

Range Management in the Yemen Highlands

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This paper gives a general overview of range management practices in Yemen (formally North Yemen) with particular reference to the highlands (>5,000 ft). Yemen is a pastoral country on the fringe of the great Arabian desert (Fig. 1). Archaeologists estimate that the area has been continuously inhabited for 75,000 years

Modern Yemen is slowly industrializing, but the rural economy is still based on subsistence farming, depending heavily on livestock, such as sheep, goats, and cattle. Recent oil discoveries may speed up Yemen's rate of industrialization, thus reducing the reliance of village economies on rangelands. However, the reunifi-

Dhamar area.

Yemen has an arid/semi-arid climate, but large differences in precipitation and between topography and precipitation (Fig. 3). Most rainfall occurs between March and September, with two dry periods, one occurring in June and the second from September to March. Temperatures in the highlands are moderate, while the coast is known as one of the hottest areas in the world with temperatures exceeding 120° F. The highlands seldom have temperatures over 87° F in the summer, while it frequently freezes at night in winter. Winter temperatures in the Tihama rarely drop below 71° F at night.

Land Use

Land use, vegetation, and carrying capacity are closely linked to topography and climate (Table 1). T.E. Lawrence (also known as Lawrence of Arabia) speculated that Yemenis were traditionally agriculturists but turned to pastoral nomadism after major conflicts among crop growing clans/family groups (Lawrence 1963). The reason for these conflicts seem to be over population. The carrying capacity of the land was exceeded and the weaker clans were forced out, forcing them to settle on more marginal land. The weaker groups were eventually driven into areas where agriculture was impossible and a nomadic life, herding camels, sheep and goats was the only alternative.

One of these marginal areas is the Tihama, where, because of aridity, agricultural practices are predominantly nomadic grazing. Traditionally, people inhabiting the Tihama are transhumant grazers (grazers with herds which move in distinct patterns depending on the season; these movements are on a fixed route). They move their herds, which include goats, sheep and camels, to the foothills in the winter (dry season). The ranges in the foothills are in fair to

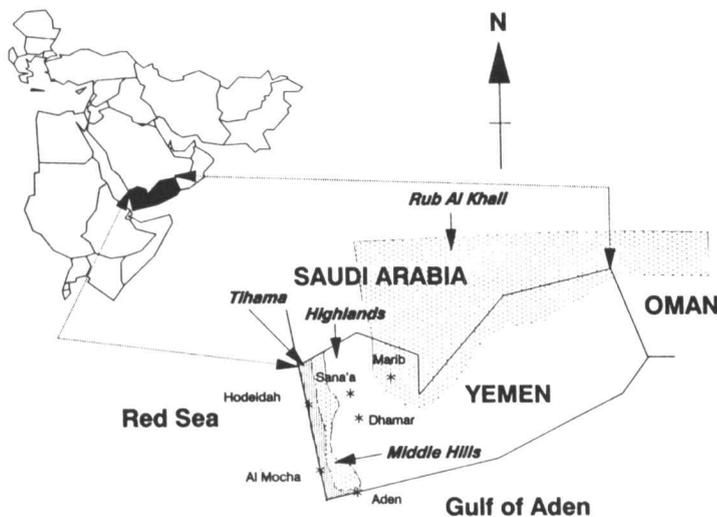


Fig. 1. Location of Yemen with some geographical and topographical features.

(Bidwell 1983). Yemen's civilization of around 1200 BC was mentioned by the Bible and Greek historians. Queen Sheba (or Saba) was from Yemen and King Solomon imported goods from her kingdom. Marib was the capital of the empire which encompassed an area from Oman to the northern parts of Saudi Arabia. Presently, Yemen has many archeological sites, of which the dam at Marib (built in 500 BC), used to irrigate 1,800 ha (4,000 acres) of desert, is the most impressive (Fig. 2).

cation of the two Yemens and the present Middle East crisis could slow this development.

