PROJECT SUMMARY

DEVELOPMENT AND FIELD EVALUATION OF ANIMAL FEED SUPPLEMENTATION PACKAGES (AFRA PROJECT II-17 - RAF/5/041)

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1. BACKGROUND

The basic reason for the poor performance of livestock in developing countries is the seasonal inadequacy of feed, both in quantity and quality. These deficiencies have rarely been corrected by conservation and, or, supplementation, often for lack of infrastructure, technical know-how, poor management, etc. In addition, many feed resources that could have a major impact on livestock production continue to be unused, undeveloped or poorly utilised. A critical factor in this regard has been the lack of proper understanding of the nutritional principles underlying their utilisation.

The Joint FAO/IAEA programme has supported animal production research in Africa for many years through country Technical Co-operation (TC) Projects, Regional Projects (AFRA) and Co-ordinated Research Projects (CRPs). These activities have helped to build up the infrastructure needed in the countries concerned to conduct much of the research in animal reproduction and nutrition. In the past the Agency has provided technical assistance in defining reproductive indices of ruminant livestock species and identifying nutritional constraints to productivity of animals maintained on smallholder farms under various topographical and environmental conditions.

During the period 1993–1996, activities of AFRA Project VIII, 'Radioisotopes in Animal Reproduction and Nutrition', have been aimed at consolidating these past experiences and establishing the relationship between productivity, feeding, and management in order to develop strategies to raise sustainable output. The development of feed supplementation strategies was to be based on locally available and affordable feed resources. Radioimmunoassay for progesterone was to be used to assess the status of animals prior to and following changes in feeding and management strategies.

Activities carried out under the AFRA Project VIII, have identified poor nutrition and poor reproductive performance as two major constraints limiting livestock production, especially in peri-urban dairy production in Africa. Therefore, the ***introduction of improved feeding practices*** *based on* ***strategic supplementation*** *using* ***locally available feed resources*** (e.g. urea-molasses multinutrient blocks, tree legume leaves, mineral supplements, high quality forage, brewer's grain, etc.) was expected to not only enhance milk production but also to introduce a sustainable farming practice that will ensure a continuous supply of milk and milk products.

The major achievements of AFRA Project VIII are summarized as follows:

- *Poor nutrition and poor reproductive management* are two most important constraints to livestock productivity in Africa.
- Past technical assistance from the IAEA has been *useful in characterizing the indigenous species of livestock* in many African countries, in relation to their productive and reproductive parameters.

- A considerable amount of *information has been generated on the feeding value* of many local feed resources that are not in direct competition with man or monogastric animals.
- Many countries in the region have recognized the *importance of developing supplementary feeding strategies* for improving the productivity of ruminant livestock. Attempts have been made to use locally available feed resources for developing such feeding strategies. A number of *Member States have developed feeding packages* that required field validation and testing under existing smallholder farming conditions in the respective countries.

2. SCOPE AND OBJECTIVES OF THE PRESENT PROJECT

In view of the satisfactory progress of AFRA Project VIII in identifying the major constraints to livestock productivity in the region, and the recognition of many Member States of the importance of supplementary feeding for improving milk and meat production, a regional strategy was proposed for developing affordable and sustainable supplementation packages for improving productivity from smallholder farms using locally available feed resources.

The new Regional Project was initiated in 1997 with the following objectives:

- To produce a supplementary feed in the form of a convenient and easy-to-use package for improving milk and meat production in peri-urban areas
- To promote the uptake of this technology through demonstrations of its advantages in terms of increased productivity and benefit:cost ratio
- To maximize the use of locally available feed material such as molasses, cereal bran, legume tree leaves, oil seed meals, etc. for feeding ruminant livestock, thereby reducing the use of high cost concentrate feeds
- To promote technical co-operation amongst developing countries (TCDC) in the region and take advantage of established infrastructure and available human and technical resources to solve problems of common interest.

From 1997 until 2000 the project has been operational with 13 Member States participating in various project activities. The project activities included Research Planning and Review Meetings, Expert Visits, Regional and National Training Workshops, Fellowship Training and Scientific Visits to National Agricultural Research Systems.

The final review meeting of the project was held from 25 to 29 November 2000, in Cairo, Egypt, under the auspices of the Egyptian Atomic Energy Authority. The meeting was attended by 9 of the 10 nominated Project Co-ordinators from 10 AFRA Member States (Cameroon, Egypt, Madagascar, Mauritius, Nigeria, Sudan, Tunisia, the United Republic of United Republic of Tanzania and Zambia).

