PROCORDEL National Conference
The Gambia

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Livestock Research for Development

PROCEEDINGS

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FOREWORD

This Conference under the theme *Livestock Research for Development* is regarded as a forum that brought together researchers from National and International Research Institutions, namely the International Trypanotolerance Centre, Government Departments with a stake in livestock, development agents, NGO's, donors and beneficiaries. Admittedly, a diverse group, but brought together with the intention to share results of three years work under the EU-funded, ITC led project PROCORDEL.

This Conference marked an important point in the life of both the institution and the project: this Conference formed part of an *ITC Emphasis week* that culminated in ITC's second *Open Day*, attended by His Excellency, Dr A.J.J. Jammeh, President of The Gambia.

Research institutions have often been criticised that results of often costly and lengthy research do not reach the end-user for whom it is destined for, in the case of livestock related research: the farmer and his animals. A veritable effort has been made by ITC/PROCORDEL not to fall into this trap again. The most important strategy was to actively involve the national partners, mainly the Department of Livestock Services and the National Agriculture Research Institute and their outreach agents, right from the beginning. An international institution cannot be as close to farmers as national institutions can be; therefore work destined for these target groups has to be implemented largely through the national partners.

The ITC/PROCORDEL has tried to address livestock improvement in a dual approach:

- Find and test appropriate solutions for the predominant low-input extensive livestock sector improvement
- Offer and test innovations for the evolving particularly peri-urban, often crop-livestock integrated market-oriented livestock sector

This approach is in realisation of the fact, that farmers, though appreciating the resistance and hardiness of the predominant trypanotolerant breeds in this country, do make decisions to also choose other improved breeds and breeding methods to increase their production output.

The project, which covers 11 countries (work in five countries is coordinated by ITC), has the unique opportunity to study constraints to the livestock sector also across borders, and to compare results. Many of the studies that are presented here were also carried out in Senegal, Guinea and Guinea Bissau. Though we will focus here on the Gambia studies, results are also available for the other countries!

This approach has certainly also enhanced networking and cooperation within and between countries and the respective sister institutions, namely the NARS. ITC/PROCORDEL has regularly convened regional meetings to enhance exchange of experience, difficulties and research results. Other projects, NGOs and donors were also integrated into this active network to strengthen the critical mass and increase funding.

It is well acknowledged that ITC/PROCORDEL is not the only project in support of the development of the livestock sector in The Gambia, but that there are many others. This Conference has therefore offered to all interested parties a platform to be used to convey their messages and to receive feedback from their stakeholders as active members in the process of livestock development for the improvement of livelihoods.

The Conference brought together 106 participants from NARS (NARI), Government Departments, international organisations (EU, FAO), the University of The Gambia, the private sector, individual farmers, farmer organisations (GILMA, Farmer's Platform) and

dairy cooperatives. Some highlights of Procordel research was also highlighted in a poster show during the Conference.

It has been a great challenge, opportunity and honour for me to coordinate and to give technical assistance to this project at ITC.

Susanne Münstermann
Technical Assistant (Regional Coordinator) for Procordel

ACKNOWLEDGEMENT

The Organising Committee of this Conference, namely Dr Andreas Schönefeld (Chairman, ITC), Mr Omar Njai (then Director DLS), Mr Jabel Sowe (Acting Director DLS), Dr Musa Bojang (Director NARI), Mrs Aminata Njie (DLS), Dr Arss Secka (NARI), Mrs Maria Cardos (Secretary, ITC) would like to thank all those who have contributed in making it a success.
On behalf of the researchers we would like to thank particularly the Livestock Assistants and other field based staff who did most of the ground work.
Special thanks go to the Delegation of the European Commission to The Gambia, namely to the Chargé d'Affaire, Mr Thierry Mathisse, for his support to timely provision of funds for the project's implementation.
The national partners of ITC, namely DLS and NARI, are the principle contributors to these projects' outputs and deserve full appreciation.
Some of the studies form part of PhD theses and are supported by European Universities and scholarship donors. Our thanks go to the University of Utrecht and the Institute for Tropical Medicine Antwerp (ITM), Wageningen, Leuven, Hohenheim and Berlin as well as to WOTRO, DED, IFS, EFP for scientific, supervisory and financial support to Messrs B. Faburay, A. Bosso, J. Somda, S. Nouala and M. Hempen, respectively.
The funding of activities carried out under PROCORDEL was provided by the European Commission under EDF 8 (REG 6157).
We would like to thank the Director General of ITC, Dr Kwaku Agyemang, for his continuous support to the successful implementation of this project.

LIST OF CONTENTS

1. OPENING ADDRESSES

The Chairman, Director General International Trypanotolerance Centre, Dr Kwaku Agyemang

I wish to express my appreciation to the Organising Committee of this National Conference on the EU-funded Project PROCORDEL, for selecting me to chair this Opening Ceremony of the Conference.

Let me first welcome all of you to this occasion and to thank you on behalf of the organizers for honouring the invitation. As you may by now have heard, this Conference is held as part of an ITC Emphasis Week. The main objective of the Conference is to share results obtained in The Gambia of this regional project, with stakeholders in The Gambia.
From the Centre's viewpoint, the holding of this Conference is a significant milestone in the process of developing partnerships with collaborating institutions. It allows our investors to see at first hand the fruits of working together with these partners, as we share here a common platform to present the results of the joint activities carried out. Secondly, it gives credibility to the Institution's claim to be able to work with a range of partners within a country and in the region as a whole. The PROCORDEL funding mechanism allowed the Centre to test the new paradigm of R&D that postulates that regional-based approaches are more efficient, arising from the use of harmonised protocols in solving problems of regional relevance.

Chargé d'Affaires of the European Commission in The Gambia, Mr Thierry Mathisse

It is a pleasure for me to address this National Conference on *Livestock Research for Development* that has been initiated by PROCORDEL, one of the EC funded regional programmes.

The support to the livestock sector by the European Commission has a long history in The Gambia and this support has been extended to include also research, effectively since the 6th EDF in 1985. Over the years the main focus of this support has also widened from rather specific support to disease investigations to today's systems approach based on research for development.

Support to the livestock sector can intervene at different levels. In the case of this EC-funded project, the objective was to include as many stakeholders as possible, including the farmers of course, and to link research with extension services.

With an institution like the International Trypanotolerance Centre based here, The Gambia is well situated to play a central role in the coordination of such a regional project, which includes 13 West African countries. Of those, the ITC coordinates the work carried out in the framework of this project in Senegal, Guinea, Guinea Bissau and Sierra Leone. Liberia was also entitled to join the project, but was unable to do so for obvious reasons.

The EC has also a long history of giving support to the ITC to implement such complex programmes. It is well understood that such a centre is ideally placed to give scientific back-

stopping and support to the National Agricultural Research Centres, not only in The Gambia but also in the Region.

