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Guidelines for Improving Livestock Production on Range Lands

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APPLICATION OF THIS TECHNICAL PAPER

TO INDIVIDUAL COUNTRIES

It is recognized that this paper is quite general in treatment of the subject. For extended use in any specific country, it should be supplemented with more detailed information on application of principles to local conditions. An alternative would be to prepare a new paper stating basic principles, and indicating their application to the agricultural conditions in the country.

Additional copies of this paper may be obtained through the AID Mission. In the event more detailed information is desired, TA/AGR will forward available data.

GUIDELINES FOR IMPROVING LIVESTOCK PRODUCTION ON RANGE LANDS

A. Introduction

Range lands and other permanent grazing lands in regions of limited rainfall have long made important contributions to the agricultural economy of developed countries, principally in temperate zones. Outside of such regions, there are about one billion hectares of permanent grazing lands in LDCs, largely in the tropical and subtropical regions. In these same countries, arable lands used for cropping occupy about one-half billion hectares. Nearly all food stuffs for the country peoples come from these arable lands, despite the much greater areas of permanent grasslands. This differential is caused in large measure by the undeveloped condition of range land production.

Range lands have much greater potential value to the economy of the countries in which they occur than is now being realized. Comparatively little effort has been made to improve the productivity of range lands, although experiments in several tropical countries indicate that an increase of 50% may be possible within 5 years after improvement begins and 100% in 10 years from the application of current knowledge. Ruminant grazing animals (cattle, sheep, goats, and buffaloes) may effectively use such lands that are suited to

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grazing but unsuited to cropping. Livestock production is a practical means of utilizing range lands, but the principles of range and livestock management are quite distinct from those of general farming or specialized crop production.

Except for wildlife and game, grazing animals provide the principal method of utilizing natural range and savannah lands to contribute to the support of man. Moreover, the livestock products of meat and milk are urgently needed to meet the growing demands for high quality protein foods that are in short supply in nearly all LDCs. Any surpluses of livestock products may also be valuable export commodities.

Range lands occur largely in regions where rainfall amounts or seasonal distribution is not adequate for dependable crop production. However, these lands do produce yearly growth of grass or other forage. These range lands are most important in semi-arid zones and sub-humid zones, and in the more humid wet-dry tropics with prolonged dry periods. Soil conditions in such zones vary widely, in depth, texture, water-holding capacity, and native fertility. Improving soil fertility may become feasible with later development, but in the initial stages other treatments are more productive.

B. Management Practices

The various management practices to be considered for improving livestock production on range lands should include the

following general categories:

1. Adjusting the number of grazing livestock to provide an appropriate balance between available forage and numbers of livestock to be supported.
2. Periodic resting of each range area, to (a) permit resting and recovery of vegetation in each area, one growing season every 3 or 4 years, and to (b) provide reserve forage supplies for dry periods.
3. Suppression of brush, other woody plants, and unpalatable and toxic vegetation.
4. Introduction and establishment of improved forage grasses and legumes, that are adapted to specific ecological zones.
5. Protection from burning, except as a controlled management practice carried out to reduce useless vegetation without destruction of desirable forage, or damage to fertility and water conserving capabilities of the land.
6. Improvement of rainfall conservation by strengthening grass cover through management practices to increase water holding capacity of soils, and to invoke water spreading and water diversions in areas where there is substantial runoff from rains when they occur.
7. Providing stock water at strategic locations and in sufficient amounts so that deficiencies in stock water supply do not mask all other improvement practices. Water supplies

must be adjusted to the urgencies of need for different classes of animals; pregnant and lactating females, all young stock under one year, other young stock, and mature animals. Watering points should be dispersed as much as feasible to avoid severe overgrazing around these.

8. Protection of breeding herds and weanlings from under-nutrition and malnutrition during periods of low quality or inadequate supply of native forage (dry periods); to increase conception rates, calf crops, and survival rates. Deficiencies in protein and phosphorus are widely prevalent in range lands.

9. Applying animal health control measures on an organized recurring schedule for control of endemic or contagious animal diseases and pests. This includes regular dipping or spraying for tick and other external parasite control, and a planned vaccination program.

