

# On-farm introduction of some dry season feeding strategies to cattle farmers on the Accra Plains of Ghana and the response of cattle to these strategies.

## 1. A survey on reasons for non-adoption of strategies

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### ABSTRACT

A baseline survey was carried out in the Dangbe East and West Districts of the Accra Plains to ascertain the reasons why cattle farmers had not adopted the dry season feeding strategies which had been known in Ghana for some time. All cattle farmers were also crop farmers producing cash and subsistence crops. Respondents in the Dangbe East District tended to have larger farms than their counterparts in Dangbe West ( $6.9 \pm 0.69$  ha vs  $4.0 \pm 0.93$  ha). All cattle owners were involved in the management of their herds in the Dangbe East District. In the Dangbe West District, a lot of absentee owners (53.3 %) left their herds in the care of hired Fulani herdsmen, and only occasionally visited the farm. In the Dangbe East District, the hired herdsman was usually an indigene. Most kraals visited (Dangbe East - 83.3 %; Dangbe West - 63.3 %) had multiple cattle owners numbering at least five. All cattle in the survey area relied exclusively on natural communal grazing lands. Cattle farmers were aware of seasonal production differences, and had also realised that the differences were due to lack of feed and water during the dry season. There were a few instances where calves had been supplemented with dried cassava peels and wheatbran, but generally no supplementation was carried out. Herdsmen grazed cattle for longer periods during the dry season. In cases of very severe drought, they moved the animals and their settlements, temporarily, to a new area with better grazing resources, returning to their old settlement when conditions improved. Farmers had heard about some dry season feeding strategies such as the feeding of crop residues and the use of multi-purpose trees. However, most farmers were not using these technologies because of inadequate knowledge and inadequate contact with extension staff. Maize stover was identified as the crop residue abundant in both districts. Based on an average

### RÉSUMÉ

ODDOYE, E. O. K., FLEISCHER, J. E., AMANING-KWARTENG, K. & AWOTWI, E. K.: *Introduction sur le champ de quelques stratégies d'alimentation pendant la saison sèche d'éleveurs de bestiaux sur les plaines d'Accra du Ghana et la réaction de bestiaux à ces stratégies. 1. Enquête sur les raisons pour la non-adoption des stratégies d'alimentation connues de la saison sèche par les éleveurs de bestiaux sur les plaines d'Accra du Ghana.* Enquête de base se déroulait dans les districts de Dangbe East et West des plaines d'Accra pour s'assurer des raisons pour les quelles les éleveurs de bestiaux n'ont pas adopté les stratégies d'alimentation qui avaient été connues au Ghana il y a quelque temps. Tous les éleveurs de bestiaux étaient également des cultivateurs cultivant des cultures commerciales et vivrières de base. Les personnes interrogées dans le district de Dangbe East avaient la tendance d'avoir des champs plus vastes que leurs homologues de Dangbe West ( $6.9 \pm 0.69$  ha vs  $4.0 \pm 0.93$  ha). Tous les propriétaires des bestiaux étaient engagés dans la gestion de leurs troupeaux dans le district de Dangbe East. Dans le District de Dangbe West, il y avait beaucoup de propriétaires absenteïstes (53.3 %) qui laissaient leurs troupeaux sous la garde de Fulani gardiens de troupeaux qui sont des ouvriers à la saison, et seulement allaient au champ de temps en temps. Dans le district de Dangbe East, le gardien de troupeaux qui est ouvrier à la saison était souvent un indigène. La plupart de kraal visité (Dangbe East - 83.3 %; Dangbe West - 63.3 %) avaient des multipropriétaires des bestiaux qui étaient au nombre d'au moins cinq. Tous les bestiaux, dans la zone d'enquête comptaient exclusivement sur les pâturages naturels communs. Les éleveurs de bestiaux étaient conscient des différences de production saisonniere et avaient également réalisé que les différences étaient à

maize yield of 0.5 t ha<sup>-1</sup>, it is estimated that at least 1.5 t of stover will be produced by each farmer. Cassava leaves and peels as well as leguminous browse plants such as *Griffonia simplicifolia* and *Jasminum dichotomum* were identified as possible feed resources.