The PROCORDEL project enhanced this role of ITC, and partner countries have expressed their satisfaction about this type of cooperation. This inter-institutional collaboration between National Research Systems, International Research Institutions and supra-regional bodies like CORAF has been very active under this project and has led to efficient networking amongst these institutions.

One of the key objectives for the allocation of EC funding to ACP countries is this aspect of *regional integration* at various levels – and agriculture and livestock development are certainly one. A well functioning network that allows for easy flow of information, collaboration on given research questions across borders and exchange of knowledge and technologies, is a good example for this type of integration.

Although this Conference will address mainly the results produced by this project in The Gambia, we should bear in mind, that many of the research questions that were addressed here, were also investigated in the neighbouring countries. This adds a different dimension to results, since they can be compared within a region and control strategies can be formulated accordingly,

In The Gambia, the key collaborators on this programme were the Department of Livestock Services and the National Agricultural Research Institute. Through these institutions, the project co-opted also the assistance of other projects and even co-funding; the outreach to the farmers, one of the key objectives of PROCORDEL, was also greatly facilitated by the national partners.

PROCORDEL was set out as a very ambitious project, designed to produce research results that are directly usable by the farmers. The programme as it was conceived originally, will end in March 2004 and it is now in the final stage of conclusions and attempts to disseminate as many of its results as possible. This Conference will contribute to this sharing of information among stakeholders.

FAO Resident Representative,
Dr Heimo Mikkola

It gives me great pleasure to attend this very important ITC activity. I am one of those few who have been able to follow ITC's activities and developments since its beginning in 1982. By being an ADB staff at that time, I visited these hotel surroundings and ITC grounds before anything had been built.

Only a sandy track came here from Banjul when we laid the first stone of Sene-Gambia Hotel. Not a sign of any other buildings and only a lot of palm trees in the place were ITC now stands, no Kairaba Hotel where we now have this Conference – and that is only 20 years ago!

Since ITC's foundation, FAO has always been a close partner to it as we share the same concern, which is to improve the welfare of livestock owners and people who depend on

agriculture and livestock. Our latest cooperation through a TCP is dealing with improved milk processing and ITC is housing the Training and Demonstration Unit including the first MILK-PRO pasteurisation unit in The Gambia.

The same goes with EU and FAO cooperation with PROCORDEL. EU is the only non-country member of FAO. This membership guarantees a close cooperation in the fields of agriculture and environment, and livestock development especially has always been important for the EU. So EU funds have financed a number of regional FAO projects especially in the fields of transborder animal diseases, like Rinderpest.

It would be unfair not to mention also DLS and NARI as mutual partners of FAO and ITC.

I wish you fruitful deliberations during this Conference and I shall look forward to attend ITC's second Open Day on Saturday.

Director General National Agricultural Research Institute (NARI),
Dr Musa Bojang

This Conference on the EU-funded PROCORDEL project is an opportunity for ITC and local partners that were involved in the project, such as NARI, to share information and experiences gained from the research activities conducted. NARI is the NARS of The Gambia, which is modest and growing with a broad mandate for research in agriculture and natural resources.
Agricultural research is demanding on resources, and operating funds for NARI from national contribution has been inadequate. Our research requirements for equipment, implements and inputs also have substantial foreign exchange dependence, which is most times unaffordable. Research at NARI, as a result of institutional history has been, therefore, restricted to priority programs associated with crops.
Funding and human resources limit research in other commodities, such as livestock. The livestock research, which has just started at NARI, is modest and calls for collaborative work with ITC and other NARS to enhance and backstop our capacity.
Our participation in the PROCORDEL project has been a capacity building process in livestock research for us at NARI, which also marks the beginning of a long-term research partnership with ITC. NARI and ITC have been partners in animal health and socioeconomic studies under the PROCORDEL project. In addition, a number of NARI professionals and technicians also benefited from ITC-based training programs on project planning, computer application in research and data analysis, using various statistical packages. We acknowledge ITC's technical support in that respect.
However, the variable experience of NARI and ITC in crops and livestock research is an additional opportunity for closer collaboration. Whereas our research is commodity based and institution specific, the beneficiaries of our research results operate an integrated system of crop and livestock with commodity interdependence. The need is therefore a collaborative approach in a participatory manner to develop research activities of mutual interest and relevance. The problem of nutrition, for example, is across the board for crops and livestock. The low crop yields obtained by farmers are partly due to declining soil fertility, as a result of removal of nutrients through cropping without external input. Inorganic fertilizers can be

scarce and sometimes unaffordable. Our soils are also low in organic matter (<1%) which is the key to soil fertility. Removal of crop residues from the field retards organic matter accumulation overtime under intensive cultivation. Crop residues, on the other hand, are also a major component of dry season feed resources. Tethering with added advantages of weed control is the best option for soil fertility restoration, but is slow in building soil organic matter, and also not available to all producers. For this, and other resource competition at the crop-livestock interface, NARI will continue to collaborate with ITC in developing strategies that promote crop and livestock productivity.

Deputy Director Department of Livestock Services (DLS),
Mr Jabel Sowe, ***presented by Dr Eunice Forster***

I want to take cognisance that this occasion is not meant to appraise the ITC as an institution but to map out the growing, pertinent and long-standing partnership with DLS over the years. Before the ITC got settled in its Kerr Serign Headquarter, the Centre's research activities were kick-started by the Department of Livestock Services, with the provision of office space, laboratory facilities and support staff. Furthermore, the Government of The Gambia played a major role in the establishment of the ITC through the provision of an ADB Facility negotiated through the old Livestock Development Project, which was used to fund the building of the current infrastructure.
However, as the years passed, and as more research programmes were implemented, it was found necessary to enhance ITC's closer collaboration and consultation with the NARS and the other development agencies – in addressing the needs of farmers, particularly in the dissemination of research results for adoption by the livestock farmers.

The creation of a Standing Committee on research and development with membership drawn from NARS, DLS and ITC with the task of coordinating programmes and fostering closer collaboration and liaison assisted in this endeavour.

Today, therefore, I am very pleased to affirm that ITC, in implementing its various research programmes, like PROCORDEL, which are all aimed at improving livestock productivity whilst preserving the environment, has maintained a new partnership with the DLS and the other national agricultural research/development institutions.

This new partnership is based on continuous dialogue between the ITC and NARS/development institutes culminating in the identification of research and development priorities and the joint formulation of implementation strategies for the activities essential for livestock development, namely the enhancement of rural incomes, the contribution to the achievement of National Food Security and Poverty Eradication.

