Range Rehabilitation Problems of the Steppic Zone of Iran

NASSER NEMATİ

Highlight: Difficulty in establishing vegetation on depleted and eroded lands in the Steppic Zone of Iran is the problem. This analysis of the range problems of Iran is intended to serve as a guideline for revegetation of the Steppic Zone of Iran. The Steppic Zone, which covers about 2/5 of Iran, is an area of 100–200 mm rainfall annually; temperature is highly variable and dependent on altitude and latitude. The Steppic Zone has been severely overgrazed and depleted since the dawn of history. The number of livestock grazed now exceeds the forage producing capacity of range-land by at least 5 times and damage to watersheds is severe. Because of low precipitation and dry hot summers (at higher elevations extremely cold winters) and commonly saline alkaline soils with low amounts of or lack of organic matter, natural revegetation is extremely slow and reseeding of grasses and legumes has not shown success.

The main ecological factors acting on the vegetation of the Steppic Zone of Iran are climatic, edaphic, topographic, and biotic (Zohary 1963; Pabot 1967). Many features of the climate make plant growth difficult. Those go beyond the low and variable precipitation, the intense solar radiation, high evaporation of summer, and the cold of

winter. Over most of the zone, the rains are often violent and occur only at long intervals; for a given amount of annual precipitation, the number of rainy days is relatively small. Much of the water streams down the slopes and the local vegetation does not benefit from it. In the fall rainy season, there are often periods of several weeks without any precipitation, which may stop germination process and kill most of the young seedlings. The violence of the

rains is equally destructive to the surface structure of fine-textured soils. Clay crusts are formed, which impede the growth of young plants and increase evaporation. The efficiency of the rains on the plants does not depend only on their abundance and regularity, but also on the mean daily temperature.

The bulk of Iran's area is occupied by steppes and deserts that are characterized by dwarf shrubs or herbaceous formations, the density of which is largely dependent upon the amount of rainfall.

Typical steppe soils are seirozems. They are mostly oropedic, shallow with a A-C profile, almost devoid of a humiferous layer, grey in color, and for the most part highly calcareous and free or almost free from injurious salts. They develop under arid conditions with rainfall not exceeding 250 mm with cool to cold winters and hot and dry summers. The soils may occur in a

The author is deputy director general of Range Management Department of Iran.

variety of forms caused by topography and nature of parent rock (Zohary 1963; Pabot 1967; Shaidae 1975).

Rangelands of Iran have been grazed by livestock for many centuries. The domestication of sheep and goats and later cattle probably began here about 8,000 years ago. There is convincing evidence that most of the mountain slopes and uplands were covered by trees, shrubs, and grasses as recently as the 16th Century (Shaidae 1975; Niknam et al 1975). Overgrazing at that time probably did not occur over extensive areas, because frequent tribal raids and wars, as well as diseases, parasites, and natural catastrophes, held the populations of both man and animals in check. These checks on population became significantly less effective relatively recently, beginning perhaps less than 100 years ago.

Restoration of the vegetation under the extremely rigorous climatic conditions of the Steppic Zone is difficult. Success from revegetation tests is uncertain. FAO (1970) reported that seedling survival in the Steppic Zone was poor mainly due not only to drought, but also to fluctuating snow covers, soil crusting, and competition from weeds. In milder climate winter losses were small and weeds were no problem, but in the long, hot, droughty summers seedling losses for most species were high. Transplanting has been successful for most shrubs in this zone.

This paper evaluates the problems of rehabilitation of the Steppic Zone in Iran by (a) summarizing some ecological factors affecting vegetation growth and (b) recommending suitable techniques.

Physiography

The Steppic Zone surrounds the Sub-desertic Zone and reaches into the east and south of Khorrasan province, into the southwest half of the Khuzistan province, and into the north of the Baluchi Zone. It covers approximately two-fifths of Iran (Fig. 1). The cities of Tehran, Ghom, Esfahan, Shahrud, Sabzevar, Birjand, Zahedan, Kerman jiroft, Lar, Ahwaz, and Abadan are in this zone. The zone can be divided into subzones on the basis of winter temperatures as follows:

1) Warm Steppic Zone (Kuzistan, the southeast of Fars province; low-lying regions between the Baluchi Zone and the Central Desert), with mean

Fig. 1. Map of Iran showing the Steppic Zone.