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### Introduction

Feeding of ruminant livestock in the dry season has long been identified as one of the major constraints to the development of the livestock industry (Rose-Innes, 1960; Montsma, 1960; Wharton, Shepard & Buamah, 1967; Sunkwa-Mills, 1974). Attempts have been made to come up with suitable dry season feeding strategies, for example, supplementation with agro-industrial by-products like wheatbran and brewers' spent grain (Karikari *et al.*, 1995), the use of rice straw fortified with urea, cassava peels and molasses (Larsen & Amaning-Kwarteng, 1976; Otchere *et al.*, 1977), the use of *Panicum maximum* straw fortified with poultry litter (Oddoye, Okantah & Obese, 1996), and the use of sodium hydroxide-treated rice straw fortified with browse (Fleischer, Sottie & Amaning-Kwarteng, 1998).

Despite all these known dry season feeding strategies, cattle farmers in Ghana have not taken them up. As far as nutrition of their livestock is concerned, little investment is made in supplementary feeding. It is not clear why this is

cause de manque de pâture et d'eau pendant la saison sèche. Il y avait quelques instants où les veaux avaient été complété avec les pelures sèches de manioc et un son de blé mais en générale des compléments n'étaient pas faits. Les gardiens de troupeaux brouaient les bestiaux pour des périodes plus longues pendant la saison sèche et dans les cas de sécheresse très sévère, déplaçaient les animaux et leurs habitations provisoirement, à un nouveau terrain avec des meilleurs ressources de pâturages; retournant à leurs ancienne habitation lorsque les conditions s'améliorait. Les éleveurs étaient au courant de quelques stratégies d'alimentation, de la saison sèche telles que l'alimentation avec les résidus des cultures et l'utilisation des arbres polyvalentes. La majorité d'éleveurs, cependant, n'utilisaient pas ces technologies à cause de connaissance inadéquate et de relation inadéquate avec les vulgarisateurs. Fourrage de maïs était identifié comme le résidu des cultures abondant dans les deux districts. Basé sur un rendement moyen de maïs de 0.5 t ha<sup>-1</sup>, il est estimé qu'au moins 1.5 t de fourrage sera produit par chaque cultivateur. Les feuilles et les pelures de manioc ainsi que les plantes de brouat légumineux telles que *Griffonia simplicifolia* et *Jasminum dichotomum* étaient identifiées comme des ressources d'aliment possibles.

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The objectives of this survey, therefore, were to find out the following:

- 1) Whether farmers perceived dry season feeding as a major problem.
- 2) Why there was a non-adoption of these studied dry season feeding strategies.

### Materials and methods

A questionnaire was designed to sample two districts, namely Dangbe East and Dangbe West, on the Accra Plains. With the help of the District Veterinary Technical Officers, known cattle farming communities were visited and cattle farmers were randomly selected for interview. In all 30 farmers in each of the two districts were sampled, making a total of 60 farmers.

The survey was carried out between July and September 1997. Data from the field administration of the questionnaires were coded. The coded data were entered into the computer by using DBASE4 (Ashton-Tate, Inc.) and imported into SAS (SAS, 1987) for subsequent analyses. The frequency

procedure of SAS was used to generate cross-tabulations (using percentages) between the two districts and the other variables.

## Results

### *Demographic characteristics of households*

Table 1 summarizes the demographic characteristics of the households surveyed. Most farms were 2 km or less from the main road (83.7 %). Most respondents did not belong to a cattle farmer's association (63.3 %). Farm facilities and infrastructure (water, electricity) were poor. Although most farmers had no vehicles, they had access to the public transport system.

In the Dangbe East District, all owners of cattle were involved in the management of their herds. Kraals which house the animals at night are built near the owner's homestead. A young man, usually a native (Ada/Krobo) is hired to herd the animals. The herdsman is paid a heifer after 3 years. In the Dangbe West District, only about 47 per cent of owners were involved in the

management of their herds. The remainder of the herds were managed by Fulani herdsmen (33.3 %), sons/relatives of owners (25.0 %), and native herdsmen (41.7 %) whose conditions of service were similar to those in the Dangbe East District.

Households were larger in the Dangbe East District as compared to the Dangbe West District (Table 1) where heads were predominantly male, middle aged (about 50 years), and farming was their major occupation. More than half of the household heads had no formal education (Table 1). All households used some wage labour for livestock, and casual labour was used for cropping, as it was seasonal (Table 1).

Cattle herds were classified as small ( $\leq 20$  cattle), medium (21-50 cattle), large (51-100 cattle), and very large ( $> 100$  cattle). Table 2 shows that most herds fell within the medium and large classes. There was not much difference between the two districts.

Dangbe East had an average herd size of  $48.8 \pm 4.51$  whilst Dangbe West had an average herd size of  $65.1 \pm 9.51$ .

