Agricultural
Administration
Unit

Overseas Development Institute
Regent's College Inner Circle
Regent's Park London NW1 4NS
Telephone: 01-935 1644

PASTORAL DEVELOPMENT NETWORK

Paper 24b
August 1987

Fodder Bank Testing among Fulani Agropastoralists in Central Nigeria:

Feeding Decisions in the Use of Improved Forages

by

Ellen Taylor-Powell

Program and Staff Development
106 Special Services Building
Texas A & M University
College Station, TX 77843

This paper is based on research conducted from 1982-1984 when the author worked as a socioeconomist with the Subhumid Zone Programme of the International Livestock Centre for Africa.

Introduction

The value of producer participation in technology development is increasingly evident. The appropriateness of technologies as perceived by local producers determines their motivation to accept change (Hildebrand, 1980-81). Their own evaluation criteria are the critical determinants of technology success (Rhoades and Booth, 1982; Lightfoot, 1984; Tripp, 1985). This paper presents findings gathered during a formative evaluation of producer reactions to on-farm trials conducted by the Subhumid Zone Program (SHZP) of the International Livestock Center for Africa (ILCA). Documentation of Fulani behavior as they invested their own resources in the forage improvement provided valuable information for modifying research recommendations to be congruent with producer objectives and circumstances.

The SHZP began operations in 1978 in the central region of the Subhumid Zone (SHZ) of Nigeria: a zone delimited by the isolines of 180-270 crop growing days. The program incorporated the central characteristics of Farming Systems Research (FSR): a wholistic orientation involving both technical and human elements; a multidisciplinary team of scientists conducting on-farm research; the participation of local producers throughout the process of technology generation. Settled Fulani cattle keepers were the program's target group given the trend among the Fulani to establish permanent residences within the SHZ. Poor cattle nutrition, particularly in the dry season, was the principal factor limiting livestock productivity.

To increase livestock production and thereby improve human welfare, forage improvements were needed. Forage was available in the SHZ but was low in quality. For five months of the year cattle obtained insufficient protein to meet maintenance requirements and cattle liveweight fell by 15% during the dry season (ILCA, 1982). The SHZP set about to develop appropriate forage production techniques based upon the Fulani situation: insecure land rights, limited labor and capital available for forage production, no mechnical expertise including experience with draught power (Mohamed-Saleem and Kaufmann, 1983).

The Fodder Bank Technology

Of the forage improvements tested with the Fulani by the SHZP, the fodder bank technology offers the most promise for improving cattle nutrition across the SHZ. The fodder bank is a fenced area predominated by a forage legume (Stylosanthes species) which the producer can establish and maintain as a supplement to natural grazing. The standard size of 4 ha is adapted depending upon land availability, producer's resources, and intended use. Cattle conduct the major establishment tasks: they prepare the seedbed through intensive grazing before seeding or trampling during nighttime confinement *; and they control the competing grass growth during the early wet season through their selective grazing behavior.

* Traditionally cattle are confined at night close to the homestead, tied in pairs at the ankle or enclosed in a brush or lightly strung wire corral. This protects the herd from predators and thieves. In this manner, cattle fertilize cropland with differing systems of confinement for the wet and dry season manuring. For discussion, see Powell and Taylor-Powell (1984); Powell and Waters-Bayer (1985).

Credit to finance the costs (Table 1) of fodder bank implementation is available through the National Livestock Projects Department (NLPD). This agency also provides extension advice and assistance for fence erection and management tasks. Activities in the establishment and management of fodder banks include (1) fencing the area; (2) preparing the seedbed including necessary land clearing; (3) firebreak establishment; (4) scarifying and broadcasting seeds mixed with superphosphate fertilizer; (5) controlling early season grass growth through managed grazing; (6) deferring grazing until the dry season (7) selective use of the fodder bank during the dry season. The fodder bank needs to be productive for 5 years to be financially viable so the legume must be managed to regenerate. As of 1986 there were 86 fodder banks established in the SHZ of Nigeria with outreach beginning in neighboring countries. For detail on the establishment and productivity of fodder banks see Mohamed-Saleem (1986).

