CHAPTER 6

Principles of Range Management-IV
———related to range vegetation———

VI. Range Vegetation Management

1. Protection of vegetation.

One of the two most important factors depressing range yields to the minimum is excessive illicit grazing, cutting and lopping by authorized as well as unauthorized livestock and men; the other factor being lack of moisture. Our range vegetation is very severely exposed to continued overgrazing, browsing, grass cutting and lopping etc. Effective protection alone can increase forage production by 2 to 4 times in most humid, sub-humid range areas of Pakistan. There may be many ways of effectively overcoming these negative biotic pressures such as erecting barbed wire fence, raising live thorny hedges, digging deep trenches/water channels/canals, using stream/river or a natural ridge, policing and developing an understanding with the neighbours. Out of all these measures three strand barbed wire fence is generally considered as most effective against range livestock.

2. Proper Range use Intensity and its Determination in the field

It means as to what proportion of a range plant biomass is to be consumed as compared to the one left standing in the range. By determining proper range use intensity, the range manager provides a suitable solution in a problematic situation where two contradictory claims are to be satisfied simultaneously. The range manager on the one hand wants maximum green forage for his livestock for obvious reason of increasing livestock based products but on the other hand he also wants to be sure that his range plants do not suffer any serious set-back and thus continue to produce large quantities of green forage (through efficient water salt absorption by roots and photo-synthesis by foliage) on sustained basis. The latter claim naturally demands that minimum amount of foliage be consumed: so that plants can continue synthesizing food unimpaired. It is clear from the above discussion that one will have to strike a balance between the two opposing pressures.

Suitable intensity of range use is different for each range and depends on many factors such as:

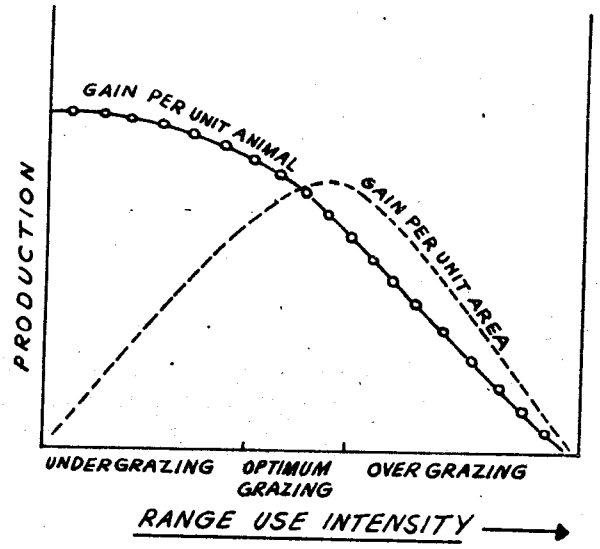
a. kind of plants,
b. growth stage of plants,
c. temperature and prevalence of hot/cold winds,
d. erosion hazard (due to kind of soil, steepness of slope/amount and intensity of rains, etc.) and
e. condition of the range.

Normally, half of the biomass be grazed in a good range. The grazing intensity should, however, be heavier (more than 50% to be grazed/browsed)if

a. the grasses in question have very strong ability to propagate vegetatively by producing numerous stolons, rhizomes, tillers and aggressive fibrous root system;
b. the grasses are in their late stage of development, i.e., after seed setting and maturity;
c. temperatures are favourable and hot drying winds are rare;
d. erosion hazard is low due to slight slope and granulated soils;
e. range condition is excellent; range vegetation is dense and dominated by grasses.

The optimum intensity would be lighter (less than 50% to be grazed/browsed) if the above conditions are reversed.

In order to conclude the discussion, it may be added that an increase in range use intensity certainly increases the production per unit area. This relationship, however, does not hold indefinitely.



When the range use intensity continues to be "very heavy" for some years, it is followed by a sudden and sharp decline in production. This failure is due to nearly complete destruction and collapse of range ecosystem.

The relationship of above ground biomass of range vegetation with its height is used for instant determination in the field as to how much biomass has been grazed by the animals and how much has been retained in the range.