Cattle found in a single kraal often had multiple owners. Only 26.66 per cent of respondents owned all the cattle in their kraals. The Dangbe East District had 16.7 per cent of single owners while the Dangbe West District had 36.7 per cent (Table 2). Kraals with between two and five owners were the most common (51.7 %).

### *Feeding*

All farmers interviewed grazed their cattle on natural communal grazing lands all the year round. There was only one farmer, in the Dangbe West District who cut grass for calves and sick animals during the dry season. About 70 per cent of farmers in the Dangbe East District and 30 per cent in the Dangbe West District allowed their cattle into their crop farms after harvest to graze crop residues. However, none of the farmers stored any of their crop residues from harvest for use in the dry season. Uneaten crop residues were either

TABLE 1

*Summary of Demographic Characteristics of Households*

Item	District	
	Dangbe East (%)	Dangbe West (%)
Distance of farm from main road ( $\leq 2$ km)	77.3	90.0
Membership of cattle farmers' association	33.3	40.0
Owner's involvement in farm management	100	46.7
Mean household size	$13.2 \pm 1.73$	$8.7 \pm 1.05$
Sex of household head	1 female	All male
Mean age of household head	$49.6 \pm 3.25$	$50.4 \pm 3.65$
Farming as major occupation	70.0	83.3
Educational level (no education)	56.7	60.0
Use of wage labour	100.0	66.7
Use of casual labour	76.7	60.0
Mean total crop farm hecterage	$6.9 \pm 0.76$	$4.0 \pm 1.05$

burnt or left on the fields to rot.

Most farmers interviewed (68.6 %) believed there were about 5 months of the year when grazing was insufficient for their cattle. These were from November to March which coincided with the dry season on the Accra Plains. A few included October as a dry month (15.7 %) and others also thought the dry period started from December (9.8 %). During the dry months of the year, farmers grazed their animals for longer hours to make up for the feed deficit. In a few cases in the Dangbe East District, the animals were moved to a new location with better grazing (Table 2).

TABLE 2

*Total Herd Size, Ownership of Cattle in a Kraal, and Measures to Make up Feed Deficit in the Dry Season in the Two Districts*

Item	District	
	Dangbe East (%)	Dangbe West (%)
<i>Total herd size</i>		
≤ 20	13.3	10.0
21-50	36.7	40.0
51-100	43.3	36.3
> 100	6.7	13.3
<i>Ownership of cattle in a kraal</i>		
1 owner	16.7	36.7
2-5 owners	53.3	50.0
> 5 owners	30.0	13.3
<i>Measures to make up feed deficit in dry season</i>		
Longer grazing hours	90.2	100.0
Move to better grazing	9.8	0.0

#### *Seasonal production differences*

Farmers were aware that the productivity of their animals declined during the dry season. They attributed this to lack of feed (70.0 %), lack of water (13.3 %), or to lack of feed and water (17.0 %). Farmers suggested that supplementary feeding in the dry season, the provision of water, or a combination of both could help solve the

problem of seasonal production differences. Table 3 shows the responses of farmers. The 'others' group comprised farmers who thought that the best thing to do was to move cattle to an area that had adequate feed and water during the dry season. Asked whether they had done anything at all to improve conditions for their animals during the dry season, most farmers said they had done nothing (Table 3). A few (8.3 %) practised some form of supplementation. Common supplements included cassava peels and wheatbran which were often fed to only calves.

#### *Visits of extension agents*

According to respondents, there were generally no visits by extension agents. When they visited at all, it was for crop production and not animal production. The local veterinary technician was a more regular visitor, and was also the one consulted when there was a problem with cattle.

#### *Feeding of crop residue*

Quite a few farmers (45.0 %) had heard about crop residue feeding (Table 4). The proportion was higher in the Dangbe West District (53.3 %) as compared to the Dangbe East District (36.7 %). For those who knew about the feeding of crop residues, nearly half (48.1%) got their information from farmer's fora and meetings. The other half (51.9 %) gave other sources which included hearing from other farmers, the Presbyterian Santeo-Katamanso Agricultural Project (SANKAT), and the Aveyime Cattle Ranch. One farmer in the Dangbe East District had worked with the Agricultural Research Station (ARS), Legon, and had his information from there.