Climate and Topography

Yemen has a diverse topography. It has mountains of more than 9,000 ft, which rise abruptly from the coastal plains. The northern part of the country can be divided into four areas: (1) the coastal plains or Tihama, (2) the hills, (3) the highlands or montane plains, and (4) the empty quarter (*Rub Al Khali*). These distinct topographical areas are the result of the same geological processes which formed the Rift Valley in East-Africa. Yemen has many dormant volcanoes and is seismically active; in 1984 a big earthquake rocked the

The Yemen as referred to in this article was formally North Yemen (or the Yemen Arab Republic). North and South Yemen became one country in 1990; the author can only authoritatively write about North Yemen. The author is with P&M Coal, McKinley Mine, P.O. Box M, Gallup New Mexico 87305

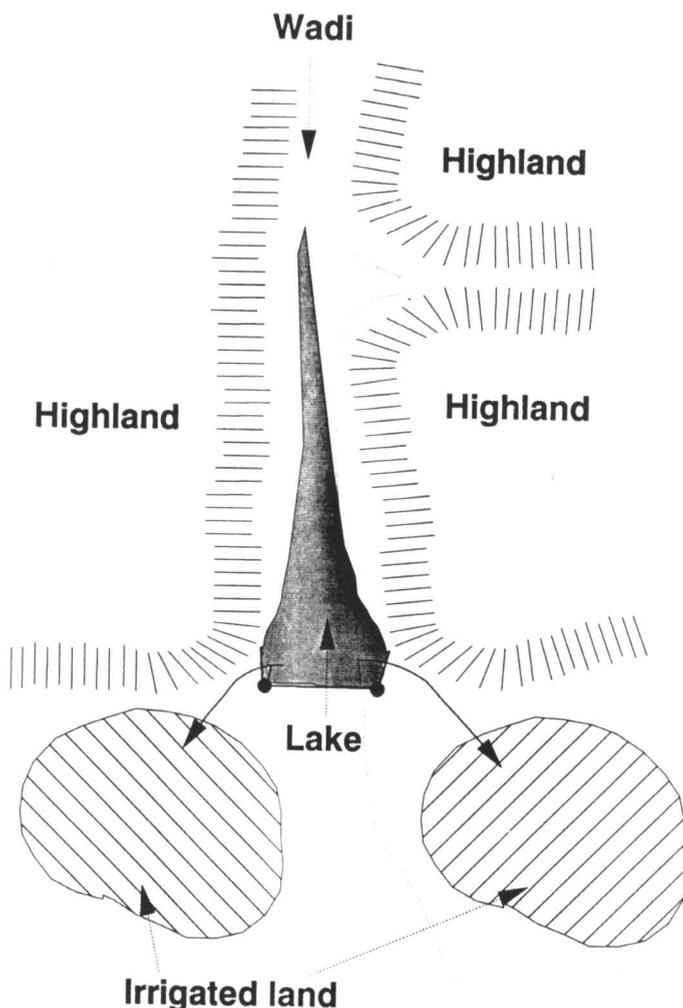


Fig. 2. Schematic overview of the Marib dam. The Dam closed the Wadi diverting runoff to two parcels of irrigated agriculture land, it is considered one of the oldest irrigation systems.

poor condition, they consist of arid woodlands with *Acacia*, *Dobera* and *Balanites* trees (Al-Hubaishi and Müller-Hohenstein 1984). Summers are spent in the coastal area, which

consist of shifting sand dunes with a main cover of *Tamarix* spp., *Acacia* spp. and date palms. Farming is practiced in and near dry river beds (*wadi*) where ground water is availa-

Table 1. Vegetation, plants and carrying capacity of the four zones in the Yemen (adapted from Al-Hubaishi and Müller-Hohenstein 1984).

Area	Vegetation type	Plants	Approximate carrying capacity
Tihama	Salt swamps Desert shrub/ Alluvial forest/ Sand dunes	Grasses, shrubs, trees	>20 acres/AUM ¹
Foot Hills	Savanna/ Acacia woodlands	Grasses, shrubs, trees	<5 acres/AUM ¹
Highlands	Desert shrub/ Desert pavement	Grasses, dwarf shrubs	16.2 acres/AUM ²
Empty Quarter	Sand dunes/ Oasis	Annuals, dwarf shrubs	n.a.

¹Estimate

²Adapted from Kessler, 1989

ble. A shallow well is dug and pumps flood irrigate small parcels of land. Traditional dryland crops are dates, sorghum, and millet and more recently irrigated vegetable crops like tomatoes and green peppers are grown in *wadis*.

The area between the coast (Tihama) and the highlands, is the most important agricultural area of Yemen. The major agriculture practice is crop farming using water harvesting and runoff water for irrigation. The area is known for its heavy convective rain storms and the foothills are extensively terraced, maximizing water utilization. Coffee, corn, sorghum, vegetables and *qat* (a mild narcotic/stimulant which is chewed like the Columbian indians use coco leaves) are grown. Cattle are raised for milk and draught power and are stall-fed with crop residues. The vegetation in this area is mostly mountain woodlands and includes many *Acacias* and *Euphorbias*.

