the future of pastoral peoples
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/IDRC publication/, /rural population/, /nomads/, /nomadism/, /development strategy/, /East Africa/, /West Africa/, /Middle East/ — /anthropology/, /rural development/, /development planning/, /livestock/, /agricultural economics/, /human settlements/, /women/, /ecological balance/, /animal production/, /conference report/, /list of participants/.

UDC: 397.7


Microfiche edition available
the future of pastoral peoples

proceedings of a conference held in nairobi, kenya,
4–8 august 1980

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Sponsored by the Commission on Nomadic Peoples of the International Union of Anthropological and Ethnological Sciences, in collaboration with the Institute for Development Studies of the University of Nairobi, with the assistance of the International Development Research Centre (Ottawa), the International Social Science Council (Paris), the Wenner-Gren Foundation for Anthropological Research (New York), and McGill University (Montreal)
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the collection and interpretation of quantitative data on pastoral societies: reflections on case studies from Ethiopia

Ayele Gebre Mariam, Arid Zones and Monitoring Programme, International Livestock Centre for Africa, Addis Ababa, Ethiopia

Planning is laying a course of action to realize desired goals. Action uses resources, and the desired goal is called an objective. Hence, planning is a question of deciding among alternatives, using different combinations of resources, with reference to the realization of objectives. The planner should be in a position to assess alternatives before selecting one.

Planning involves forecasting based on information — a measure of the real situation. Most of the information essential for planning is in the form of quantitative data, which are based on observation. The simplest operation that can be performed on quantified data is to calculate averages. An average is a mean of the highest and the lowest observation and is expressed in numbers.

use of averages

What information can be gained by the calculation of averages from single measurements? One average that is useful to planners is the cost per unit item, which can be used in cost–benefit analyses, rate of return, etc. Such analyses are tools in choosing the most satisfactory way of realizing an objective. Also calculating averages simplifies handling of large amounts of data.

Nevertheless, quantification is only a guideline. What information is lost when single measurements are calculated into averages? To answer this question, one can compare herd growth in reality with herd growth in models. Units that are actually practicing herd management are studied, and an attempt is made to identify the factors affecting their management practices and their herd growth.

herd growth in reality

In pastoral societies of East Africa, the management unit is usually based on family relationships. It is both a production and a consumption unit. Its
composition depends on the development cycle of the family. The family develops by birth, marriage, and death of individual members. Family development is in turn affected by the relation between the family and its means of subsistence.

Family development, on the other hand, can be seen as children are born. These personnel, through socialization, are made to accept certain duties and later given more responsibilities.

These processes result in the shaping and moulding of economic groups of specific composition (Rudie 1969–70). Changes in family composition lead to changes in the means of subsistence and in the labour force. The system is viable as long as there is a balance between the number of animals required to satisfy consumption needs and the amount of labour to satisfy the labour requirements. Naturally, this balance is affected by the family development cycle. In examining this concept further, I will refer to Borana nomadic pastoralists, exploring: what the management unit is and how the herd is established.

Each male child is presented with a heifer at his naming ceremony, which takes place when he is about a year old. This gift is locally referred to as handura (navel) cattle and is the beginning of his herd. It is supplemented later with further gifts, animals obtained in raids, etc. A successful warrior can collect a large herd by raiding (Baxter 1966).

When a man marries, he pays the bride’s family three head of cattle, consisting of one cow and two bulls. These are given to the father, and it is assumed that he can dispose of them as he wishes. When a young man and woman marry, the herd should be large enough to support them. By the time the newly married couple have a child old enough to look after the herd, a family is said to be viable.

On the domestic side, the women build the huts and control activities that go on inside them, such as making food. Women make milk containers and leather costumes, and the men are responsible for building kraals and fences. They carve wooden utensils and tools; they also build dams and dig wells.

Unmarried adolescent girls and uninitiated boys help their mothers in the construction of huts. Preadolescent boys look after the milk cows, their calves, a bull, and horses. These animals graze around the homestead and are called lon warra.2 They supply food for the part of the family that remains permanently in the homestead. Men and adolescents, assisted by young boys, take the remaining animals to graze farther afield. These animals are called fora — reserve herd — and generally include dry cows, bulls, heifers, steers, and a few milk animals for the herders. When homestead cows become dry and milk cows become available in the fora, a shift takes place. The major shift takes place during the rainy season, when fora animals are brought to the grazing areas of the homestead herds.

