

local problems can be investigated and where advanced training can be given, with some of the more promising students being sent abroad for extra training.

The subject of animal husbandry education requires more study on a world-wide basis. In recognition of this it has now been decided to deal with it as one of the major items for discussion at a World Animal Production Conference to be held in Rome in 1963 under the auspices of the various animal production associations of the world in co-operation with FAO.

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Livestock production with particular reference to the nutritional problems of West Africa

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Introduction

Livestock throughout West Africa, by temperate standards, have a low rate of growth and reproduction. This aspect of low productivity is still widely attributed to the inherent characteristics of West African livestock, despite the early work of Anderson (1933) in Northern Nigeria, which indicated clearly the role of malnutrition in bringing about low productivity. Recently Oyenuga (1958) has reviewed the factors affecting productivity and suggested that nutritional factors are at present

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far more important than inherent characteristics in limiting the productive ability of West African livestock. Anderson reported a 100% improvement in the time taken for cattle to reach sexual maturity when he gave them concentrates. Thomas (1954) obtained similar results with beef cattle in Ghana, and Hill (1956) doubled the yields of dairy cattle by transferring them from the harsh nutritional environment of Northern Nigeria to the more fertile grassland at Ibadan. It is worthy of note that 25 years of selective breeding had failed to improve the yields of the same cattle. Wilson & Hollingsworth (1960) in Ghana, found that balanced feeding raised the egg production of unselected local hens to three times the estimated performance of the same birds under village conditions. There seems little doubt, therefore, that the low productivity of West African livestock is at present due to prolonged malnutrition.

Ruminant nutrition

Cattle, sheep and goats form a far higher proportion of the domesticated animals in West Africa than they do in temperate countries. This situation may be due basically, to the fact that ruminants do not compete for scarce and expensive human staples, but it is also due sociologically to the fact that goats and sheep do not appear to the owner to need any feeding at all and require only a minimum of attention. However, as a result of the influence of the various Government's extension services and development schemes there are increasing numbers of West Africans who wish to improve the nutritional environment of their animals. These livestock owners are up against formidable problems. Annual droughts are prolonged and severe with consequent water and herbage shortages. An overall estimate of the length of the dry season would be meaningless in as variable an area as West Africa, but over the grassland savannah regions, where most cattle are found, a 20-week dry season can be expected. This dry season can be equated to the British winter in terms of requirements for conserved feed supplies. In the general absence of conserved fodders, it is not surprising that losses of 1-2 lb live weight/day have been reported (Miller, 1958; Montsma, 1960a) which may amount to an overall loss of 25% of the live weight in a single season. Despite greatly accelerated growth rates after the recommencement of the rains, these annual setbacks are undoubtedly responsible for the time taken to reach slaughter weight.

Water supplies are being improved by a series of water conservation projects throughout West Africa. The attendant dangers to soil and grassland conservation, associated with uncontrolled or unplanned grazing near new water points, have been reviewed elsewhere (Lansbury, 1961). The problem of providing suitable supplements for dry-season grazing, however, has hardly been tackled. This may be due to the preoccupation of research and extension officers with the immediate problems of arable production which, on the whole, are more easily tackled and whose remedies are more easily demonstrated. Undoubtedly the sparsity of available information about the nutritive value of West African feeds and livestock requirements has also been a stumbling block and is reflected in the widespread use of such excellent but rather unsuitable handbooks as *Rations for Livestock* (Woodman, 1957). However, a certain amount of local data is now becoming available.