The highland people are sedentary and grow a large variety of crops (sorghum, barley, wheat, lentils, corn, alfalfa, and *qat*), but livestock is the major source of income. Sheep are the main livestock, but most households have a cow for milk, a camel for plowing fields, a donkey, and a few goats for meat. In addition to a cheap meat source, goats are considered more adventurous than sheep and are mixed in grazing flocks to lead the sheep. These flocks are herded between rangeland and agriculture land by children and older men. Cows and camels are generally stall-fed. Women wrap sorghum stalks with some alfalfa and feed it to the animals. Recent advances in irrigation technology and an influx of money from Middle Eastern oil fields into the villages has resulted in a slow shift away from livestock towards agriculture and horticulture. This area has some *Ziziphus* and *Tamarix* trees, but is mostly a short grass and low shrub area.

Traditional nomads (bedouins) live further east in the *Rub Al Khali* live. These people live in tents and move to areas where forage is available. They practice little crop farming and

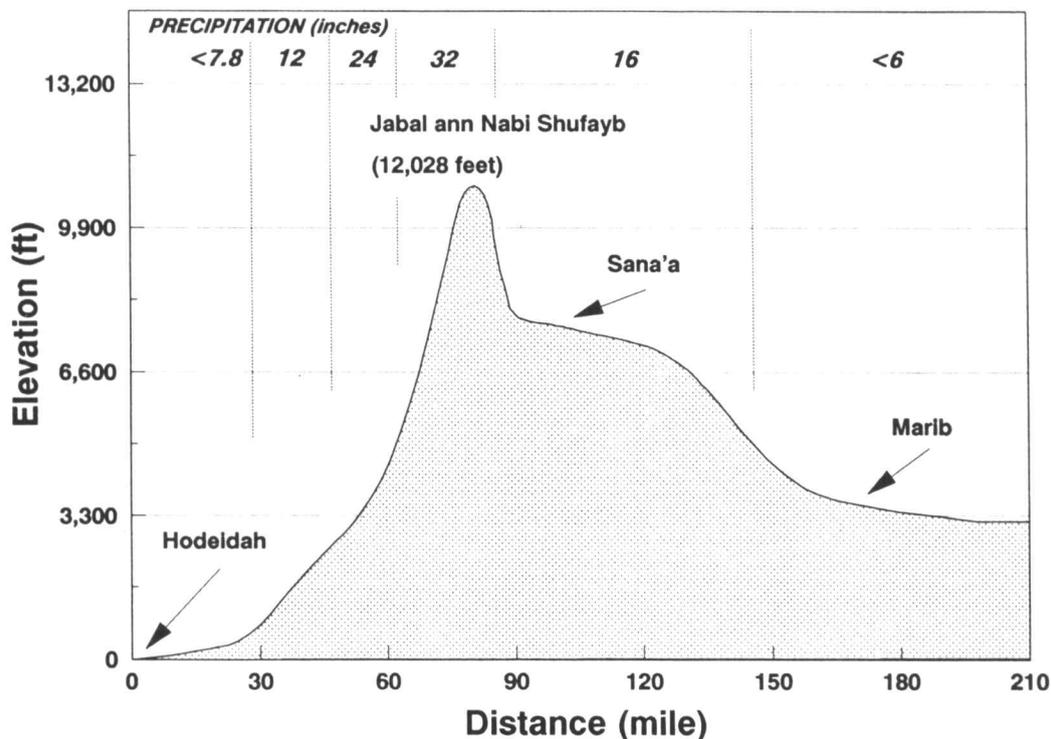


Fig. 3. Topographical cross section of former North Yemen (from Hodeidah to Marib). Across the top average annual precipitation amounts are given in inches.

depend on camels, sheep and goats to supply their needs. Recently, oil was found in this area. Vegetation of this area is some annual species and *Tamarix* in the river bottoms.

Range Management Practices in the Highlands

It has been estimated that 70% of the total land surface of former North Yemen, or 5.5 million square miles, can be considered rangeland. Rangelands are not extensively mapped and their economic potential remains unknown.

The highlands are a mosaic of agriculture land, volcanoes, rangeland, rock outcrops, wadis, and areas with a desert pavement. Livestock practices in the highlands are mostly sedentary—herds leave and return to the homesteads on a daily basis. Herding in general is done mostly by old men and children, and herds of different households are sometimes combined for practical reasons. In those cases, the herders are compensated for watching someone else's herd. Women are mostly responsible for feeding cows and camels, while men are responsible for growing crops or salaried jobs in the major towns.