Based on the PROCORDEL results, DLS and ITC have jointly implemented the transfer of the following technologies to the farmers who are the ultimate beneficiaries. Just to name a few:

- Dissemination of genetically improved indigenous breeds of cattle and small ruminants as a result of the pure breeding programme which aims at increasing the production of local livestock

- Cautious introduction of crossbred F1 animals to farmers in the Peri-urban area for improved milk production
- Implementation of the FAO funded TCP on improving milk safety and increasing farmers income using the *Village Milk System* around the Kombos targeting women groups and other stakeholders
- The piloting of *Intensive Feed Gardens* under IFAD sponsorship using adopted fodder legumes like leuceaena leucocephala and cajanus cajan with the aim to improve livestock nutrition and production.

Other areas of strong collaboration between the ITC and DLS are training, information exchange and capacity building. This is in recognition of the fact that human resources development is pivotal in any research and development program. It also recognises the fact that the Gambian situation of shortages of well trained staff, limited funds, limited information and inadequate opportunities are the factors which negatively impact on the effectiveness of disseminating technologies and innovations to farmers.

Although I believe that international and regional Centres have very important roles to play in research and development in the foreseeable future, I also equally believe that the future progress of Research and Development belongs to a strong NARS and to the further empowerment of local research and development agencies. Therefore, in the spirit of the PROCORDEL initiative in promoting capacity building and information exchange, I wish to encourage the ITC to maintain and further catalyse this collaboration even after PROCORDEL.

In conclusion I would like to encourage all of you to make use of this excellent opportunity to participate fully in the technical presentations and discussions scheduled for this important Conference.

President of Farmers Platform, *presented by Mahamadou Fayinkeh*

This gathering today is especially meant for members of the National Farmers Platform and we believe that the implementation of the research results will go a long way in achieving some of the aims and objectives of NFPG members.
It forms part of the National Farmers Platform's strategy to liaise closely with research institutions, and extension agencies in order to allow the farmers to benefit from the implementation efforts.

I would therefore like to express my sincere thanks and appreciation to the International Trypanotolerance Centre who have always made sure that we participate and benefit from their programmes. NARI, of which we are Board members, together with DLS and ITC have all contributed greatly in bringing together the researcher, the extension workers and the implementer into one family.

I will not end my statement without giving special thanks to the donor EU for accepting to fund this project with all the conditions around it. I am urging them to give us a helping hand

because there is a need to continue the second phase of the project in the form of partnership also with the ultimate beneficiaries, the livestock farmers.

Deputy Permanent Secretary, Department of State for Agriculture,
Dr Badara Loum

The Gambian Government's policy for the livestock sub-sector continues to stress the need for diversification and commercialisation of livestock whilst concomitantly maintaining the balance between production levels and feed resource availability. This project is in line with the policy objectives of the sub-sector as it provided support to the improvement of livestock production, particularly in the enhancement of meat and milk production. You will agree with me that these products are essential in meeting the growing demand by our people for locally produced quality products of animal origin.

The project PROCORDEL has supported the attainment of the mentioned policy objectives through the development of consolidated strategies for better exploitation of the potential of our indigenous stock, such as the N'Dama cattle, the Djallonke sheep and the West African Dwarf goats. It is worth mentioning that genetically improved male breeding stock of these three species are now available to farmers in The Gambia for breeding with their own animals, this will lead to the upgrading of the local flocks and herds, resulting in a higher productivity of these hardy animals. This process is supported by the formation of farmers associations that in partnership with the Department of Livestock Services will manage the dissemination of these improved animals.

Furthermore ITC's efforts in the development of an emerging peri-urban dairy sector are commendable. The introduction of crossbred cattle breeds in the peri-urban area has been successful, and I have been reliably informed that the crossbred cattle are now accessible to the end users – the farmers. This innovation offers great opportunities for increasing domestic milk production to substitute for imported dairy products.

Government has clearly expressed its support to this initiative by allocating HIPC funds for the further expansion of the crossbreeding programme. However, such a development required a lot of support, monitoring and supervision and it is appreciated that PROCORDEL provided the requisite support for this programme to succeed.

The milk produced through such schemes and also from the local cows shall now be improved in quality through better processing and marketing. The formation of dairy cooperatives is also under way and with the assistance of FAO of the United Nations. Fully equipped dairy units are being supplied to these groups. This will greatly improve the availability of fresh milk to the citizens, given that shelf life of the products will be prolonged and a healthy product will be guaranteed.

The project has also given a major boost to ITC's training programme and many stakeholders in the livestock sub-sector have benefited from it, e.g DLOs, LAs, VOs, livestock owners, milk vendors, slaughter house personnel and herdsmen. It is worth mentioning that during the project period a total of about 100 Gambian professionals and

technicians have been trained at ITC, at YBK and also outside The Gambia, as well as 350 livestock farmers and other persons as ultimate beneficiaries of the project.

This project has also greatly contributed to regional integration in terms of collaboration between the West African Research Centres, Government Agriculture and Livestock Departments and other stakeholders in this sector. The Gambia has hosted a significant number of meetings and training courses for participants from the ITC's mandate countries, namely Senegal, Guinea, Guinea Bissau and Sierra Leone. It is regrettable that Liberia could not benefit from the programme as originally planned.

The Government appreciates this EU funded project for its strategy to implement activities through the national agencies in-charge, hence increasing their capacity. Furthermore, the outreach to the ultimate beneficiaries of research, the farmers, has become visible and tangible and the impact on the livelihoods of farmers is being realised.

Collaboration between the ITC and the national bodies will not end after this project but it is realised that these links have been very active during its lifespan and we are hopeful that this will remain so also in the future.

In concluding, I hope that this Conference will not only concentrate on the implementation and achievements of PROCORDEL but this opportunity should also be utilised to critically review and pave the way forward for livestock development in this country.

I am convinced that we will have two very interesting days ahead of us and I would like to invite you to actively participate!