Nutritive values and requirements

Oyenuga (1958) has ably reviewed existing data on the chemical composition of Nigerian feeding-stuffs. Unfortunately very few recent data are available regarding the composition of the unimproved arid savannah grassland from which most cattle production is obtained and which appears to be greatly inferior to the grassland of south-western Nigeria described by Oyenuga (1958). Some valuable information has been obtained at the Regional Research Centre at Samaru in Northern Nigeria, which includes the results of digestion trials, but it has not yet been published. A limited amount of information on the composition and digestibility of Ghanaian fodders has been presented by Lansbury (1960a), who has also conducted comparative digestion trials in an attempt to assess differences between classes and breeds of West African ruminants (Lansbury, 1960a). In these trials Lansbury found no significant differences between West African Zebu and non-Zebu cattle, despite the very popular if unsubstantiated belief that the ability of Zebu cattle to thrive on the coarse grassland of the arid savannah was due to great powers of digestion. Cattle had significantly higher digestive coefficients than sheep, especially with dry roughages. An outstanding feature of these trials, which was reproduced a number of times in change-over experiments, was the depression of digestibility which occurred when animals were fed on a low plane of nutrition, especially with poor-quality roughages. This suggested an upset in rumen metabolism which may have been caused by the extremely low intake of nutrients, particularly of nitrogen compounds and phosphorus. In view of these results, it seems doubtful whether the use of British and American digestibility data, which are often presented without reference for instance to plane of nutrition or to class of animal, is of much value in West Africa. It is probably true to say that formulation of rations, at any rate in what was formerly British West Africa, is mostly based on the tables either of Woodman (1957) or of Morrison (1949). Although guides to the proper feeding of livestock have been published locally by Hartley & Ross (1938) and more recently by the Regional Research Centre (1960), at Samaru, no basic research has been reported that ascertains the requirements of West African livestock for maintenance and production or their relationship to temperate standards.

It is clear that a fundamental approach to the problems of livestock nutrition in West Africa is not yet possible owing to the lack of basic information. The situation is not, however, without scope for improvement since the margin between present levels of nutrition and the point of diminishing returns is probably very large indeed. A great deal can be accomplished by an *ad hoc* approach to the more outstanding problems provided full use is made of the limited information available.

Limiting factors in ruminant nutrition

After water supplies, the need for supplementary fodders in the dry season is the next priority. It has been suggested by Lansbury (1960a) that owing to the low appetite or dry-matter intake of West African cattle, which is estimated at about two-thirds that of cattle in temperate zones, poor-quality feeds with a low concentration of digestible nutrients may be of little value. This suggestion is in conflict with

the widely held belief, expressed by such experienced workers as Faulkner & Brown (1953), that quantity is at present more important than quality. Lansbury's data, however, show arithmetically that most of the roughage and silage samples he examined, although supplying adequate energy, could not supply enough protein for maintenance. This calculation seems to be supported by the practical experience of Brown (1938) using hay and Montsma (1960*b*) using silage who both found that low-quality supplements to grazing depressed live-weight gains compared with those of animals not given supplements. Whether or not the allegedly greater power of the West African ox to digest fibrous material enables it to obtain sufficient energy for both maintenance and production is not known. For some feeds very high digestion coefficients for crude fibre were obtained (Lansbury, 1961) but digestion coefficients for the total organic matter of the same feeds were not correspondingly high and did not suggest exceptionally high levels of digestible energy. None-the-less, in feeding trials by Miller (1958) in Nigeria and Lansbury & Montsma (1960) in Ghana, bullocks showed far better responses to protein and phosphate supplements than to energy supplements, which indicates that energy may be less important than protein and phosphorus as a limiting factor in dry-season herbage.

The chemical composition of natural savannah herbage of the Accra plains in Ghana has recently been studied by Rose-Innes & Lansbury (1961) in relation to stage of growth, season and frequency of defoliation. It was clear from the results obtained that the levels of protein and phosphorus were extremely low, the mean digestible protein content being about 2% and the phosphorus content about 0.06%. Similar but more simple studies were made on samples sent in from ten Government stations in various regions of Ghana (Lansbury, Blair & Mabey, 1961) and these gave very similar results.

It was found possible, by frequent defoliation, to maintain the concentration of protein and phosphorus at fairly high levels. It could, however, only be done at the expense of total yields which were markedly depressed by frequent defoliation. Indeed persistent defoliation at fortnightly and monthly intervals completely killed out perennial species. A fairly satisfactory balance was obtained by cutting at intervals of not less than 6 but of not more than 8 weeks. This procedure maintained crude protein and phosphorus levels at about 6% and 0.14% respectively. It should be noted, however, that in practice it can only be done during the period of continuous active growth, which is confined to the rainy season.

As a limiting factor, phosphorus has received very little attention despite the extremely low levels of soil and plant phosphorus known to exist throughout West Africa. Although deep-rooting browse trees and shrubs may supply more phosphorus than the grassland (Nye, 1958; Mabey, 1961), it is doubtful whether the combined grazing supplies much more than 0.08% of the total intake, which of course is far below the minimum safety level of 0.15% suggested by Morrison (1949).