3. Grazing According to Carrying Capacity:

Number of animals to be kept on the range should be so adjusted that it would not allow any vegetation to go waste but at the same time reproductive/growth capability of the vegetation must not be allowed to suffer for any long time.

Grazing by fewer animals than the capacity of the range results in higher production per animal unit. This is so because each animal has plenty of palatable/nutritious food available to him all around. He is not required to make any efforts in search of forage. As a consequence, the animal quickly become pretty big in size but livestock production per unit area decreases. Grazing by more animals than the capacity of the range on the other hand results in lower production per animal unit. The feed being in short supply, each animal is required to make persistent and some time desparate efforts to fetch a blade of grass. The animal is thus

reduced to an un-usually small size and loses its productive efficiency. Total livestock production per unit area increases at least during early stages of overgrazing at the cost of product quality. Although during later stages of overgrazing, even total livestock production decreases as a result of loss of vegetation.

The grazing capacity of a range can be estimated in many ways but one short easy method is as follows:

One should throw an appropriate number of quadrats of one meter square area at random within each range block. (The number of quadrats depends on the amount of variation in the vegetation, size of the block and desired accuracy of the results, etc). It is suggested that total sampled area should be between 1 to 5% of total range area. It is advisable to partition any block into sub-blocks on the basis of uniformity of vegetation. The above ground parts of range vegetation lying within a quadrat are then harvested at about 3 centimeters height above soil surface. The harvested "forage" is then air dried, weighed in grams and an average is computed. Half of this forage is then generally considered to be available to the livestock for grazing; the other half being retained for ensuring good growth and reproduction in the coming years. (Please refer to the earlier discussion on Range Use Intensity). The half-weight of air dried forage is multiplied with a factor of 10 to get the amount of available forage in kg. per hectare. This procedure may be repeated once twice or thrice from same sampling sites during the growing season depending upon the length of growing season and resprouting capability of a species. The sum of all these repeated estimates give an idea of total available forage during the year. This is divided by 3285 kg which is the annual feed requirements of one animal unit (a cow) which gives the carrying capacity of the area in terms of animal units per year. The animal units (cows) are then easily converted into equivalents of other animal species, according to the following table.

Animal Equivalents

Cow	1.0 Animal Unit
Yearling	0.6 " "
Bull	1.3 " "
Horse	1.3 " "
Donkey	0.6 " "
Sheep	0.2 " "
Goat	0.3 " "
Camel	1.7 " "
Mule	1.0 " "
Buffalo	1.5 " "

4. Uniform or even grazing/browsing

It means the utilization of range forage evenly at desired intensity through out the range area. Range livestock generally tend to over-graze certain patches and undergraze other patches. This phenomenon results in reduced yield per unit area. Over-grazed patches yield less forage production because there is not enough foliage and reserve food left for development of new shoots and roots which are pre-requisites for photosynthesis and salt/water absorption. Undergrazed patches yield less production because available forage produced by the patch is not consumed and is allowed to go waste. It may be further pointed out that if

vegetation is left ungrazed or undergrazed for quite some time, it may become woody and unpalatable/undigestible.

There are numerous factors which contribute to uneven utilization of range forage by the animals. Some of the important ones are as follows:

a. Presence of unpalatable woody or poisonous vegetation.
b. Distant location of watering points.
c. Inaccessibility of certain parts of the range or their uneasy accessibility due to various reasons.
d. Animal behaviour.

The following operations are generally suggested for promoting uniform grazing:

a. i. Replacement of unpalatable and poisonous vegetation with palatable and nutritious species.
ii. Improvement of vegetation through cultivation, seeding, fertilization and water spreading etc.
b. Establishing watering points at appropriate spacing.
c. Placing salt in least grazed places.
d. Removal of hurdles and obstacles by constructing tracks, culverts, pruning of thorny shrubs and trees.
e. i. Use of temporary fencing (low voltage electric fence) for forced grazing of disliked gegetation.
ii. Establishing salting points, providing shelter (trees or sheds).
iii. Hiring graziers, for directing grazing.

