

Tribes, Chiefs, and Transhumance: A Comparative Institutional Analysis

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Source: *Economic Development and Cultural Change*, Vol. 42, No. 1 (Oct., 1993), pp. 87-113

Published by: The University of Chicago Press

Stable URL: <http://www.jstor.org/stable/1154614>

Accessed: 18-03-2017 03:33 UTC

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Tribes, Chiefs, and Transhumance: A Comparative Institutional Analysis*

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I. The Explanation for the Dominance of Transhumance

Building on some descriptive surveys, Hans Binswanger, John McIntire, and Chris Udry have provided an articulate explanation for the prevalence of transhumance (long-distance herding activities) in arid and semi-arid regions (ASARs) not only in the animal husbandry sector itself but also over all other economic activities.¹

Their argument is basically as follows: ASARs are characterized by (a) poor land quality, (b) low population density and hence the relative scarcity of labor, (c) simple technology, and (d) extreme seasonality and year-to-year fluctuations in rainfall and production. These characteristics imply that (1) land is of low value and in surplus supply, (2) property rights in land do not exist, (3) transport and communications costs are sufficiently high so that they limit product markets to being small, local, volatile, and highly sensitive to the relatively frequent and severe supply shocks due to weather, (4) market failures exist in both credit and insurance markets, (5) foodstuffs are dominant in the consumption bundles of the local inhabitants, (6) resource accumulation generally takes the form of movable assets and especially livestock, and (7) since animal husbandry is less labor intensive than agriculture, it tends to dominate.

Given (a) the availability of pasture land from the commons at no cost, (b) economies of scale in animal supervision, and, especially, (c) the very substantial risks of severe animal losses due to drought, the herds belonging to individual households must be relatively large to assure survival in the long run.² Indeed, herd size is typically larger than would be expected on the basis of the average income that the herd generates. Because of extreme seasonality in water and pasture

availability, success in herding typically requires the animals to be moved long distances in the course of the year, that is, transhumance. The skill and mobility requirements of animal husbandry of the transhumance type are sufficiently different from agriculture so that households generally need to specialize rather permanently and to a much greater degree in either herding or agriculture in ASARs than in other regions.³ Also, whereas in other regions mixed farming (i.e., a mixture of agriculture and herding) is encouraged by the use of animal manure in raising agricultural productivity, in the primitive agricultural technology of ASARs, because fertilizer is unimportant, mixed farming is generally not feasible.⁴ As a result, however, product markets are necessary for exchanging agricultural and animal products.

Almost totally overlooked in the existing analysis of ASARs is that the dominant transhumant activities almost invariably take place within tribal societies and that the relevant economies of scale involve externalities. The existence of tribes and the critical role of the tribal chief can be seen in most but not all societies in which transhumance is a dominant activity. Indeed, tribal features are so prominent in the vast majority of ASARs throughout both Africa and Asia that the existence of both such institutions would hardly seem likely to have arisen by chance. For this reason, we argue that their explanation lies in the external economies of scale inherent in the conduct of transhumance in ASARs. At the same time, since there are some cases in which transhumance is practiced either not in tribes or in tribes without chiefs, the exceptions also warrant explanation. This article, therefore, focuses on the interrelationships between these heretofore neglected features of transhumance and on the factors that make tribal institutions essential in some contexts but irrelevant in others. In realizing these objectives, the article draws liberally on the existing theory of external economies of scale and of club goods (also known as "local public goods").

Our presentation is as follows: some additional explanations for the dominance of transhumance, along with the several institutional challenges to its existence are identified in Section II. The theoretical model is developed in Section III. A brief survey of the institutional characteristics of ASARs in Africa and Asia relevant to the validity of the theory is presented in Section IV. Finally, some conclusions are presented in Section V.

II. Additional Explanations for Transhumance and Its Institutional Problems

One additional explanation for the dominance of transhumance in ASARs is the remarkable innovation that ASAR residents have demonstrated in finding multiple uses of their animal staple. For example, in the Saharan and Arabian deserts, where only camels are capable of

practicing transhumance because of the long distances that must be traversed without water, legends are full of the many uses of the camel as a beast of burden, means of transport, and source of meat, milk, cheese, hides, and military weaponry (and thus security). By the same token, sheep, goats, and cattle all provide a variety of meat products, dairy products, blood, bone products, animal oil and fat, textiles (wool, hides, and skins), fuel (dung), and, on occasions, other goods and services as well.⁵

Second, because the vulnerability of both animal herds and humans to communicable diseases in high temperature zones rises with human and animal concentrations and frequency of contact, the dispersed character of transhumance (including nomadism) may limit the risks of infection, sickness, and mortality in both humans and animals.⁶ Also, not infrequently, the animals are made healthier and more productive through transhumance than they would be in sedentary conditions.⁷

Third, biological research has shown that the delicate grasses native to ASARs yield greater overall carrying capacity for the stock when they are used only periodically in the course of the year (as in transhumance) rather than when used continuously (as in the case of sedentary animal husbandry).⁸

Fourth, and most important, with the animals remaining extremely vulnerable to drought but without insurance against losses due to drought, the extremely high local variability of rainfall in ASARs implies that the risk to the individual herdsman can be reduced substantially by gaining access to the largest possible grazing area.⁹ While geographic dispersal can also reduce production risk in agriculture, because of lower transport costs in livestock (inasmuch as the animals provide their own mobility) such dispersal is much more economic in animal husbandry than in agriculture. Of special relevance is that the economies of scale in risk reduction are primarily external to the individual herdsman and hence would not necessarily be taken into consideration in individual decisions with respect to the allocation of land between animal husbandry and agriculture.

Fifth, in some herding societies, the mix in activities is biased by social norms that emphasize the superiority of both pastoral products and the pastoral way of life over those of agriculture.

Finally, since ASARs are characterized by the relative absence of law and order, assets are vulnerable both to damage from war and brigandry and to theft. Since frequently such vulnerability decreases with the mobility of the assets, the greater mobility of investments in livestock may make them safer than other forms of investments.

We turn now to the institutional problems faced by transhumance. Even though herding in ASARs is somewhat less prone to insecurity than are other activities, it is by no means immune to it, and, indeed,

security generally remains a basic problem. The thin population of such areas makes it generally uneconomic for any state to provide adequate law and order. As a result, the state's provision of law and order is both less prevalent and less effective in ASARs than elsewhere. The security problem for transhumance in ASARs is accentuated by the facts that animals, as the main source of wealth in these regions, are obvious targets for raiders and thieves and, since transhumance frequently takes place near or across borders, the culprits can relatively easily escape penalties by crossing borders.

The transhumance sector, moreover, is subject to even greater risks of nature than is agriculture in ASARs. For example, droughts, fires, floods, cold weather, or pest infestations have frequently wiped out as much as half the animal stock in whole regions within a single year. Since during droughts herdsmen are often forced to deplete their herds to purchase grain for themselves and their remaining stock, the terms of trade of meat for grain tend to fall precipitously, thereby explaining why herdsmen are found so prominently among those most affected by famines, as was the case in Ethiopia and the Sahel in the 1970s.¹⁰ Whereas agriculture can rebound completely and quickly (i.e., within 1 year) from such catastrophes, the rebuilding of herds proceeds very slowly, the maximum rate being the natural rate of increase of the herds. Indeed, in practice, rebuilding rates may lie far below the (theoretical) natural rates when animal reproductive rates are adversely affected by the inferior pastures of drought or postdrought conditions.

Another serious problem facing transhumance, and one not considered in the existing literature, is that posed by the potentially severe competition among different herdsmen for the always scarce high-quality pastures and water sources. Especially in drought conditions, the competition for water and pastures can be sufficiently severe to raise the risks of injury or death stemming from physical conflict among herdsmen.

Then, there is the well-known "tragedy-of-the-commons" problem of overgrazing, desertification, and ecological decline that arises when each herdsman has an incentive to put more animals on a commons of given size than is justified by long-run carrying capacity (knowing that every other herdsman has the same incentive).¹¹

Frequently also, there may be other external threats, for example, in the form of other animals that persistently prey either on livestock (as with wolves, foxes, lions, large cats, and wild dogs) or on the available pastures (as with rabbits and insects).