In view of this exceedingly low level of phosphorus, it is surprising that serious manifestations of deficiency have not been reported. The low rates of reproduction, short heat periods and slow growth observed in West African cattle have never been

attributed officially to phosphorus deficiency, but few serious attempts have been made to ascertain the importance of phosphorus as a limiting factor. Miller (1958) and Lansbury & Montsma (1960) have observed substantial responses to phosphate supplements, but the experiments were with rather limited numbers of cattle and were of short duration. The danger of more acute phosphorus deficiency may arise as attempts are made to increase the size and rates of growth and reproduction of West African cattle by breeding and management.

Non-ruminant nutrition

Apart from the question of competition for human staples, poultry and pigs are generally more efficient than ruminants as converters of food into flesh. It is especially so when, as in West Africa, seasonal wastage reduces the conversion efficiency of cattle and sheep.

Both exotic pigs and exotic poultry thrive under West African conditions provided management and supervision are reasonably good. Pig flesh is objectionable on religious grounds to a very high proportion of West Africans; the poultry industry, however, promises very rapid development indeed under the stimulus of various overseas technical aid missions and official encouragement. Owing to the rapid turnover and the fairly complete control which is possible over the nutritional environment, there is much scope for these rapid changes and development.

The genetic and nutritional levels to be desired are controversial and have been reviewed by Lansbury (1961). Undoubtedly the local fowl is efficient in that under village conditions it manages to produce a number of eggs without regular feeding. These birds are scavengers in balance with their surroundings and any great increase in their numbers would involve an increased demand for food and the balance would be upset. Further, it has been the experience in the past that whenever numbers of birds increase to any great extent in a village disease breaks out and the entire fowl population may be lost. If disease control and proper feeding are to be adequate, the high overheads of supervision, housing and prophylaxis must be borne. In order to justify these overheads a poultry industry producing eggs for sale rather than for subsistence, based on really high-yielding hens, is a necessity. It is general experience that, provided management is adequate, improved breeds of poultry imported from temperate countries thrive in West Africa. Indeed there is as yet no experimental evidence that the local bird is any more resistant to the major endemic diseases (Kaschula, 1961) than the imported bird.

The production of eggs in West Africa has so far been on a limited scale. Recently a number of educated Africans have ventured into egg production with success. It seems likely that, within the next few years, there will be a rapid increase in egg production by this new class of poultry keeper who are ready and willing to make use of up-to-date methods. The type of ration commonly used at present will not support full production. During a course in poultry husbandry, nutrition and disease held at the Kaduna Veterinary Investigation Centre, I was able to discuss sources of supply and current feeding practices with Government poultry technicians from various parts of Nigeria, Gambia, Sierra Leone, Liberia and Ghana. It soon became clear

that most, if not all, diets are seriously deficient in several respects. These deficiencies in order of probable importance are of suitably balanced protein, vitamin B₁₂, riboflavin, vitamins A, D and E, and minerals. The need for an adequate amount of protein is generally appreciated but the need for animal protein as a source of balanced amino acids and for the growth and hatchability factors, vitamin B₁₂ and riboflavin, is less well understood and is also very difficult to satisfy. Blood meal of unknown biological value, stock-fish and locally prepared fish residues are sometimes used but tend to be given to all classes of poultry. As these products are in short supply it would be better if their use were confined to chick starter and breeder's diets.

Because of the lack of such supplements as dried-milk products and brewer's yeast, riboflavin is commonly deficient. Much of the slow growth rate observed in young chicks is caused largely by riboflavin deficiency. Since the quality of home-made yeast is not easily controlled under West African conditions, it is frequently of doubtful nutritional value. A considerable problem arises from the current widespread use of cod-liver oil and red palm oil to supply vitamins A and D. The high ambient temperature and humidity tend to cause the rapid destruction of unprotected vitamins once the oils are mixed in the feed, especially if trace minerals are present. The use of yellow maize or green leaves to supply vitamin A has been encouraged, but there are practical difficulties since yellow maize as a crop is not favoured by farmers and suitable green leaves are not easily obtained during the dry season.

Although, from a theoretical survey, vitamin E does not appear to be deficient, a large proportion of the poultry assistants interviewed had seen encephalomalacia (crazy chick disease). Its presence was confirmed by Kaschula (1961) who noted outbreaks apparently associated with the use of high levels of cod-liver oil. From the descriptions obtained from the poultry technicians this deficiency seems to occur occasionally among local chicks, especially when rice bran, which is rich in free fatty acids, is used in the diet. It seems likely that the problem is one of oxidative rancidity developing in free fatty acids with a consequent destruction of vitamin E.