5. Frequency of Grazing:

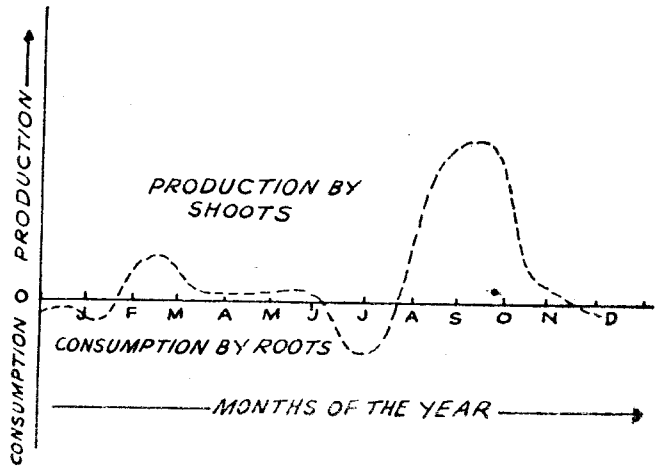
It refers to (1) continuous light grazing throughout the grazing season, (2) light grazing over extended period in a grazing season, (3) intermittent grazing and rest throughout the grazing season, (4) heavy grazing over permanently fixed short (condensed) period in a grazing season and (5) heavy grazing over rotatable short (condensed) period in the grazing season. Response of range vegetation to frequency of grazing is differential. Adoption of a specific frequency of grazing over a number of years will result in a change in density and diversity of range vegetation. A host of other local factors also influence the differential response of vegetation.

Continuous light grazing throughout the grazing season favours vegetatively propagated species (grasses) as compared to seed propagated species in case these are of equivalent palatability. In general, less palatable species gradually become vigorous and more frequent as the years pass by. Exposure of vegetation to continuous grazing or to very frequent intermittent grazing is generally suited where growing season is near optimum and nearly year long in duration.

Heavy concentrated grazing over a short/condensed period which may be either fixed permanently or rotatable and followed by complete rest for remaining year gives much more maneuvourability to the range manager in controlling health and floristic composition of vegetation and in leading range vegetation development in desired direction. This pattern of concentrated grazing over a short period followed by a long rest is particularly more suitable when growing period is highly seasonal. Perennial range grasses, in general, react positively to increased frequency of 4-5 intermittent grazing/rest per grazing season. Grasses sprout and tiller with increased vigour after each grazing. Total forage yield thus increases significantly. Non-grassy herbaceous forage species, on the other hand, react negatively to repeated grazing during a grazing season. These species gradually get weakened and finally disappear within a few years under high frequency of intermittent grazing.

6. Suitable Grazing Season with respect to growth stages of vegetation.

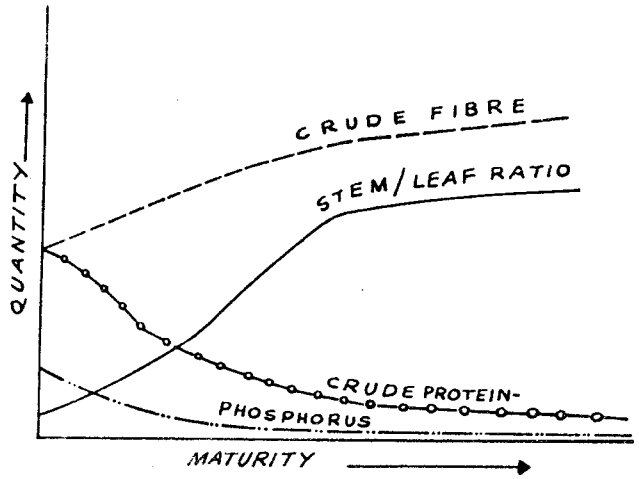
Plant growth is not uniform during the year but follows a certain pattern which is synchronized (linked) with the season of the year. Plant growth is a function of the proportion of photosynthesized food that is used in the formation of plant tissues as compared to the remainder which is stored in roots and underground stems (rhizomes). This stored material is later used to provide food for rapid growth during next growing season.