Watering is the most labour-intensive work, and all members of the family lend a hand. The pattern is that for the warra animals, the wife of the head of the household or preadolescent boys are responsible, whereas the head of the household or adolescents take care of the fora. However,

---

1 The Borana live in southern Sidamo Administrative Region and occupy an arid region along the border of Kenya.

2 Animals belonging to a particular household are often split into a subsistence herd (lon warra) and one or several reserve herds (fora).
different kinds of herding arrangements are also practiced. Families of the
same encampment or kin groups sometimes keep their warra and fora cattle
together, depending on the size of a herd and the available labour force. If
camp groups have few warra and fora animals, the members usually herd in
turn. In the pastoral sector, the labour required for the care of one animal is
usually also sufficient for the care of enough animals to feed the family. Once
these minimum labour requirements are met, the productivity of the herd will
not increase with the addition of labour.

A family is said to be viable because the labour it can provide is enough
for the exploitation of its means of subsistence, the herd, which in turn is
adequate for the support of the members of the domestic unit. Viability in
pastoral production requires that herd offtake (slaughter, consumption, gifts,
mortality) be less than the reproduction rate (Haaland 1979). A pastoral unit
is less than viable if its food consumption is greater than the reproduction rate
of the herd.

However, the question of viability extends beyond this level: to find out
the viability of a pastoral unit, one must consider ecological, economic, and
political factors. “Behavioral solutions are selected with reference to how
satisfactory they are as strategies of value maximization given the preference
and skills of actors, and the limitations imposed by the conditions they
operate in” (Haaland 1976:4). The political and economic environments are
important in determining the viability of an individual actor.

Inheritance rights are another aspect of herd growth seen in reality and
are also related to the family development cycle. “The rule of primogeniture
is one of the few points at which an authoritarian principle intrudes into an
egalitarian social system. The rule is a major source of tension in Borana
family life and it affects the structural core of the patrilineal descent group: it
has the effect of scattering brothers and breaking up the joint families that
brothers are expected to set up after their marriage” (Legesse 1973:25).
Primogeniture among the Borana means that the eldest son inherits the herd.
Young brothers are dependent on the eldest brother for some share in the
stock, and he depends on them to herd animals he has inherited from his
father.

herd growth in models

To have a clear picture of herd growth in models, one should
understand how a herd is defined. Management responsibility and property
rights do not always coincide among pastoralists. Most anthropologists claim
that the stock friendship system, which is a system of insurance against
disaster, is typical of East African pastoralists.3 This redistribution system
creates a flow of animals from those with more cattle to those with few cattle

3 According to Baxter, who did fieldwork in Kenya, redistribution by the stock
friendship system is not important. Bride wealth is low, four head of large stock and
some oddments, and is seldom transferred from one herd to the other. Borana divide
their stock into lactating cows, dry cows, lactating camels, dry camels, and sheep and
goats. Most Borana keep animals of each type. Close agnates, particularly brothers,
live in dispersed villages. Each stock owner has an interest in his total herd, which is
geographically dispersed, and several stock owners living at a distance have interest
in the herd he manages. However, from the short period I have been in Borana
country, I retain the impression that the stock friendship system does prevail among
the Borana of Ethiopia.
or to stockless individuals in exchange for their labour. In terms of milk production, a herd is a management unit, but in terms of slaughter and disposal, it is property. The relation between property rights and management responsibility is not as complicated for small stock as it is for cattle or camels. Small stock reproduce rapidly, and redistribution systems are less important. However, it is difficult to find out how many cattle a household "owns." The reason is that herds as ownership units are difficult to distinguish from herds as units for household production; also, there are difficulties in counting cattle in the field (Dahl and Hjort 1976).

Formal herd-growth models are based on herd parameters such as the calving and mortality oftake, etc. The aim of the formal herd-growth model is to simulate a cattle or camel herd and sheep and goat flock, with typical age and sex distributions. Into this model various restrictions on growth and changes in the herds are introduced. According to Dahl and Hjort, the assumptions used are: "... the numbers of calves born during each of the last 14 years are equal to each other, ... the mortality rates within each age interval are constant from year to year, so that the age structure is only a result of the normal mortality structure and not an aggregated result of fluctuations in births and deaths in earlier years, [and] ... all those who die within one year die at the same time, i.e., at the end of the year" (Dahl and Hjort 1976:45).