Finally, due to the prohibitively high cost of fencing materials in such areas, the need for large herds to traverse large distances, and the proximity of both animal trails and pastures to cropped land, conflicts between herdsmen and farmers are likely.¹² As Ronald Coase, Carlisle

Ford Runge, and Robert Ellickson have demonstrated, such conflicts give rise to high transaction costs in the form of animal loss to the herdsman, crop loss to the farmers, and monitoring and enforcement costs to one or the other or both.¹³

III. Theorizing: External Economies of Scale and Local Public Goods

We proceed now to a model explaining the role of tribes and their chiefs in the economic activities of ASARs.

External Economies of Scale

Let us assume a given ASAR with two relevant activities, agriculture (A) and animal husbandry (H), the outputs of which are producible by the individual household i with labor (L) and land (water and pasture) (K) according to what is believed to be the following CRTS Cobb-Douglas production functions:

$$A_i = E_A K_{Ai}^{1-\alpha} L_{Ai}^{\alpha}, \quad (1)$$

$$H_i = E_H K_{Hi}^{1-\beta} L_{Hi}^{\beta}, \quad (2)$$

where E_A, E_H are technical efficiency parameters, and the output elasticities reflect the factor intensities of the different activities. Again for simplicity, assume that each household i has a Cobb-Douglas utility function U_i in terms of A and H goods alone

$$U_i = A_i^{\gamma} H_i^{1-\gamma}. \quad (3)$$

Assuming also that each household is identical and that the various other requirements for aggregation of utility functions are satisfied, the same equations without subscripts can be used to represent the aggregate production functions and welfare functions, respectively. Assume also that the relevant resources, land and labor, are both fixed in supply, that is,

$$K_A + K_H = \bar{K}, \quad (4)$$

$$L_A + L_H = \bar{L}. \quad (5)$$

The aggregate versions of equations (1) and (2), when combined with the resource constraints in equations (4) and (5), allow the transformation function between A and H to be derived. Assuming that A is more labor intensive and H more land intensive, that is, that $\alpha > \beta$, the transformation curve would be like that given by PP in fig-

ure 1. The assumed form of (3) implies the concavity of the community indifference curves U_1, U_2, \dots

Maximization of the aggregate version of equation (3) subject to equations (1), (2), (4), and (5) corresponds in figure 1 to picking the point (A_1, H_1) on PP that is tangent to the highest possible community indifference curves, namely U_1 . Of the two goods, H_1 and A_1 would be the optimal amounts produced and consumed.

Suppose that in reality there are external economies of scale in H activities associated with the fact that the larger the amount of land at the aggregate level allocated to H , the lower the amount of K that each individual landholder-herdsman would need to obtain his target amount of H . His gain arises not from the fact that he would need fewer animals and, hence, less pasture on average to obtain a given amount of meat but, rather, primarily from the fact that all other herds-men in the region would require fewer animals and less land, thereby leaving more for him. Hence, given the variation in local weather conditions within any given region, the individual herdsman would (on

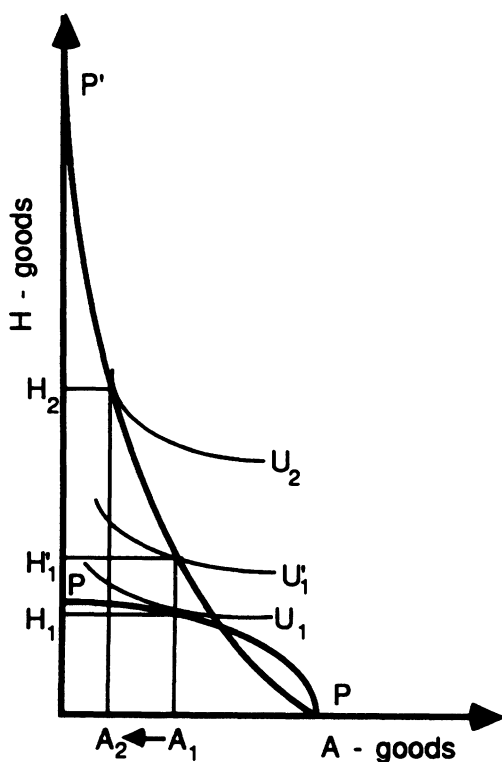


FIG. 1.—Effect of external economies of scale on resource allocation and welfare.

average) need less grazing land per unit of meat output H (or a smaller stock of animals) to produce any given amount of meat the larger the land area is to which he and his fellow herders would have access in times of bad weather. These economies of scale, however, would be external to the individual herdsman in that they would increase the land (pasture and water) available to others and vice versa.¹⁴

This implies that at the societal level the production of H would be given by

$$H = K^{\beta_1} L^{\beta_2}, \text{ where } \beta_1 + \beta_2 > 1. \quad (2')$$

Following Chipman's model of external economies of scale, this implies that the transformation curve would extend from P out to P' in figure 1. The new point of tangency (A_2, H_2) implies a greater specialization in animal husbandry and a higher level of social welfare U_2 (than U_1). It should be noted that the PP' frontier can be either bowed in or bowed out.¹⁵ Although (following convention) we have chosen it to be bowed in, the results would not be affected by the contrary choice.

Because the economies of scale are external to the individual herdsman, each identical herdsman would neither take such economies into consideration nor have access to them. Hence, each would decide on an allocation consistent with the aggregate (A_1, H_1), the point of tangency between the perceived transformation function (PP) and the highest possible indifference curve U_1 .

How can the external economies of scale be realized (and internalized)? The mechanism we have in mind derives from the existence of a tribe made up of persons related by lineage, language, and culture occupying a certain tribal area. Each member of the tribe, instead of claiming exclusive use or ownership rights to a parcel of grazing land within the tribal area, agrees to share the grazing rights on this parcel with any and all other members of the tribe in return for reciprocal grazing rights on all other parcels in the area. In other words, because of the local variability of the weather in a given season, each member of the tribe can reduce his or her production risk by gaining access to the largest possible area, in this case all the grazing land occupied by members of the tribe. That is, the production risk of each member of the tribe would be minimized by treating all grazing land in the tribal area as a tribal commons. With the grazing land treated as a commons to all tribal members, the higher transformation function PP' can be realized.

Given the need for agriculture as well, the tribe would need a means of allocating the land between A and H . We view this as the role of the tribal chief. It is the chief who possesses the enforcement power necessary to make use of the higher (or in the terminology

of Chipman, “objective”) transformation function PP' . Knowing (or having discovered in an evolutionary process) that the higher transformation curve PP' can be made tangent to the higher social indifference curve (U_2), the tribal chief can set aside an amount of land for H activities (K_H) consistent with production of H_2 . While the tribal chief would set aside the appropriate portion of the tribe's \bar{K} as tribal grazing grounds, the choice of the activity in which to specialize and the micro management decisions in each such activity would be left to the individual households belonging to the tribe. While the issue of how the chief is selected or originated is beyond the scope of this article, our literature review suggests that chiefs are typically wealthy and among the largest owners of livestock. This would give them sufficient incentive to internalize the externalities and the means as well as power with which to exercise leadership. If the difference between the tribal solution coordinated by the tribal chief (A_2, H_2) and the individual solution (A_1, H_1) were only due to failure of the latter to realize the existence of the externality, one might suppose that the actual level of utility attained in the latter case would be given by U'_1 , implying a considerably smaller difference between the individual and tribal solutions. Nevertheless, without the institution of the tribal commons, U'_1 would be unattainable.

Despite the simplicity of the model, comparative static manipulations with it provide several important and testable implications. First, any increase either in the endowment of land relative to labor or in the preferences for animal products ($1 - \gamma$) would increase the relative importance of H . Any decline in land quality would be expected not only to lower both $1 - \alpha$ and β_1 but also to raise the weather risk and hence the importance of the externality and the difference between the individual and tribally determined allocations. So, too, any rise in E_A relative to E_H , as has occurred with improvements in dry farming, would be expected to lower the relative importance of H . In the presence of a market in which A and H can be exchanged, the choice between A and H would also be affected by the exogenously determined terms of trade.

