and other products—both in the villages and out on the range depends entirely on fuel oil from the surrounding vegetation. Even though kerosene is now available there are as yet no appliances that would make its use practicable for large-scale traditional milk processing. Before the revolution it had begun to be used generally for home lighting, heating, cooking and samovars and the new village bath house, but brush was still used for baking bread and cooking communal meals on holy days. The revolution disrupted the supply of kerosene and relaxed controls on wood cutting, but the process of increasing dependence on kerosene will probably soon resume.

Apart from transhumance and fuel, areas like Turan appear always to have been dependent on neighboring cities for investment in agriculture and irrigation. The apparent isolation of desert settlements in the modern period probably began with the motorization of communications in these areas after the Second World War. It may end as national economic and communications systems gradually comprehend everything within their borders. In the meantime, the research reported in these pages was designed with the assumption that both the populations and the resources of drylands like Turan are of increasing economic and cultural importance to the larger national and regional community into which they are being drawn.

Suggested Reading


Hamlin, Christopher L. 1977 "Machine processing of LANDSAT data: an introduction to anthropologists and archaeologists." Archaeological Science Center for Archaeology (ARCHA) Newsletter. Volume 12, number 1/2.


Sponger, Brian 1979 "Flexibility and interdependence in traditional pastoral land use systems: a case for the human component in ecological studies for development (Turan)." Proceedings of an International Meeting on Ecological Guidelines for the Use of Natural Resources in the Middle East and Southwest Asia. Morges, Switzerland: International Union for the Conservation of Nature and Natural Resources (IUCN Publication. New Series #3).


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DRed LAND SETTLEMENT LOCATION

Social and Natural Factors in the Distribution of Settlements in Turan

LEE HORN

Settlement in Turan takes three principal forms: year-round permanent villages, summer milking stations, and winter sheep stations. This three-way division follows local usage in distinguishing among sites on the basis of seasonality of occupation and activities, but they usually differ in a number of other ways as well: size and composition of social groups, location relative to resources, degree of investment in structures, and site morphology including size, layout and construction materials. Villages are the most permanent type of settlement from the point of view of locational stability, degree of investment and seasonal continuity of occupation. They rely on agriculture and pastoralism in varying proportions, and with few exceptions remain inhabited year round by a majority of households.

Summer milking stations are occupied in the spring and summer by local villagers who need to take their animals away from the plain during the milking season to increase milk yields, or who need to separate themselves from the village for greater efficiency of milk processing chores, including gathering brushwood for fuel. Milking stations thus are outposts of local villages.
On the other hand, winter sheep stations, the third type of settlement, usually are not directly associated with local villages. Most of them today are bases for commercial flocks of sheep migrating yearly from summer pastures in the high mountains above Tehran. Their social attachment to the Tauran system is largely through the locally hired shepherds who move into them for the winter months. All of the settlements are small, ranging from a single household or handful of shepherds to no more than four hundred at the largest village.

Each of the three types of settlement has its own particular environmental requirements. The best village locations are concentrated on the Central Tauran Plain on account of the nature of arid land farming. Because of the sparse and highly unpredictable quantity of rainfall in Tauran, crops must be irrigated in order to support a permanent sedentary population of any size. To support a population at today's levels or even at those lower levels which held throughout the past, sufficient and reliable supplies of water for irrigation can be obtained only by artificial means.

Here, as elsewhere in Iran, the solution lies in subterranean water channels known as qanats which tap ground water beneath the sloping alluvial fans and deliver it by gravity flow at a point, sometimes many kilometers away, where the surface is lower. Qanats require special configura-

\[ \text{Diagram of a typical qanat.} \]

[Image of a typical qanat diagram]

\[ \text{Cross section of a qanat.} \]

Diagrams and cross sections illustrate the qanat system, showing how water is diverted and distributed.

\[ \text{Aerial view of a qanat.} \]

Aerial views provide a comprehensive view of the qanat system, highlighting its underground and surface components.

\[ \text{Distribution of qanats.} \]

The distribution of qanats is mapped, showing their spread across different regions and their proximity to villages and other settlements.


tions of terrain, soils and drainage both for construction and for proper performance. Moreover, the field site must be appropriate for agriculture—it must be flat enough to hold the water and fertile enough to support yearly or at least short fallow crops. Since few locations meet these requirements naturally, improvements are necessary beyond the provision of water.