Table 1. Establishment and maintenance costs of a 4 ha fodder bank in 1984

Establishment Costs

Item	Cost (US$)
Metal fencing, including labor	2220.40
Seed (40 kg)	624.00
Fertilizer (600 kg)	163.80
TOTAL	$ 3008.20

Maintenance Costs

Fencing	@ 10% replacement	222.30
Seed	@ 10% reseeding	62.40
Fertilizer	400 kg	109.20
Labor	9 days	58.50
TOTAL		$ 452.40

Source: NLPD Records, 1985

The Fodder Bank Testers

Until 1984, the SHZP research work was concentrated in two case study areas near Kaduna (Fig.1). Yearly rainfall is about 1200 mm falling between May and October. With a 180 day growing season, principal crops in the region include sorghum, maize, millet, yams, and groundnuts. Kurmin Biri is within a government grazing reserve. Fulani have resettled within the reserve boundaries from neighboring areas to secure land rights where they can settle permanently without being disturbed by farmers. Though established in 1970, the reserve has not been formally gazetted. The indigenous farmers cause some concern so Fulani expectations of legal land rights have been largely unrealized. As of 1984, only 32 Fulani households were settled year-round inside the 31,000 ha reserve. Cultivation density is estimated below 5%.

Abet, in contrast, is an area where Fulani have settled spontaneously amid crop farmers, the more common settlement pattern in the Zone. In Abet, Fulani negotiate with local farmers or authorities for land on which to settle and cultivate. Population density is much higher at about 70 people/square km and about 25% of the land is cultivated. Constituting about 10% of the population, some Fulani families have lived in Abet year-round for four generations (Waters-Bayer and Bayer, 1984). In 1982, Kachia, contiguous to Kurmin Biri, became a location of fodder bank establishment. This is an area where Fulani have purchased occupancy rights through the District Head. Such transactions give Fulani the right to trade and inherit land, making land improvement investments more attractive. Information on the