The Tribe and Free Riding

The above model shows that the intervention of the tribal chief can allow an external economy to be internalized, thereby improving the welfare of each tribal member. Nevertheless, since nonmembers would have the incentive to free ride and any individual herdsman might have the incentive to keep other herdsman away from the pasture and water used by his own herd, it is clear that the existence of the tribe and advantageous intervention by the chief has a public good character. In principle, in large tribal grazing grounds, exclusion might be costly, and the benefits might accrue to everyone irrespective of their support

to the tribal chief. This explains why tribal societies almost invariably have very careful rules for identifying membership, generally based on lineage descent groups traced back to common ancestors.¹⁶ Rules are enforced with strong selective incentives.¹⁷ Those outsiders attempting to free ride on the tribal grazing grounds may be treated very severely, as may those members of the tribe who do not obey the rules laid down by the tribal chief. Negative selective incentives are easy to apply within tribal societies inasmuch as social ostracism alone is likely to be a sufficient penalty.

At the same time, however, the rules have to be sufficiently flexible to avoid discouraging private investments of the type that would enhance land productivity, such as the digging of water wells.¹⁸ If access to privately dug wells were open to everyone, the benefits of such investments would leak out to others, undermining the incentives to dig them in the first place. Should lands be threatened by environmental degradation from overgrazing in drought conditions, even members of the tribe may have to have their access to the natural pastures and water sources on those tribal grazing grounds restricted.

Local Public Goods and the Size of the Tribe

Perfect flexibility in the size of the tribe and of its rules is of course not possible. Information and transaction costs rise sharply with the number of rule changes and ambiguities in membership rules, thereby greatly limiting the frequency and magnitude of the changes in the nature and rules of the tribe. Once all the mechanisms—including social norms necessary for the successful functioning of the tribe and its chief—are created, they are difficult and costly to change. As a result, like other institutions, tribal institutions may outlive their usefulness. Because of the high transaction costs in changing to and from a tribal system, the tribal system may also be inefficient when conditions are changing rapidly, for example, when they alternate between favoring *A* (which may make the tribe and its use of the “objective” production frontier suboptimal) and *H* (in which tribal institutions are useful). In such circumstances, other more flexible systems may arise, such as the nontribal zoning system administered on behalf of the Mesta (the powerful guild of sheepherders and owners) by the respective rulers of Spain and Naples from the fourteenth to the nineteenth centuries.¹⁹

Since the above model of external economies of scale assumes a given endowment of labor \bar{L} and of land \bar{K} , it leaves open the question of the optimal size of both the tribe (numbers of members) and the territory under its control. This however, is precisely the question addressed in the standard model of local public goods or clubs.²⁰ This model, summarized in figure 2, allows for the simultaneous determination of \bar{K} and \bar{L} (or number of members of the tribe $[n]$) in the above model of external economies of scale.

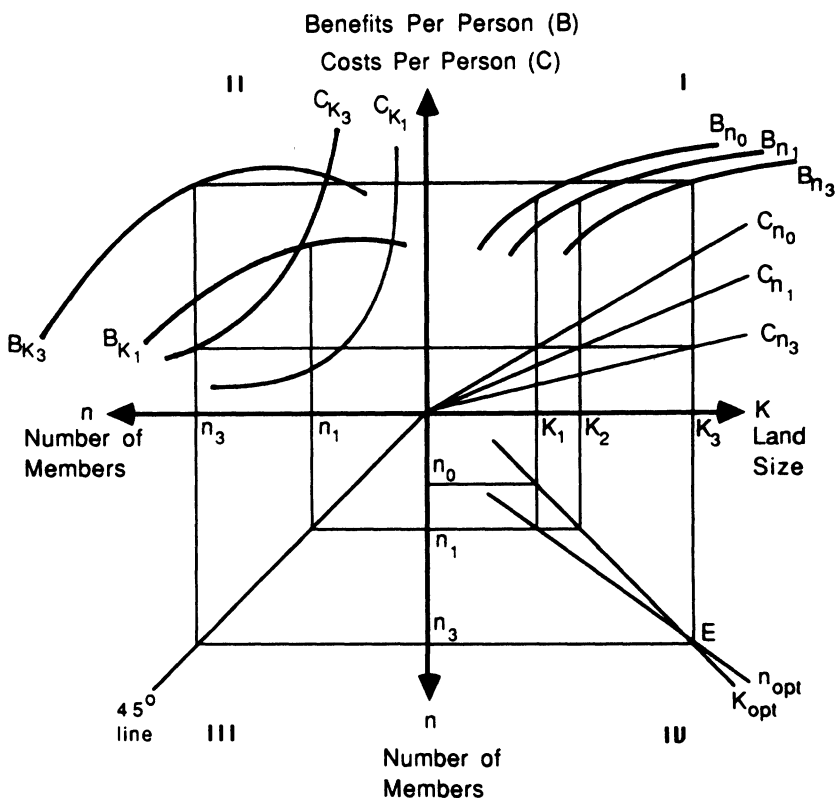


FIG. 2.—The joint determination of size of tribal area (K) and number of members (n).

For any given number of tribal members n , there corresponds a different schedule of benefits (expected value of the profits of herding) per person (B) derived from increasing the size of the tribal land area K . Large amounts of K would be necessary to achieve the same level of B for each successive increase in number of members. For this reason, the per capita benefits schedules $B(n)$ would be of the form and position demonstrated in quadrant I of figure 2. Assuming for simplicity constant unit transaction costs of obtaining control over and of regulating access to the commons with respect to the size of K , the per capita cost curves for successively larger memberships would be of the shape and position indicated by C_{n_0} , C_{n_1} , C_{n_3} in the same quadrant of figure 2. For the given number of members n_0 , the per capita net benefits ($B - C$) of tribal area K would be maximized at K_1 , for n_1 , at K_2 , and so on. The loci of such points can be used to trace out the K_{opt} schedule in quadrant IV of figure 2. More realistically, the unit transaction costs of obtaining control over the commons might be expected to rise with K (at least after a point), thereby changing the

magnitude of $(B - C)$ and the shape of the K_{opt} schedule but not the basic analysis.

Likewise, for each given size of the tribal area K , there would correspond different schedules of per capita benefits and per capita costs with respect to number of members of the tribe (n), such as those depicted in quadrant II of figure 2. Once again, the maximum $(B - C)$ is attained by equalizing the slopes of the $B(K)$ and $C(K)$ curves. For example, for $K = K_1$, $B - C$ is maximal at n_1 , and for $K = K_3$, $B - C$ is maximized at n_3 . The loci of these points can be used to trace out the n_{opt} curve in quadrant IV of the diagram.

Both the optimal size of tribal area K_3 and the optimal number of members n_3 are optimized at the single point of intersection E . Moreover, any point of disequilibrium would give rise to pressures which would induce convergence toward the equilibrium.²¹

Naturally, this application of this model of clubs is highly simplified and leaves out many interesting issues, such as the situation of nonmembers of the tribe, other private as well as public goods producible within the tribe, differential tastes and preferences among members of the tribe, the nature and magnitude of exclusion costs, effects on different generations, and other dynamic issues. Nevertheless, the simple model is suggestive of considerations affecting the optimal size of the tribal area and number of members.

For example, a reduction in the quality of land and/or increase in the local variability of rainfall would be likely to shift the $B(K)$ curve in quadrant I downward and to the right for each given n but especially so at higher levels of n . Thus the upward slopes of $B(K)$ curves would be increased for each given level of K . At the same time the $C(K)$ curves would be flattened out, narrowing the gaps between them at each given level of K . This would have the effect of shifting K_{opt} in quadrant IV outward and flattening it. At the same time, the lower quality of land and greater local variability in rainfall would have the effect of shifting the $B(n)$ curves in quadrant II downward, especially at low levels of K . This would have the effect of shifting the n_{opt} curve in quadrant IV upward and to the right, making it likely that the size of the tribal territory K would rise while the number of tribal members n would fall. An increase in the leadership quality of the chief or in communication skills among members of the tribe would likely shift $C(n)$ downward and to the right for each K but especially at high levels of n . This would have the effect of shifting the n_{opt} curve in quadrant IV downward and to the left, thereby raising both K and n .