Even though the use of crop residue was known, none of the farmers used it. The most important reason assigned for non-use of crop residue (32.8 %) was that it was unavailable in sufficient quantity (Table 4). Others said they did not have enough knowledge about crop residue feeding (29.4 %). The "others" group (22.2 %)

TABLE 3

*Solution for Seasonal Production Differences and Actions Taken to Solve Seasonal Production Differences in the Two Districts*

Item	Districts	
	Dangbe East (%)	Dangbe West (%)
<i>Solution for seasonal production differences</i>		
Supplementary feeding	63.3	33.3
Provision of water	33.3	33.3
Supplementary feeding and provision of water	0.0	23.3
Other	6.7	13.3
<i>Action taken to solve seasonal production differences</i>		
Supplementary feeding	6.7	10.0
No action	86.7	86.7
Other	6.7	3.3

TABLE 4

*Knowledge of Crop Residue Feeding in the Two Districts*

Item	District	
	Dangbe East (%)	Dangbe West (%)
<i>Knowledge of crop residue feeding</i>		
Yes	36.7	53.3
No	63.3	46.7
<i>Reasons for non-use of crop residues</i>		
Crop residues not available in sufficient quantity	11.1	54.5
Do not know enough about the use of crop residues	22.2	36.4
Crop residues are too expensive	11.1	0.0
Inability to transport crop residues from farm to kraal	11.1	9.1
Other reasons	44.4	0.0

comprised people who were not prepared to use crop residue at all (60.0 %) (they would continue

to use their old traditional methods, i.e. extended grazing times during the dry season and moving cattle to areas with better grazing), and those who had not thought about the use of crop residues, even though they knew about it (40.0 %). The latter were from the Dangbe East District and comprised 44.4 per cent of the respondents there.

*Urea treatment of crop residues*

Only four farmers, two from each district, had heard about urea treatment of crop residues. The two farmers in the Dangbe West District got their information from farmers' fora/meetings. One of the two farmers in the Dangbe East District had his information from the Aveyime Cattle Ranch, and the other one got his information from ARS, Legon. None of these farmers had used the urea treatment method because they said they did not know enough about its use.

*Use of multi-purpose trees (MPTs)*

Quite a sizeable number (55.0%; Dangbe East-70.0 %, Dangbe West-40.0 %) had heard about the use of MPTs. Of these, 75.8 per cent had heard about it from extension officers. The trees (e.g. *Leucaena leucocephala* and *Gliricidia sepium*) were introduced as part of the alley cropping or farming concept, but extension officers had informed farmers that their leaves could also be cut and fed to cattle. The remaining 24.3 per cent had their information from other sources such as farmers' meetings/fora, Aveyime Cattle Ranch, SANKAT, and ARS, Legon. The farmers were, however, not using MPTs mainly because they did not know where to obtain the seedlings of these trees (40.9 %). Other farmers said they had not grown any trees as yet (28.2 %), and some farmers had just not thought about it (23.8 %) (Table 5).

*Use of local browse trees*

Apart from three farmers (two in the Dangbe East District and one in the Dangbe West District), all the other farmers interviewed were aware that

TABLE 5

*Reasons for Non-use of Multi-purpose Trees (MPTs), Local Browse Trees and Agro-industrial By-products (AIBPs) in the Two Districts*

Item	District	
	Dangbe East (%)	Dangbe West (%)
<i>Reasons for non-use of multi-purpose trees</i>		
Have not grown any trees yet	27.8	28.6
Establishment of trees is time consuming	0.0	14.3
Do not know where to find tree seedlings	38.9	42.9
Have not thought about it	33.3	14.3
<i>Reasons for non-use of local browse trees</i>		
Have not thought about cutting and feeding local browse	69.2	52.7
Harvesting and feeding would be time consuming and would require extra labour	0.0	26.3
There are not enough browse trees available for cutting	30.8	21.1
<i>Reasons for non-use of AIBPs</i>		
AIBPs are too expensive	88.9	57.9
AIBPs not easily available	0.0	26.3
Do not know enough about the use of AIBPs in cattle feeding	11.1	10.5
Other reasons	0.0	5.3

their cattle fed on certain browse trees (e.g., *Griffonia simplicifolia*, *Jasminum dichotomum*) during the dry season. During the dry season, farmers in the Nakonkope village of the Dangbe East District actually send their animals to a place where these trees are known to be in abundance before they go out to graze. Three farmers (one in Dangbe East and two in Dangbe West) cut local browse trees to feed their calves, but generally the cutting of local browse trees for feeding was not practised. Most people had just not thought of cutting the local browse trees to feed their

animals (60.9%). Others thought the browse trees available in the wild were not enough to allow for cutting and feeding (25.9%). The rest (13.2%) thought that harvesting and feeding of browse would be time consuming and would require extra labour (Table 5).

