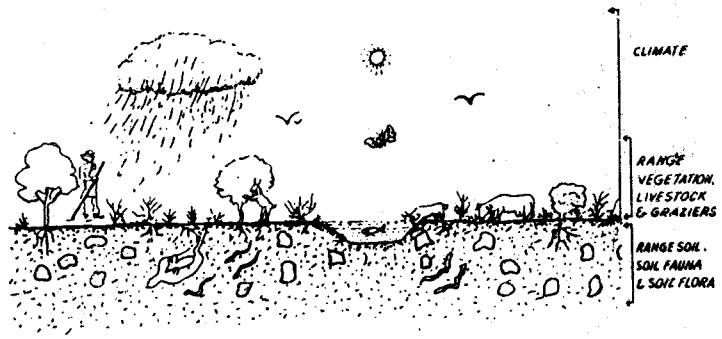
Ecosystem refers to a 'natural unit' comprizing of specific site, native vegetation and animals of all types as well as local people living together at one time having nearly well defined boundaries and being independent of other similar units.

Range Ecosystem is a special type of ecosystem where native vegetation is dominated by grasses and shrubs that are suitable for grazing/browsing and where grazing/browsing animals (cattle, camels, horses, sheep, donkeys and goats) are dominant over all other types of animals such as birds, reptiles and insects etc.

COMPONENTS:

Range Ecosystem comprizes of following components.

a. **Site:** (accessibility, altitude, slope, aspect, local climate, precipitation, streams, ponds, underground water, surface soil, subsoil and parent material).
b. **Natural vegetation** of all types: Proportion and vigour of forage shrubs and grasses that are suitable for grazing and browsing.
c. **Animals:** Number and types of grazing animals such as camels, horses, donkeys, buffaloes, cows, sheep and goats etc. Small rodents, birds, reptiles, insects and micro-organisms of all types.
d. **Management and Pastoral community** associated with range area, their resources, manoeuvrability, skill and institutions.

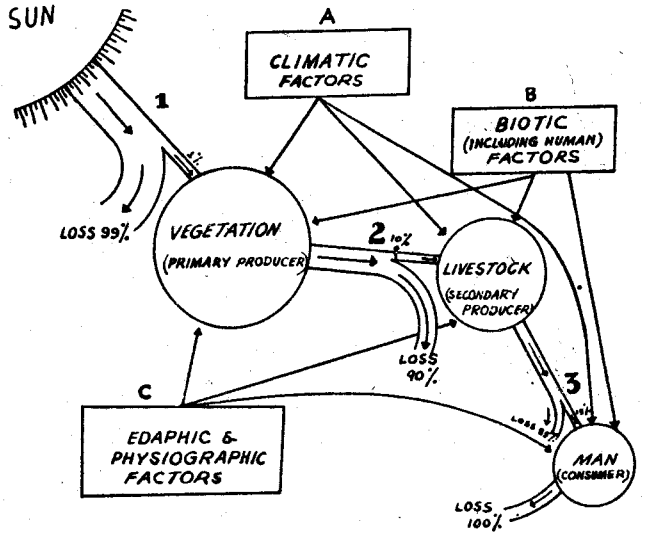


MUTUAL INTERACTION OF COMPONENTS

All above mentioned components of Range Ecosystem interact with each other over a period of time and yield plant and animal products. Site provides necessary physical base and mechanical support for plants and animals. Plants obtain their vital inputs such as light, oxygen, carbon dioxide, water, nitrogen, phosphorous, potassium, calcium, magnesium etc from the site. Site determines variety, extent and productivity of plants. The plants in return not only improve the site but also provide feed and shelter to animals. The animals provide organic manure to plants, help in seed dispersal, soften the seed coat, bury the seed in the soil,

loosen and open up the soil, decompose litter, eat away leading shoots and thus promote tillering etc. The animals consume live as well as dead plant parts and build their biomass in the form of meat, hides, skins, wool, bones etc, which is the end product of a Range Ecosystem. As a result of advances in science and its application, man has presently acquired immense power to bring significant changes in site, vegetation and animals. He can thus easily enhance the efficiency of the system by discovering and overcoming various limitations and can increase its productivity on sustained basis.