IV. A Comparative Institutional Analysis of the ASARs in Africa and Asia

On the basis of the models presented in the previous section tribes and their chiefs would be expected to be more important in societies practicing transhumance the greater the variance in rainfall from one

microregion to another and from year to year. By contrast, where rainfall and weather are predictable, there is less reason for tribal institutions.

Since transhumant activities have been greatly affected, and in some cases almost totally undermined, in recent years by colonialism, oil discoveries, state-supplied security, and other investments and technological changes that have favored agriculture, most cases cited below are drawn from the late nineteenth century. While we mention only a few of the better-studied examples of ASARs with and without tribes, our extensive survey of the literature makes us confident that the patterns revealed in these cases are representative.

Tribes with Chiefs

Three cases are cited of societies composed of tribes with chiefs, thereby most closely conforming to both models of the previous section. These are the Tuareg of the Central Western Sahara, the native reserves of Botswana, and the Rwala of Syria, Jordan, and Iraq.

The Tuareg of the Central Western Sahara. Until their eventual defeat and subsequent subjugation by France at the turn of the century, the Tuareg had control over a vast area from the Sahara (and in particular the Air Mountains of Southern Algeria, near the frontiers of both Mali and Niger) southward to the savanna of Niger and Nigeria.²² The extraordinary size of the area dominated by the Tuareg can be attributed to its low quality of land and high risk of drought, on the one hand, and the importance of external economies of scale in risk reduction, on the other. Although nomadic pastoralism lies at the heart of Tuareg economic activities, especially in times of prosperity, commercial, artisanal, transport, and agricultural activities can also be quite important. The unusually large size of the area, the unsuitability of much of it for agriculture, and the fact that the camel was the animal best suited to much of it combined to give rise to the following distinctive features of the Tuareg case.

First, as mentioned above, the Tuareg society was extremely hierarchical, with chiefs at the top, followed, in turn, by other wealthy camel owners, poorer non-camel-owning herdsmen, artisans, and slaves. The wealthy camel owners were the most influential, collectively deciding on matters of war and peace and the most important allocational decisions. Their power was attributable to their monopolistic control over the ownership of both camels and weaponry. The camel, which was so essential for warfare, was also highly valued, hence making ownership of camels difficult to achieve for a relatively poor nomad or farmer. Animal acquisition among poorer herdsmen, therefore, was generally limited to more affordable sheep and goats.

Second, camel ownership and the suitability of camels to long-distance transport activities across the desert implied that the wealthy

camel-owning Tuareg were also in a position to monopolize transport services and access to markets outside the Sahara. With little or no competition and large price differentials from place to place, these trading activities were rather profitable, further increasing the camel owners' wealth.

Third, being highly specialized in camel transhumance, transport, and allied commercial and military activities, the wealthy Tuareg needed to obtain grain. This they did either by installing their slaves on desert oases or the better-watered points along the caravan routes or by offering "protection" in return for a share of the crop from peasants living at their mercy on the edges of the Sahara. The chiefs and councils of elders played crucial roles in coordinating these deployments.

The extremely hierarchical character of Tuareg society also fostered the flexibility to cope with the severe droughts that, on occasion, lasted as long as a decade. That flexibility was supported by the following mechanisms: (a) during good times the wealthy Tuareg provided loans to slaves and poor nomads, allowing them to develop small herds and to undertake *A* in return for a share of the net proceeds; (b) in times of drought these smallholders would be forced to sell off their drought-decimated herds in order to emigrate southward to take up *A*, often under the "protection" of the Tuareg; (c) when good times returned, the slaves and other non-Tuareg would be allowed to return to *H* activities in the Air Mountains through the reissuance of credit. Only the Tuareg, however, had communal use rights to the relatively well watered Air Mountains during the dry season of drought years. The concentration of wealth in the hands of a relatively small elite, combined with the safety valve of slave and other non-Tuareg emigration and the extremely large tribal grazing grounds, allowed the wealthy to maintain their herds even when having to endure many consecutive years of extreme drought.²³

All this was during the heyday of the Tuareg. Eventually, the French military authorities reduced the power of the Tuareg by forcing them to disarm and confiscating large numbers of their camels. This led inevitably to a decrease in the size of Tuareg tribal grazing grounds and in the Tuareg's ability to invest in *A*. Also, the trans-Saharan trade declined under French taxation and the Tuareg lost their monopoly hold over both it and the related trading activities. Moreover, especially after Algerian independence, government-induced sedentarization of the nomads caused desertification, which, in turn, has forced the nomads to move southward. Meanwhile, the simultaneous expansion northward of *A* has put the squeeze on the pastoral nomads of the Tuareg and other groups.

The native reserves of Botswana. While the Sahara constitutes the most important ASAR in Africa, there are other ASARs in Africa

where the transhumance type of animal husbandry is relatively important. One of the most important of these is Botswana. Thanks to some remarkably insightful analyses of preindependence Botswana, Botswana is also a good country to study from an institutional perspective.²⁴

In the last 30 years, Botswanan society has been substantially transformed by the emergence of mining and tourism. As recently as 1940, however, 90% of the population of Botswana were located in some nine different native reserves, and *A* and especially *H* activities dominated. These reserves resulted from the deliberate attempts in 1899 by the British colonial administration to clarify the previously ambiguous (and hotly disputed) borders between the different tribes. One of the native reserves, the Tati Reserve, was owned by a single private company but, unlike the other reserves, each of which was managed and controlled by a different tribe, it was composed of many different groups.

Except for the wetlands of the Northwest (where animal husbandry was severely limited by the sleeping-sickness-bearing tsetse fly), like other ASARs, rainfall in the native reserves of Botswana was relatively light (15–20 inches per year) and, consistent with the model of figure 1 above, was subject to high variance both year to year and place to place.

In view of the importance of economies of scale realizable at the aggregate level, that is, by the tribal chief, it is easy to understand the competition between the various tribes for additional territory prior to the British colonial intervention of 1899. Relatively important in this competition were the number of tribal members and their military technology. In 1899, however, the lands of Botswana were divided into nine native reserves, small blocks of European land, and very large crown lands.

Of particular relevance is that the 11-year average of measured rainfall reported by Isaac Schapera was virtually the same at nine of the 10 weather stations throughout the Savanna region of Eastern Botswana in which the various reserves are located. Because of the comparable land quality of the different native reserves and the fact that the boundaries between them were frozen by the British colonial administration, one can test for the hypothesized external economies of scale. Specifically, if fewer animals would be needed per unit of land in larger grazing areas, the land-to-animal ratio should rise with size of the tribal area.

Table 1 provides the relevant data on size of the tribal grazing area and land-to-animal ratio for each of the nine tribal areas, as well as their relative rankings in both respects. The resulting Spearman coefficient of rank correlation (ρ) between the two rankings is .875, which is significant at the 1% level. By excluding the not entirely

TABLE 1
DATA FOR RANKING THE AREA AND LAND/CATTLE RATIOS OF THE TRIBAL
AREAS OF BOTSWANA

Reserve	Total Area (in Morgen)	Size Rank	Morgen per Head of Cattle	Land/Cattle Rank
Ngwato	12.10×10^6	1	34.5	4
Tawana	10.42×10^6	2	101.3	1
Kwena	4.54×10^6	3	67.6	2
Ngwaketse	2.72×10^6	4	40.2	3
Kgatla	1.08×10^6	5	19.9	5
Rolong	$.13 \times 10^6$	6	15.6	6
Tati	$.10 \times 10^6$	7	4.6	8
Malete	$.05 \times 10^6$	8	4.4	9
Tlokwa	$.02 \times 10^6$	9	5.1	7

SOURCE.—Isaac Schapera, *Native Land Tenure in the Bechuanaland Protectorate* (Johannesburg: Lovedale, 1943), p. 213.

comparable Tati reserve from the sample, the value of ρ falls to .833, but this is still significant at the 1% level. The results are also insensitive to the addition of smaller stock (sheep and goats) in standard units to the numbers of cattle in calculating the land-animal ratios.

Certainly, more research would be required on land quality and numerous other possible influences on land-animal ratios before the above results could be accepted without question. Nevertheless, in view of the apparent similarities in weather, technology, and land quality reported by Schapera in his studies, this tentative result is quite remarkable. Tentatively accepting, therefore, the hypothesized existence of external economies of scale in H but not in A , let us turn to the institutional implications.