With these few remarks, it is my singular honour and privilege to **declare this Conference open.**

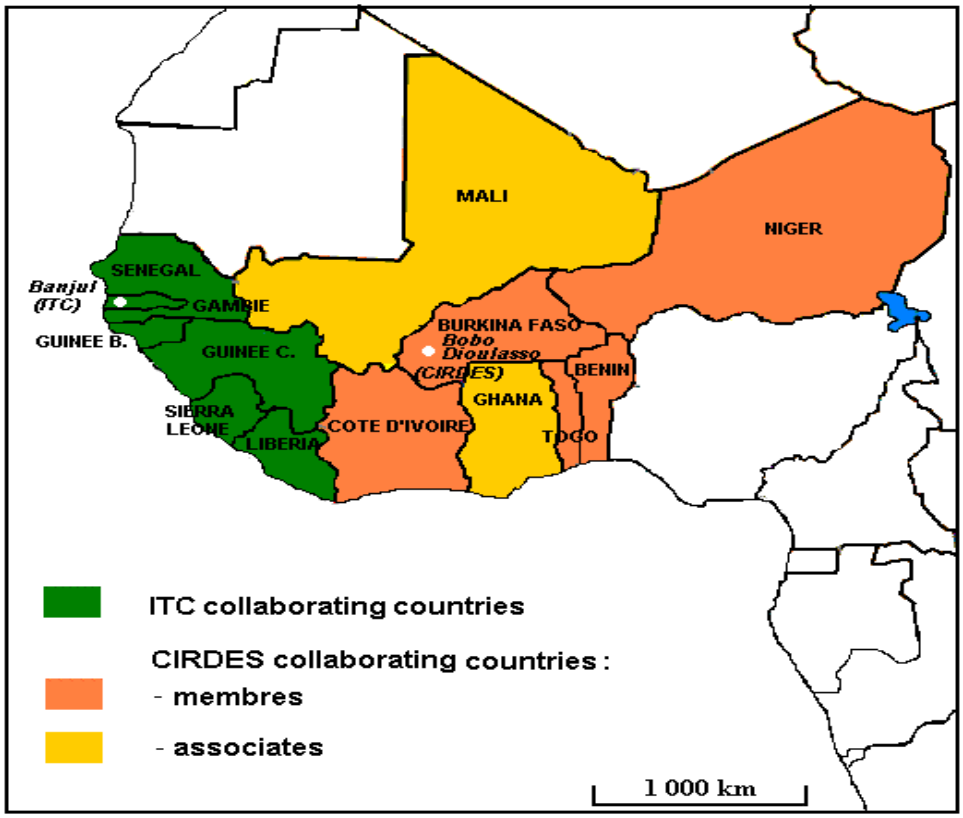
SESSION ONE

This session, after a brief introduction to the PROCORDEL Project, focused on some major research and development activities in the *Low-input system* which is predominant in The Gambia.

AN OVERVIEW ON THE PROJECT PROCORDEL

Presented by Susanne Münstermann, Regional PROCORDEL Coordinator

The *Projet concerté de recherché-développement sur l'élevage en Afrique de l'Ouest*, a regional project funded by the European Commission, looks back on a history of previous support to the livestock sector in the sub-region. During the EDF 6 (1985 to 1990) the two countries Senegal and The Gambia received support from the EU that focused on epidemiological assessments of prevailing diseases and established the productivity status of indigenous livestock. Based on the promising results, the scope of countries was enlarged during the funding under EDF 7 (1993 to 1999) and included Senegal, The Gambia, Guinea, Côte d'Ivoire and Burkina Faso. Emphasis during this period was on characterisation of farming systems with the identification of household constraints, the establishment of a basis for technology testing and some pilot interventions.



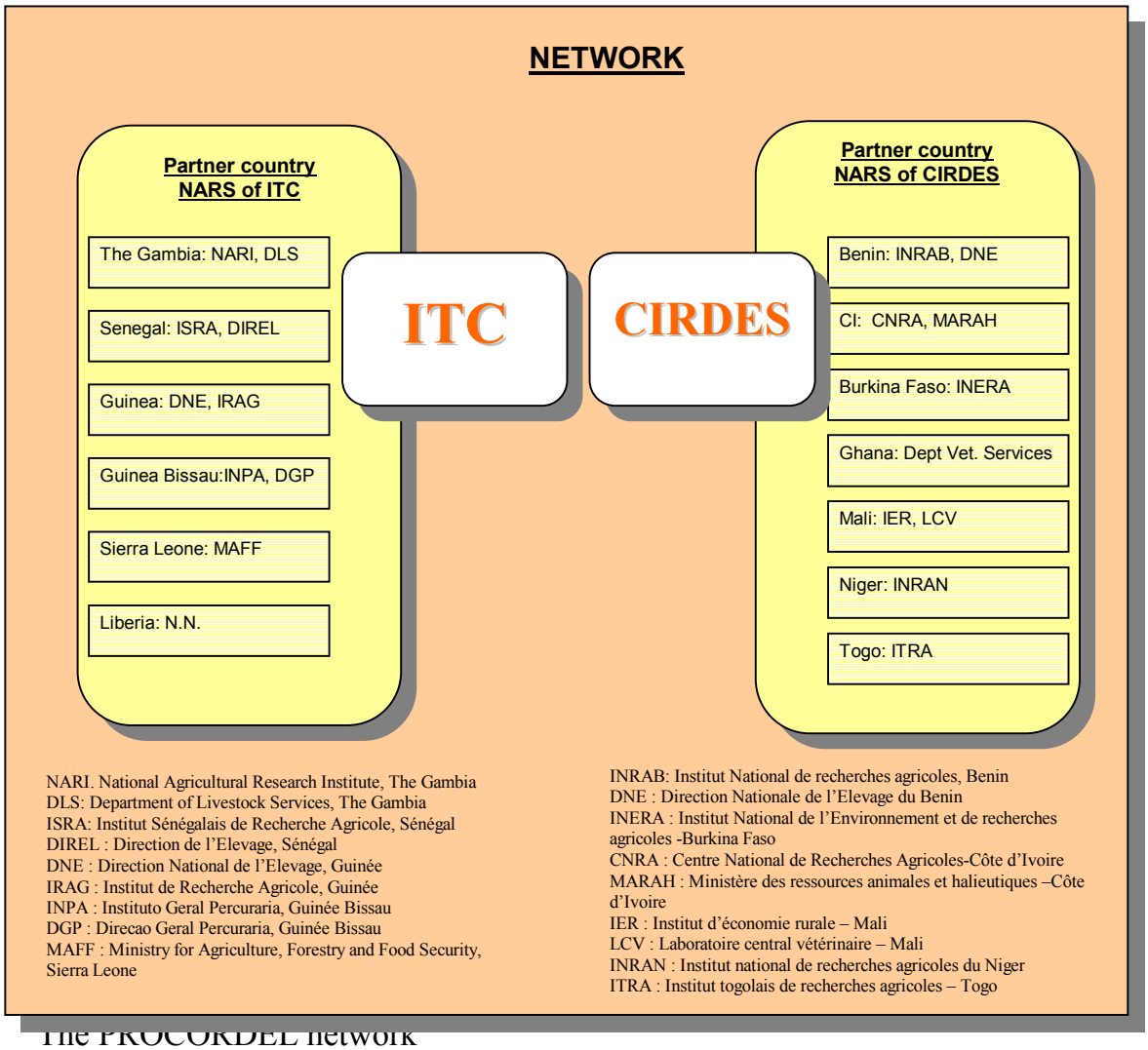
Countries covered by PROCORDEL

At the end of this last EDF funded project it was felt that a much better integration of the NARS in the region is needed to bridge the gap between research and the ultimate beneficiaries, namely the producers, hence a new project was proposed.