ENERGY: The driving force responsible for the proper functioning and growth of ecosystem is solar energy. This form of energy is available in abundance in Pakistan with respect to intensity and duration. In fact available solar energy is about 2-3 times more than the optimum level. Range vegetation (primary producer) utilizes about 1 per cent of solar radiation that reaches the ground surface and converts it into chemical energy of plant organic molecules. Range livestock (secondary producer or herbivore) in its turn utilizes about 10 per cent of chemical energy consumed by them and converts it into animal organic molecules. Man (consumer or omnivore), predators (tertiary producers or carnivores) and scavengers cum decomposers (final consumers) utilize about 15 per cent of consumed chemical energy in the form of animal organic molecules and convert it into a new and different type of animal organic molecules. The basic philosophy of Range Management is to ensure maximum capture of solar energy by range vegetation and its maximum transfer from plants to livestock and then to man. This can be done when wastage and leakage of energy is minimized at all points of capture and stages of transfer in the system.



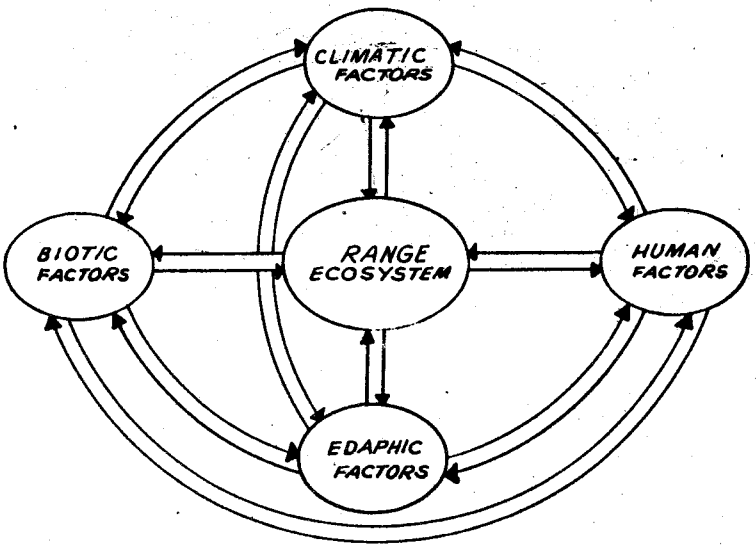
A Such as radiation, precipitation, temperature, wind, etc.
B. Such as plants, grazing animals, rodents, decomposers and man etc.
C Such as soil texture, structure, depth, slope, fertility, etc.

1. Solar radiation, energy: violet, blue and orange radiation
2. Chemical energy: Carbohydrates, proteins, vitamins, etc.
3. Chemical energy: Milk, meat, fats, bones, hides, skins.

ENVIRONMENTAL FACTORS:

Range Ecosystem along with its components can't function properly and produce various range products efficiently unless it gets support from a large number of environmental factors. These factors are too many to be enumerated. For the purpose of convenience and understanding these are classified into 4 groups i.e. climatic, edaphic, biotic and human. Various components of the range ecosystem play additional role of factors affecting efficiency and productivity of the system. These factors affect the system and are in return

affected by the system. Almost each factor affects all other factors, and is in return affected by all other factors. Many factors complement each other. Each factor has 3 levels i.e. minimum, optimum, and maximum. The optimum level is not necessarily at the middle point between minimum and maximum levels. These factors are not equally important. The importance of a factor is determined by estimating the difference between existing level of a factor and its optimum level. The production of an ecosystem is governed by the factor that is either most limiting or in excess. The importance of a factor is variable and depends on type of species, age of individuals and current levels of other factors. These factors supplement each other. Some factors cause immediate response whereas others cause delayed response of the ecosystem. The effect of some factors disappear soon after the removal of these factors whereas the effect of some other factors lags long after their removal (lagged effect).



CONSTRAINTS OR LIMITATIONS:

In order to ensure maximum sustainable production it is very important to learn in some detail various weak points or limitations of the Range System. A knowledge of these constraints of the system or losses from the system will automatically open the way for suggesting possible measures for their effective control.

Following is an incomplete list of points of energy loss or leakages from above mentioned process of energy capture, conversion and final consumption.

I. LOSSES OF ENERGY FROM SITE:

1. **Site inaccessible** or not easily accessible or seasonally accessible i.e. range products not easily harvestable.
2. **Unfavourable aspect** such as southern or south western in hot arid regions of northern hemisphere.
3. **Compact and impermeable** or loose unstable soil.
4. **Excessive stoniness,** gravelly, coarse textured; little quantities of available soil.
5. **Shallow soils,** get too hot or too cold quickly, insufficient water and nutrient pool for plants.