Growth rates based on these assumptions are valid for large aggregates of stock and not for the individual stock owner. According to Dahl and Hjort, a herd doubles in 24 years. Some of the crucial information this model fails to take into account is that:

- The cyclical changes in the size and composition of the family are not included in the model.
- The actual calving rate in any year will vary dramatically from the average, i.e., between 100% and 20%. These variations have dramatic implications for herd growth. If the calving rate reaches 100%, different strategical considerations are implied for different individuals. For a large herd owner these considerations differ from those for a poor pastoralist, as grazing land is communal and livestock individually owned. The large herd owners are usually tribal chiefs, government officials, and traders. As these people have entrepreneurial ability, they convert their capital in herds into other forms of capital. In the case of the Jijiga rangelands, for example, large herd owners started building cisterns for selling water to stock owners and embarked on mechanized farming. Although cisterns were the main investment, opening shops and establishing large-scale farms were other forms.
- Price conditions in the international market affect prices at the local level and for each individual stock owner. Price fluctuations are likely to have different implications for the poor and rich pastoralists. For individuals with small herds, a higher price means that they need sell few animals to satisfy their needs. Sale of animals implies reduction of capital and less security, but pastoral herds are a risky form of capital, owing to natural hazards, diseases, predators, and thieves. The large herd owners, therefore, sell many animals when the price is high, because of alternative investment opportunities in the pastoral sector.
(for example, Jijigga). They also have a normal supply response for female animals (Haaland 1976).

- Nomadic pastoralists do not depend solely on animals for their income. Pastoralists sometimes grow crops on marginal land, although they realize a far lower yield than in the agricultural zones. The large herd owners also transfer their capital in herds into grain production on nonpastoral lands. Trading is another source of income for pastoralists. Pastoralists engage in trading activities such as opening tea shops and selling consumer goods. They sell livestock and buy grain for consumption. Some nomadic pastoralists, like the Afar in the northeast rangelands of Ethiopia, supplement their diet by collecting bush foods, i.e., nuts and fruits.

- In pastoral lands, drought is a common phenomenon. What happens to stock owners when they are hard hit by drought? A stock owner with few animals will be sloughed off pastoral activities and will have to seek an alternative source of income to be reinvested in animals. Although some members of a family work as labourers, others subsist on the remaining animals, consuming additional foods such as bush fruits. Some pastoralists undertake cultivation, using farming methods that are new to them, with donkeys, camels, and hand tools.

The common models of herd growth do not usually consider these factors. First, the raw data are collected during surveys that may not reflect the reality of herd growth. There is also a scarcity of information on age and sex distribution in pastoral herds. Because livestock surveys are associated with taxation, it is extremely difficult to elicit a cooperative response from pastoralists. The stock owners provide the surveyors with unreliable information. After a drought, if there is ample grazing, a herd can double in 4–5 years according to Dahl and Hjort (1976); however, a herd does not necessarily double in 24 years. The drought reduces the number of animals for household production. Calves and old animals die and, hence, create irregularities in the age structure of the herd. This has a long-term effect on the production of milk and calves.

When there is drought, the market price of animals goes down because there are too many animals at market. As the price of animals decreases, the price of grain soars, as it did among the Afar in 1972–75. The farming population living adjacent to the Afar, to the extent that they had grain supplies, were in the better trading position.

In a year without drought the number of animals utilizing the range increases, and sometimes the increase leads to overgrazing a deteriorating pasture and, hence, decreased productivity per animal — a combination that means less food for the pastoralists. It has been shown by Haaland (1976) that overgrazing is caused by:

- The uses of livestock in a number of social relationships;
- Lack of investment opportunities in or outside pastoral areas; and
- The individuals’ need to maximize their livestock holdings.

Whereas the large herd owner transfers capital from herds to other forms (Ayele Gebre Mariam 1977), the smaller herd owner continues to build the herd, irrespective of the damage to the environment. The reason is that the herd capital is perishable and must be replaced.

During both drought and nondrought periods, the relationships between individual pastoralists must be studied: how individuals act toward each other
and how the whole group acts toward other units sharing the same circumstances. Generally, the weaker lose their grazing rights and water points to the strong groups. Through raids, the weaker group also loses animals. To alleviate the losses from raids, central governments sometimes intervene, but the action does not necessarily provide peace and security in pastoral areas.