The most important implication is that private property rights in land would not seem to be an efficient institutional arrangement for Botswana.²⁵ Since, as pointed out above, in the absence of cheap fencing and with A and H activities in close proximity to one another, to minimize the crop losses each activity imposes high transaction costs on the other. Hence, the two activities must be kept separate by zoning.

Admittedly, private property rights would not be problematic in this respect when accompanied by strong zoning ordinances. But with zoning restrictions the land rents associated with private property lose their allocative role, suggesting that, once land is allocated by zoning ordinance, the efficiency-increasing advantage of private property rights in land would be lost. In societies like Botswana where literacy is not widespread and legal contracts are difficult to enforce, it is not difficult to see why tribal organizations would arise. The tribe is a corporate entity that owns the land and is able to internalize the external economies of scale.

The success or failure of the chief of any particular tribe in achieving the optimal allocation of land between the two activities could be expected to have a significant influence on that tribe's historical development. The preindependence Botswanan experience is highly instructive in this regard.

Notably, the allocation of land to various uses was one of the most important functions of the Botswanan tribal chief. First, he allocated some land for the tribal capital, which was then divided into different districts or "wards" for residential purposes. Next, he designated higher-quality land, especially land near the tribal capital, to be set aside for *A* and he divided it among the various wards. Each ward head, in turn, subdivided the *A* land assigned to him into plots assigned to the individual households of that ward. The remaining land was kept in commons as pastureland and as such reserved for *H* activities.²⁶

While the individual households enjoyed relatively complete private property rights in agricultural land, which included not only use rights but also trading and inheritance rights, their only rights to pastureland were those of common access rights subject to regulations in use. The trading of agricultural lands made it possible for individual households to diversify geographically their agricultural landholdings. This was unnecessary, of course, with respect to common pastureland since households had access to all segments of it.

Since conditions could change over time, the tribal chief could decide to move a whole village to another area or to switch the use of a block of land from *A* and *H*. The only right retained by the landholder was that of compensation in kind for any confiscated land.

Over time, of course, with technological and other changes, common pastures and zoning would no longer be optimal. As elsewhere in Africa, Botswana has had numerous privatization and settlement programs. Seldom, however, have these programs been successful, and indeed, many settled ranchers have voluntarily abandoned their private farms in order to reassume use of communal tenure, at least in the case of *H* activities.²⁷

The Botswana example provides empirical support both for the model of external economies of scale in *H* and for the relative efficiency of tribal institutions in internalizing these economies and hence in raising the welfare of tribal members. It explains why private property may be dominant in *A* but common property dominant in *H*. It also illustrates the relative flexibility of the system in allowing entry and exit of tribal members, consistent with the notion that the tribal membership is a multiattribute club good. While normally the optimal size of the tribal area might vary over time with changing circumstances, as a result of British colonial policy it was frozen. The system was also sufficiently flexible to provide considerable incentives for land-improving investments since in normal nondrought years the

fruits of such investments would be restricted to those making the investments. In the Botswanan system, tribal allocation of land undercut the last remaining advantage of private property rights.

The Rwala of Syria, Jordan, Iraq, and Saudi Arabia. The Rwala are a large nomadic tribe which until recently regularly practiced transhumance with camels throughout a large territory currently shared by four nation-states of western Asia, namely, Saudi Arabia, Iraq, Jordan, and Syria, including the Golan Heights presently occupied by Israel. Occasionally, their nomadic activities took them even further, that is, to Turkey in the north and the United Arab Emirates in the southeast. With a membership of perhaps half a million persons, and ownership of the vast majority of camels in the region, the Rwala have dominated the region for the last several centuries.

Among the dramatic environmental changes that have taken place since the latter part of the nineteenth century, are the imposition of central control by the various nation-states in the region; the introduction of small pick-up trucks which have largely replaced the camel as beasts of burden; the introduction of truck-borne water tanks and machine guns; the replacement of camels by sheep as the principal form of livestock; the discovery of oil and the growing availability of wage employment; the replacement of tribal lands by state ownership; and urbanization, agricultural growth, and ecological decline.²⁸

Traditionally, without a strong state the Rwala were the main providers of security and order in the region. While the Rwala permitted the animals of other tribes to graze in, farmers to cultivate in, and merchants in towns and cities to send their caravans through Rwala tribal territory, they did so for a price. The latter was extracted by the Rwala either by raiding or by imposing payments of the *Khuwa*, a kind of tax for permission for such use of the area in return for exemption from raiding.²⁹ Naturally, *Khuwa* payments tended to be somewhat higher for land in the higher-quality, less-arid marginal agricultural lands and also to change gradually over time. Since the *Khuwa* provided the Rwala with income in lieu of exclusivity in land use, in years of normal rainfall it generally made for more amicable and cooperative relations between Rwala and non-Rwala. Especially in areas policed by towns and cities, when incursions by Rwala animals on the croplands of *Khuwa*-paying peoples were detected, the Rwala would be required to pay indemnities to the cultivators (implicitly a negative receipt of *Khuwa*). Since the *Khuwa* payment changed only slowly over time, in drought years the marginal agricultural lands would have greater value, and hence the Rwala would have the incentive to let their animals graze on these marginal lands at the expense not only of the cultivators but also of their own forgone *Khuwa* revenues. While *Khuwa* has been treated in the literature as compensation for the provision of security and protection against the raids by outsiders, it can

also be seen as a discriminatory tax on *A* of the non-Rwala relative to *H* of the Rwala. Norman Lewis has pointed out that, when agricultural prices and/or productivity were sufficiently low, whole villages voluntarily abandoned their farms and homes rather than pay the tax, whereas in other times they would return and the Rwala herdsman would recede into the desert. The relation between the Rwala bedouin, on the one hand, and non-Rwala traders and farmers, on the other hand, was basically symbiotic.³⁰

However, as the colonial and then postindependence nation-states became stronger in the twentieth century and such states began to provide the non-Rwala peasants with law and order, including protection from Rwala taxes and raids, in return for a tax, and as agricultural export opportunities improved and more animal products were imported, the allocation of these marginal agricultural lands tilted in favor of *A*, thereby reducing the relative benefits of the Rwala taxation solution to external economies in *H*.

Some of the other environmental changes identified above have also contributed to the decline of both the traditional system and the size of the tribal grazing area. First, the presence of water trucks and the demise of the market for camels has made sheep raising more feasible. Second, the availability of water trucks has decreased the importance of drought risk and hence the optimal size of the tribal grazing grounds. Third, state ownership making grazing lands available to everyone has given rise to overgrazing and desertification. Fourth, the increasing availability and attractiveness of wage employment has undermined tribal cohesion and norms.³¹

A Tribe with No Chief: The Al-Murrah of the Arabian Empty Quarter

Our next case is that of a transhumance-dominated ASAR that has a tribe but no chief. This is the case of the Al-Murrah nomads who control the Empty Quarter of Saudi Arabia.

An even more forbidding environment to humans and animals alike than the Sahara is Arabia's Empty Quarter. It is in this desolate region that the Al-Murrah nomads, sometimes referred to as the "nomads of the nomads," practice their transhumance.³²

Whereas most other ASARs have some relatively mild and well-watered haven, the Empty Quarter has none. For this reason, there is considerably less competition for the generally extremely poor pastureland, implying that security is a much less important concern. As a result, while the tribal area has to be sufficiently large to provide adequate risk reduction in the face of sparse and highly variable rainfall, as shown in the Tuareg case, the number of tribal members need not be large.

The Al-Murrah number only about 15,000 and operate in a highly

decentralized way. They maintain some 20 wells, the access to which is determined by carefully drawn lineage patterns. The relatively closed access to the wells limits the importance of free riding that would otherwise undermine the incentives for well drilling and maintenance. Nevertheless, in very bad years each tribe opens its wells to members of other tribes.

Consistent with the model explaining the essential role of the chief in allocating land between competing uses and the fact that agriculture is possible nowhere within the Empty Quarter, the Al-Murrah has no chief. The dearth of hierarchy in the structure of the Al-Murrah tribe implies that the policing of unacceptable behavior, such as murder, wife stealing, and animal theft, has to be self-provided by relatively low level subunits of the tribe. The membership in these subunits or clans is determined by genealogies and involves collective responsibility to settle the debts or other transgressions of fellow clan members vis-à-vis others. Of particular importance, both in solving crimes and in daily survival, are a variety of skills, including the ability to track people and stray animals.