January temperatures generally above 10°C.

2) Mild Steppic Zone (Khom, Kerman, Zahedan, Birjand) with January means of about 5 to 8°C.

3) Cold Steppic Zone (Tehran, Esfahan, Sabzevar, and the mountainous regions of the center and southeast) with January temperatures of less than 4°C.

Climate

In general the climate of the Steppic Zone is continental, temperate, and arid. Because most of the precipitation occurs in winter (Table 1), the climate is considered Mediterranean. Precipitation ranges from 100 mm in the south to 200 mm in the north. In most parts of the Zone winters are cool, summers are hot, atmospheric humidity is low, and evaporation is high (Tables 2 and 3). In the colder parts of the Steppic Zone, summer temperatures are high but winters are cold with good snow cover at the higher elevations. High intensity

winds are frequent, especially during the spring and autumn. These factors combined to make a difficult environment for plant growth. These growing conditions prevent establishment of seedlings and young plants, and thus complicate the task of rehabilitating depleted rangelands by either natural recovery or artificial means.

Details of the local climate in the Steppic Zone vary widely because of the differences in elevation, latitude, and local relief. The main features that make plant growth difficult are low and variable precipitation, intense solar radiation, and high evaporation during summer, and cold winters. Much of the limited precipitation falls in light showers that are not effective for plant growth, or, conversely, in high intensity storms that are lost by run-off from the poorly vegetated slopes. High winds of several days' duration are common. In winter, these blow snow into drifts and leave areas with thin vegetative cover bare, exposing the

Table 1. Altitude and mean precipitation (mm) for main cities of the Steppic Zone.

Station and altitude	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Abadan (3 m)	22	13	15	16	5	—	—	—	—	—	22	34	127
Ahwaz (20 m)	41	22	32	14	6	—	—	—	—	2	27	45	189
Birjand (1455 m)	41	25	29	36	14	—	—	—	—	—	9	15	169
Esfahan (1590 m)	17	11	17	19	9	1	2	—	—	2	13	19	110
Ghom (928 m)	22	11	20	25	10	1	1	—	—	7	16	19	132
Isfahan (566 m)	41	16	12	7	1	1	1	2	—	—	4	15	100
Kerman (1749 m)	30	27	38	21	13	1	3	—	1	2	9	23	168
Sabzevar (940 m)	23	18	29	24	19	4	—	1	—	4	13	17	153
Semnan (1200 m)	20	15	26	20	11	3	—	1	—	2	8	12	118
Shahrud (1370 m)	15	13	26	21	17	4	2	1	3	7	9	9	127
Zahedan (1370 m)	36	20	19	15	7	—	—	—	—	1	7	23	128

Table 2. Mean temperature (°C) for main cities of the Steppic Zone.

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Abadan	12.6	15.3	19.2	24.4	30.2	35.0	36.1	35.9	32.0	26.6	19.2	13.7	25.0
Ahwaz	12.3	14.9	18.9	24.1	30.2	34.6	36.6	35.8	31.7	26.6	19.3	13.4	24.9
Birjand	5.0	7.6	12.6	17.1	22.0	26.3	28.4	26.6	22.8	17.3	10.1	6.0	16.8
Esfahan	3.3	6.2	10.5	15.0	20.3	25.5	28.1	26.5	22.7	16.2	9.4	4.3	15.7
Ghom	5.0	8.3	12.4	17.5	23.7	28.2	30.9	29.5	25.4	19.1	11.1	6.1	18.1
Iranshahr	16.5	19.0	22.6	26.1	32.0	35.5	37.0	36.0	33.3	29.0	23.2	17.9	27.3
Kerman	4.8	7.9	11.8	16.2	20.6	25.3	26.6	25.0	21.6	15.8	9.8	5.8	15.9
Sabzevar	3.0	6.6	10.8	16.5	22.2	26.7	29.9	27.3	23.6	18.9	9.0	4.3	16.4
Semnan	3.5	6.6	10.3	16.0	22.4	27.0	30.5	29.5	25.5	19.4	11.2	5.2	17.3
Shahrud	1.5	4.7	8.5	14.3	19.8	23.5	26.2	25.0	21.2	15.3	8.5	3.4	14.3
Zahedan	7.0	11.0	15.5	19.5	24.1	26.8	28.2	26.2	22.4	17.1	12.1	8.4	18.2