According to Dahl and Hjort, Bondestam gives a vivid example of the effects of the Ethiopian drought of 1972–75 by quoting a stock owner in Geshamo town, Ogaden: “Before I had 50 cows, 100 camels and 400 sheep and goats. Now I have only 18 cows and three-quarters of my camels, sheep and goats have died. Next week, I will have only 5 cows. Before I was fairly well off. In two or three weeks time I will own nothing but my house and clothes” (Dahl and Hjort 1976:115–116). The statement of this stock owner shows that the most significant factor in the pastoral production system is rainfall, which is not constant. Rainfall is by no means inevitable and is not evenly distributed in any year. Rainfall affects the whole ecological pyramid. As a result, mortality, calving, offtake, etc., when based on averages obtained from short-term surveys, fail to describe reality.

A management unit does not depend on only one kind of stock. Stock owners keep cattle, camels, sheep, and goats for complementary purposes. The reasons are that small stock, although more vulnerable to diseases than are large stock, are cash buffers because they have a high reproduction rate; they lactate during dry periods, unlike cattle; goats and camels can survive a drought better than cattle and sheep; and small stock allow more rapid herd growth. A management unit may also grow subsistence crops or trade livestock products for crops when exchange rates are favourable. Stock owners also depend on bush fruits.

Averages are limited in scope. They do not show the systems of relationships because they are derived only from units of population and individuals. Sampling is one of the means of arriving at averages, but it is not necessarily reliable. Leach (1967) quotes from The Disintegrating Village: “... under the present system of paddy cultivation by sharecroppers the landowners have no incentive to introduce any permanent improvements to the land because they do not get the full benefit of such improvement.” Leach writes that the author nowhere considers the many cases where sharecropper and owner are related. In fact, according to Leach’s findings all young men are sharecroppers, and most old people are owners; sharecroppers are the heirs of the owners. This example shows that the quantified indices presented as averages do not show the system of relation but rather present data in isolation, which is likely to lead to wrong interpretations.

- Numbers may not be wrong, but they draw the surveyor’s attention away from what is of crucial significance.
- In some cases, numbers will be presented as averages of averages; these do not reveal the facts.

**alternative operations**

Some operations are preferable to the calculation of single measurements into averages. Distribution and simulation are better bases for forecasting averages. The distribution mechanism takes care of the highest and lowest herd growth rates and not of the average of the two. A model
showing distribution might include household categories, cattle, sheep, goats, camels, and cropland. In simulation, "the aim is to play out the plan on a computer on a gaining [sic] situation in which some of the game players actively try to thwart the plan" (Churchman 1968:172–173). This kind of test is not an end in itself. Simulation makes use of computers and computer-programing languages. In simulation inputs, alternative methods are provided to produce alternative outputs. The growth rates of cattle, camels, and sheep and goats simulated by Dahl and Hjort are only averages valid for large aggregates of stock. However, the fortunes of an individual herd owner may deviate considerably from the average.

The technique of simulation helps one to see the interrelationships between people, animals, plants, and other factors that affect these, such as the family development cycle, rainfall variability and distribution, alternative sources of income, and markets.

implications of herd projection models

A good example of the implications of the herd-projection models is a livestock development program at Yavello in Borana country. The project area lies in the Arero Awraja of Sidamo province. This range unit has more than a million hectares but is only grazed in the wet season. The main objective of the program is to develop the livestock sector so that it earns foreign exchange and increases the size of the tax base.

Grazing permits are issued annually and are renewed for stock owners who abide by the management regulations. No one is allowed to graze stock in the area without a grazing permit. Grazing permits are issued to those stock owners who traditionally have exploited the area. Stock owners have to pay an annual fee for the permit, and the fee covers government costs for water facilities and other services. The annual fees will increase as grazing in the project area becomes profitable.

A range management unit was established. This unit divided the area into 16 ranges. Each range was further subdivided into four grazing areas that are grazed for an average of 3 months each year. Each range has three patrols who guard the areas not being grazed against trespassers and fire. Each range also has sources of water adequate for a year.

A stockpond was constructed. As the stockponds were completed, many more livestock were to be grazed in the area, so that there would be room for an increase in the number of people. The other components are animal health measures and marketing. According to the plan, export markets for beef must be given the highest priority.

The models used in preparing this livestock project are noteworthy. Before the project — the Range and Livestock Development Project — the annual offtake was 2–3%. This low offtake was attributed to low production and not to cultural factors, such as the extent to which the Borana are disinclined to sell animals. Animals reach maturity slowly: females calve at 5 years; males require 5–8 years to reach marketable size. The calving rate was thought to be 60%. Of the calves born, 55% died of disease or starvation within 1 year. Thereafter, marketing rates were about 10%.

To understand this traditional production system, the planners formulated a "composite" herd. They used 100 cows as a base in theory and postulated that the herd produced 60 calves a year. Other assumptions were
Table 1. Composite herd by age and sex based on mature cows before the project.