Since mobility is all important for survival, investments are limited to animals and children (who take care of the animals). Hospitality is a cooperative social norm that reduces risk and limits the basis for costly conflicts between the Al-Murrah and other tribes.³³

Grazing Areas with neither Tribes nor Chiefs

Finally, we come to two exceptional cases, namely, the Shahsevan of Iranian Azerbaijan and the Central Asian Arabs of Afghanistan, who, instead of having tribal grazing areas open to all tribal members, have arrangements approaching private property rights.

The Shahsevan of Iranian Azerbaijan. At the heart of the argument for the tribal grazing ground in the model of the previous section is the unpredictability of rainfall and weather and variations therein from one locality to another. Hence, in more predictable conditions transhumance would be expected to lead to institutions more closely resembling private property than tribal grazing grounds.

Although clearly characterized as an ASAR with transhumance, the Shahsevan nomads of Iranian Azerbaijan are a case in point of a herding society with private property.³⁴ The reason for this is as follows. Although seasonality is considerable, thereby justifying transhumance, the weather patterns are unusually regular, with little variations from one locality to another. Although still tribal in principle, relatively permanent allocations of specific parcels of both winter and summer pastures are allotted to individual households or camps, each consisting of four or five households that pool their herds. These allocations are even inheritable. This, of course, provides maximum incentives for land-improving investments and suggests that only household

or camp-level economies of scale are important. As publicly supplied security has increased, the optimal size of the tribe or club has decreased. In the process, however, both the maintenance of the sheep highways connecting the winter and summer pastures and the rights to use them have declined.³⁵

Flexibility in the Shahsevan system in the face of variations in climate, household size, ecological factors, and market conditions is evidenced by the fact that the individually owned shares in tribal estates can be bought and sold, though preferably, but not necessarily, only among members of the tribe. By allowing the successful to buy out the unsuccessful, competition ensures that the Shahsevan system is dynamically efficient in the sense that, over time, tribal land becomes allocated primarily on the basis of skill and ability to manage.

The Central Asian Arabs of Afghanistan. A somewhat similar case is that of the Arabs of northeastern Afghanistan studied by Barfield and Krader.³⁶ What is especially interesting about this group is how the importance of tribal institutions has changed over time. Until the mid-nineteenth century these Persian-speaking, sheep-raising "Arabs" had practiced a three-step transhumance from plain to steppe to mountain in the vicinity of Bukhara near the frontier of Afghanistan and Turkmenistan. As in the case of the Shahsevan nomads of Iran, the weather in this area, though highly seasonal, was rather regular and dependable. As a result, pasture rights were in effect privately held, and tribal solidarity was rather limited.

After considerable strife and turmoil, however, between 1865 and 1868 the region used by these Central Asian Arabs came under the control of Russia. Given the relatively high quality of the land, the Russians subsequently converted the land to cotton, thereby depriving the Arabs of their pastures and pushing them across the border into the Qataghan region of Afghanistan.

They were once again able to find pastureland for their sheep in the new region but only in an underpopulated malaria-stricken area with very low quality pastures. The Arabs remained in this area for over 30 years. Because of the lower quality of the pastures and the greater variation in weather (both from one year to another and from one locality to another) the land was held in common, and the transhumance they practiced was decentralized and nomadic in character. All areas under their control were open to all Central Asian Arab nomads. During this period tribal solidarity returned, the tribal grazing grounds increased in size, and other tribal institutions were strengthened.

After World War I, however, another tribe, which had occupied the best and most dependable pastures in this area, was relocated elsewhere, and the Arabs moved in. Indeed, after the reorganization of tribal land in 1921, the Arabs were given use-right titles to this highly desirable land. These rights were then distributed to individual

households more or less in proportion to their herd sizes, and they could even be sold or rented. Each sheep-owning household was granted not only use rights to specific land areas in both steppe and mountains but for a fee also winter access for their sheep to the marsh lands of the plains. This combination of grazing lands in the plains, steppe, and mountains is generally regarded as the best and most dependable in Afghanistan. Because of the low risk involved, once again there was little advantage to large size in the tribal grazing grounds and hence no need for communal grazing. Since these private property rights were provided by the state, not the tribe, neither a chief nor a tribe were needed any longer. In general, Barfield has shown that tribal solidarity has gradually dissipated, the use of tribal genealogies has virtually disappeared, and marriage outside the immediate family has become much more common.³⁷ An interesting exception to this rule, however, is the Katopoi clan (within this Arab community) among whom land has remained in communal form and tribal institutions have remained rather strong. Notably, the Katopoi clan is the poorest of all the Central Asian Arab clans, and the land at its disposal is the least dependable, implying that the risk-reducing benefits or larger size of the tribal grazing grounds would be more substantial for this clan than for the others in the area.

V. Conclusion

As argued in Section II above, the institutional problems that need to be overcome to have successful animal husbandry activities in ASARs are quite formidable.

The case studies given in Section IV provide anecdotal and statistical evidence for some of the main elements in the theoretical models proposed for analyzing these problems. Specifically, from the data on various tribal reserves in Botswana there is evidence of economies of scale in the form of decreased inventories of animals per unit of land. There is also evidence from the various ASARs reported here that the size of the tribal area and the allocation of land between *A* and *H* seem to vary according to exogenous environmental conditions in ways predicted by the models. Technological changes, such as the introduction of roads, trucks, railroads, irrigation, and so on, have had substantial and fairly predictable effects in undermining the role of tribal institutions.

Numerous studies have questioned the efficiency of communal and tribal institutions by demonstrating the existence of a negative association between communal land ownership and productivity. An important implication of our model, however, is that the lower the quality of land or the more variable the weather, the more important it is that the land be held in communal, that is, tribal form. In other words, potentially at least, the causality may be reversed, calling into

question the validity of the evidence cited for the inefficiency of communal land ownership. Other implications are that the greater the external security problems and the larger the area, the larger the number of members or the greater their relative military strength needs to be. Where agriculture is not even potentially competitive with animal husbandry, for example, in the more arid regions, the zoning function of the tribal chief becomes redundant. In such a case there may be a tribe without a chief. But, when the two sectors are potentially competitive, one or another of various zoning mechanisms becomes imperative, that is, either zoning imposed by the decree of the tribal chief or taxes and subsidies designed to offset the failure of market prices to reflect the external economies of scale in *H* activities.

Although the above case studies demonstrate that tribal institutions can be quite flexible, there are certainly limits to their flexibility. For example, they may not be able to respond to rapidly changing relative prices or environmental conditions. Indeed, Douglass North goes so far as to cite tribal institutions as a serious barrier to institutional change and economic development. Although the nontribal Spanish Mesta system seems to have been advantageous in terms of providing the needed zoning in a more flexible way, even the Mesta was by no means free of conflict and inflexibility.³⁸

The model also suggests that increasing (decreasing) population density should shift resource allocation toward *A* (*H*) in any given ASAR. Djavad Salehi-Isfahani shows that there is considerable evidence from the Middle East for this relation. For example, the shift from *A* to transhumance-type *H* in Iran and Iraq was concurrent with population decline resulting from the Mongol invasions of the thirteenth century. This implication of the model is also supported by the decline in *H* activities that has occurred in most countries of the Middle East and North Africa when and where population has grown rapidly (as early as the mid-nineteenth century in some ASARs of this region, and since the 1950s in virtually all of them). While this evidence is also consistent with Ester Boserup's population-determined theory of land use, the shifts into and out of *H* have frequently been much more pronounced than would have been expected on the basis of such small variations in population density.³⁹

Even without a change in population density, the model predicts that insecurity would favor *H* over *A*. As noted above, this occurred in fourteenth-century Spain, in the Middle East during various invasions, in both Southern and Eastern Europe, and in much of the Middle East during the Second World War.