Table 3. Mean percent relative humidity of main cities of the Steppic Zone.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Abadan	69	60	50	47	36	24	32	31	34	43	57	65	45.6
Ahwaz	71	63	54	50	37	29	35	35	37	46	57	68	48.6
Birjand	57	49	45	42	31	24	24	26	27	30	44	54	37.7
Esfahan	6	51	43	39	31	24	23	25	24	30	47	57	37.9
Ghom	64	56	47	45	35	32	31	31	32	40	52	62	44.0
Iranshahr	60	45	34	70	24	30	36	31	26	32	40	35	36.7
Kerman	52	46	37	36	26	18	18	18	21	27	41	46	32.0
Sabzevar	67	58	52	46	35	27	26	25	27	34	50	63	42.8
Semnan	66	55	44	42	35	29	28	29	31	34	46	60	41.7
Shahrud	66	59	54	49	42	38	37	37	43	51	58	63	49.4
Zahedan	55	40	36	34	26	18	17	18	21	26	39	48	31.5

Table 4. Chemical and textural analyses of soils from Ali-Reza Range.

Sample	Depth (cm)	pH	T.N.V. ¹ (%)	P (avg) (ppm)	K (avg) (ppm)	Clay (%)	Silt (%)	Sand (%)
1	5	7.8	6.5	3.5	400	9	19	72
	20	7.9	15.0	1.0	330	8	10	72
	40	7.8	7.2	Trace ²	150	8	10	82
2	5	7.8	11.7	3.5	330	8	26	66
	20	7.8	25.0	1.0	280	16	26	58
	40	7.7	26.0	Trace	150	19	18	63
3	5	7.8	19.0	3.0	280	7	27	66
	20	7.6	22.5	Trace	150	10	16	74
	40	7.6	18.5	Trace	50	16	11	73
4	5	8.0	21.0	Trace	220	27	34	39
	20	8.5	15.0	Trace	110	18	34	48
	40	8.4	18.5	Trace	120	26	42	32
5	5	7.8	14.0	3.0	390	28	20	59
	20	7.1	14.5	Trace	130	17	4	79
	40	7.9	13.0	Trace	170	17	5	28

¹ T.N.V. = Total Neutralizing Value (Ca CO₃).² Trace = less than 0.5.

ground surface to cold and robbing it of moisture. Temperature changes are frequently sudden. In the winter and spring, a series of warm days that induce germination and growth may be followed by freezing temperatures that kill the seedlings. The spring growing period is short. When moisture is available, temperatures generally are too low for plant development; and when temperatures raise, the soil dries rapidly. This makes it difficult for seedlings to become established and is the main factor limiting the growth of annuals.

Soils

The nature of the soils also creates

problems. Erosion is incredibly prevalent and severe. Soils generally are extremely low in organic matter and have poor structure. Chemical and textural analysis of soils from the Ali-Reza Range, which is located 70 km south of Tehran, is reported in Table 4. Most of the desert soils in need of revegetation are heavy textured, and emergence of seedlings is hampered. Soils with high calcium carbonate and low organic matter content are prevalent. Vesicular soils develop a heavy surface crust underlain with a 3- to 5-cm layer of vesicles or granules that dry rapidly. Germinating seedlings have little chance of emergence under

these conditions and they soon perish of desiccation. Vesicular soils frequently develop on areas that have been cultivated and then left idle with a scant vegetation cover. Under these conditions, the little organic matter present is rapidly destroyed. These are the situations most in need of rehabilitation, but they present a most difficult problem of establishment.