<table>
<thead>
<tr>
<th>Age (y)</th>
<th>Females</th>
<th>Age (y)</th>
<th>Males</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-15</td>
<td>100</td>
<td>5-15</td>
<td>4 (bulls)</td>
</tr>
<tr>
<td>4-5</td>
<td>8</td>
<td>7-8</td>
<td>7</td>
</tr>
<tr>
<td>3-4</td>
<td>10</td>
<td>6-7</td>
<td>7</td>
</tr>
<tr>
<td>2-3</td>
<td>12</td>
<td>5-6</td>
<td>7</td>
</tr>
<tr>
<td>1-2</td>
<td>17</td>
<td>4-5</td>
<td>8</td>
</tr>
<tr>
<td>&lt;1</td>
<td>(30)</td>
<td>3-4</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2-3</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1-2</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;1</td>
<td>(30)</td>
</tr>
</tbody>
</table>


that 55% (33) calves die before reaching 1 year of age; 20% die before reaching 2 years; an average mortality of 10% occurs annually before 5 years of age; at least half the deaths are of females, which would normally have been kept for replacement; one male is kept as a herd bull, leaving seven males aged 5 years (Table 1).

The total herd, excluding calves, is 215, and male animals for market or consumption account for offtake at 3.25%. These assumptions were arrived at before the implementation of the project and served as the basis for project preparation. In other words, this kind of model was used to depict herd growth. There are some facts that these herd projection models fail to show.

First of all, the model does not explain what a herd is. Planners took 100–125 animals known to graze in the wet season, excluding calves. However, the question of who owns the herd is important because different pastoralists each have their own strategic considerations as regards the sale or slaughter of their animals. When planners state that the calving rate is 60%, what does it imply? Here again the different strategic considerations of poor and rich pastoralists have to be taken into account. In droughts, for instance, the figure of 60% would be meaningless.

The planners of this project believed that the average nomadic cattle owner has about 40 animals, including males and females, 1.5 of which annually reach the age of 5 years for sale. Income does not exceed $112.50 when the price of a marketable animal is $75.00 (National Range Development Project 1969). However, the income of a stock owner not only consists of the cash from the sale of animals but also includes all the animal products (milk, cottage cheese, hides, etc.). When one looks at the family development cycle, the variations are enormous, just as they are for the average herd.

What is expected of the project? The planners have forecast that animals will mature at age 4; that is, females will calve at the 4th year; the age at which animals are sold will be reduced from 8 years to 5. They also expect calf mortality to be reduced from 55% to 10%; adult mortality will be reduced to 3% annually.

The impact of the project objectives on the composite herd after the implementation of the project can now be studied (Table 2 and 3) (National Range Development Project 1969).

The figures show that the offtake is 20% instead of 3.25%. The first preproject model was based on assumptions, and the second model (after
the project) is still based on them. One question is for whom is the offtake
20% — a large herd owner or a small herd owner. Marketing conditions are
dictated by factors outside the pastoral sector, including the processing plant
at Melgue Wondo and the international market price. The number of animals
marketed depends on the price of grain, which the pastoralists consume to
supplement their diet. Grain is available from the Sidamo highlands.

According to the plan, to achieve the 20% offtake, pastoralists have to
be forced, if necessary, to sell bulls at 4 years of age. Consequently, herd
growth is controlled but not population growth, with the result that there
would probably be less food for consumption.

After the implementation of the project, it was anticipated that by the 6th
year the number of cattle in the Yavello unit would double, and the age and
sex distribution would be very close to the ratios of the composite herd. In
reality this did not happen, as there was drought in the 4th year of the
project. Although the initial assumptions may have been as accurate as
possible, the conclusion was wrong owing to circumstances that could not be
taken into account in advance.