In the absence of state-provided security, such as was the case in the frontier areas between the Christian and Arab portions of Spain in the late Middle Ages, or in the ASARs of the Middle East and North Africa until the twentieth century, historically security for the nomadic

pastoral activities in ASARs had to be provided by the herdsmen themselves. They were armed, highly mobile, and organized into tribes and in some cases confederations of tribes for self-protection against thieves, animal raiders, or opposing groups.

As modern states have entered such regions, they have tended to view the tribal pastoralists as threats to their own existence and power. Both the colonial and subsequent postindependence regimes have almost invariably practiced policies designed to weaken the power of the tribes. Important among these policies have been confiscation of tribal weapons and camels, the buying off of tribal chiefs by giving them private property rights over formerly tribal lands, and public investments in well digging, housing, and other activities designed to encourage settlement and sedentarization. In at least some of these cases, these policies have been well motivated, seeing sedentarization and private property rights as the best means of achieving a prosperous *H* sector in the long run.

However, as we have argued theoretically and as in hindsight has now become clear, such policies were based on faulty understanding of the conditions in ASARs in general and of the special problems of transhumance in particular. The results have been almost universally disastrous. As Keith McLachlan has pointed out, the percentage of the labor force employed in the *H* sector in North Africa and the Middle East is believed to have fallen precipitously, for example, from 10% as recently as the mid-1960s to about 1% in the mid-1980s.⁴⁰ Naturally, some of this decline would have come anyway as a result of the "Dutch disease" effects of the oil boom and changing market conditions. Nevertheless, some of it could have been averted by better policy, as suggested by the following astute observers of the experience with sedentarization in both the Sahara and southwest Asia: "Collective ownership is essential to the cohesion of the nomadic group. Wherever animal husbandry is still active, therefore, steps must be taken against the monopoly of tribal lands by individuals, the communal states of pasture lands must be preserved, and in the case of arable land, there must be a return to collective redistribution."⁴¹ And: "But such wholesale sedentarization has proved difficult to achieve and in cases where it has been strongly enforced it has often had disastrous results, causing high mortality of stock and people, pauperization and proletarianization of large populations, and economic decline in whole provinces. Furthermore, no alternative patterns for the utilization of grazing resources have emerged."⁴²

Notes

* Paper presented at the Middle East Economic Association meeting in Washington, D.C., December 27–30, 1990. We gratefully acknowledge the useful suggestions of Charles Anderton, Marcel Fafchamps, Ken Koford, Ti-

mur Kuran, Ian Novos, John F. O'Connell, Patricia Reynolds, David Schap, Chris Udry, Makoto Yano, Ben Yu, seminar participants at Stanford University and the University of Southern California, and an anonymous referee.

1. Hans Binswanger and John McIntire, "Behavioral and Material Determinants of Production Relations in Land Abundant Tropical Agriculture," *Economic Development and Cultural Change* 36 (October 1987): 73–99; and Chris Udry, "Production Relations in Semi-Arid African Agriculture," in *The Economic Theory of Agrarian Institutions*, ed. Pranab Bardhan (Oxford: Clarendon, 1989), pp. 122–44. Transhumance is here defined broadly to include any long-distance migration of domesticated animals, thereby including pastoral nomadism and semi-nomadism. This definition contrasts with those of some specialists who distinguish transhumance from pastoral nomadism on the basis of the regularity and specificity of the migration patterns. Since not all nomads are pastoral (some nomads are merchants or wage workers), not all nomads practice transhumance. Historical records show that the practice of transhumance goes back to ancient times and was preceded by seasonal migrations of wild animals. See R. Capot-Rey, "The Present State of Nomadism in the Sahara," in *Proceedings of the Paris Symposium*, vol. 18 of *Problems of the Arid Zone* (Paris: Unesco, 1962), pp. 301–10.

2. Aside from economies of scale in supervision, there are economies arising from the fact that animals often ingest their food better when grazing in large groups than when grazing separately or in small groups. See D. F. Tribe, "Influence of Pregnancy and Social Facilitation on the Behavior of Grazing Sheep," *Nature* 166 (1950): 16–29; and W. W. Swidler, "Some Demographic Factors Regulating the Formation of Flocks and Camps among the Brahui of Baluchistan," in *Perspectives on Nomadism*, ed. William Irons and Neville Dyson-Hudson (Leiden: Brill, 1972), pp. 69–75.

3. This specialization is more apparent in production than in ownership inasmuch as farmers may own animals that are let out to herdsmen who merge them with their own herds. However, even this practice is limited by the potential for moral hazard that arises in the care of someone else's animals.

4. In semi-nomadism, however, the animals may remain in at least one location sufficiently long and with enough rainfall or irrigation water to permit the same household to undertake agricultural and herding activities simultaneously. Alternatively, some members of the household may farm at the home base while others take the animals away for varying periods of time.

5. We do not wish to imply that the residents of ASARs make do without agricultural products. Even those in animal husbandry generally exchange their products for agriculture goods.

6. See esp. Fredrick Barth, "Nomadism in the Mountain and Plateau Areas of South West Asia," in *Proceedings of the Paris Symposium*, pp. 341–55.

7. This is especially true of some breeds of sheep whose health and fleece are improved by exercise and camels whose strength and capacity are improved with vigorous exercise; see, e.g., Capot-Rey.

8. See esp. Fredrick Barth, *Nomads of South Persia* (Boston: Little Brown, 1961), and "Nomadism in the Mountain and Plateau Areas of South West Asia"; O. Bremaud and J. Pago, "Grazing Lands, Nomadism and Transhumance in the Sahel," in *Proceedings of the Paris Symposium*, pp. 311–24.

9. This point is made forcefully by Daniel W. Bromley and Jean-Paul Chavas, "On Risk, Transactions, and the Economic Development of the Semi-Arid Tropics," *Economic Development and Cultural Change* 37 (July 1989): 719–36.

10. See esp. Amartya K. Sen, *Poverty and Famines: An Essay on Entitlement and Deprivation* (Oxford: Oxford University Press, 1981).

11. Among the most important evaluations of this problem are Ian Livingstone, "Economic Irrationality among Pastoral Peoples: Myth or Reality?" *Development and Change* 8 (1977): 209–32, and "The Common Property Problem and Pastoralist Economic Behavior," *Journal of Development Studies* 23 (1986): 5–18; S. Sandford, *Management of Pastoral Development in the Third World* (New York: Wiley, 1983).

12. Similar conflicts may arise among the herdsmen because of the deterioration of animal quality that arises as a result of mixing breeds and sick animals.

13. Ronald Coase, "The Problem of Social Cost," *Journal of Law and Economics* 3 (1960): 1–44; Carlisle Ford Runge, "Common Property, Externalities: Isolation, Assurance and Resource Depletion in a Traditional Grazing Context," *American Journal of Agricultural Economics* 9 (1981): 595–606, and "Common Property and Collective Action in Economic Development," *World Development* 14 (1986): 623–35; and Robert C. Ellickson, "Of Coase and Cattle: Dispute Resolution among Neighbors in Shasta County," *Stanford Law Review* 38 (1986): 623–87.

14. The external character of these economies is demonstrated by the fact that the size of a herdsman's herd is largely determined by the size of his household (especially by the number of sons used to supervise the herd), by his historical endowment of animals, by his past experience in accumulation, and by the health of the animals. Given these, the primary effect of the increasing size of accessible grazing land in bad years is that, on average, more pasture land becomes available to other herdsmen. The scale economies considered here are not those with respect to herd size since these are already reflected in the herd size choice of the individual herdsman.

15. See, e.g., John S. Chipman, "External Economies of Scale and Competitive Equilibrium," *Quarterly Journal of Economics* 84 (1970): 347–85; Brian R. Binger and Elizabeth Hoffman, *Microeconomics with Calculus* (Glenview, Ill.: Scott Foresman, 1988).

16. Lineage rules have the effect of increasing homogeneity. But, since in good times the benefits of large numbers can outweigh those of homogeneity, fictive kin lines can be created, allowing otherwise ineligible individuals and households to qualify for membership. In hard times, by contrast, lineage groups may be defined more narrowly so as to dispossess those whose rights are more ambiguous. This is another source of flexibility in tribal systems.

17. These rules may also increase homogeneity of background, thereby raising the cost of entry and exit, encouraging "voice" instead of exit, and discouraging in- and out-migration, both of which might undermine the effectiveness of social norms among tribal members. As a result, the prospects for success in collective action may be enhanced.