10. Develop programs of regular sales of livestock, so as to:

    (a) adjust numbers of animals to apparent supplies of forage.

    (b) dispose of excess males, weak or non-breeding females, and older cows. Trim herds to the most productive younger animals, to maximize profitable off-take.

    (c) invest income from sales in range land and herd improvement.

11. Developing methods of providing milk for home use, without robbing the cow's calf. Calves should be given maximum opportunity for growth and development, since they will determine the vigor and productivity of the entire herd in three or four years time.

12. A consistent program of selection of superior animals for improvement of the herd should be followed. Particular attention should be given to selection of vigorous breeding bulls, of desired conformation, and the number of these should be limited to those required to serve the breeding cows. (For cattle, one bull to 20 or 25 cows.)

C. Discussion of Management Practices

1. Adjusting livestock numbers to forage supplies.

Overgrazing is a very common practice in rangeland management. It greatly weakens the carrying capacity of the range in succeeding years, and is credited with actually fostering the encroachment of brush, thorn, and other woody and unpalatable types of vegetation. A general standard of utilization is to limit grazing in any one year to about 60% of the growth made by the forage plants during the period of adequate moisture. This practice should avoid weakening of the most palatable and nutritious forage species, and

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permit these to compete more successfully with woody and undesirable vegetation. To successfully invoke this practice the range manager should have the counsel of a range specialist who is skilled in making estimates of range condition. The prompt sale or slaughter of excess animals is a prime requisite to making meaningful adjustments of stock numbers to feed supplies.

2. Periodic grazing and resting range areas.

This practice is most effective when it is applied during the annual season of growth, and each range area should be thus protected at least once in four years. This resting permits forage species to reseed naturally and thicken the stand. The resting strengthens individual forage plants, increases their rooting depth and drought tolerance, increases the retention of rainfall in the soil, and reduces runoff and soil erosion.

The rotation of grazing on specific range areas should provide for holding some ranges in reserve, to insure adequate feed throughout the normal dry season, and an additional reserve to mitigate the effects of unusually severe droughts. The overall stocking rate should be low enough to insure against the disaster of feed exhaustion and damage to the producing herd. The prompt sale of animals that are in excess of estimated carrying capacity

of the ranges while the animals are still in reasonably good condition, is more prudent than allowing the entire herd to suffer from starvation, with heavy losses and no compensating income.

3. Suppression of undesired vegetation.

Stockmen recognize that brush, thorn, and other woody plants, as well as toxic and unpalatable herbaceous species, have little or no feed value. It is not so generally understood that such useless plant growth is increasing from year to year as a result of overgrazing of the palatable forage; and that the useless plants are making heavy inroads on the limited soil moisture and fertility supplies, and are actually intercepting much of the sunlight needed for strong growth of forage species.

Two general methods may be used in dealing with problems of brush, and other useless or toxic vegetation in countries that have some capacity to invest in control measures. The most direct approach is to treat range lands with herbicide chemicals that kill or damage the undesired plants without injury to the forage species. The techniques of airplane application of herbicides have been well developed, and are widely used in some regions. The type of chemical applied, and the methods of use must be adjusted to the kind of plant growth to be suppressed. Preliminary field trials are needed to determine the effectiveness of

kill, and the extent of the benefits to forage production, prior to heavier investments. Hand clearing or machine clearing of woody growth and unwanted vegetation, may also be effective and should be explored where aerial spraying is not feasible. Hand clearing is laborious, but may be preferred where local labor is available, and the clearing may be extended over a longer time period.

The second method should accompany the direct approach; and this consists of adjusting grazing and other management practices to favor successful competition of forage species with undesired woody, unpalatable or toxic plants. Overgrazing is the most common cause of encroachment by unwanted species. Yearly burning also kills most of the seed of grasses and legumes on range lands, and destroys the opportunity for natural reseeding and thickening of the stand of forage plants. Burning also volatilizes all nitrogen and sulfur in the standing vegetation, and thus continued burning gradually exhausts the soil's capacity to supply these nutrients needed for strong growth. Unless direct control of undesired plant species is accompanied by improved management practices, the benefits may be rather short-lived, because the brush and weeds will again come to predominate. (Controlled burning as a management technique, is discussed in following items.)

