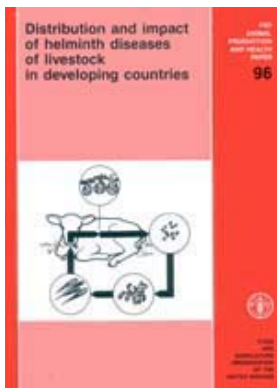


Distribution and impact of helminth diseases of livestock in developing countries



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Introduction

The FAO Expert Consultation on Roots, Tubers, Plantains and Bananas in Animal Feeding was held in Colombia at the Centro Internacional de Agricultura Tropical (CIAT) near Cali, from 21 to 25 January 1991.

BACKGROUND

Over the last two decades the total amount of animal feed used in developing countries has increased rapidly so that by 1988 approximately 280 million tons were produced. More than half of this feed (149 m.tons) was produced from cereals, of which more than 38 million tons were imported in the late 1980's. During the 1970's the use of cereals in animal feed in developing countries was estimated by FAO to have increased by 7.1% per annum whilst in the 1980's the rate of increase was 2.8%.

Levels of imports of this order clearly place pressure on limited foreign exchange supply, whilst the overall use of cereals and other feedstuffs, used in this way, might well be at the expense of human need.

The main purpose of such feed use is to increase the production and availability of animal protein within such countries, for which there is a clear need. In order to achieve a rapid increase in the production of such products, many developing countries have directly transferred technologies from developed, often temperate countries. Often this has involved the direct use of raw materials of temperate origin at the expense of potential local equivalents. Often such local materials outyield more conventional feedstuffs (though sometimes requiring more handling and processing) or may even be byproducts of other industries which are poorly used or discarded.

The incentives to develop appropriate livestock systems, based largely on locally produced materials, have not been sufficient in many

developing countries till recent times. Now many such countries are experiencing population pressure with increased demands on both food supply and foreign exchange, difficulties in servicing foreign debts and reduced earnings from exports. As a result FAO has on various occasions been requested by developing countries to assist them to develop local substitutes for imported materials for animal feeding. Concern has been expressed on this subject in many regions of the developing world and in particular in Asia, the Near and Far East, the Pacific and Latin America.

In order to resolve this problem it is strongly felt that livestock production systems should be developed for developing countries, matching locally available resources and in particular feed resources to local needs.

PURPOSE

This Expert Consultation was aimed at establishing:

- the current availability of roots, tubers, plantains and bananas around the world for use in animal feeding and the potential that exists for greater production and use;
- the technology that is available, and that likely to be available, for harvesting, processing, preserving and storing the above materials so that they can be used as feeds for livestock;
- the nutritional value of the above products for the various livestock classes and practical ways of feeding these materials;
- the effects of using these materials to replace conventional animal feedstuffs on developing countries farming and national economies.

OPENING SESSION

The speech of welcome was delivered by Dr C. Bastanchuri, FAO Representative in Colombia. First of all he thanked the Director-General of CIAT, Dr G. Nores, and his staff for so generously welcoming the consultation and for the active participation in the preparation of the meeting.

In his speech he reminded the participants of the great needs to resolve the economic problems of developing countries through making them less

dependent on exports of primary materials. He also emphasized that this consultation particularly addressed this problem and that the presence of Dr. Jaime Navas Alvarado, who is deputy director of the Instituto Colombiano de Agropecuaria, reflected the importance that the Colombian Government gave to the subject to be considered.

Dr. Alvarado then gave an address of welcome on behalf of the Colombian Government. He confirmed the great interest in his country towards becoming more self sufficient in animal feeds and agreed that the subjects under discussion would be particularly relevant to the national and regional situation. He also noted the great spread of international interest in the subjects covered which was reflected in the range of countries from which the experts were drawn. From this he concluded that major breakthroughs in the field would have particular significance in many countries undergoing development problems. In particular he hoped that the presence of such an experienced group of experts interacting with staff of CIAT and other Colombian contacts would greatly facilitate the exchange of ideas and information between countries and regions for the common good of all.

Dr. Gustavo Nores, Director-General of CIAT, gave the opening speech and welcomed all participants. He stated his pleasure in hosting the consultation because of the tremendous importance of the event in relation to the challenges the world scientific communities will face over the coming decades to make technologies available that will link the growing numbers of small farmers to expanding markets.

In particular, he pointed out that the fastest growing demand in the developing countries is for animal products to which this particular consultation was specifically addressed. Also he noted that with cereal prices likely to drop over the next decade producers of commodities addressed in this consultation would be under greater competitive pressure. The development of more appropriate and economic technology would greatly assist such producers to compete effectively.

Prior to the introduction session a short speech was given by Dr. D.H. Machin, technical secretary of the Expert Consultation. He explained that the consultation fell within the overall framework of meetings

organized by the Animal Production and Health Division of FAO in the last ten years, to review the possible feed resources present in the developing world and to promote a better utilization of these local feed resources in such countries.