A CORAF led conference in Dakar in 1999 brought together the representatives from ITC's mandate counties, namely The Gambia, Senegal, Guinea, Guinea Bissau and Liberia. At this conference, national research agendas were presented and prioritised, with emphasis on those of regional importance. A similar exercise was carried out at the ITC's sister institution, CIRDES in Burkina Faso.

The outcome was that 13 countries subscribed to the idea of asking for financial support to enhance the capacity of their NARS to carry out adaptive research in support of livestock development. However, it was also realised that scientific guidance and coordination by the two sub-regional livestock-based International Research Institutions, ITC and CIRDES, would be of advantage in respect to regional integration.

The concept of PROCORDEL was thus born!



The PROCORDEL network

The key information on this project is: it covers a 4-year period (May 2000 to April 2004), is funded from the 8th EDF at a global budget of 8 Million Euro and targets livestock producers, extension agents, farmer's associations and decision makers as the recipients/beneficiaries. For each country a ***National Coordinator*** has been nominated (for

The Gambia: Mr Omar Njai up to 9/03, followed by Mr Jabel Sowe). The programme is implemented within the institutional setting of ITC into which it is fully integrated.

The ***Objectives*** of the programme are:

> The programme aims at a sustainable increase in stock breeders' incomes, greater availability of animal proteins and improved food security in West Africa.

The ***Purpose*** of the programme is:

> To help the intermediate and final beneficiaries of research (stock breeders, outreach agencies, decision-makers) do their tasks better by applying recommendations resulting from the research programme.

The ***Results*** of the programme are:

1. The research themes, eligible in the current programme, are defined using criteria that will allow addressing the beneficiaries' felt needs through a participatory process
2. The research projects on the selected themes are implemented and generate directly useable results
3. The research results are passed on and put at the disposal of the beneficiaries

To refine the initial research agenda set as a result of the CORAF conference and the first Work programme, ***Annual Planning Workshops*** were held at ITC with up to 4 country representatives participating, during which each country presented preliminary results of ongoing work. Thereafter, each country proposed actions for the next year in form of either:

- Continuation of present activity or follow-up activity
- Closing the present activity
- Proposal for a new activity

Proposals with regional relevance were given priority. The Annual Work Programmes (AWP & CE) were formulated on the basis of the workshop results.

The research agenda was defined following the *systems approach*:

- Low input and Market- oriented system

Within these two systems, two major fields of R & D were addressed:

- Animal health
- Animal production

Within the systems/fields, six major result areas were addressed:

- Disease risk assessment
- Pure breeding
- Cross breeding
- Nutrition
- Public health
- Socio-economics

The principle for implementation of this programme is ***networking, association with partners in the livestock sector*** and attempts to solicit ***co-funding***. With these principles in place, the programme is unique in as far as it does not stop at the research side of a given problem; it fully involves and gives responsibility to the NARS partners, who are much closer to the ultimate beneficiaries than an International Research Institution; it attempts to transfer results without delay to the end-users and hence it tries to bridge the gap between research and application of its results.

A practical example for this implementation approach is the studies on milk hygiene, undertaken in the ITC mandate countries:
The ***research question*** identified as important by the partner countries was *investigations on the hygiene and quality of locally produced milk*. Research protocols were designed and the work executed by the NARS partners in collaboration with ITC scientists. The ***research answer*** became available and indicated in this case that *up to 86% of all milk samples collected in Gambia, Guinea, Senegal were highly contaminated, also with human pathogenic bacteria.*
An entirely research oriented project would stop here and publish the data. PROCORDEL, however, attempts to translate these ***results*** into ***development messages*** suitable to design ***development activities***. In this example the message was twofold:

1. more training and awareness creation is needed for milk producers and vendors on the importance of hygienic handling of milk in order to avoid high bacterial contamination and potential transmission of zoonoses
2. the introduction of milk pasteurisation would be advantageous in respect to an improvement of the hygienic quality of locally produced milk and for the establishment of a dairy sector in The Gambia and Guinea, where dairy product marketing is entirely informal

The first of these two messages was translated into actions under the PROCORDEL training programme, more specifically in form of the *Train the Trainer* and *Train the Farmer* package that had been developed for *transfer of technologies*.
For the introduction of pasteurisation in The Gambia (and Guinea) PROCORDEL did not have sufficient funds and hence, funding was solicited from FAO under the *Village Milk System Programme*. In collaboration between NARS, the FAO TCP projects (Gambia and Guinea) and ITC, milk producer cooperatives were formed, low-cost milk pasteurisation units and the *in-pouch Milk-Pro* unit established for operation by these cooperatives. In order to expand the transfer of these particular messages, an additional source of funding from GTZ was solicited to support the monitoring of this process and the extension of the training and quality control activities to the Kolda, Tambacounda region in Senegal.
In parallel with research and development activities, technical training manuals are being developed and translated into the relevant local languages.

In this practical example the importance of ***technology transfer*** is already highlighted. The *training component* of PROCORDEL is mainly implementing this transfer of results, but also addresses capacity building and human resources development. Through the development and application of the 2-phase Module *Train the Trainer* and *Train the Farmer* the participation of beneficiaries increased drastically over time.

In November 2003 a technical support mission assessed the key results of PROCORDEL and came to the conclusion that, although a lot had been achieved already, more needed to be done on the transfer of technologies to the beneficiaries. ITC and CIRDES have therefore started to work on a proposal for a one-year extension with the purpose to give emphasis to technology transfer, testing of their economic viability and training/extension.

It is well recognised that PROCORDEL/ITC is not the only project in The Gambia in support of livestock development. There are many others and only the consolidated efforts of all of them will make a serious impact. We are therefore grateful to the representatives of other projects who have accepted to present a summary of their interventions on the occasion of this National Conference on Livestock Research for Development.

This National Conference aims at spearheading awareness on the multitude of efforts to make serious advances in livestock development. The ITC Open Day, following this Conference on Saturday, attended by high-ranking officials of the Government and members of the diplomatic cops, will reinforce this message.

Acknowledgement and thanks are given to all the national partners in The Gambia, without their efforts this programme could not have succeeded!

LOW-INPUT LIVESTOCK AGRICULTURE: AN INTRODUCTION

Presented by Abdou Fall

In the West African region, two livestock production systems have been identified: the Low-Input Production System (LIPS) and the Market Oriented Production System (MOPS). The MOPS are usually operated in urban and peri-urban settings and they make relatively intensive use of external inputs (feed, drugs, imported livestock genotypes) and are usually targeted at meeting demand in livestock products from highly populated areas. The LIPS, often called traditional system, is more extensive in nature as it relies on naturally occurring inputs. This introduction characterizes the LIPS by describing its main features and highlighting the specific issues and trends that form the basis of the design of the system improvement strategies and the research and development thrust set up by ITC to improve the contribution of livestock to the welfare of farmers in West Africa in general and in The Gambia in particular.