18. As A. M. Khazanov put it: "The mobility of nomads and the permanent instability of pastoral economy give rise to a fluid social organization, which is capable of change and which has the requisite segmentary means with which to accomplish this. In the majority of nomadic societies the most appropriate principle for this turns out to be descent, in which the structuring role of the relations of kinship is conceptualized. Thanks to the application of the principle of descent, the complex and multi-level character of the social organization of nomads is often expressed in the aggregate of separate segments, discrete descent groups of different genealogical depth which, if the need arises, are capable of fission or fusion" (*Nomads and the Outside World* [Cambridge: Cambridge University Press, 1984]).

19. See John A. Marino, *Pastoral Economics in the Kingdom of Naples* (New York: Cambridge University Press, 1988); Jeffrey B. Nugent and Nicolas Sanchez, "The Efficiency of the Mesta: A Parable," *Explorations in Economic History* 26 (1989): 261–84.

20. This model was developed by James M. Buchanan, "An Economic Theory of Clubs," *Economica* 32 (February 1965): 1–14, and subsequently popularized by Todd Sandler and John T. Tschirhart, "The Economic Theory of Clubs: An Evaluative Survey," *Journal of Economic Literature* 18 (December 1980): 1481–1521.

21. Sandler and Tschirhart. Conceivably, however, with nonlinear $Cn_o \dots Cn_i$ curves, the K_{opt} curve itself could be nonlinear, suggesting the possibility of multiple equilibria.

22. Among the many rich sources of information on the Tuareg are Stephen Baier, *An Economic History of Central Niger* (Oxford: Clarendon, 1980); Barth, *Nomads of South Persia* (n. 8 above), "Nomadism in the Mountain and Plateau Areas of South West Asia" (n. 6 above); and "A General Perspective on Nomad-Sedentary Relations in the Middle East," in *The Desert and the Sown: Nomads in the Wider Society*, ed. Cynthia Nelson, Research Series no. 21, (Berkeley: Institute of International Studies, 1973), pp. 11–21; E. Bernus, "Les composantes géographiques et sociales des types d'élevage en Milieu Touareg" (Geographical and social determinants of types of animal husbandry in the Tuareg domain), in *Pastoral Production and Society*, Proceedings of the International Meeting on Nomadic Pastoralism, Paris, December 1–3, 1976 (Cambridge: Cambridge University Press, 1979), pp. 229–41; Douglas L. Johnson, "The Nature of Nomadism: A Comparative Study of Pastoral Migrations in Southwestern Asia and Northern Africa," Research Paper no. 118 (University of Chicago, Department of Geography, 1969); Jeremy Keenan, *The Tuareg* (New York: St. Martin's, 1978); Johannes Nicolaisen, *Ecology and Culture of the Pastoral Tuareg: With Particular Reference to the Tuareg of Ahaggar and Ayr*, Ethnograph Study no. 9 (Copenhagen: National Museum, 1963).

23. A similar, though somewhat earlier, case is that of the Tuareg-like Pastun nomads of Afghanistan. See esp. Johnson; and Daniel Ballard and Charles M. Kiefer, "Nomadisme et secheresse en Afghanistan: L'exemple des Nomades Pastun du Daste-e Navor," in *Pastoral Production and Society*, pp. 75–90.

24. Isaac Schapera, *Native Land Tenure in the Bechuanaland Protectorate* (Johannesburg: Lovedale, 1943), and *Government and Politics in Tribal Societies* (London: Watson, 1956).

25. In other respects, however, such as providing incentives for investment in land improvement, private property may be advantageous. But, as noted above, similar incentives can be provided without private property.

26. Any disputes arising over land use may also be settled by the tribal chief. The fairness and efficiency with which the chief's decisions are regarded by tribal members has a lot to do with the chief's long-run effectiveness.

27. See esp. R. K. Hitchcock and T. Nkwe, "Social and Environmental Impacts of Agrarian Reform in Rural Botswana," in *Land Policy and Agriculture in Eastern and Southern Africa*, ed. J. W. Arntzen, D. Nyongco, and D. Turner (Tokyo: United Nations University, 1986), pp. 93–99.

28. Useful ethnographic studies of the Rwala include Alois Musil, *The Manners and Customs of the Rwala Bedouin*, Geographical Society Oriental Explorations and Studies no. 6 (New York: American Geographical Society, 1928); Johnson; Dale F. Eickelman, "Pastoral Nomadism," in *The Middle East: An Anthropological Approach* (Englewood Cliffs, N.J.: Prentice Hall, 1989), pp. 73–94; William Lancaster, *The Rwala Bedouin Today* (Cambridge:

Cambridge University Press, 1981); Norman N. Lewis, *Nomads and Settlers in Syria and Jordan, 1800–1980* (Cambridge: Cambridge University Press, 1987).

29. It should be emphasized that, while raiding was a regular and important income-earning activity of the Rwala (and many other tribes), it was subject to definite rules. Violations of such rules could earn dishonor.

30. N. N. Lewis; Lancaster.

31. Dawn Chatty, "From Camel to Truck: A Study of Pastoral Adaptation," *Folk* 18 (1976): 113–28; Omar Draz, "Revival of the Hema System of Range Reserves as a Basis for the Syrian Range Development Program," in *Proceedings of the First International Rangeland Conference*, ed. Donald N. Hyder (Denver: Society for Rangeland Management, 1978), pp. 100–103.

32. Donald Powell Cole, *Nomads of the Nomads* (Chicago: Aldine, 1975), and "Bedouin and Social Change in Saudi Arabia," in *Change and Development in Nomadic and Pastoral Societies*, ed. John G. Galaty and Philips C. Salzman (Leiden: Brill, 1981), pp. 128–49.

33. A rather similar case seems to exist among several essentially chiefless tribes in Northern Somalia in and around the Ogaden Desert. See I. M. Lewis, *A Pastoral Democracy: A Study of Pastoralism and Politics among the Northern Somali of the Horn of Africa* (London and New York: Oxford University Press, 1961), and *A Modern History of Somalia: Nation and State in the Horn of Africa* (Boulder, Colo.: Westview, 1965); and Abdi Ismail Samatar, *The State and Rural Transformation in Northern Somalia, 1984–86* (Madison: University of Wisconsin Press, 1989).

34. See esp. Richard Tapper, *Pasture and Politics, Economics, Conflict and Ritual among Shahsevan Nomads of Northwestern Iran* (London and New York: Academic Press, 1979), and "Individuated Grazing Rights and Social Organization among the Shahsevan Nomads of Azerbaijan," in *Pastoral Production and Society* (n. 22 above), pp. 95–114.

35. A somewhat similar example in which some but not all pastures are privately owned occurred in the Tuva region near the border between Southern Siberia and Mongolia where, because of the winter cold, privately built shelters play an important role. See Sevyan Vainshtein, *Nomads of South Siberia: The Pastoral Economies of Tuva* (Cambridge: Cambridge University Press, 1980).

36. Thomas J. Barfield, *The Central Asian Arabs of Afghanistan: Pastoral Nomadism in Transition* (Austin: University of Texas Press, 1981); Lawrence Krader, "Principles and Structures in the Organization of the Asiatic Steppe-Pastoralists," *Southwestern Journal of Anthropology* 11, no. 2 (Summer 1955): 67–92.

37. Barfield.

38. Douglass North, "Institutions," *Journal of Economic Perspectives* 5, no. 1 (Winter 1991): 97–112; Nugent and Sanchez (n. 19 above).

39. Djavad Salehi-Isfahani, "Pastoralism, Dryfarming and Irrigated Agriculture Land Use in the Subsistence Economy of Iran" (Virginia Polytechnic Institute, Blacksburg, 1990, mimeographed); Ester Boserup, *Conditions for Agricultural Growth* (London: Allen & Unwin, 1965).

40. Keith McLachlon, "The Decline of Nomadism," in *Cambridge Encyclopedia of the Middle East and North Africa* (Cambridge: Cambridge University Press, 1988).

41. Capot-Rey (n. 1 above), p. 309.

42. Barth, "Nomadism in the Plateau Areas of South West Asia" (n. 6 above), p. 342.