4. Introduction and establishment of improved forage grasses and legumes.

Within the last 25 years a very considerable number of improved forage grasses and legumes have been identified and tested in various ecological zones. These are species collected from all world tropical regions, and are long-lived when once introduced into range lands and other permanent grazing lands. There are five grasses and two legumes suggested for semi-arid conditions, ten grasses and six legumes for sub-humid conditions, and twelve grasses and ten legumes for the wet-dry tropical zones having prolonged dry seasons. For many of these forage species, superior strains within the species have been identified, named, and seed produced. These superior strains are termed "cultivars."

Preliminary row or small plot plantings of adapted species or their improved cultivars should be made in each important ecological zone, to select those best suited for introduction and establishment. Those species or cultivars showing the greatest promise may then be tested under range conditions.

Seeding should take place before the onset of rains. On land with a hard surface, some surface scarification may be necessary to foster germination and seedling establishment. One of the acceptable times for burning of range land or other

permanent grazing lands is to provide conditions favorable to surface seeding of desired forage plants. Such seeding also is more likely to succeed, following suppression of brush and other unpalatable growth by use of herbicides or mechanical clearing, than if carried out on lands dominated by undesired plant types.

5. Burning as a management practice.

There is a widely prevalent belief by pastoral people that burning of range lands and permanent grazing lands is beneficial. However, a wide range of carefully conducted experiments indicates that any benefits are short-lived, and that repeated burnings result in progressive deterioration of the forage supply, and degradation of the land's capacity to store rainfall for plant use and to control destructive erosion. Burning aggravates the damage from overgrazing, by still further weakening the desired forage species, and destroying the seed of these species which would otherwise provide some natural reseeding and thickening of the stands of forage.

Burning has temporary benefits in removing all dead growth that has very low feed value, thus permitting stock to feed on new growth with its high nutritive content. For stock in a weakened condition resulting from near-staravation, this is important. However, a longer range management program that adjusts livestock numbers to the forage producing capacity of the grazing lands, and that provides

reserves of unused forage for critical periods, will obviate most of the need for burning.

Burning should be recognized as a management practice to be used only for specific purposes - as a means of preparing ranges for seeding to introduce improved forage plants, or to dispose of surface mats of dead material following the suppression of brush, thorn, and useless vegetation.

6. Improvement of soil storage of rainfall.

Water supply is the dominant factor controlling productivity of grasslands in regions of limited rainfall. Loss of water by runoff following rains is more severe on overgrazed lands and on lands with a predominance of woody growth (small trees, brush, thorn, etc.). Both conditions produce a relatively impervious soil surface. A soil cover of grass and forage legumes has the opposite effect, of increasing surface soil permeability to rains, and of slowing down runoff so that there is increasing opportunity for penetration. The fibrous root systems of grasses and forage legumes are partially regenerated each growing season and thus actually improve the soil's capacity to store water for subsequent plant growth. These characteristics of grasses and forage legumes are not possessed by trees, brush, thorn, and other woody types of plants that have woody perennial

roots contributing little to improved soil structure. Woody plants that intercept light, increase runoff losses, and exhaust soil moisture, have direct harmful effects on forage grasses and legumes, and tend to suppress desired forages.

On land areas with relatively steep slopes, or on stony or rocky areas with little plant cover, rainfall runoff is usually high. Where these areas drain onto gentler slopes having some soil depth, water spreading has been used effectively to produce feed. A series of diversion channels and ridges may be used to reduce the speed of runoff water and cause it to be absorbed by broad expanses of soil. Such channels and ridges should be carefully engineered, both to reduce costs of construction and to lead the runoff to areas where it will augment soil moisture and production of forage. The costs of constructing these water diversion and spreading structures should be evaluated in terms of the expected benefits under efficient range land management.