Main features, issues and trends

The vast majority of farmers in LIPS are subsistence or semi-subsistence farmers that grow crops and raise livestock to make a living. They are smallholder farmers who rely mainly on family labour inputs for cropping and livestock related activities. Because of the scarcity of resources, farmers in LIPS adopt a risk aversion strategy which entails limited use of external purchased inputs that in turn is not conducive to adoption of new technologies. Livestock is kept for multiple objectives: subsistence (milk, milk products), sales or

exchange, inputs to agriculture (power, manure), on-farm and off-farm transportation, and insurance against crop failure.

High disease risk due to ecto- and endoparasites, vector and vector-borne diseases and other infectious diseases is a major cause of livestock productivity losses. Because of the high disease risk prevailing in LIPS and the limited access to affordable veterinary inputs, farmers in LIPS use indigenous livestock breeds that are adapted to the feeding, health and climatic environment. These animals are more resistant to diseases, more heat tolerant and can survive better on roughages than exotic breeds.

LIPS are also characterised by an extensive land use system. Animals are fed on natural pastures and crop residues. Feed supplementation is mainly meant to improve survival rates during periods of seasonal feed shortages. Because of the seasonality in feed supply in quantity and quality, animals store body reserves during periods of abundance of feed and mobilize them during the long dry season when nutrient supply does not match requirements. The subsequent decline in body weight and milk yield leads to low productivity levels in LIPS that leave limited surplus for marketing.

Lack of infrastructure and high transaction costs are serious constraints for the effective delivery of public or private support and financial services in LIPS. Farmers are unlikely to engage in innovative production processes in the absence of these critical services (extension, training, information, finance, feeds and veterinary inputs). In addition, limited access to markets reduces potential profit margins farmers could make. As a result, the vast majority of poor farmers in West Africa are found in LIPS. However, LIPS are dynamic and are responding to new challenges in the socio-economic environment and to driving factors of change such as rapid population growth, and increased demand in livestock products. For instance, farmers have changed species composition due to drought and they are moving to more intensified and integrated mixed farming systems.

In the light of the main issues, constraints and opportunities in LIPS, two main strategies have been designed to guide the research development agenda of ITC for LIPS:
(1) secure and maintain livestock assets through integrated vector and parasite control measures
(2) develop technology options that improve the efficiency of use of resources.
Under PROCORDEL implementation in The Gambia, these strategies have been operationalised though research and development activities in the areas of animal health, animal production and socio-economics as follows:

Animal health

- Assessment of vector and vector-borne diseases in indigenous cattle
- Epidemiology of cowdriosis in small ruminants
- Efficiency of trypanocide use in trypanotolerant cattle
- Equine disease and husbandry constraints

Animal production

- Genetic improvement (selection) of indigenous cattle, sheep and goats breeds
- Innovative feed resources and feeding strategies integrated with nutrient cycling

Socio-economics

- Characterization of dairy systems
- Impact of policy reforms on the livestock sector

GENETIC IMPROVEMENT PROGRAMME OF TRYPANOTOLERANT CATTLE, SHEEP AND GOATS IN THE GAMBIA: AN OVERVIEW OF THE MAIN FEATURES AND ACHIEVEMENTS

Abdou Fall, Austin Bosso, Nerry Corr, Kwaku Agyemang
Presented by Abdou Fall, Austin Bosso and Nerry Corr

1. Introduction

Low-input livestock production systems are predominant in West Africa. They are mainly characterised by variations in quantity and quality of feed supply and high disease risks (trypanosomosis and tick-borne diseases). It is known that the genetic improvement of breeds through selection is an option to improve productivity of ruminant livestock in these areas. This is especially true in the West African sub-humid zones where trypanotolerant breeds, living in harsh environments, have proved to be more productive than previously thought. The exploitation of the adaptability of these breeds in low-input systems is therefore a sound strategy to improve the livestock industry in these areas with the view to sustaining the livelihood of millions of poor farmers in the West African region.

The main rational behind investing in pure breeding is to improve the efficiency of production in a cumulative manner, hence reducing the required number of animals needed to meet the demand in livestock products. The desired environmental implication of this strategy stems from the reduced pressure on scarce natural resources base, and at the same time meeting the increasing demand for animal products driven by urbanization, increased revenues and population growth. The genetic improvement of trypanotolerant breeds will ultimately lead to enhanced competitiveness of these breeds threatened by indiscriminate crossbreeding practices resulting from inadequate national and livestock sector policies, habitat change and lack of proper evaluation of their economic value.

The establishment of a successful pure breeding programme in West Africa has been a serious challenge for scientists, policy makers and implementers. In the past several pure breeding programmes have been undertaken, but they have failed to deliver the expected results because of several reasons, including the lack of continued commitment for financial, political and technical support. Lack of clearly defined and understood national policies to back up breeding schemes, difficulties to disseminate the genetic progress made on-station to farmers and the lack of trained manpower have also contributed to these failures.

The N'Dama cattle, West African Dwarf Goat (WAD) and the Djallonke Sheep pure breeding programmes in The Gambia, were initiated in 1994 and 1995 respectively. The objective is to improve meat and milk (in the case of cattle) production without loosing their trypanotolerance and adaptive traits. The establishment and operation of the breeding schemes has been supported by GTZ/BMZ from 1994 to 2000. Thereafter the support was received from PROCORDEL.The designs of breeding schemes are attributed to Prof. Dempfle (former Director General of the International Trypanotolerance Centre). These programmes, being implemented by ITC in collaborations with the National Agricultural Research Services in The Gambia have been running for approximately 8 years. The programmes are now well established and functioning and could serve as a model for low cost breeding schemes in low and medium livestock production systems in the region. The

strengths of the schemes stem from their designs and operations intended to overcome some of the limitations and constraints identified in previous programmes. With the EU-funded PROCORDEL, the breeding scheme has been consolidated and great emphasis has been placed on the dissemination of the genetic progress made on station.
The objectives of this paper are to describe main features of the ITC-led breeding programmes and to highlight achievements made after 8 years of operation.