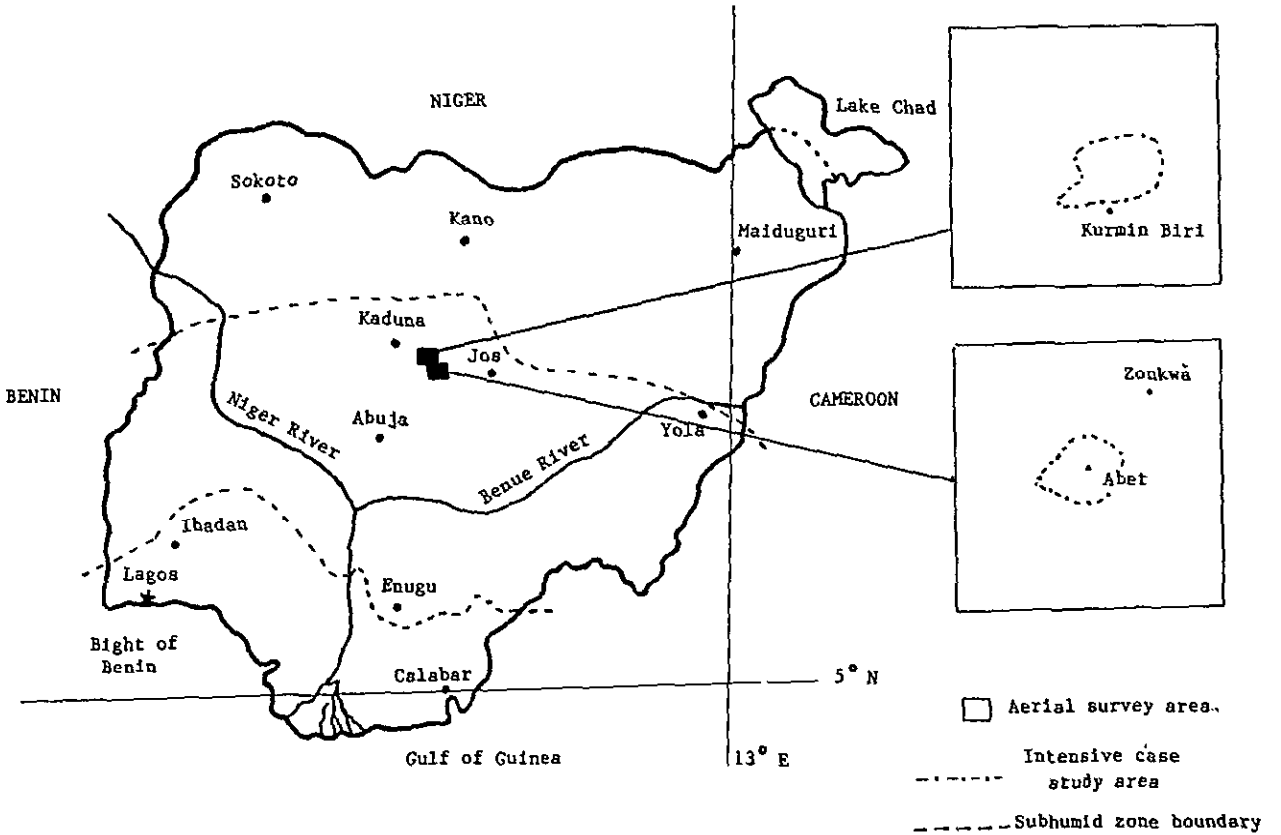

Figure 1. Map of Case Study Areas in the Subhumid Zone of Nigeria

socioeconomic background of the Fulani fodder bank testers in the three sites during 1984 is seen in Table 2. The average herd size is 60 head of cattle. This compares to average herd sizes of 55 in the dry season and 68 head in the wet season according to aerial surveys of the Zone as a whole (Bourn and Milligan, 1983); and an average herd size of 48 in Kurmin Biri and 35 in Abet from the SHZP survey of 29 herds (Mani et al., 1986).

Table 2. Socioeconomic characteristics of the fodder bank testers (n = 18 Fulani)

Characteristic	Average	Range	Responses
Herd size (a)			
No. cattle/hshld	60	30-124	
No. sheep/hshld	9	0-31	
Farm size (ha/hshld) (b)	1.1	.23-2.19	
Household size (a)	14	8-22	
Active males/hshld (a,c)	5	2-8	
Age of hshld head	48	28-75	
Off-farm income			
Yes			9
No			9
Literacy (hshld head)			
Arabic			4
Hausa + Arabic			4
Hausa + English			1
Hausa + Arabic + English			1
None			8

(a) n= 17; excludes 1 household with 700 head of cattle and 30 in the household because atypical of sample
(b) n=10 farms measured; all these Fulani farm except 1; 2 others practice farming very minimally
(c) active males above six years old indicate potential labor for herding, farming and cattle management; actually they may be involved in schooling or off-farm employment

All the fodder bank testers were Kachichere Fulani, having migrated westward from the Kachichere settlement area on the edge of the Jos

Plateau (Waters-Bayer, 1983). They are considered settled Fulani though they may move their homesteads within a limited distance periodically. Cattle are normally herded within a few kilometers of the homestead though herds or parts of herds may be transferred at various times of the year to distribute stocking pressure and to exploit seasonal grazing resources. Herd management and intrahousehold decision making of these settled Fulani have been described by Waters-Bayer (1985).

While cattle husbandry is the principal occupation, most of these Fulani also do some cropping. The principal reason for cropping is to reduce expenditures for grain so that animals do not have to be sold to buy staple grains (sorghum, millet, and maize). Land availability and labor shortages are the limiting factors to the size of the cultivated area. The Fulani cropping system is less diversified with less intercropping than that of the neighboring crop farmers (Powell and Taylor-Powell, 1984). Forage production at the expense of food production is an unattractive alternative.