7. Providing stock water.

Unless feed supplies are matched by sufficient water to meet the needs of livestock, grazing lands have limited value. In regions of limited rainfall, pastoral peoples and other range managers need the assistance of surface geologists and engineers in finding and developing stock water supplies. Surface impoundments have limitations

because of high evaporation rates, as well as the cost of construcing dams and associated structures; but this may be the preferred method of providing stock water in some areas. Another alternative is the exploiatation of deep aquifers by use of pumps, above-ground storage reservoirs, and connecting pipelines to watering points. It should be noted that pumped water requires a capital input, and continued maintenance by trained people. Also, the possibility of developing cisterns in dry washes (that carry flowing water for short periods following heavy showers), with subsurface walls to hold back the slow downslope movement of water within the sand-silt aquifer of the channel, may provide short-term water in areas where other sources are not feasible. Governmental or other external assistance is necessary for developing all such water supplies.

The pastoralists who extend grazing to points so distant from water that stock are watered only on alternate days are operating with a great handicap. The stress of aggravated thirst is most serious for the breeding herd and younger animals. Low conception rates, high pre- and post-natal losses, and heavy losses of weanlings are partly attributed to restricted access to water. Since lactating

animals are generally used by pastoralists to produce milk for human use as well as for the calf, stock water shortage is a serious limiting factor for livestock reproduction. Both the amount of milk per day and the duration of the lactating period are adversely affected by water limitation. For all animals, water supply must be considerably above survival requirements to allow effective use of feed for growth and reproduction.

8. Protection of the breeding herds from under-nutrition and malnutrition.

Forage produced during periods of rain, and subsequent growth made on stored soil moisture, is generally highly palatable and nutritious. However, active plant growth ceases when soil moisture is exhausted; and the dry standing plants become steadily lower in feed value with passage of time. In general, such dry forage not only becomes progressively lower in content of all digestible nutrients, but the content of protein and essential mineral elements falls below levels required for growth. Protein content of dry forage after passage of several months into the dry season may fall to levels of 6% (dry weight), in contrast to 12% which is the minimum level of a complete ration for maintenance of milk flow and reproduction. When total

protein supply falls to lower levels, growth ceases even though the feed continues to supply enough energy. When both energy and protein become deficient, the animals begin to lose weight, and this continues until feed becomes more abundant, or the animal dies. Breeding animals are particularly vulnerable to both under-nutrition in which total feed is inadequate, and malnutrition in which protein and mineral supply becomes inadequate. Protein deficiency often prevents conception; it causes serious pre- and post-natal losses of calves, and weakens the dam and her capacity to produce milk and support a calf. Phosphorus deficiency in the forage very often accompanies protein deficiency, although the causes and correction are separate matters.

In regions with communal grazing practices, it may be feasible to set aside reserve grazing areas for use by the breeding herd in periods of feed shortage as a practical method of dealing with undernutrition. Supplemental feeding with rather small amounts of high protein concentrates (oil seed meals, etc.) has been used to good advantage in maintaining productivity of the breeding herd. Such protein supplements actually increase the nutritive value of dry forage of low quality. Consideration should be given to overcoming phosphorus deficiencies by adding mineral phosphate to the salt mixture, or adding soluble phosphates to the drinking water, as may be appropriate.

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Both protein content and mineral content of forage are improved by establishing forage legumes on range lands. Improved grazing practices may be used to increase the abundance of native legumes. The legumes are naturally high in protein, and are usually much richer in such minerals as phosphorus and calcium, than grasses and browse plants.

It is important to know that both undernutrition and malnutrition of livestock may be corrected in large measure by adopting management practices that are feasible for practical production of livestock on range lands.

9. Animal Health Control Measures.

Experience has shown that animal diseases may strike with devastating swiftness and with great losses, in the absence of effective programs of prevention and treatment measures. These diseases fall into four major groups - those caused by viruses, those caused by infectious organisms, those caused by protozoan blood parasites, and those caused by internal and external parasites. There are no general control measures, but many of the individual diseases may be brought under control by specific treatments that prevent spread of the disease-causing agent, or that provide immunity.