If one is aiming at maximum plant production on sustained basis, the range plant must be permitted to a reasonable extent to follow above mentioned pattern of storing sufficient food in roots and stems by adjusting intensity frequency, carrying capacity and season of grazing etc. It must be clearly borne in mind that season and time of grazing with respect to growth stages of the range plants and intensity/frequency of grazing etc. have a far-reaching affect on the condition, floristic composition, nutritive value, and reproductive capability of range vegetation. Range plants are generally much more susceptible to damage by grazing during certain times of the year, or during certain growth stages such as heavy rain or soon after heavy rainfall, extremely hot or cold weather, drought and early growth stage. In the first case, soil becomes plastic and gets compacted leading to accelerated erosion and other problems associated with compaction. In the second and third case, the plants are already under stress; and even light or moderate grazing would result in serious damage to the plants. In fourth case, plants are defoliated or uprooted at a time when they have least food reserves in the roots.

Grasses are more susceptible to damage by heavy grazing when these have just started to make new growth after overcoming dormant period (winter) and are heavily drawing on reserves of food in the roots. The response of various range species to above referred grazing treatments is differential. Heavy grazing of mixed range vegetation early in the growing season followed by a period of rest will, therefore, tend to depress species which start growth early in favour of late starters. Little delaying of grazing in the growing season on the other hand will favour early species. Timing, frequency of grazing during growing season and intensity of grazing can be manipulated to maintain the desired balance among various species. It is self-evident that any change in botanical composition of range vegetation would certainly influence the season of growth and productivity.

Although quantity of forage produced increases with increasing age of vegetation, the nutritive value and palatability/digestibility certainly decreases. It gives a generalized change in composition of a range grass with increasing maturity.



At the end, it may be added that grazing season in an area may be as long as 12 months or it may be of less duration such as 8 or 6 or even 3 months because of climatic extreme condition that are unbearable by livestock and because of lack of forage. In certain special cases where two types of climatic extremes (hot and cold) prevail, grazing season may have to be split up in two separate periods during the calendar year.

7. Forced Grazing

It refers to compelling the livestock to consume certain vegetation which is generally less palatable and is normally avoided. It may be achieved by enclosing the animals in narrow strips or small pockets or by tethering them over the required site for desired period. It minimizes waste of plant biomass and weakens less desirable species in due course.

8. Strip Grazing

It consist of making available a strip of grassland daily for intensive rapid grazing by the animals for one day with the help of temporary (electric) fence. An area of 50-100 square meters per animal unit per day is generally required. Previous days fence may also be retained in order to prevent back-grazing of the regrowth. It leads to uniform grazing and increases the efficiency of utilization. It is however costly and is profitable only on highly productive rangelands.

9. Forage Cutting

It refers to manual or mechanical harvesting and collecting of range forage and transporting it to the

head quarter for stall feeding to livestock or for hay/silage making. Forage cutting is selective in terms of species and area and, therefore, plays a vital role in giving a direction to vegetation development. It is done in areas which are either inaccessible to livestock or which are not to be opened for grazing due to watershed values or other reasons. Hay/silage making is an important corollary of forage cutting. In many cases surplus forage or unpalatable or undesirable forage is cut and used for this purpose and which would otherwise go waste. The quality and taste of natural forage generally improves or can be artificialy improved by adding protein rich constituents and nutrient mineral powder to promote its consumption.

10. Natural Seeding

It refers to performing certain trivial operations in the range that lead to seed dispersal, seed embedding, seed germination and assured establishment of young seedlings of desired species. Operations include delaying grazing till seed maturity, harrowing or cultivation on fallow pockets and protecting young seedlings for a year or so. It is a very powerful tool in the hands of range manager for achieving desired density and floristic composition of range vegetation.

11. Weeding and Cleaning

It refers to removal of undesirable herbaceous and woody plants respectively either manually, mechanically or chemically. It is again a powerful tool that influences vegetation composition. In view of its high cost, it is however, rarely undertaken in rangelands. Number and types of animals, time, season and duration of grazing etc. are more frequently employed for suppressing weeds in rangelands.