Where land slopes, terraces are built to facilitate irrigation and prevent erosion; where soils are thin, sifting is encouraged and donkey loads of dung and earth are applied. Even down in the lower, sandier areas where flat land is plentiful, soil improvement is still important because natural soils are light and sandy, and qanat water saltier than at higher locations. Qanat building, however, is a skilled, dangerous occupation requiring considerable time and labor. For a qanat to be worth constructing a certain level of agricultural return must be expected. Given a fixed amount of water, increased investment in terraces and soil condition will bring higher yields and increase the extent of productive land. A qanat in good condition warrants continuous input of labor which, in turn, warrants a population resident for most of the year to provide that labor.

Thus, though the original factors in qanat placement and agricultural site location derive from the distribution of
natural features, carefully maintained sites gradually become enhanced by artificial improvements. The cumulative effect of alterations to the terrain and soil tends to make an older site more desirable than a newly established one, and water and land at a site that is not continuously maintained will deteriorate, requiring extra effort in rehabilitation. These factors, plus the initial expense of building the qanat, contribute to residential stability at agricultural sites. Many villages on the plains are at least a hundred years old and some appear to have been occupied more or less continuously for perhaps two thousand years.

In Central Tauran agricultural productivity is high and villages are larger and more stable than elsewhere in Khar and Tauran. Pasture, however, is comparatively poor. Whatever the original carrying capacity of the plain might have been when it was first occupied, today the range has deteriorated to the extent that residents who choose to live primarily from pastoralism are obliged to take their animals off the plain to outlying stations. Good agricultural sites in the region around Khar and the area to the east and south of Central Tauran are much farther apart than they are on the plains because more of the terrain is either sandy, salty and low, or mountainous and lacking in good soil. But although agricultural potential is low, pastoral potential is excellent, and most seasonal sites are in these areas. Summer stations are sometimes located at abandoned qanat-watered villages where crops may also be grown, but some summer and all winter stations are located without regard to agricultural resources, except insofar as both require a water source for domestic purposes and for watering flocks. Besides qanats, these sources may be small springs or dug wells from which water must be raised by rope or winch. Wells sometimes tap into collapsed underground qanat channels.

Aside from a common need for water and pasture, the other environmental requirements at the two types of pastoral stations are different, at least in emphasis. In the first place, because of the frequency with which water is drawn, summer stations are based right at their water sources. In winter, however, the need for protection from the cold and snow is great. Winter stations, on the other hand, may be as far as four kilometers away from water: in winter the animals are watered only every other day, and the few men who tend them require less water for domestic purposes than do families at summer stations with their milk processing and household chores.

Secondly, sources for firewood are more important at summer stations where a household may use a donkey load or more of brush a day to boil milk products. Milk is not processed at winter stations and fires are built only for warmth and cooking. Dung is often used for fuel at winter stations. However, fuel requirements are probably of lesser importance because, in general, where grazing is adequate, so is firewood.

A third and perhaps most important factor is topographic. Summer stations tend to be located on higher terrains, both for the better quality of the range in hot weather and for human comfort. Winter stations tend to be found at lower, warmer altitudes and are more carefully protected from exposure to wind and cold. They are usually semi-subterranean, dug into southerly slopes. Many are close to the sand sea or huvir—which areas are unbearably hot in the summer. Even where the difference in altitude is slight, there are perceptible differences in vegetation and temperature.

The distribution of natural resources and topography relative to agricultural and pastoral activities is the best single explanation for the arrangement of settlement in Tauran at this general level. It is not a complete explanation, however. For example, it has already been seen that seasonal stations consideration is given to situations which provide protection from the elements. (Villages, being more closely tied to their fields and qanat systems, make more use of architectural adaptation.) Furthermore, it does not take into account the need for social interaction among settlements, nor the effects of ease of access to one another or to the large service centers outside of the area. Until a proper regional survey is undertaken in the field it is impossible to discuss the nature of social spacing in Tauran, but it is an important question where settlements are far too small to survive in isolation from each other either economically or socially.

Finally, it is a static explanation based on recent observations alone. It does not consider the dynamic nature of settlement processes nor take into account the fact that today's villagers are not the ones who made most of the decisions on site location. Usually they have only inherited or reoccupied locations that were first established generations ago: for example, no new qanats have been built on the Tauran Plain within living memory. If one assumes that the past resembled the present and that neither environment nor technology has changed, then what holds today would be a reasonable explanation for past decisions as well. In spite of the "timeless" appearance of much of the life and landscape of Tauran today, however, both have changed since the first occupation by farmers and herders some two thousand years ago.

The environment has been changed by both natural and human agents. Some changes are easy to see—the deterioration of the range from grazing next to permanent settlements, the restructuring of the terrain in the course of agricultural activity, the increase in the number of surface flow water systems because of qanat building, the drifting of the sand sea over once productive land. Others can only be assumed or inferred from historical and paleo-botanical and geomorphological work in Tauran. These are not static or invariable. The sort of the continent in arid zones—not only the year to year variation in rainfall or temperature that makes the weather so unpredictable to the farmer or herder, but longer trends of gradually increasing drought or precipitation (or heat or cold or both), cycles which have a much greater effect on the distribution of local populations and settlements than do short-term shifts. The evidence from the record is not documented for this time range in another climate.