A typical household in the high-

lands has 50 to 75 sheep, a few goats, a cow, a camel, and at least 1 donkey. Herders leave home at 9:00 AM with the sheep, goats, and donkeys (for hauling water). Before leaving home the animals are fed sorghum stalks, particularly during the dry season. Grazing is rotated among rangeland, fallow land belonging to the owner of the flock or rain-fed alfalfa fields. The herd will return in late afternoon and are usually supplemented with straw and sometimes alfalfa. Fallow fields consist of crop residues and are covered by weeds and Bermuda grass. Fallow lands are left uncultivated for at least 5 years to accumulate enough soil moisture to grow one crop of sorghum. When left fallow, they are heavily grazed to reduce the leaf area of weeds, which may potentially transpire most of the water accumulated in the soil. In a recent paper, Kessler (1989) estimates that rangelands in combination with fallow agriculture land supply 40% of the dietary requirements of sheep in the Yemen highlands. The rest of the diet comes from a combination of stubble (weeds), alfalfa fields, plowed fields (where animals eat the roots of

Bermuda grass), and the few privately owned tracts of rangeland.

The villages have distinct boundaries, usually commonly owned by the villages, with little private ownership of rangeland. This results in the rangelands being heavily overgrazed and in very poor condition. Plant cover ranges between 0% and 25%; On average, rangelands do not support a cover greater than 15%. People know which land belongs to their village and rarely venture to land from other villages. Even so, grazing rights problems are known to escalate. In one instance, a full scale war with artillery was waged between two villages over such a disagreement. One strategy for people to obtain grazing rights in other villages is to buy land in different villages.

Other grazing schemes in the highlands include combined grazing by three villages. During a certain part of the year two villages are closed to grazing, while all herds are in the third village. This is rotated from village to village, giving each area approximately 9 months rest per year.

Presently, there is no effective grazing system in most villages. The

choice of grazing lands depends mostly on the location of the owner's fallow land and his alfalfa fields. Fields are usually fragmented, which is done for risk avoidance: it will surely rain in one field when when they are scattered all over. All rangelands are open, and a herder will try not to graze more than 3 days in an area. This does not mean that the area will be rested because other herds graze the area on subsequent days.

There are a few pieces of privately owned rangelands (*mahjur* = forbidden to graze). These areas have a strict management scheme. Traditionally they were used as water harvesting areas for crop production. Water from these areas drains on to important agriculture land, which is the practice in many hilly Middle-Eastern countries (Evenari et al. 1971). The owner of a *mahjur* usually owns the agriculture land beneath, he manages it, and has the grazing rights to these *mahjurs*. If he does not own sheep, he may sell the grazing rights of the area for a period he thinks is appropriate. *Mahjurs* are usually in good to excellent condition, and development projects commonly use them as reference areas for range condition evaluations. The designation of *mahjur* was made centuries ago and our research indicates that no changes can be made in the status of land, and no new *mahjurs* can be established. The concept can therefore not directly be used as a management tool.

Like the *mahjurs*, old people sometimes mention common areas with grazing restrictions or village *mahjurs* (in Syria these areas are called *hema* [Draz 1978]). It is not yet certain if this concept can be used for range improvement, for instance by imposing grazing restriction to an area. Villagers are wary about systems introduced by the government. They fear that the government will eventually annex an area being developed by the government, by claiming that the government developed and improved it.

Traditional grazing schemes for common lands seem to have been abolished after the droughts in

1970–72 and 1982–84. These droughts were so severe that the vegetation was not able to recover. Range condition and productivity has declined so much, that the carrying capacity decreased and, in spite of declining animal numbers, rangelands are still over-grazed. The loss of grazing schemes was aggravated by a break down of the traditional power base due to labor migration. Village men travelled throughout the Middle East to work on oil rigs, which caused a drain of the more innovative and progressive men, who usually are the village leaders. The migration led to a gradual erosion of the traditional power base, which resulted in a break down of traditional rangeland-use agreements. Although it could be interpreted as negative for the rangelands, the migration had mostly positive economic effects. The additional money was particularly important during the drought periods. Yemen experienced the same drought years as the Sahelian region in Africa. Famine never occurred, because the increase in foreign currency permitted food to be imported for the villagers as well as their herds.