Feeding Decisions in the Use of Improved Forages

Research estimates indicated that a 4 ha fodder bank with an average legume yield of 5,000 kg/ha would be sufficient to supplement 15-20 productive cows (in-calf and lactating females) in the average sized herd during the 6 month dry season (Milligan and Kaufmann, 1979). Grazing for 2-3 hours per day would provide supplementary protein during the critical period of the dry season to the class of stock which would respond most profitably, that is, lactating and pregnant cows. The expected response was increased milk production (offtake and calf

consumption), improved calf survival and growth rate, which were congruent with Fulani production objectives. Fulani participated in selecting which animals should graze the fodder bank and were given the option of either morning or evening grazing periods.

Observations of Fulani management in their use of the fodder banks revealed that they were not following the recommendations, particularly in terms of restricting grazing to the selected animals. In order to understand these deviations, the 11 fodder banks for which a grazing recommendation had been made in 1984 were closely monitored to identify which animals were actually using the fodder banks. Follow-up, informal interviewing, surveys, information from other data pools, and observations were combined to understand Fulani reasons for their decisions in the use of the forage.

All of the 11 Fulani included more animals than had been selected. For seven Fulani (64%), whole herds were given access to the fodder banks: either the total management unit ranging from 30-120 animals (3 cases) or that part of the herd which remained at the homestead when the other animals were transferred elsewhere (4 cases with a range of 16-61 animals). If sheep were normally herded with the cattle in the dry season, then the sheep were also found in the fodder banks. Typically, Fulani in the area keep sheep in the ratio of 1 sheep to 4 head of cattle (Bayer, 1982).

Only four of the 11 Fulani restricted the number of animals grazing the fodder bank. But even they included more than the recommended number. And as the dry season progressed, they included still others, particularly weak animals. By within 2-6 weeks after fodder bank grazing

had commenced, they had included their whole herds. Their choice of animals and reasons were as follows: lactating cows in poor condition with declining milk supplies because the welfare of the calf was in danger (4 responses); dry cows and heifers to induce cycling (2 responses); pregnant cows to produce strong calves (1 response).

In evaluating a related dry season feed supplementation package, the Small Holder Dairy Scheme, it also was found that the Fulani (n=14) did not ration cotton seed cake to the selected lactating and heavily pregnant cows (Taylor-Powell and Suleiman, 1986). Rather they gave priority to lactating cows in poor condition who had insufficient milk for their calves. They increased animal numbers as the dry season progressed with any animal thought to be weak. This often meant that whole herds were given access to the feed supplement or that part of the herd which remained at the homestead when animals were transferred elsewhere in the dry season.

Responses from 24 Fulani indicate the animals considered to be most in need of supplementation in the dry season (Table 3). Several Fulani mentioned calves of age 5 months to one year as under particular stress in the dry season. Actual Fulani behavior showed that if a given feed resource is limited in availability and/or costly, such as cotton seed cake, then priority might be given to lactating cows in poor condition to ensure calf survival. But as the dry season progressed, other animals would be given access to the feedstuff. As animal condition changed over the course of the dry season with the decline in forage resources, so did Fulani choices in the use of feed supplements.

Table 3. Cattle most in need of supplementation in the dry season (n= 24 Fulani respondants)

Category	No. of responses	Reason
Old lactating cows	15	animals weak with insufficient milk for calves; calves weak
Any lactating cow in poor condition	5	insufficient milk for calf so calf under stress
Any weak and/or sick animal	3	might not withstand the dry season
All animals	1	all animals decline in the dry season

The Fulani in this area have the custom of using various feed supplements in the dry season including kanwa (local mineral supplement traditionally fed to cattle), salt, wheat bran, chaff (usually of sorghum), and selected low-lying fadama grasses which are cut and carried to the homestead. Bran and chaff may be obtained from wives, from farmers in payment for manuring their cropland, or bran may be purchased (1983 price of US$0.15/kg). Some Fulani have been observed feeding sorghum grain but only in cases where grain was plentiful and only for survival feeding. Except for kanwa, salt, and cut branches, the other locally available feedstuffs are generally fed to animals too weak to follow the herd during normal grazing. Feeding trials using agro-industrial supplements were initiated by the SHZP in 1979. Since then, a farm service center at Kurmin Biri operates dry season feeding schemes which allow interested cattle keepers to purchase feed supplements on credit. Supplies of groundnut cake and cotton seed cake can be found in

town markets. Table 4 shows the types of feed supplement used by local Fulani not registered in a government scheme.