2. Main features

2.1. Breeding objective and breeding goals

The objective is set to increase productivity, i.e. to make production more efficient with the given resources and increase the benefits from animal husbandry in mixed farming systems in rural areas.
The breeding goals and selection criteria were determined taking into account the goals set by policy makers, the results of a large participatory rural appraisal study, results of a large consultation with stakeholders in West Africa and the outcome of a model calculation deriving marginal profits (Dempfle and Jaitner, 1999).
In recent studies on breed and trait preferences by farmers, cattle owners in The Gambia ranked the N'Dama, Zebu-type Gobra breeds and their crosses for the preferred traits (Steglich and Peters, 2002). These traits included animal size, milk yield, calving frequency, traction ability, ability to cope with feed shortage and disease resistance (Table 1). The N'Dama was rated higher than the Gobra for its adaptation to feed deficits, disease resistance and traction ability whereas the Zebu was preferred for their size and milk yield. This study underscores the priority given by farmers to adaptation to environmental stresses as well as growth and milk yield. The main outcome of this work was the confirmation that sound breeding goals for the genetic improvement of N'Dama cattle should be to increase meat and milk without loss of disease resistance and other adaptive traits.

Table 1. Agropastoralist's ratings (range of ratings : 0-5) of cattle breeds in The Gambia

Evaluation criteria	Gobra	N'Dama*Gobra	N'Dama
Size	4.9	4.3	3.1
Milk yield	4.7	4.3	3.2
Calving frequency	2.9	3.1	4.4
Adaptation to dry season	2.3	2.9	4.7
stress	2.7	3.5	4.7
Utility for traction	1.8	2.6	4.6
Disease resistance			

Source: Steglich and Peters, 2002

2.2 Breeding plan

During the design of the breeding plan, three alternative options were considered for the optimization of the breeding scheme: progeny testing, half-sib and young sire schemes. The young sire programme proved as efficient as the half-sib programme. It had the additional

advantage of being simple and therefore easier to operate (Dempfle and Jaitner, 1999). The programme infrastructure and operation are designed to minimize the possibilities of selecting animals that might perform poorly in farmers' flocks/herds (genotype by environment interaction). The conditions in nucleus and testing herds and flocks are made quite similar to an on-farm situation. The breeding scheme was designed as an open nucleus. In addition to ITC animals, a large screening operation is carried out annually to select and introduce into ITC herds the male offspring of outstanding cows with respect to milk production. The screening operation revealed to be a sound entry point to strengthen farmers' participation to the breeding programme and to reduce inbreeding by introduction of new genetic material in the herd.

The breeding activities require a high quality of animal recording. Parameters recorded include: matings, parturition, birth and monthly bodyweights, weekly milk records, treatments, exits (culling, mortalities). Data are stored in a database and are managed and analysed with SAS. The selection is based on the estimation of breeding values using BLUP that makes use of all available information from all relatives and allows for accounting for environmental effects and also gives genetic trends.

2.3 Selection criteria

2.3.1 Cattle

The ongoing breeding programme annually utilizes 6 breeding bulls and 400 adult breeding females. Animals are selected based on the breeding values of daily weight gain and milk yield combined into a total breeding value. The breeding bulls and the breeding females with their suckling calves (around 200) are kept in one main herd (divided in 6 smaller herds) in Keneba under low to medium tsetse challenge. After weaning at an age of 12 months, animals are moved to Bansang (high tsetse challenge) were they are kept in four herds (males and females separated). Records on weight are taken on a monthly basis for each individual animal. After three years selection based on estimated breeding values for daily weight gain (from 15 to 36 months) and milk production takes place. The best males are chosen to replace the breeding males, whereas most of the females are allowed to breed in order to be performance tested with respect to milk yield. About 75% of those are chosen to replace females of the active breeding stock.

2.3.2 Small ruminants

To achieve the set goal, breeding values based on daily weight gains from 4 to 12 months of age are estimated for all animals born in the flock. For each species, the breeding schemes are designed to contain 200 breeding females and six (6) breeding males (active breeding stock). Annually, there are on average 80 males and 80 females available as selection candidates. Suckling animals (0 to 4 months) and young animals (5 to12 months) are kept in Keneba. Young animals are weaned at 120 days of age. In total, there are around 400 animals in the nucleus flock. Sires are used for two years to prevent mating with their daughters. Every year, the best males (4 to 5) are chosen to replace the breeding males and the second best are identified for the multiplication tier. Similarly, every two to three years about 75 % of the females are replaced in the active breeding population.

2.4 Dissemination

The realised genetic progress, at the nucleus level, needs to be disseminated among farmers for the sustainability of the programme (see diagram below for mechanism). The ITC breeding programmes place, therefore, a strong emphasis on the dissemination of the genetic material. The pure breeding scheme for both cattle and small ruminants is designed as a 3-tier scheme including the nucleus (ITC), multipliers and farmers (farmers).

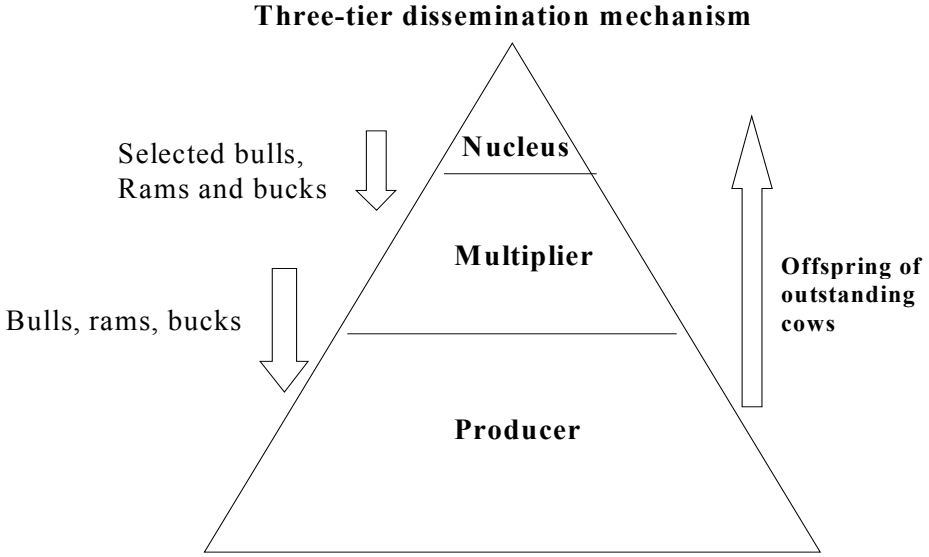


Figure 1. Breeding Pyramid

The multiplier tier plays the major role in disseminating the achieved genetic progress from the nucleus into village flocks and herds. The multiplier tier receives superior breeding males out of the ITC nucleus flock/herd. They use these breeding males for a specified length of time and sell male offspring to farmers in the producer's tier. The farmers use the males with the objective to increase the productivity of their flock/herd. With the collaboration of the Department of Livestock Services, multiplication herds and flocks have been established and are being regularly monitored.

There are 3 mechanisms put in place for the dissemination of genetic progress from the nucleus herds and flocks: (1) Village approach (the multiplier being the whole village flocks), (2) Kaffo approach (a group of farmers in the village pool their flocks to form a multiplier) and (3) Individual approach (the multipliers being individual farmers having a reasonable flock size).