Thus labor migrations are slowly changing traditional agriculture and livestock systems in more accessible villages. The increased money supply stimulated private water development. Wells were dug and the villages' interest is now slowly shifting to the production of irrigated crops. The majority of cultivated crops under irrigation can still be used as forage crops or are crops with by-products which are used as livestock forage, but there remains a steady shift towards potatoes and horticulture crops. Presently, irrigation increases the production of by-products, and irrigation is expected to reduce pressure on the rangelands. On the long-term; however, it is expected that Yemen will exhaust its ground water. Water level in wells around Sana'a is dropping approximately 3 ft per year.

Traditional Strategies to Overcome Drought and Fodder Production

Sheep owners in the highlands have five strategies to overcome adverse years or seasons: (1) grow a

wide array of multiple use crops, (2) produce forage, (3) purchase forage, (4) migrate, and (5) sell animals. Except alfalfa and sorghum, most crops are grown for human consumption and by-products are used as supplements for animals. Sorghum is mainly grown as a fodder, although a grain yield is preferred. In dry years plants are harvested for fodder and seeds for next year's crop will be bought in the *suq* (market). Some farmers specialize in seed production which they sell in the markets. During severe dry seasons, people are seen feeding their animals wheat and barley plants which needed a few more weeks to mature. When asked, farmers replied that their animals came first because human food could be bought in the *suq*, and forage, which is also sold at the *suq*, is too expensive. Still, a thriving community exists which grows fodder as a business. Every town has a fodder *suq* where sorghum straw and alfalfa are sold on a daily basis. In general Yemenis are very opportunistic and animals are actively bought and sold depending on the forage situation. In severe cases, animals are sold to purchase fodder. Herd management is such that at the beginning of the dry season they will try to sell animals to buy sufficient fodder for the duration of the dry season. One rarely sees starving animals.

When all systems fail during severe droughts, the sedentary highlanders migrate to places with a better forage supply. It is then that strict village boundaries are abolished, suffering farmers can go anywhere. People living in areas with a good forage supplies will accept migrants, feed them and their animals, and often given them a place to stay. This is all done for free, for a drought is seen as an act of God.

Presently, there is an increasing interest in establishing areas with private fodder shrub/tree plantations, which is partly caused by the introduction of irrigated agriculture. Irrigation leads to an increased production of better agriculture land, which in turn lead to a release of marginal fallow land for grazing and fodder tree/shrub plantation establishment.

One of the most preferred species in the highlands is *Atriplex numularia* (from Australia). It is well understood that planted areas need to be protected from grazing during the first few years, and projects have been able to convince farmers to treat shrubs and trees like crops and not to graze revegetated areas. As a result, herbaceous cover on these protected areas has increased immensely. It remains very difficult to establish village plantations. There is a major mistrust of the government, and management of commonly owned land is extremely difficult.

The Future

Rangelands in Yemen are in a downwards spiral, but deterioration can be expected to stabilize in the near future. The future stabilization of the decline in range condition will be the result of a slow shift from livestock raising to irrigated agriculture and from unmechanized to mechanized farming, caused by the influx of money into the village economy. Camels are already disappearing from the countryside; they are being replaced by tractors. Furthermore, herding animals

is fairly labor intensive (1 person is needed per 50–75 animals), resulting in the abandonment of animal husbandry. The slow shift from livestock to agriculture is further stimulated by the young generation, who after they receive an education, decide that there are easier ways to make a living than herding animals. Thus it can be expected that there will be a shift either towards fattening farms, villagers combining their herds and hiring a herder, more mechanized agriculture or the raising of cash crops. In addition, the first feed lots are being established in the Tihama and seem to be very successful. The main practice at these farms is to produce irrigated fodder, which is harvested and stall fed to the animals. The slow shift away from livestock may eventually improve range condition. Other avenues to improve range condition could include *mahjurs* and the revegetation of areas with fodder shrubs as long as it is done on private land, possibly extending to common land when the scheme is proven to work. We have found that the herbaceous plant cover and range condition improved at a very fast rate when contour furrows are established in an area. Furrows are used for water harvesting and are planted with fodder

shrubs. Presently though, the rangelands are still deteriorating, even while the total number of livestock has decreased in the last 10 years. The productivity of the rangelands has declined so much that the carrying capacity has decreased and rangelands are still over-grazed.

Strategies for range improvement in the future may have to emphasize 1) applied grazing research, 2) starting an extension campaign to make the people (villagers, local politicians, and donor agencies) more aware of the economic potential of the rangelands, 3) the creation of a range management agency, and 4) the education of students in range management, in Yemen or overseas.

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