3. TECHNICAL SUPPORT

The technical assistance and cooperation for the Project was oriented towards:

- providing technical advice on developing feed supplementation strategies, e.g. the production of urea-molasses-multinutrient blocks, mineral supplementation packages, legume tree leaf and/or agroindustrial by-products based practices, etc.
- supporting the organization and execution of regional technical meetings and training courses

- providing training on radioimmunoassay (RIA) for progesterone, development of supplementation strategies using *in vitro* and *in vivo* approaches, and methodologies for technology transfer, to professional staff, through regional training workshops, fellowships and scientific visits
- providing RIA kits for progesterone togetherwith appropriate standards, the assay protocols, and external quality assurance services for use in the project to evaluate reproductive performance of animals in response to supplementation strategies being developed and tested by the participating groups
- promoting the establishment of specific agreements for the provision of technical expertise, biological material and financial resources between countries
- encouraging countries in the region to adopt technological strategies which are well proven and cost effective.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1. General

- All participating Member States have developed feed supplementation packages based on locally available feed resources and have completed on-station and on-farm studies.
- Those Member States that extended the packages to the farmers have been able to determine the cost effectiveness of the packages.
- Six regional training workshops have been completed as programmed.
- National workshops were organized by 90% of the participating Member States.
- A training Manual on “Guidelines for Development of Feed Supplementation Packages” was compiled and is available to AFRA Member States.
- Some participating Member States have compiled a database on "Feed Resources and Reproductive Parameters of Livestock".
- Radioimmunoassay (RIA) facilities have been upgraded in all participating Member States and the solid state RIA technique has been established.
- All participating Member States have successfully participated in the external quality assurance programme for RIA.
- The project has lead to the successful co-operation between scientists from AFRA Member States and the willingness to plan together for the future.
- All participating Member States who have completed on-farm studies should ensure wider application and extension of the packages.
- All Project Coordinators who successfully developed and tested supplementation packages should develop strategies for sustaining them by establishing suitable mechanisms such as establishment of a revolving fund system or entrusting the manufacture of the package to a private industry.
- Where applicable Project Coordinators should incorporate the project activities into their national R & D programmes.

4.2. Scientific

- Feeding standards as practiced in developed countries could be misleading when non-conventional feed resources are used in formulating rations for ruminant livestock in developing countries. The alternative approach to the use of feeding standards would be to ensure that the production system matches the available resources. The development of feed supplementation strategies based on locally available feed resources should take into

account the nutrient needs of the two-compartment system represented by the micro-organisms in the rumen and the host animal.

- The nutritional value of cereal crop residues to ruminants is constrained by low N and high fibre contents. These constraints can be alleviated by treatment with alkali, the most suitable of which, for smallholder use, is urea. Technical interventions and adaptation procedures suitable for a range of conditions, imparting flexibility to the urea treatment, have been identified. These will lead to widespread adoption of this technique in Africa.
- The *in vitro* gas production technique enables selection of a feed for high efficiency of microbial protein synthesis in the rumen along with high dry matter digestibility, and provides a basis for development of feeding strategies to maximise substrate fixation into microbial cells. The microbial protein production can be determined using the isotopic (^{15}N, ^{32}P, ^{35}S incorporation) and non-isotopic (DAPA, purines, 16S RNA). Introduction of this technique in Animal Nutrition Laboratories in the region is suggested.
- Up to 90% reduction in tannin levels could be achieved by anaerobic storage of tannin-containing feeds in the presence or absence of urea, by the use of oxidising agents, by the treatment with white-rot fungi or by the use of polyethylene glycol, preferably in a slow release form. These approaches enhance the biological value of tannin-rich feeds.
- The crop-livestock mixed system has the advantages of allowing diversification of risks, using labour more efficiently, recycling wastes thus preventing nutrient losses, adding value to crops and crop products while providing cash for purchasing farm inputs. The major constraints in most crop-livestock mixed systems on smallholder farms in African countries are: the negative soil nutrient balance, and low digestibility of feeds especially in the dry season. In Zambia, the technologies have been identified that can be introduced to smallholder farmers to improve quantity and quality of feeds and to increase animal productivity. These are: improving soil by mulching, conservation tillage, introducing multipurpose fodder shrubs, grasses and legumes to reduce soil erosion and as animal feed, improving feed quality through treatments of crop residues, reducing nutrient losses from manure by stall feeding, strategically supplementing specific classes of animals (e.g. lactating animals) to improve efficient use of limited feed, and using multi-nutrient feed blocks.
- Poultry waste has been successfully used in ruminant rations in Egypt. The total bacterial count was considerably lower in sun dried poultry waste compared to the oven dried waste. Aflatoxins were not detectable in the concentrate mixtures containing poultry litter. Both feed intake and milk production in ewes was not affected by the inclusion of 14% poultry waste as a dietary supplement, suggesting that cottonseed meal and other high protein feed ingredients could be, at least partially replaced, by poultry waste without any loss in productivity. The weight and age at puberty of lambs fed a ration containing 17% poultry waste was similar to those given a ration without any poultry waste. Similarly, poultry waste up to 20% in the diet had no detrimental effect on growth in cattle and buffaloes and on the reproductive performance in buffalo heifers evaluated. The inclusion of 15% poultry waste in mixed concentrate feed decreased the cost of feed by about 10%.
- In Ghana, cows fed 1.5 kg concentrate generated the highest net income from milk sales. They produced 53% more milk and 16% more milk revenue than the control cows. A sustained means of information dissemination was considered vital for the growth of the emerging dairy industry in the Kumasi area. Farmers should be encouraged to form and sustain their own trade associations which could raise funds to ensure that member farmers receive vital information for their efficient operation.
- The daily consumption of 0.6 kg urea-molasses minerals blocks (UMMB) resulted in an additional 30 to 55% milk production during the dry season in Madagascar, with a cost:benefit ratio of 1 : 4 to 1 : 5 and an extra income of US$ 0.365 per litre of milk.