The importance of minerals is badly underestimated by most poultry keepers in West Africa, partly because of the failure of merchants and extension officers to impress upon farmers that most poultry feeds are balanced on the assumption that additional calcium carbonate will be given. Calcium deficiency is widespread and produces spectacular results with heavy-laying birds. Lansbury & Harding (1957) investigated calcium paralysis in battery birds in Ghana and found that blood levels of calcium were extremely low despite normal levels in the diet. This calcium paralysis could be remedied by increasing the level in the diet to 4.5%, but the birds remained very sensitive to even short-term shortages which could arise owing to a careless poultryman forgetting to fill the troughs. Calcium in the form of oyster-shell and limestone is not in very plentiful supply, although at present there is no shortage of the former in coastal and riverine areas. Calcium phosphates are available as burnt bones, which appear to be a good source of supply since large quantities are exported annually and could be diverted. The need for careful burning to destroy

pathogenic organisms would need to be emphasized, however. Manganese is important and it is probable that a cheap imported trace-mineral supplement that for economic reasons does not contain the locally available major elements, calcium, phosphorus and salt could be used with profit since signs of manganese deficiency are common.

Supplies of suitably balanced rations for poultry have been difficult and costly to obtain. Extension schemes have failed in the past since rations could only be obtained from Government research stations with limited production facilities. Imported balanced meal and 'grain balancers' are now increasingly available at a high price. Since much of the protein material may have originated in West Africa it would be desirable for these poultry feeds to be manufactured on the spot, making full use of groundnut, sesame, palm nut and soya products that are at present exported.

It is here that up-to-date knowledge, in regard to the supplementation of all vegetable poultry rations, could be of great value, especially in view of the present desperate shortage of animal protein. Lansbury (1961) carried out trials with local feeds in Ghana, based on the now well-known work of Carpenter & Duckworth (1951, 1954) and Carpenter & Ellinger (1951). These trials showed that all vegetable diets fortified with minerals and vitamins were deficient in the amino acids, cystine and methionine and lysine. These deficiencies, however, caused only transitory checks in growth which had no significant effect on subsequent egg production. These checks were eliminated completely when levels of these amino acids were raised by the inclusion of soya-bean meal and the synthetic methionine.

Conclusions

For ruminants, it seems to me that the role of the animal's nutritional environment in restricting productivity is far greater than is generally appreciated. Attempts to raise productivity by developing or selecting animals capable of more rapid growth and development and faster reproduction are bound to be disappointing unless the nutritional environment can be raised simultaneously, or unless it becomes possible to breed for an improved food conversion efficiency under the present harsh conditions.

As has been concluded elsewhere (Lansbury, 1960a), it would seem that at present the growing of special fodder crops for dry-season feeding offers the best solution to the problem of provision of dry-season fodder in terms of yield and economic use of fertilizer. This, however, can only be done by placing cattle in direct competition with man for arable crop products, a situation which is highly undesirable in a country where human staples are sometimes near famine levels. It is also a nullification of the very advantage which we should be exploiting, that is the ability of the ruminant to convert grassland into animal products of the highest nutritional value, without competition for technical resources, which could be better applied to arable food crops for man. Perhaps the first step should be to bring existing grassland up to its optimum value by supplying the missing or deficient constituents which at present limit its value. For protein and phosphorus there is analytical evidence of deficiency supported by responses to protein and phosphorus supplements. The

immediate problem is how to supply these nutrients in a sufficiently cheap and simple form. It is here that very simple supplements based on urea and phosphates should be investigated urgently. The next step may be the quantitative improvement of cattle food supplies by irrigation, conservation or the utilization of cheap by-products. At the same time it must be recognized that there are great problems of overgrazing, soil and water conservation, and the ever present problems associated with land tenure and the conflict between nomadic cattle owners and settled farmers. These are problems which cannot be tackled by the nutritionist but which may directly limit development of cattle production.

The basic problems concerning the nutritional requirements of West African ruminants and the absence of feeding standards remain to be tackled.

The prospects for the poultry industry are bright, but more attention should be paid to the most economical way of utilizing West African feeding-stuffs, particularly the oilseed by-products which are at present exported to countries less starved in protein and which can, after fortification with vitamins and minerals, go a long way towards meeting the needs of West Africa's poultry industry.

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