One of the more effective preventive measures for arthropod-borne diseases is the practice of dipping or spraying livestock with chemicals to kill ticks and other disease vectors. The tick-borne diseases include several that are of major importance, such as East Coast fever,

piroplasomosis, theileriosis, anaplasmosis, heartwater, sweating sickness, and trypanosomiasis. To be effective, dipping or spraying must be repeated at regular intervals of five to seven days to keep animals reasonably tick-free, since reinfestation comes from ticks naturally found in the grazing lands. Wild animals also carry such ticks, and these animals may serve as reservoirs of the disease organisms. Ticks that have fed on blood of any infected animal are capable of carrying diseases to livestock, and must be destroyed on livestock as soon as feasible. In addition to carrying diseases, ticks seriously affect the vigor of livestock by loss of blood and the secondary infections in tick induced wounds.

There are a number of devastating infectious diseases of livestock that may be controlled by vaccination to give protection against infection, and by treatment with antibiotics and other drugs for infected animals. These include anthrax, black quarter, leptospirosis and malignant edema. The preferred treatment depends on the incidence of each disease in the region. Vaccination is indicated when diseases are endemic in the region; but quarantine of infected herds and treatment by antibiotics may be appropriate for isolated outbreaks.

One of the virus types of diseases that formerly caused great mortality in Africa and the Near East is rinderpest, caused by a virus. Immunization of all animals is a highly effective preventive treatment. Contagious bovine pleuropneumonia is a devastating infectious disease that may now be controlled by immunization in advance of possible exposure to infection.

Failure to deal effectively with serious diseases may completely nullify all other livestock management practices. It is important that preventive measures found necessary to control serious diseases of the region be given high priority in livestock production on range lands and other permanent grazing lands. In addition, there must be vigilance in noting the occurrence of all types of disease, prompt identification of the causal agent, and protection against spread by invoking appropriate treatments and/or quarantine. Indigenous types and breeds of livestock are generally more resistant to diseases and parasites than exotic breeds and types, but such resistance is no guarantee against disastrous losses. Since some animal diseases are transmissable to man, disease prevention and control adds another dimension in livestock programs.

10. Timely marketing of livestock.

There is a belief in some quarters that pastoral groups

and farmers who keep livestock are unwilling to market animals since the size of their herds is an index of status, and are also used for "bride purchase." However, there is accumulated evidence that livestock producers in LDCs are motivated by other factors, such as using livestock as a continuing source of food (milk, blood, meat), as a method of accumulating "capital" to meet future needs, and as a hedge against devastating losses resulting from drought or disease. This evidence indicates that livestock owners are making considered economic decisions based on information available to them, and that changes may be accepted when it becomes clear that real benefits will accrue that are substantially greater than the risks involved in making such changes.

Effective and equitable marketing practices, that give the livestock producer a fair price for his stock, accompanied by safe repositories for his funds, will open the way for sales of stock by even the nomadic tribes.

With marketing channels open and functioning equitably for the producer, it becomes feasible to use selective marketing as the means of greatly improving the efficiency of production. The three major types of action that should improve such efficiency are (a) reducing size of herds and flocks to the apparent supply for forage for the period

extending until the next season of rains; (b) disposing of all animals that are not productive, so that feed supplies will have the greatest net benefits to the basic herd; and (c) investing a portion of the capital accumulated by livestock sales, in range and herd improvement. Livestock producers in LDCs are heavily dependent on external guidance from specialists in whom they have confidence, to present the evidence in favor of changes, to invoke improvements in marketing practices and pricing, and to supply counsel on using income from sales to strengthen the producer's economic position.

11. Competitive demands for milk to raise calves and to meet home needs.

Many of the cattle in LDCs are maintained to produce milk for home use. However, the calves from such cows are dependent on the same supply of milk for survival and growth. Since the indigenous cows produce low volumes of milk under local management systems, there is insufficient milk to meet the minimum requirements both for raising the calves and for meeting human needs. Usually the calf is progressively deprived, as the rains cease and the supply and quality of feed decreases. Such practices as allowing the calf to nurse only once daily, or to suck the remaining milk after the cow has been hand milked, make little or no

allowance for the calf's actual needs for growth. The end result is usually a stunted calf, or failure to survive. The maintenance of a herd of healty vigorous animals is nearly impossible when regeneration is largely dependent on such calves.