Table 4. Use of locally available feed supplements (n= 38 Fulani)

Feedstuff	No. of Fulani using feedstuff	% of Total
kanwa	38	100
cut branches	23	61
salt block	11	29
cut grasses	9	24
chaff	7	18
bran	5	13
salt (granular)	2	5

Fulani related low cattle productivity in the dry season to both the poor quality and quantity of the grazing resources. Production levels (referred to in terms of milk supply, cow fertility, general animal condition and weight) were said to be high in the early wet season during June-July and also during the early crop residue grazing in December and January. Production declined from September to December when the grasses had matured and again from February until the rains arrived. Productivity reached its lowest point in the late dry season, March-April. This depiction of a bimodal pattern with peaks in the wet season and the early dry season agreed with the SHZP survey data collected from traditionally managed Bunaji herds (Otchere, 1986).

Interviews with a random sample of 38 Fulani, indicated on average that half the herds in Kurmin Biri and two-thirds of those in Abet lost cattle in the dry season (Table 5). This situation had not been indicated during the preresearch state of knowledge reviews. The loss

per herd is more than one animal higher in the grazing reserve than in the farming area. Fulani distinguished between diseased animals and animal losses that resulted from the dry season conditions due to weakness.

Table 5. Cattle losses in the dry season in Kurmin Biri and Abet during 1982/83 and 1983/84

	1982/83		1983/84	
	Kurmin Biri (n=13)*	Abet (n=25)	Kurmin Biri (n=13)	Abet (n=25)
No. of herds which lost cattle	6	18	8	16
% of herds which lost cattle	46	72	62	64
Total no. of cattle lost	24	63	40	45
Average/herd which lost cattle	4	3.5	5	2.8

* n = herd managers surveyed

As the quantity and quality of the range resources declined over the dry season, and all animals were seen to be losing condition, even a limited feed resource - the fodder bank - was made available to all animals. To the Fulani, this meant a greater chance of being able to sell an animal when desired, i.e., when in good condition, when sale price was high, when cash was needed, rather than when demanded by external events such as an emergency sale in the late dry season at which time the animal was emaciated and market prices were low. Whether to ensure the viability of the herd or to obtain a maximum sale price, the return in not having to cull an emaciated animal in March-April was

visible and immediate. The difference between the sale of an animal in normal condition and one in distressed condition was on average about US $384.00 (SHZP survey data). From the Fulani perspective, the profitability of the fodder bank was in maintaining animal condition and herd numbers.

Fulani behavior in the use of the forage is consistent with the multiple objective nature of this Fulani cattle keeping system. Female animals are the most valued asset because of the calves and milk that they produce. But all animals are considered productive and have a purpose, whether it is the milk for the calf, for the family, for the wives to sell; whether the animals represent capital that can be used to purchase grain, consumer goods, pay childrens' schooling fees; and/or whether the animals represent the means to meet social and cultural obligations. In the absence of other investment opportunities, animals that can be accumulated beyond the perceived needs of the household served as an investment, an insurance against times of adversity. Cattle also bring prestige and the means to help others. This in turn builds personal constituencies. Cattle keeping is both an economic activity and a way of life (van Raay, 1975; Riesman, 1980).