- Supplementation of forage with feed concentrate and with UMMB increased milk production by 1.26 and 1.5 litres per cow/day respectively, and significantly improved body condition score and body weight change. Both supplementation strategies had no significant effect on reproductive performance, as judged by RIA for progesterone. However, there was a slight reduction in the number of days postpartum (DPP) to first progesterone rise (65.3 vs. 77.6 days), DPP to conception oestrus (120.2 vs. 128.7 days), and calving interval (400 vs. 414.5 days) in the block supplemented cows compared to non-supplemented control animals. Conception rate improved from 48% to 68% in the supplemented cows. The increase milk production gave a profit of US$ 0.11–0.29 per cow/day, which was a considerable increase in income for smallholder farmers in United Republic of Tanzania.
- Leguminous browses; *Calliandra calothyrsus, Leucaena leucocephala,* and *Gliricidia sepium* have been successfully incorporated into the diets of West African Dwarf Goats in areas around Dschang in Cameroon. The supplementation improves growth and body conformation of the animals, giving an additional revenue of at least 4500 CFA without incurring any additional costs.
- In Tunisia, mineral supplementation in the form of di-calcium-phosphate significantly increased the body weight (by 1.67 kg) and the average milk fat content (by 5.6 g/L); and decreased the inter-calving interval by 38 days. The body condition score of the cows and the milk quantity and quality (protein and density) tended to be higher in the mineral supplemented group.
- The supplementation of lablab to diets of Bunaji cows in Nigeria increased milk by 79% and body weight by 224%. The gross benefit of supplementation was Nira 3458 per cow with the cost:benefit ratio of 1:1.5.
- Supplementation using the UMMB improved milk yield of cows giving a net financial benefit of Rupees 450 per cow per lactation, under Mauritius conditions. Cows that calved resumed ovarian activity earlier in the block supplemented animals (67 vs. 73 days).
- In Sudan, poultry manure-molasses mixture used as a complete diet in the sedentary system, and molasses as a substituted diet in transhumance system significantly increased milk yield. In sedentary, migratory, and transhumance production systems, the cost: benefit ratio from milk sales increased by 75%, 67%, and 162% respectively after the supplementation.
- A large quantity of crop residues is available in African countries for livestock feeding. The low protein/fibrous materials (crop residues and natural grazing) have a pivotal role in dry season feeding, and, therefore, a modest improvement (5–10%) in their feeding value would substantially reduce the effects of underfeeding on both survivability and production. The nutritive value of residues can be improved by correct harvesting and storage, supplementation with N and physical and chemical treatment. Further work is required on conservation of fodder, as silage, for milk production.
- Of the tools suggested here, a combination will probably be most effective. It is for the extension worker and farmer to decide on the options most appropriate for a given set of circumstances. Availability and costs of off-farm inputs, together with the perceived value (sales and outputs used within the household) should be the determining factors. The options presented here should not be seen as definitive. Further research is needed, particularly at the farm level. Closer collaboration between those in development within the Africa region is called for.