This problem would be reduced if cows could be bred so as to freshen at the beginning of the flush period of forage growth, so that milk flow would be continued for a longer period, and both calf and the home could be more nearly supplied. Even this system fails to provide continuing milk flow in dry seasons. Milk flow on a year-round basis would become feasible if supplies of feed and water could be made available throughout the year, but this is often not feasible.

Raising calves largely or wholly on milk substitues has been tested experimentally in many LDCs, and this shows promise for commercial dairies. For other situations, the conflicting demands on milk to raise calves for regeneration of the herd, and to supply needs of the cattle owner's family, constitues a major problem. Management practices to provide satisfactory solutions to the problem must be worked out, region by region, to be acceptable to the cattle owners.

Early sacrifice of calves from cows selected to produce milk for human consumption is a possible solution. This

practice might be combined with the production of first generation crosses between exotic milk types and indigenous types. Early sacrifice of the calf, and use of the first generation cow solely for milk production could be useful if combined with adequate feed and water and control of diseases and pests.

The foregoing discussion of the problem with milk cows is generally applicable to goats, buffalos, and milking sheep.

12. Livestock Improvement.

Many livestock producers are aware of the superior attributes of some members of the herd or flock, but little use has been made of this knowledge for herd improvement. However, the possibility of significant selection and breeding is greatly improved as supplies of feed and water become more stable and enlightened management of the herd results in stronger and earlier maturing breeding stock. Reduced mortality and large calf crops also give the breeder a greater opportunity to select animals that appear to have superior inheritance, as distinguished from escape and survival from all of the prevalent hazards that otherwise afflict livestock production.

In a herd of cattle with stabilized production, one healthy bull should be capable of serving 20 to 25 cows.

Selection of bulls with desirable conformation and other traits associated with productivity is a particularly effective method of breed improvement, since each bull will impart his inheritance to all of the calves he sires. When the choice of bulls is accompanied by slection of brood cows for his service, genuine improvement in each successive generation becomes possible.

The same principles apply to buffalos, goats, and sheep. When reasonably stabilized production has been achieved, herd improvement by selection becomes feasible.

The effort to make giant strides in herd improvement by importing exotic types and breeds of animals from temperate zones, is unlikely to be productive in the tropics. The exotic breeds and types are usually poorly adapted to tropical climates, lack resistance to the endemic diseases, parasites and pests, and are poorly suited to conversion of local feed supplies and to adapt to local types of management. Serious efforts should be made to selectively increasing the productivity of indigenous types and breeds, before attempting to by-pass all of the basic factors of production by importing exotic animals, or semen from such animals, in the hope of instant improvement.

D. Group action to make range improvement possible.

In many, if not most of the LDCs, range lands and other exten-

sive grass lands are not owned by individuals, and are not fenced. The individual animals in livestock herds used to graze these lands are owned by individuals or families, but are herded in communal flocks and herds. In general, there is no limit to the number of animals that each owner contributes to the communal grazing group. Also, there is virtually no legal restriction on the use of range land and permanent grasslands by herds and flocks from other regions, except those of ill-defined tradition.

Under these conditions, there is no inducement for undertaking such practices as control of stocking rates, rotation of grazing, and establishment of feed reserves, range reseeding, and other range improvement practices. Neither is it feasible to undertake comprehensive tick-control, development of stock water supplies and other practices that involve management of total populations of livestock.

To make possible the programs for improving livestock production on rangelands, it is necessary to have official allocations of range areas to specific groups of livestock producers, even though this does not include actual title to the land. When such allocations of range lands are made to the pastoralists traditionally associated with these lands, or to other groupings that may be identified, there is then an inducement for the users to undertake range protection and improvement, and the associated livestock management practices. The designated group can then take collective action to improve production with expectation of reaping the rewards, or of paying the penalty in reduced productivity for not undertaking appropriate action.

The mechanism of forming "Associations" made up of livestock producers in the specified region, and of making governmental technical

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assistance available to such associations, is a promising approach. Group actions improve the potential for more efficient production without disturbing private ownership of livestock.

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