**effects of the project in reality**

No evaluation was carried out for the project, and, consequently, these
impressions are purely subjective. The project was never fully implemented.
The stockponds were constructed, but there was no water-control
mechanism. Animals came into the ponds to drink instead of being provided
with water in a trough. The traditional practice of watering animals was not
implemented. As a result, the ponds looked muddy and dirty. Among the
Borana, wells are owned by individuals and are said to belong to the head of
the clan. According to the custom, members of the clan to whom the wells

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**Table 2. Composite herd by age and sex based on 100 mature cows after the
project.**

<table>
<thead>
<tr>
<th>Age (y)</th>
<th>Females</th>
<th>Age (y)</th>
<th>Males</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>6</td>
<td>&gt;4</td>
<td>5 (bulls)</td>
</tr>
<tr>
<td>7</td>
<td>20</td>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td>6</td>
<td>20</td>
<td>2</td>
<td>26</td>
</tr>
<tr>
<td>5</td>
<td>21</td>
<td>1</td>
<td>27</td>
</tr>
<tr>
<td>4</td>
<td>21</td>
<td>&lt;1 (calves)</td>
<td>(30)</td>
</tr>
<tr>
<td>3</td>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1 (calves)</td>
<td>(30)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Table 3. Annual sales from the same composite herd, after the project.**

<table>
<thead>
<tr>
<th>Females</th>
<th>Sold</th>
<th>Males</th>
<th>Sold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cull heifers (2 years)</td>
<td>3</td>
<td>Steers</td>
<td>25</td>
</tr>
<tr>
<td>Old cows</td>
<td>20</td>
<td>Old bull</td>
<td>1</td>
</tr>
</tbody>
</table>

belong have access to them. However, it appears that some clan members are excluded, whereas members from outside are occasionally included. The basis for this is that well management is controlled by a council. To have access to the well, one must have political support and must participate in the tasks of the well. Because watering livestock is a labour-intensive activity, each stock owner has to have enough labour to manage the animals. Herd growth is balanced with the increase in labour input (Helland 1979). The stockponds freed labour to take on other activities in herd management so the size of the herds could be increased. Even in cases where troughs were built, watering did not require a large labour force. As a result, probably both the human population and the livestock population increased and the range was depleted.

The construction of stockponds attracted stock owners from distant places during the dry period. Hence, the Yavello project area was overgrazed — a fact that probably meant less productivity per animal and less food for the stock owner. Most of the stock owners stopped moving their animals to the dry-season grazing areas and utilized the Yavello pasture all year round. The Gujji from the northern part of the project area were attracted, and the number of animals was more than had been anticipated.

The idea of grazing permits was not accepted by the pastoralists, and the marketing system was not implemented. The overall result of the Regional Livestock Development Project was overgrazing created by an increase in the bovine and human populations. After the implementation of the project, livestock numbers failed to remain constant through the sale of stock. The small herd owners sold few animals to fulfill their basic subsistence needs, even when the price increased. Among the Borana, I observed that even large stock owners sell few animals as the price rises. Their interest is to build up stock numbers. In the end, there were more animals than the range was able to support. Households require a certain number of animals to be viable, and viability is seen in terms of the amount of labour in the household in relation to its means of subsistence. It appeared from the project that there was an excess of household members in relation to the number of stock available for subsistence. Although the number of households was growing, the project does not seem to have formulated any plan to skim surplus households and relocate them in other sectors of the economy.

Up to now Africa livestock projects have not been successful, as the Borana case clearly shows. The alternative is to embark on a range management program in which wet- and dry-season pastures are demarcated, and, perhaps, range associations set up, based on the traditional users of an area. A range association would have its own water supplies and would control the seasonal movement of people and livestock. The dry-season grazing could be closed during the wet season. These measures may be expected to increase the range resources. All the inputs of a livestock development project, such as veterinary services, access roads, marketing, water development, supplies and services programs, etc. should be introduced. However, as a result of these new inputs, the livestock population will grow — a fact that will result in overgrazing, lower productivity per animal, longer calving periods, and so on.

A balance between herd and population growth could be maintained if a kind of progressive taxation were imposed on the pastoralists, forcing them to sell animals. Pastoralists should be charged a fee for veterinary services,
water supplies, and other services rendered, according to the number of animals they own. The increase in the human population should be planned for and relocated in other sectors of the economy. In this case, consideration of the economy of the country is indispensable. Both measures require a political move at government level (personal discussions with Haaland). Even this kind of planning does not take care of the drought phenomenon, which is extremely difficult to control.

In sum, quantitative data fail to take into account the social, economic, and environmental factors affecting a production system, and so modeling based solely on quantitative data is inadequate.

discussion

Sandford: In pastoral areas, large fluctuations, in rainfall for instance, make firm planning forecasts impossible. However, the inutility of quantitative data for making forecasts does not imply that quantitative data are useless. Partial analysis, in which changes in one element are analyzed on the assumption of ceteris paribus in other elements, is a useful tool.

van Drunen: Project staff should not be lured by sophisticated large-scale data collection but rather choose small-scale qualitative surveys. The first type are so expensive that finances will not be available for the second type.