#### *Use of agro-industrial by-products (AIBPs)*

Quite a high percentage (80.0%; 60.0% - Dangbe East; 100.0% - Dangbe West) knew about the use of AIBPs. In the Dangbe West District, all farmers knew about the use of AIBPs, the most common one being wheatbran which can be easily obtained. Of those who knew about the use of AIBPs, 39.6 per cent said they had heard about them from Veterinary Technical Officers. Half of the farmers (50.0%) had heard from other sources, and these included other farmers, particularly in Ashaiman where the use of wheatbran is quite popular, SANKAT, and the Aveyime Cattle Ranch. Despite all these encouraging observations, most farmers (89.6%) were not using any AIBP of any sort. Just 10.4 per cent of farmers, all of whom were in the Dangbe West District (20.8%), were feeding some form of AIBP. The major reason given for this was that AIBPs were too expensive (73.4%) (Table 3) or were not easily available (13.2%). Currently, a 25-kg bag of wheatbran sells for about ₵18,000.00, but this often

increases around December (dry season) which is when cattle farmers really need wheatbran. Christmas holiday breaks by the flour-milling companies create a shortage.

#### *Use of urea-molasses blocks*

Farmers were unfamiliar with the use of urea-molasses blocks.

#### *Knowledge of other dry season feeding strategies*

Two farmers, one in each district, had heard

about the making of silage and hay. In addition, one other farmer in the Dangbe West District had heard about silage making. This information was gathered from ARS, Legon (Dangbe East), and from the Amrahia Dairy farm (Dangbe West).

### Discussion

There may be the need to popularise cattle farmers' associations so that they may be used as the vehicles to develop the cattle industry. There is also the need for basic infrastructure, like water and electricity, to be extended to cattle-farming communities. The provision of clean (pipe-borne) water (for cleaning and in milk processing), for example, is necessary for the dairy industry.

The involvement of the farm owner in managing the cattle herd has an influence on the welfare of the animals. In an earlier survey carried out in five districts on the Accra Plains by Okantah *et al.* (1997), about 44 per cent of the farms surveyed had the owner as the farm manager. In all other cases, the farm owner had hired a herd manager to look after the herd. The herd manager is usually unable to take major decisions affecting the welfare of the herd, unless he has consulted the owner. This is a major constraint as the owners sometimes stay away for long periods and only show up when they want animals to sell. The experience of the Animal Research Institute (ARI) with supplementation of cattle on the Accra Plains (Okantah *et al.*, 1999b) is that unless herd owners are involved, improved technologies will not be adopted. These findings suggest that it would be easier to introduce new technologies in the Dangbe East District where all herd owners are involved in managing their cattle.

The rural household is relatively large compared to urban households. This is partly due to a lot of men having more than one wife. Also, in farming communities, especially, the larger the family, the more hands that are available to work on the farm. The larger families in the Dangbe East District could therefore be a reflection on the larger crop farms in the district. It appeared that cattle farming was traditionally a male affair.

Women usually kept the smaller ruminants (sheep and goats) and poultry. The survey carried out by Okantah *et al.* (1997) also recorded a high level of illiteracy among cattle farmers (49%), male dominance, and large families.

The differences in the use of wage (hired) labour between the two districts were related to the involvement of the herd owners. In the Dangbe East District, where all herd owners were involved in managing their herds, the herd owner and household head was the same person. In the Dangbe West District, where the herd owner was not always involved in managing the herd, the person interviewed was sometimes the herd manager. The herd manager himself can be considered as a wage labourer, but the distinction has been made to bring out these differences.

Multiple ownership of kraals often leads to kraals having many cattle which are difficult to handle. In addition, most of the respondents complained that some owners would not provide anything (drugs especially) for their animals. As it is not practical to treat some animals in the herd for ticks and leave the others untreated, they often have to spread the drugs they buy for the whole herd (kraal). The worst offenders are close relatives who take things for granted.

The total reliance on natural communal grazing is a serious problem in the cattle industry in Ghana, and has also been reported by Okantah *et al.* (1999a). The available quantity and quality of the communal grazing lands fall sharply during the dry season. Maize stover could be used as a dry season feed for ruminant animals if harvested and stored. Based on an average maize yield of 0.5 t h<sup>-1</sup> in the Dangbe East and West Districts, it is estimated that 1.5 t of stover per ha will be produced (Kossila, 1988). Cassava leaves, which have a very high crude protein content, would complement the stover very well. Cassava peels, a by-product of the cassava dough and gari-processing industries, is also available and would serve as a source of readily soluble carbohydrates.