Also, ownership patterns affected decision-making in the use of the forage and tended to ensure egalitarian treatment of cattle. The household head was the central manager and was responsible for the day-to-day welfare of the herd. Individual cattle, however, might be owned by a wife (wives), children, relatives or entrusted by non-kin owners. Major management decisions were not made in isolation nor by one individual. Weak or sick animals received special treatment regardless

of ownership. For the rest of the herd, multiple ownership implied multiple decision makers. This added complexity to the management of the forage as well as the tendency to treat all animals as equally as possible. In the words of one Fulani, "As the ruga head, all the cattle are under my authority. I have to treat them all fairly whether they belong to a wife, child or someone else. For example, maybe I have 5 children and only 1 mango - I would not give that 1 mango to just one child but would cut it and divide it among all the children. I must manage with what I have to see that all receive their share."

Besides the production objectives and ownership characteristics, numerous interacting factors influenced Fulani decisions concerning the use of the improved forage. These are briefly discussed below.

(1) Dry season conditions. Fulani decision-making in the use of the fodder banks was affected by such changing and interacting factors as wind and sun intensities; length and severity of the dry season; cattle densities and their effect on water and grazing resources; availability of alternative dry season feed resources (eg., crop residues, fadama grazing); timeliness, abundance and distribution of the early rains.

Although the center areas of Abet and Kurmin Biri were only 40 km apart, significant locational differences existed between the two areas that affected dry season grazing possibilities. This resulted in different management of the introduced forage technology. Kurmin Biri was said to have a more severe dry season: the dry season was longer; there were less crop residues to graze given the low farming population; lowlying areas were fewer so the better quality and prolonged

availability of fadama grazing resources were limited; riverine sites were inaccessible for grazing due to dry season farming enterprises by the indigenous crop farmers; the natural grasses were considered to be of a different type and of lower quality than in more densely cultivated areas; the vast expanse of bush meant a greater threat of fire depleting the bulk of the dry season grasses. Two of the Kurmin Biri testers initiated night grazing in their fodder banks in mid-March - a development of some import because these Fulani do not habitually leave their animals untethered and untended at night. Likewise, the Fulani in Kurmin Biri continued to use their overgrazed fodder banks through April allowing cattle to lick up the little remaining debris. Early rains in Abet, in contrast, brought new green grass growth. Fulani discontinued using their fodder banks and sent their herds to graze the wider area.

2. Herd transfers. Herd splitting and transfers of cattle during the dry season determined the type and number of cattle using the fodder bank. For Fulani who split their herds in the dry season (dependent upon labor sharing agreements or the availability of household labor to move and manage herds in separate locations), those animals remaining at the homestead could be given preferential treatment. Usually a small lactating herd was left at the homestead along with castrates and young bulls. The majority of the cows were sent elsewhere to exploit better quality grazing.

Four types of animal transfers were recorded:

- dry season transfers when the herd was usually split and part moved to another area for the entire dry season to distribute grazing pressure and/or to take advantage of better quality feed resources;

- crop residue transfers when herds were moved away from the homestead to nearby farming areas to exploit crop residue resources, generally lasting for the first 2-3 weeks of the crop residue grazing period;

- transfers for manuring contracts when herds were relocated to spend their nights on farmers' fields in order to leave manure there for which the Fulani was paid; these transfers occurred at various times and were of various duration throughout the dry season;

- early rain transfers when herds were moved to adjacent districts to graze the new grass growth; "follow the rain" transfers began in March and were of varying duration dependent upon stocking pressure and rainfall pattern.

3. Labor availability. Grazing management and selective feeding decisions were influenced by the availability and competence of the labor supply. Separating animals and managing two groups of cattle, one in the fodder bank and the other grazing elsewhere, required additional labor inputs. Young children often did the herding in the dry season but they might be unwilling or unable to separate and control two groups of animals. If a more skilled herder was absent (not unlikely given off-farm employment, travel, time spent at markets, etc.), then selective feeding did not occur.