Technology and the political climate have changed as well, and as in the case of the environment the changes have been both fluctuating and permanent. Those changes most important to settlement have been in the areas of pastoral technology, local industry, transportation and political security.

Up until twenty years or so ago, camel herding was an important subsistence activity throughout the lower pastures of Tauran, especially in and around the sand sea. It was a way of life and provided dromedary meat and milk. Caravaning was important throughout the region. Settlements near the shifting dunes of the sand sea have always been relatively permanent, agriculturally and especially subject to the hazards of blowing sand, heat and flood ing. Now that sand has been pushed back, it is less advantageous to make a living at the sand's edge, and several abandoned
dence it is impossible to say whether villages grew up along the route or the routes led from village to village, but major sherds scatter of the historic Islamic periods (along with pre-Islamic evidence) are situated one day's march apart and mark settlements which undoubtedly provided the traveller with fodder, food and fuel.

Besides camel herding, two other occupations are missing today—charcoal production and metalurgy (mining and smelting). It is only in the last fifteen years that charcoal production has been outlawed, but no one today has any memory or knowledge of metalurgical activity. Probably these two occupations were always sporadic, depending as they did upon an outside market and the presence of alternative ways of earning a living. One might suppose that both tended to increase in years of insufficient rainfall (given an urban market in the first place) when local food production failed to meet subsistence requirements. Because these sites may have been temporary and highly specialized, their location and distribution relative to mineral or metal resources will be a challenge for archaeological survey. There are no obvious signs of settlement at any of the tracks of industrial activity recorded so far.

Finally, the effects of insecurity and lack of political control are still very apparent in Turun. Up until as recently as World War II the people lived in or close to fortified, multiple family dwellings known as qál. The settlement pattern is now dispersed through the countryside because each water source and field system needed protection. The pacification of the countryside through the installation of gendarmerie posts has made such self-defense unnecessary, and today not every qanat site is occupied year round. Some which could still support a small settlement are operated from a distance as summer pastoral stations. Today there tend to be fewer, larger agricultural settlements which better meet the social and economic needs of the population.

If, however, the location of sites tends to be fixed by history and environment, the distribution and activities of the people who occupy them are not. Completely new locations may be infrequent, but local residents still have individual decisions to make on where to live and work. Fluctuations in the size of animal and human pop-

ulations, and associated shifts in emphasis on different settlement and productive strategies, result in shifts in the distribution of both populations. Pastoral sites and small villages in the outlying areas have been especially susceptible to these fluctuations and are highly unstable relative to the occupational continuity at more central locations. Villagers are aware of microenvironmental differences and can compare villages with respect to water (quantity, temperature, sweetness, thirst quenching qualities) or exposure to winter cold, summer heat and winds in season. They realize, though, that each village has advantages as well as disadvantages in these respects. Besides, some goals are incompatible. A setting which is cool in the summer may be freezing cold in the winter. On the other hand, isolation and the correlated lack of access to services, especially schooling, health, houses and medical care, are considered to be serious deficiencies. Although of relatively recent introduction, these services have already had an observable effect on internal shifts in residence as well as emigration to urban areas. Where access to them is unavailable, most solutions can cause considerable conflict between economic production and values. If families with school age children (specifically males) leave the isolated outliers to live nearer the schools which are presently only on the Central plain and at one of the Khar villages, then there will be a drop in agricultural productivity at these sites. Pastoral production, always the more important economic activity in outliers, is still possible because male family members can stay behind and manage the animals in the winter when they are not being milked. But then families are split, which is already a problem for migrant workers and shepherds but not previously too great a one for those engaged in domestic modes of production. Furthermore, without increasing agricultural yields or the extent of arable land on the plain, the only way for a newcomer to make a living by farming would be through inheriting or buying land held by someone already on the plain. Thus it is that the habit of population growth presently experienced, migration to and from the plain is possible only if land is being vacated by villagers who are moving away altogether, probably to the city, for the pull of urban life and its advantages is strong. People make residential decisions with regard not only to natural resources but to social resources, which are not necessarily compatible. Too often the result is abandonment of rural areas for cities, causing urban overcrowding and lowered rural productivity. Studies such as those described here help in understanding the dynamics of population distributions in isolated settings and allow local populations to participate in the planning of programs that will correct the imbalance in services and opportunities that has so long been a characteristic of arid lands.