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Overview of needs and justification for use of roots, tubers, plantains and bananas in animal feeding

by D.H. Machin

INTRODUCTION

Over the past twenty years many developing countries have experienced considerable difficulties in providing sufficient food to satisfy the ever increasing demands of expanding populations.

In order to meet these needs they have looked to transfer technology from developed countries. Often this technology has been developed for temperate rather than the tropical or subtropical environments common to most developing countries. Due to the close environment interaction between crops and their environment only certain aspects of temperate technology could be utilized. For this reason cropping systems that were developed had to be designed for each environment in order to function at all. However, in the case of livestock, which are less environmentally sensitive, it was possible to transfer not only technology but whole systems, including animals, building designs and feeds.

Many of the developing countries that followed this approach to resolving livestock production deficits were able to finance such activities through the export of primary products, such as oil, minerals, tea, coffee, etc., or by borrowing.

Over the last decade the above practice has commonly proved to be financially unsustainable due to:

1. escalating demands for livestock products, from expanding and increasingly urbanised populations, outstripping the amount of foreign exchange available to purchase the necessary inputs.
2. reduced amounts of foreign exchange available for continued importation caused by falling earnings from the export of many primary products and the need to allocate greater amounts of foreign exchange to finance earlier borrowings.

For the above reasons FAO has on various occasions been requested by developing countries to assist in seeking effective means of resolving these problems. This expert consultation constitutes part of the initiative to try to resolve this problem.

UTILIZATION OF CEREALS FOR ANIMAL FEEDING IN DEVELOPING COUNTRIES

The use of cereals for animal feeding in developing countries was recently considered at the meeting of the Intergovernmental Group on Grains (IGG), held in FAO, Rome in November 1990 (FAO, 1990). The report prepared for this meeting showed (Table 1) that of the total of 900 million tons of compound feed, in grain equivalents, used worldwide in 1988, around 280 million tons were used in developing countries (grain equivalent refers to the feed value of 1 kg of barley in terms of metabolisable energy and protein). Of this total more than half (149

TABLE 1.
Estimated World utilization of livestock feed in grain equivalents

	World			Developing countries		
	Output	Growth rate		Output	Growth rates	
	1988 (m.tons)	1971-80 (percent/year)	1981-88	1988 (m.tons)	1971-80 (percent/year)	1981-88
Concentrates	900	2.4	1.8	279	5.8	3.3
Cereals*	623	2.4	1.1	149	7.1	2.8
Oil meals**	119	4.8	3.3	36	4.7	4.0
Brans & by-products	110	2.3	2.1	74	3.7	2.8
Roots & tubers	32	-0.5	2.4	17	2.9	3.9
Pulses	17	-1.3	12.3	3	1.4	1.9

* Cereals including rice in milled form.

** Includes fishmeal, tonnages are expressed in grain equivalents.

Source: FAO 1990.

million tons) consisted of cereals, including 127 million tons of coarse grains, 12 million tons of wheat and surprisingly 10 million tons of milled rice.

The IGG meeting also assessed the international trade in animal feed. The briefing report showed that whilst developing countries were net exporters of grains (approximately 5 million tons) in the early 1970s they had become net importers by 1988 to the extent of about 21 million tons. It is also of particular interest to note that estimates indicate that between 75 and 80 percent of all shipments to developing countries are cereals used for animal feed production.

The replacement of these imports by local alternatives would enable developing countries to save considerable foreign exchange, which would otherwise have been needed to purchase the imported material, as well as pay related shipping and transport charges. At the same time, the development of local industries to produce substitutes for imported feedstuffs could stimulate local industrial activity and help increase local employment opportunities.

THE NEED FOR INCREASED ANIMAL PROTEIN PRODUCTION IN DEVELOPING COUNTRIES

It is predicted that the population of the world will rise to around 6.25 billion from a current estimate of 5.29 billion by the year 2000 (Table 2). As a consequence the world population will have doubled from that of 1960. Clearly more feed of every type will be required. The current systems of feed production seem to be largely unsustainable and in particularly those associated with the production of animal protein. The clearance of forests to produce land to graze animals, overgrazing of these and existing lands, together with methane and carbon dioxide produced by such activities are currently believed to be implicated in world environmental problems. It is therefore clear that more appropriate and sustainable systems of livestock production and feeding will need to be developed to meet both the current needs and future expansion.

World *per capita* protein production estimates are shown in Table 3. These show that total protein supplies in developing countries (57.6g in

TABLE 2. World Population Growth by Decade, 1950-90, with Projection to 2000.