Vegetation

In arid sections of the Steppic Zone of Iran, wherever human influence is minimal, natural pastures are essentially composed of strongly rooted perennial grasses and woody or shrub-like species which form the solid basis of the vegetation, determine the microclimate, and play an important role in the formation of the soils.

Included with the valuable bunchgrasses and shrubs are annual and perennial legumes and forbs of undetermined quality. Individual species of the latter group may be unpalatable or even toxic. However, these unpalatable species are nevertheless a part of the biological complex of the matured rangeland, and there is no reason to destroy them insofar as they do not tend to eliminate the good species.

When the natural rangelands have not been impoverished by human exploitation, they possess a rich flora as well as an abundant and varied forage resource (Fig. 2). However, the perennial forage grasses and legumes have often disappeared over vast tracts of land centuries ago; the same can be frequently said for the combustible ligneous species. The remaining vegetation thus consists of uninteresting species and those which can best survive due to their particular life forms (Fig. 3). Among the types of natural rangelands which have not been too depleted are those dominated by the following species: *Aristida plumosa*, *Artemisia herba alba*, *Pennisetum dichotomum*, *Aeluropus litoralis*, *Stipa barbata*, *Bromus tomentellus*, *Festuca ovina*, *Agropyron touri*, *Hordeum fragile*, and *Bromus persicus*.

These types of rangelands almost always contain a certain proportion of spring species (herbaceous or woody). In reality, they are generally to be found only in a relic state in narrowly confined localities.

Grazing Use

Actually, most of Iran is grazed by domestic livestock at one time or

Fig. 2. Steppic site near Kerman in a relatively good state.

Fig. 3. Steppic site near Kerman, heavily grazed.

another. The only exceptions are extremely steep and rocky areas and completely barren salt flats, sand dunes, and deserts. Much of the grazed areas, however, produce little forage and should not be considered as true rangeland. It has been reported that 88% of the total requirements of all of the country's livestock is provided by natural forage (Shaidee 1975).

The distribution of the range forage types, their actual production compared with potential, the grazing use they receive, and whether they are deteriorating or improving in productivity can be described only in the broadest terms. Pabot (1967) reported that at the present time, practically all the ranges of Iran are overgrazed and because of overgrazing, the carrying capacity of much of the ranges varies from 50 to 100 ha per animal unit.

In addition to extensive livestock

numbers and overgrazing, the ranges have suffered from destructive management practices. Most ranges are grazed too early in the spring before the forage plants have had a chance to build up food reserve or the soil has become firm enough to maintain its structure under the effects of trampling. Many ranges are grazed at the wrong season.

Seeding Problems

Two zones play an important role in providing forage for Iran's range livestock. These two zones (Steppic and Substeppic) together cover more than half of the country and they receive enough rainfall to support a fairly dense and productive cover of good forage plants if properly managed.

In the Substeppic Zone, rainfall is adequate (200 to 400 mm) to permit successful reseeding of adapted forage species with present knowledge and

techniques.

The climate limitations in the Steppic Zone are much more severe than in the Substeppic Zone, and widespread reseedling is not possible. Except in remote parts where stock water is lacking, range depletion has been general and recovery will be slow and difficult even with greatly reduced stocking and good management. Except where rainfall approaches 200 mm per year, and the soils are favorable, the climate is generally too severe to justify large scale reseedling, at least with present knowledge. It is likely that successful reseedling will depend on the use of soil and moisture conservation methods in most places.

Conclusions

Increasing pressure on depletion of rangelands calls for immediate rehabilitation of rangelands of Iran to insure cover for soil protection and food for animals. Since many ranges are so depleted that artificial revegetation measures are necessary to restore production, we must learn more about limiting factors for plant growth on these sites and requirements and tolerances of desirable plant species. The necessary program for rehabilitation of the Steppic Zone therefore involves research in: (1) Natural recovery of rangelands through proper range management. (2) Reseeding grasses and legumes in suitable sites with proper techniques. (3) Transplanting on areas where previous two solutions cannot be used.

Natural regeneration of rangelands is not feasible in many areas because a seed source of the desirable plants is no longer present. Planting by seed has very often failed because of reasons already discussed. Thus, shrub transplanting may be the best solution under our present knowledge.

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