6. **Steep slopes,** deeply cut ravines, highly uneven leading to shallow soil.
7. **Little erratic** and irregular rains and loss of rain water through run off.
8. **Loss of soil** by wind and water (erosion) and Loss of nutrients through run off and leaching.
9. **Occurrence of frequent floods** or drought or both.
10. **Rapid oxidation** (burning) of soil organic matter because of hot sun during long summers or locking up nutrients in litter and hard woody tissues.
11. **Low water/nutrient** holding capacity of soil because of shallowness of soil, steep slope, coarse texture or low organic matter contents.
12. **Frequent pilferage** by thieves and raids by dacoits and predation by wild animals especially near border areas along forests and along river banks.
13. **Trespassing and disturbance** in the vicinity of cities.
14. **Pollution** of water and air near industries, making them unfit for plants and animals.

II. LOSSES OF ENERGY FROM PLANTS (PRIMARY PRODUCERS)

☐ 1. **Lack of vegetative cover** and low leaf area index (patchy or scanty vegetation).
☐ 2. **Reduced efficiency of range vegetation** [redacted]

A. Climatic restraints

1. Aridity, desiccating winds leading to reduced plant growth or even death.
2. Too low/too high temperatures, frost, short growing season, hail storms, etc.
3. Lack of intensity and duration of sun light leading to reduced growth.

B. Edaphic restraints

1. Lack/excess, non-availability and un-even distribution of nutrients (horizontally or vertically), leaching of nutrients into deeper layers.
2. Presence of salinity, its extent and intensity.
3. Aridity or water logging i.e., lack of moisture and of oxygen.
4. Sheet, rill or gully erosion - unstable soil.
5. Lack of organic matter leading to reduced nutrient supply and low nutrient/water holding capacity of soil.
6. Lack of decomposers and soil loosening organisms leading to reduced nutrient release and reduced water absorption.
7. Lack of controlled burning leading to excessive pool of unavailable locked up nutrients.

C. Genetic restraints

1. Vegetation unsuitable under existing environment, i.e., having low production potential.
2. Vegetation not very responsive to improvements in the environment such as irrigation, fertilization etc.

D. Biotic restraints

1. Grazing of too young plants leading to their uprooting and destruction.
2. Uneven grazing of vegetation because of herd behaviour, variation in vegetation, lack or absence of fencing, roads, culverts and presence of hurdles.

3. Lack of mixed cropping leading to intense competition among plants of one species and reduced yield.

3. Non-availability of synthesized energy

1. Undesirable plants/poisonous plants, thorny or hairy plants.
2. Presence of higher proportion of fibre (wood) in old plants.
3. Foliage not easily accessible to range animals i.e., trees or even entire plants or group of plants may not be easily accessible to small or large range animals due to height or other hurdles.
4. Consumption by insects, rodents, birds and other herbivores and spoilage by pathogens.

III. LOSSES OF ENERGY FROM ANIMALS (HERBIVORES, SECONDARY PRODUCERS).

1. Lack or excess of animals with respect to year-round or periodic production by range plants.
2. Reduced efficiency of animals because of

A. Climatic restraints

1. Too high/low temperatures.
2. Strong, cold or desiccating winds.
3. Too cold/hot, brine or dirty drinking water.
4. Drought.

B. Edaphic restraints

1. Steep slope and prevalence of boulders and big stones. It is difficult for animals to maintain their balance, to climb up and to reach their food.
2. Prevalence of sharp stones on soil surface that injure animals feet.
3. Unfavourable aspect such as southern or south-western in hot arid regions of northern hemisphere.
4. Lack of drinking water, drinking points being far apart.
5. Sparse vegetation (animals have to walk and exert more to fulfil their appetite).
6. Deficiency of nutrients (consequently vegetation may also be deficient in essential minerals).

C. Genetic restraints

1. Un-suitable animals with respect to kind of topography, local climate and vegetation (wrong selection of animals).
2. Animals having low production potential, not very responsive to improvements in vegetation and other environmental factors.
3. Animals developing non-target tissues i.e. more fat accumulation, or large skeleton system and big horns etc.

D. Biotic restraints.

1. Prevalence of pathogens, parasites and predators.

2. Lack of sanitation and non-availability of veterinary aid.
3. Range livestock fighting among themselves and ultimately injuring or even killing each other.
4. Excess of old (slow growing) animals.
5. Excess males leading to decreased production rate.

3. Non-availability of synthesized energy

1. Lost animals.
2. Dead animals.
3. Undesirable, inedible and unlawful animals.
4. Undesirable, inedible animal tissues and organs.

VI. LOSSES OF ENERGY FROM MAN (OMNIVORE, FINAL CONSUMER).

1. During vegetation establishment, range development and livestock grazing.

a. Failure to exploit and develop local resources such as conserving natural rain water and breaking hard pan in order to utilize sub-soil.
b. Failure to arrange inputs from outside such as water from nearby stream, fertilizers from market etc.
c. Failure to provide protection to range vegetation and livestock.