The farmers' claim that they had no visits from extension staff may need further clarification.

According to extension staff in the Dangbe West District, they had been visiting farmers and advising them on all matters concerning the husbandry of their livestock. However, during the survey, the Veterinary Technical Officers were in more contact with the farmers. These officers actually took the researchers around to interview farmers during the survey. In a survey of agricultural extension services to smallholder farmers in the Dangbe West District (Aboe, 1998), it was reported that extension technology/information transferred to the farmers was biased towards crops as compared to livestock. Constraints to the adoption of technology included lack of finance, expensive and unavailable inputs, late arrival of inputs and difficulty in understanding, and irrelevance of technology/information transferred. The survey also reported that despite these constraints, most of the farmers who were in contact with the extension agent had observed some improvement in their farming activities. The areas which had more contact with the extension agent recorded higher improvement (82 %) than those which had less contact (18 %).

Since all farmers grew some crops, residues from maize, groundnuts and cassava, among others, were available free of charge. It appears that farmers have not been educated enough on the advantages of using these materials as dry season feed supplements for their animals, and also on how to combine them for the best results. This would explain why farmers either burn their crop residues or allow them to rot on the fields. The excuse by some farmers that sufficient quantities of crop residues were unavailable was false. Apart from the estimated 1.5 t of maize stover, which they would generate from their own farms, there may also be a few big crop farmers who do not keep animals and will be willing to sell their crop residues at minimum cost. By careful feed budgeting, it should be possible to spread whatever is available over the dry season, at least, to maintain animals.

In Ghana, urea-ammoniation of straw is a

relatively new technology, even though some studies have been carried out at the University of Ghana, Legon. It is a fairly simple way of improving the digestibility and crude protein content of crop residues, and its use among livestock farmers, especially during the dry season, needs to be encouraged.

The use of MPTs, which normally have leaves with a high crude protein content, would have complemented the low protein in crop residues such as maize stover; therefore, this needs to be encouraged. The fact that farmers were aware that cattle fed on certain local browse trees supports the assertion by Rose-Innes (1977) that browse plants play a very important role in dry season feeding, and that but for their presence, dry season weight loss would be even more marked. There may be the need to encourage the propagation and use of local browse trees as another way of reducing dry season weight loss.

The pricing of AIBPs will be an important consideration in whether cattle farmers use them as dry season feed supplements or not. Another consideration is that poultry and pig farmers also use a lot of these AIBPs, especially cereal brans like wheatbran and ricebran. It may, therefore, be necessary to identify AIBPs which are not used by the poultry and pig industry, such as poultry litter, pineapple and citrus pulp, and banana waste, and make these available to cattle farmers for use in the dry season.

Even though it is a relatively new technology in Ghana, the urea-molasses block was displayed at a farmers' forum held at the Aveyime Cattle Ranch in 1996. It was therefore expected that, at least, farmers in the Dangbe East District would have heard about it.

### Conclusion and recommendations

The survey established the following:

1. Farmers were aware that there was a problem with dry season feeding which affected the productivity of their herds.
2. Farmers knew about some of the techno-



logies developed for use in the dry season, but were not using them.

The answers given by farmers for why they were not using these dry season feeding strategies indicated that dissemination of information might have been a problem. Where farmers knew about a technology, the uptake of the technology was often accompanied by problems such as lack of enough information about the technology to apply it properly. In the special case of AIBPs, price was also an important consideration.

The problem with dissemination of information may be traced to the poor contact between the extension agent and the farmer. The impact of extension services on the activities of the farmers, and consequently on food production, depends on the level of contact between the frontline staff and the farmer. The extension agents need to have more contact with farmers, and also need to balance the information between crops and livestock, particularly in livestock-producing areas. The link between scientists and the extension agents also needs to be improved to ensure a steady flow of information from the scientists to the farmer, through the extension agent and *vice versa*.

The issue of herd management is one of the areas that need to be addressed if the cattle industry is to move from its extensive systems of management, through a semi-intensive system, to a more intensive system as practised in the developed countries. Crop-livestock integration, where animals are used for traction and manure, and crop residues are fed back to the animals, needs to be encouraged.

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