All of the Fulani used the morning hours for grazing the fodder banks. Not only was it was easier to separate the animals at the time of milking, done exclusively in the morning, but morning grazing fitted into the traditional grazing practices in the dry season. During this time of year, the limited feed resources meant that grazing began early

in the morning, generally by 7 am versus 10-11 am in the wet season. The long grazing day was divided between two herders. Grazing of the fodder bank coincided with the early morning period of grazing which was usually done around the homestead to take advantage of crop residues and available forages at least until these resources were depleted. The tendency during the early dry season was for all animals to move into the fodder bank, especially if the fence was insecure. In some cases, the fodder bank was used as a holding pen for the whole herd until the daytime herder was ready.

4. Forage Quantity and Quality. Based on an extensive indigenous technical knowledge regarding legumes and grasses and their differing effect on animal condition, the Fulani evaluated the quality and quantity of forage inside and outside the fodder bank and made feeding decisions accordingly. Most of the Fulani did not use their fodder banks daily. As the season progressed and the grazing possibilities changed, so did their use of the fodder bank.

The benefit the fence provided was evident in Fulani discussions. The fence did not secure land as some critics ventured was the Fulani intent in having a fodder bank. Rather the fence protected the area for the use of one herd. Because the fence protected the area from communal grazing, the fodder bank could be reserved until later in the dry season when little other forage was available, the sun was the hottest, and animals were under the greatest stress. Thus, the general consensus was that because the fodder bank was not large and could not feed their herds throughout the entire dry season, it was best to save this resource until February - March. Once the crop residues and natural

range had declined in quantity and quality, then the fodder banks could be used to provide a relatively steady feed resource especially during the latter part of the dry season.

The fodder bank technology was conceived by the SHZP as a ration to supplement natural grazing. In effect, the Fulani adaptations to the research recommendations resulted in an alternative form of rationing. Although the Fulani did not restrict the use of the improved forage to the productive females as envisioned, they did restrict the frequency of use. They fitted the fodder bank into their traditional dry season grazing management strategies which utilize a variety of forage and browse species (Bayer, 1986). It provided cattle with an additional grazing resource and diet supplement during a most critical period. By using the fodder bank to save nutritionally stressed animals, it is estimated that fodder bank owners can save at least two forced sales worth US$767.00 annually so that the total costs of fodder bank development can be redeemed in 4 years (Kaufmann, unpublished data). The Fulani adaptations to the fodder bank technology have indicated new lines of research in terms of alternative feeding strategies of improved forages and the most economical periods of use.

Conclusions

Feeding decisions in the use of improved forages by Fulani agropastoralists were complex, multifaceted, and fluid. These complexities included such factors as production objectives, cattle ownership patterns, locational and climatic variables, dry season herding practices, labor availability, and estimates of forage availability and quality. There were no set, predetermined decisions of

when the forage would be used or by which animals. Rather Fulani changed the frequency of use and the animals grazing the fodder bank as the dry season evolved based on changing circumstances, subjective appraisals of grazing resources, and animal condition. The feeding strategy was largely one of maintenance, feeding where all cattle are viewed as being equally important. The aim was to minimize losses and to maintain herd numbers.

Fulani evaluated and adapted the fodder bank to meet their own production objectives, circumstances, and environmental conditions. Monitoring Fulani behavior during their use of the technology and seeking the production logic behind their behavior signalled ways to improve the forage production and utilization recommendations. Such informal research by local producers and allowing such experimentation to influence agricultural decision making are critical to the successful design and transfer of technology.

REFERENCES

Bayer, W. 1986. Agropastoral herding practices and the grazing behaviour of cattle. In R. von Kaufmann, S. Chater and R. Blench (eds.), Livestock Systems Research in Nigeria's Subhumid Zone. Addis Ababa: International Livestock Centre for Africa, pp.427-440.

Bayer, W. 1982. Small ruminant production: Review of the literature. Working Document. Subhumid Zone Programme. Kaduna: International Livestock Centre for Africa.

Bourn, D. and K. Milligan. 1983. The dynamics of cattle distribution in the Nigerian Subhumid Zone. Report to ILCA's Subhumid Zone Programme. Kaduna: International Livestock Centre for Africa.

Hildebrand, Peter. 1980-81. Motivating small farmers, scientists and technicians to accept change. Agricultural Administration 8:375-383.