2. During harvesting, transport, marketing.

a. Delayed offtake or untimely harvest of animals after their production rate had long been declined.
b. Failure to transport animals to the most profitable market at appropriate time of the year due to absence of good roads, culverts, transport and telephone/wire-less facilities.
c. Failure to develop temporary storage pens for living animals in close proximity to the markets in order to gain some time to fetch higher prices.
d. Failure to avoid the excesses of middle men of the market.

3. During slaughtering/storage/ consumption

a. Losses due to improper slaughtering and dressing, i.e. loss of blood, bones, hooves, horns and guts etc.
b. Failure to use waste products of slaughter-house as poultry feed, etc.
c. Losses due to absence of cold storage facilities near slaughter houses especially when range livestock products are known to be highly perishable and valuable.
d. Losses due to existing cooking, serving and eating habits.

4. Due to unforeseen problems/catastrophe and mismanagement.

a. Failure to make appropriate arrangements for overcoming unforeseen problems and catastrophe, i.e. floods, drought or famine, etc.

i. Failure to store a sizeable quantity of emergency or deficiency feed (hay, etc.) in the range,

or

failure to grow irrigated fodder in close proximity to the range to cater for emergencies and

deficiencies.

ii. Failure to understand vegetation trend and recognize the seral stage of the existing vegetation (with respect to expected succession) and failure to undertake appropriate operations.

iii. Failure to transport drinking water or supply emergency feed from outside to the animals in the range in case of drought or famine.

or

failure to transport animals to the market for emergency sale in case of drought or famine.

b. Failure to number or tag animals, and failure to stop pilferage, due to lack of watch and ward.

c. Failure to get benefits from latest discoveries and techniques or methods such as

i. fattening yards not available for keeping animals for a few weeks or months prior to final sale,

ii. unable to exploit extremely favourable export market of Middle East, etc.) for livestock products.

d. Starting Range Management in a highly hostile environment.

CORRECTIVE MEASURES:

Most of the above listed losses of energy from the Range Ecosystem suggest some ways and means or measures which are effective in minimizing these losses or which enhance the efficiency of plants and animals in the transfer of energy from one form to another.These measures are called operations, practices or activities. In some cases one operation may be quite enough to plug losses at two or more points; in other cases two or more operations may be required to stop loss at one point; and in some other cases only one operation may be sufficient for one loss. Some of the examples are as follows:

1. Cultivation or soil loosening.
2. Natural or artificial reseeding.
3. Fencing (temporary/permanent, complete/partial).
4. Water spreading.
5. Fertilization.
6. Establishing shelter belts.
7. Construction of animal sheds.
8. Construction of water points.
9. Construction of dipping tanks.
10. Construction of storage sheds.
11. Construction of roads, culverts, etc.

These operations are of two kinds:

1. Range Management Operations

These practices or activities are essential for obtaining maximum production within the existing potential. These are regular and routine features of an ecosystem management. These operations are generally inexpensive. Some of the examples are as follows:

1. Natural re-seeding.
2. Soil cultivation.
3. Temporary fencing.
4. Development of existing watering points.
5. Provision of shelter or shade.

6. Provision of common salt.

2. Range Improvement Operations

These operations increase the systems potential by giving it an upward quantum jump; these are required only once in a while in an area. These operations are usually of permanent nature and are generally expensive. Some of the examples are as follows:

1. Permanent fencing.
2. Construction of small dams, dykes, water channels, etc., for water spreading.
3. Artificial re-seeding.
4. Gully plugging.
5. Brush control.
6. Development of new watering points.
7. Construction of animals sheds etc.
8. Selection/breeding of better varieties and breeds.

TEST QUESTIONS

1. Define the following.
   Range Ecosystem, Energy, Primary Producers, Omnivores, Scavengers, Range Management Operations, Range Improvement Operations.
2. Briefly describe the major components of a Range Ecosystem.
3. How are various Range components related to each other?
4. Write a short note on flow of energy in a Range Ecosystem.
5. Write a comprehensive note on the environmental factors affecting a Range Ecosystem.
6. Briefly describe the characteristic features of environmental factors.
7. Briefly point out various losses of energy from a Range Ecosystem.
8. Describe in detail various losses of energy from range plants.
9. Suggest ways and means of overcoming Range energy losses because of mismanagement by man.
10. Write a note on energy losses from a Range site.
11. Write a note on corrective measures with reference to energy losses from a Range Ecosystem.