Year	Population (billions)	Increase by decade (millions)	Average annual increase (millions)
1950	2.515		
1960	3.019	504	50
1970	3.698	679	68
1980	4.450	752	75
1990	5.292	842	84
2000	6.251	959	96

Source: United Nations, Department of International Economics & Social Affairs, World Population Prospects 1988 (New York: 1989)

1983) were around half those of developed countries (99.2g in 1983), of which approximately 20% was animal protein in developing countries but 50% in developed countries.

There is considerable discussion amongst human nutritionists and dieticians on the need to include protein of animal origin in human diets. It is however clear that animal protein is generally more digestible than plant protein, the amino acid balance of the animal protein more closely matches human requirements, other essential nutrients are more common in such products such as iron, calcium, phosphorus, etc. and there are generally less toxicological problems associated with the use of animal products. For these reasons, it is generally easier to obtain a balanced wholesome diet, where animal proteins provide a significant proportion of the total protein consumed.

Reference to Tables 3 and 4 indicates that in theory the amount of total protein available in developing countries should be sufficient to meet the overall populations needs. For this statement to be true it must be assumed that the protein is distributed according to the need and that the protein available is of adequate quality. Table 4 was prepared to indicate the total and variation in protein need by humans of varying age and sex. It is also particularly pertinent to note that the "Safe level of Protein Intake" referred to is based on protein having the quality and digestibil-

TABLE 3. Per Capita Supplies of Total and Animal Protein (in grams per day)

		Total Protein	Total Animal Protein	of which from			
				Meat	Milk	Fish	Eggs
World	1971-73	65.1	21.5	10.0	6.6	3.3	1.6
	1981-83	68.3	23.1	10.9	6.8	3.7	1.7
Developing Countries	1971-73	52.7	9.2	4.1	2.5	2.1	0.5
	1981-83	57.6	11.3	5.1	3.1	2.3	0.8
Developed Countries	1971-73	96.0	52.3	24.6	16.8	6.8	4.1
	1981-83	99.2	56.8	27.3	17.4	7.7	4.4

Source: *FAO Economic and Social Development Paper, No. 80, aspects of the world feed-livestock economy; Structural changes, prospects and issues (Rome, 1989).*

TABLE 4. Example of Safe Protein Intake for a Family Group of Varying Age and Weight

Family Group Member	Age (yrs)	Weight (kg)	Safe Level of Protein Intake (g/day)*
Grandfather	60+	65	49
Grandmother	60+	50	37.5
Male	30-60	70	52.5
Female	30-60	55	41
Female (non pregnant)	18-30	55	41
" (pregnant)	18-30	55+	47
" (lactating)	18-30	55+	58.5
Children:			
Male	14-16	55.5	52
Female	14-16	52	46
Male	10-12	34.5	34
Female	10-12	36	36
Male/Female	3-5	16.5	17.5
Baby	under 1	7-10	14

* Based on protein with the quality and digestibility of milk or egg.

Source: Data extracted from: *Energy and Protein Requirements, Report of a Joint FAO/WHO/UNU Expert Consultation, Technical Report Series, No. 724, World Health Organization, Geneva, 1985.*

ity of milk or egg. In practice it is likely that many of the most vulnerable members of societies in developing countries will be receiving the minimum (or less) quantity of protein and this will be mostly of vegetable origin. For this reason it is likely that a large proportion of such societies will be receiving diets deficient in many of the essential nutrients of proteinaceous origin.

It would therefore appear that increasing the production and availability of animal protein in developing countries is of significant importance if the human populations of such countries are to be adequately fed.

ALTERNATIVE TECHNOLOGIES FOR REPLACING IMPORTED FEED MATERIALS AND MATERIALS FOR WHICH HUMANS COMPETE

There is a range of measures that developing countries can implement in order to alleviate the above mentioned problem. These include:

1. Maximizing the efficiency of current livestock production systems so that all existing resources, including human skills, animals, livestock facilities and feeds are used as efficiently as possible.
2. Establishing what agro-industrial byproducts, that could be used in animal feeding in a country, are currently either unused or used inefficiently and if their use is economically viable use these to replace imported or human feeds.
3. Developing local crops that can be grown to supply the nutrients currently obtained from imports or feeds that might be better used by humans.

The particular materials to be considered in this consultation clearly fall into the latter two categories, though all points should be considered in resolving the overall problem. In particular, the first measure listed above is particularly relevant to the application of the last two. Even in developed countries with well established traditions of byproduct utilization the value of "wastes" (byproducts) or non-traditional feedstuffs has till very recently been disdainfully undervalued. In many such countries this view has now been replaced with an appreciation of their true worth, to such a point, that the profitability of many livestock industries now depends on the use of feeds largely consisting of

byproducts. This change in the traditional approach to livestock feeding has now led to a more commercial approach to nutrient supply, involving the use of crops on the basis of the yields of total nutrients per unit of land and the cost of production of each nutrient. On this basis alone this should result in the utilization of less cereal and more root and tuber crops in many traditionally cereal producing areas (it is of interest to note that the Netherlands are currently using less than 15% cereal in its feed industry).