ILCA, 1982. ILCA Annual Report 1982. Addis Ababa: International Livestock Centre for Africa.

Lightfoot, C. 1984. On-farm experiments in farming systems research. In C.B. Flora (ed.) Proc. of Kansas State University's 1983 Farming Systems Research Symposium - Animals in the Farming System. Paper No. 5. Kansas State University, Manhattan, Kansas, pp. 558-563.

Mani, R.I., R. von Kaufmann, and E.O. Otchere. 1986. The productivity of Bunaji (White Fulani) cattle and the effect of forage legume supplementation in improving productivity in agro-pastoral herds in the Subhumid Zone of Nigeria. Research Report. Subhumid Zone Programme. Kaduna: International Livestock Centre for Africa.

Milligan, K. and R. von Kaufmann. 1979. Nutritional balance of the "average" Bunaji cow. Subhumid Zone Programme Internal Communication No. 8. Kaduna: International Livestock Centre for Africa.

Mohamed-Saleem, M.A. 1986. The establishment and management of fodder banks. In R. von Kaufmann, S. Chater and R. Blench (eds.), Livestock Systems Research in Nigeria's Subhumid Zone. Addis Ababa: International Livestock Centre for Africa, pp. 326-350.

Mohamed-Saleem, M.A. and R. von Kaufmann. 1983. Fodder banks: A practical means of dry season supplementation for traditionally managed cattle in the Subhumid Zone of West Africa. Subhumid Zone Programme Internal Communication No. 57. Kaduna: International Livestock Centre for Africa.

Otchere, E.O. 1986. Traditional cattle production in the Subhumid Zone of Nigeria. In R. von Kaufmann, S Chater, R. Blench (eds.), Livestock Systems Research in Nigeria's Subhumid Zone. Addis Ababa: International Livestock Centre for Africa, pp. 110-140.

Powell,J.M. and E. Taylor-Powell. 1984. Cropping by Fulani agro-pastoralists in central Nigeria. ILCA Bulletin 19:21-27.

Powell, J.M. and A. Waters-Bayer. 1985. Interactions between livestock husbandry and cropping in a West African savanna. In J.C. Tothill and J.J. Mott (eds.), Ecology and Management of Tropical Savanna. Sydney, Australia: Australian Academy of Science, pp. 247-251.

Riesman, Paul. 1980. The Fulani in a development context. In S. Reyna (ed.), Sahelian Social Development. Abidjan: U.S. Agency for International Development, pp. 71-186.

Rhoades, R.E. and R.H. Booth. 1982. Farmer-back-to-farmer: A model for generating acceptable agricultural technology. Agricultural Administration 11:2, 127-137.

Taylor-Powell, E. 1986. Technology design and transfer: A case study of implementation of an international agricultural research program. Ph.D. diss. Cornell University, Ithaca, N.Y.

Taylor-Powell, E. and H. Suleiman. 1986. Extension implementation of ILCA interventions: Dry season cow supplementation and fodder banks. In R. von Kaufmann, S. Chater, R. Blench (eds.), Livestock Systems research in Nigeria's Subhumid Zone. Addis Ababa: International Livestock Centre for Africa, pp. 382-390.

Tripp, R. 1985. Anthropology and on-farm research. Human Organization 44:2, 114-123.

van Raay, H.G.T. 1975. Rural Planning in a Savanna Region. Rotterdam University Press, Rotterdam.

Waters-Bayer, A. 1985. Dairying by settled Fulani women in central Nigeria and some implications for dairy development. Pastoral Development Network, Paper 20c. London: Overseas Development Institute.

Waters-Bayer, A. 1983. History of the Fulani in Nigeria. Working Document. Subhumid Zone Programme. Kaduna: International Livestock Centre for Africa.

Waters-Bayer, A. and W. Bayer. 1984. The Fulani of Abet: Research for development of agropastoralism in the West African savanna. Entwicklung und Laendlicher Raum 18:5, 16-20.