12. Controlled Burning

It refers to destroying thorny, woody, too old or otherwise undesirable range plants by controlled fire. It is a cheap and effective method of modifying vegetation composition. It is particularly adopted when manual or mechanical uprooting is either not feasible or not economical. A very important additional advantage of controlled burning is the release of mineral nutrients from old woody vegetation into the soil. These newly liberated nutrients are readily available for fresh forage production by other plants in the neighbourhood of old burnt plants. Controlled burning in winter results in vigrous lush green regrowth in spring from old root stocks.

13. Topping of forage shrubs and trees

Many shrubs and trees tend to gain height and produce foliage that is too high to be browsed by the animals. It is, therefore, very important to periodically cut back the leading shoots of such plants to promote formation of new shoots near the ground surface. In this way "available" forage production can be significantly increased.

VII. Range Vegetation Improvement

This principle aims at increasing the site potential by undertaking appropriate operations. The increase

is usually sudden and substantial. The operations are generally expensive and of permanent nature. These need to be repeated only after quite a few years.

The original high production potential of Pakistan's rangelands have been drastically lowered by nearly complete break-down and retrogression of the ecosystem due to excessive grazing and misuse during last two to three centuries. It is because of existing deteriorated condition of our rangelands that normal management and conservation operations as discussed under previous principle, fail to yield high production. The best alternative for achieving a quantum jump in production is to opt for range vegetation improvement operation.

In the following discussion only some of the important range improvement operations are included. The usefulness and effectiveness of these operations depends on numerous local site factors. One will have to select an appropriate operation very carefully in order to get desired results. An incorrect selection would cost more and would yield little benefit.

1. Artificial Reseeding of Grasses.

This operation is undertaken where:

a. original vegetation is undesirable and is to be replaced,
b. original vegetation does not produce sufficient seed,
c. large bare patches exist without any seed source and
d. winter forage species are to be introduced.

It consists of suitable site selection, removal of existing undesirable vegetation, preparation of site (cultivation, harrowing, discing, etc.) strengthening of field boundaries, seed broadcasting, seed embedding in the soil. It is carried out just before the onset of major growing (rainy) season, i.e., last week of July in Thal and North Punjab. Seed may be mixed with sand at the time of broadcasting in order to achieve uniform dispersal. Seed may have to be palleted with dung cum clay paste for improving the dispersal, germination and survival of hairy/awned seed. Average seed rate in Thal varies from 8 to 10 kg per hectare. In places where ploughing and seeding is not possible due to one reason an other, tuft planting may be carried out along contour trenches and pits etc. Once satisfactory germination and sprouting has been achieved and young grass stand has been established, it must be protected, watered (whereever possible) and lightly fertilized for accelerating its growth rate in order to get large quantities of nutritious forage. Examples of artificial reseeding are in Rakh Dagar Kotli Range (Mianwali) and Mong Rasul Range (Gujrat).

2. Artificial Reseeding of Legumes and Forage Shrubs.

Legumes provide nutritious forage and enrich the soil. These provide forage at a time when grass forage is scanty. These require better soil preparation, better moisture regime and better protective measures than grasses. Cultivation, strengthening field boundaries, trenching, pitting, seeding or transplanting and adoption of protective measures are examples of a few operations required for the purpose. Good quality seed of suitable species should be procured from a reliable source.

3. Introduction of exotic plant species

It consists of importing the propagules (seeds, etc.) of desirable forage species from other localities and countries. If wisely done, this operation alone can bring a revolutionary improvement in range forage. One should carefully compare the climatic data of the site(s) of the proposed exotic species with that of our own range area, before importing the species. Efforts must be undertaken on a small scale to begin with, in testing exotic grasses, legumes and other forage shrubs in consultation and with assistance of related research personnel. The performance of these species should be carefully examined and should be selected for their fast growth/increased production, nutritional value, palatability, drought tolerance, salt tolerance and providing forage during off seasons when local vegetation provides scanty forage. Extensive planting should be undertaken only after confirming success in the preliminary trials for 4-5 years and with the approval or consent of research staff. Soil preparation, time and method of sowing, seed treatment if any, timing and number of watering and adoption of certain protective measures be undertaken as advised by the source personnel and local research staff.