It is therefore quite clear that wholesale transfer of livestock systems from dissimilar environments is not likely to be either the most economically, nor productively efficient. Most situations, even at individual farm level, are sufficiently different to merit the development of individually designed systems, taking into account local factors and applying fundamental scientific and economic principles.

MATERIALS THAT COULD BE REPLACED BY ROOTS, TUBERS, PLANTAINS AND BANANAS

Cereals generally make up between fifty-five and eighty-five percent of most conventional compounded animal feeds, where they supply a major part of the nutrients provided. Tables 5 and 6 respectively, show a range of compositions for the most commonly produced feeds and cereals. From these it is possible to see that cereals, used at the levels indicated above, will provide not only the main part of the energy in feeds, but a significant part of the total protein, together with minerals and vitamins.

Proteins and essential fatty acids are generally supplied from oilseed cakes and meals and animal and fish protein products, many of which originate from the regions of the world in which most developing nations are located. Developing countries are in fact net exporters of these materials. Over the last two decades these exports expanded at the rate of 6.8 percent a year to reach a level of 29 million tons in the late 1980s.

Considering the above points it would appear that replacement of the cereal component of feeds is likely to offer a beneficial first step towards alleviating animal feed supply problems. The second step should then be to increase the supply of feedstuffs so that animal production can be

TABLE 5.
Compositions of a range of typical compounded animal feed

Feed	Protein %	Energy MJ/kg*	Oil %	Fibre %	Calcium %	Phosphorus %
Broiler Starter	23.0	12.7	3.0	3.0	1.0	0.7
Broiler Finisher	19.0	13.1	3.0	3.0	1.0	0.6
Layer	17.0	11.7	2.0	3.0	3.5	0.6
Pig Breeder	15.0	12.7	3.0	5.0	0.8	0.6
Pig Fattener	16.0	13.0	3.0	3.0	0.8	0.6
Calf Rearer	15.0	11.0	2.0	6.0	1.0	0.7
Dairy Cow	15.0	10.7	2.0	8.0	1.0	0.6

* *Metabolisable Energy, monogastric or ruminant*

TABLE 6.
Composition of a range of cereal grains used in animal feed production

Cereal	Protein %	Energy MJ/kg*	Oil %	Fibre %	Calcium %	Phosphorus %
Maize	9.0	14.2	4.0	3.0	0.02	0.25
Millet	11.0	12.5	3.5	8.0	0.03	0.30
Sorghum	10.0	13.8	3.0	2.5	0.04	0.25
Rice (rough)	8.0	11.2	1.5	9.0	0.10	0.32
Wheat	11.0	13.0	2.0	3.0	0.05	0.35

* *As for table 1*

TABLE 7.
Composition of a range of root, tuber, plantain and banana products
(dry matters)

Product	DM* %	Protein %	Energy ** MJ/kg	Oil %	Fibre %	Calcium %	Phosphorus %
Cassava Root (whole)	36.2	2.8	14.0	0.7	1.6	0.1	0.02
Cassava Leaf	17.8	25.4	9.9 (9.2)	3.7	10.2	1.5	2.4
Sweet Potato Root (whole)	59.0	5.2	13.5	1.2	2.6	0.2	0.2
Sweet Potato Leaf	10.8	19.4	5.8 (10.0)	3.6	12.6	1.8	0.2
Plantain Fruit (mature)	29.4	4.0	14.5	0.8	1.1	0.8	0.3
Banana Fruit (ripe)	31.0	5.4	15.2	0.9	2.2	0.2	0.1
Banana/Plantain Plant	16.0	6.4	3.5 (9.9)	0.8	23.7	0.9	0.3

* DM = Dry Matter

** Metabolisable Energy values for monogastrics, ruminant values in brackets

increased and greater amounts of meat and livestock products made available to all.

The plant materials identified for particular consideration in this consultation, to replace cereals, are listed in table 7. This table also includes an example range of compositions of primary raw materials that may be derived from these plants. A comparison of the compositions of the cereals and the possible substitutes being considered here produces the following conclusions:

1. That, on the basis of their composition alone, the roots, tubers and fruits of plants being considered here would appear to have considerable potential to provide a considerable amount of the nutrient at present provided by cereals in animal feeds.
2. Although the materials referred to in 1. would appear to be able to completely replace the energy component in livestock feeds, they would be unable to provide other nutrients as well as cereal grains. However, the use of a combination of such materials with leafy material from the same plant, although reducing the energy component, could produce a blend of nutrients that could largely substitute for cereals.
3. The lower protein content of possible alternatives referred to in 1. could also be compensated for by better utilization of locally produced protein sources, which are at present exported, or the use of proteinaceous agro-industrial byproducts, azolla, etc.