4. Water spreading and fertilization over extensive range area

Water spreading on extensive areas is rarely possible since various prerequisites for the purpose are rarely available. However if these conditions are available, water spreading must be undertaken without fail. Extensive fertilization is also very rare, although it is extremely useful especially when linked with water spreading. If judiciously carried out, these two operations in conjunction can boost forage production tremendously on sustained basis under Pakistan's environment. Fertilization, when intended, should be carried out in preferably two small doses. Total fertilization should be about 20% of standard amount added to fodder crops in irrigated tract. Complete and slow released fertilizers be preferred.

5. Intensive Forage Production with irrigation and fertilization in restricted cultivated area.

Drought tolerant, high yielding varieties of fodder crops such as sorghum, millet, guara, sesbania and alfalfa etc. should be grown with irrigation and fertilization on level fields or in broad sunken strips etc. The area under irrigated fodder production should be extended as for as possible even when it leads to surplus fodder production. It may be recalled that surplus fodder may also be offered for sale alongwith sale of livestock or their products.

6. Breeding new forage crop varieties

It is a highly useful and productive line of work although it is tedious and time consuming. It yields sustainable increase. It is generally undertaken by Govt. functionaries and or large private establishments. If some one is interested and has the necessary skill, one must go ahead in his own modest way and should remain in contact with research centres engaged in similar works.

7. Use of bacterial inocula and mycorrhizae

Numerous species are known to help each other and cause significant increase in yield on regular basis.

One such classical example is nitrogen fixing bacteria and legumes. Another example is association of mycorrhizal fungi with numerous crops. The bacteria and fungi provide certain basic needs of plants (nitrogen, phosphorous, water etc.) and the plants in return provide carbohydrates etc. The net result of this association or symbiosis is a significant increase in plant yield on sustained basis. The important question is to select a suitable strain for the specific crop variety and timely and proper inoculation. Once established, the bacteria and fungi perpetuate and flourish by themselves.

8. Controlled Burning on extensive scale

This may have to be undertaken when range is overstocked with old trees which are virtually without net growth and woody grass stubbles of *Panicum antidotale* and *Elionurus hirsutus* for example which injure animal mouth. Removal of such and other useless and even harmful plants is a must for profitable management. The cheapest method so far available is burning them with full control/precautionary measures. Burning always results in lush green sprouting of old stubbles. Burning, even when controlled, is a very risky operation and is similar to handling fire arms. Adoption of all precautionary measures and respecting safety rules cannot be over emphasized.

9. Development of Alternatives to Open Grazing in the range

Open grazing of forage by range livestock is the basic characteristic of range management. It may, however, not be possible or desirable in certain small areas for all the time or for some period due to one reason or another . The forage in such localities should not be allowed to go waste. Manual or mechanical arrangements must be made for its harvesting, air drying, baling, transporting, chopping and processing for silage if required. Such feed may be fortified with molasses, urea and minerals etc. before use. Fattening yards for feeding livestock for last minute weight gain be established at suitable place.

TEST QUESTIONS

1. Briefly explain the following:
   Animal Equivalent, Animal Unit, Quadrat, Grazing Season, Corral, Tethered Grazing, Typ of Forage Shrubs, Forage Cultivation.
2. The principle of Range Vegetation Management is the 'CORE' of Range Management. Discuss this statement.
3. Enlist 6 Range Vegetation Management Operations in order of their priority. Briefly describe any 2 operations.
4. What is meant by Range Use Intensity ? Give its brief description.
5. Under what conditions, can Range Use Intensity be increased ?
6. Briefly explain Carrying Capacity/Grazing Capacity of a Range area. How can it be estimated ?
7. How "Excessive Grazing" affects Range Productivity ?

8. How can one encourage Uniform Grazing or Even Utilization of a Range Block ?
9. How is Frequency of Grazing related to Range Productivity ?
10. How is "Grazing Season" related to "Range Vegetation Growth Cycle" ?
11. Why "Light Grazing" promotes the growth of Range Grasses ?
12. What operations are generally included in the principle of Range Vegetation Improvement ? Enlist these in order of priority.
13. What is the importance of Artificial Reseeding in Pakistan ? Describe "Artificial Reseeding of Range Grasses".
14. Discuss "Water spreading" in Suleiman Hills.