3. Achievements

3.1 Institutional set-up

The establishment and functioning of strong linkages between different actors involved in the breeding scheme are necessary conditions for successful and sustainable breeding programmes. It is also of utmost importance for each partner to have a clear understanding and fulfilment of its role. The main actors identified are farmers and their associations, ITC

and the Department of Livestock Services. Central to the ITC approach for these breeding schemes is farmers' participation. This is being encouraged through regular screening operations and several training courses given to livestock assistants supervising multiplier units, and to farmers. The training courses are supported by PROCORDEL and are jointly run by DLS and ITC. They are intended to build capacity of the national system (NARS) to run the breeding programme and to claim ownership of the breeding scheme in the long run. Related to this, several field visits to ITC's breeding facilities and the establishment of livestock breeders associations have also been supported by PROCORDEL. A close working relationship with government, extension institutions has generated effective linkages between researchers operating the nucleus and participants in the second and third tiers of the scheme. These arrangements have yielded and sustained enthusiasm among key stakeholders: DLS and farmers' associations. Annual divisional and national livestock shows are opportunities to promote the breeding scheme and a way to exhibit selected animals.

3.2 Multipliers association

Two livestock multipliers associations: Gambia Indigenous Livestock Multiplier Association (GILMA) have been established in the Saloum and Fuladu areas (GILMA-Fulladu and GILMA-Saloum). Both of them are registered associations that are now in charge of all transactions dealing with the purchase and marketing of breeding stock from ITC and multiplier units to other farmers. Their main objectives are to (1) make farmers aware of the availability of breeding males in multiplier villages, (2) to purchase male offspring from multipliers and disseminate them to needy farmers and (3) to organize farmers to be more involved in the breeding schemes. They are also involved in supply of veterinary inputs to improve management of multipliers. The associations are currently constrained by the lack of proper communication, the lack of publicity, the lack of organisational and managerial skills and the lack of funds for self-maintenance. ITC and DLS are presently addressing these constraints with the support of funding partners.

3.3 Genetic progress achieved

The amount of genetic progress that can be achieved depends on four key factors that are: the realised selection intensity, the average accuracy of selection and the realised generation intervals. Genetic parameters (heritabilities, phenotypic and genetic correlations) together with the amount of information on an animal determine accuracy of estimated breeding values and therefore accuracy of selection. During the design phase attractive genetic progress of about 1% per year was predicted (Dempfle, 1999). In the absence of estimates of genetic parameters, literature values were used to design the ITC breeding programmes. After 8 years of operation and animal recording, it is now possible to determine genetic parameters for cattle and small ruminants and to evaluate genetic trends. Estimation of genetic parameters and evaluation of genetic trends, for weight and growth trait at different ages for cattle and small ruminants, was undertaken under PROCORDEL as part of a PhD thesis. For cattle, heritabilities (h2) ranged from 0.11 for weight at 24 months to 0.4 for weight at 36 months. Genetic correlation (r_g) between birth weight and weight at 12 (W12), and 15 months were moderately high (0.51 and 0.6, respectively). The genetic trends were highest for weight at 3 years of age and for weight gain in the early dry season (0.88 kg/year and 0.35 kg/year respectively). Given the genetic trend achieved for W36 and the relatively

high heritability, it was concluded that this might be a candidate trait to use as selection criteria for the ongoing breeding programme (Bosso et al, 2003).

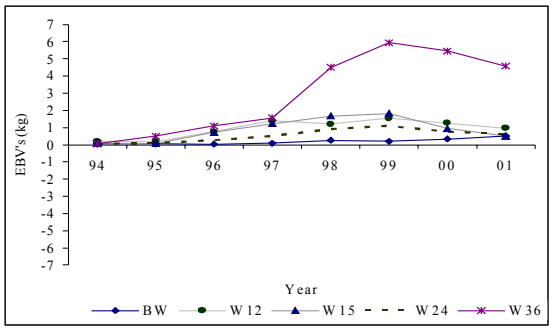


Figure 2 . Genetic trend for cattle for weight traits at different age from 1994 to 2001.

3.4 Dissemination of the genetic progress

A great challenge faced by ITC and DLS is how to shift gradually multiplication facilities to the status of a commercial breeder selling improved genetic material to farmers. Efforts are being made to achieve this based on the use of sound criteria for the selection of candidate multiplication herd and flocks and through training and regular monitoring. Current bottlenecks include the flow of males from multiplier to farmer flocks and herds. There have been concerns about possibilities that the superior rams and bucks from multiplier flocks may be unaffordable to farmers. Moreover, traders who are not driven by breeding objectives may be exploiting the situation to their advantage. ITC and DLS are currently helping farmers to devise marketing strategies to ensure that they have access to improved genetic material from multipliers. The GILMA associations are now buying animals from multipliers to sell on a credit basis to other member farmers.

3.4.1 Small ruminants

The multiplication sites for sheep and goats were successfully identified since 1999. There are now 10 multipliers established in 5 villages and two Kaffos in CRD, URD and NB divisions. Ten breeding males were directly given to individual farmers for breeding. Amongst this 10, 4 went to Sierra Leone to support the post-war livestock restocking schemes. In total there are 78 breeding males given to multiplier villages (Table 2). These breeding males from the nucleus have until now produced 1416 offspring in the multiplier villages. It is estimated that since 2000, an estimated 595 breeding bucks and rams have been produced from these multiplication facilities.

	Divisions, The Gambia			**Sierra Leone**	Total
	CRD	NBD	URD		
Sheep	20	6	4	2	32
Goats	22	9	13	2	46
Total	42	15	17	4	78

Table 2. Number of improved bucks and rams from the nucleus distributed to farmers to set up multiplier flocks

3.4.2 Cattle

The cattle dissemination programme started in 2001 with twenty-six (26) improved bulls distributed to individual multipliers in 16 villages. Ten (10) other bulls are presently in the process of being distributed to new multipliers or to reinforce multiplier villages as Gimbala Kerr Chendu, where the large herd size led farmers to suggest the establishment of one village multiplier herd. More economic benefits to farmers are forthcoming as the number of bulls from the nucleus and from the multipliers is expected to increase in the future.

5. Conclusions

The strong and robust breeding programme for cattle, sheep and goats established by ITC in The Gambia since the mid 1990 with GTZ/BMZ funds has been consolidated since 2001 thanks to EU-funded PROCORDEL. The support to the nucleus operations has placed a great emphasis on the dissemination of the genetic progress made on station. Strong linkage mechanisms have been developed between ITC, the Department of Livestock Services and farmers. Farmers are better organized and have gained better capacity to play a key role in the breeding process. Genetic parameters have been estimated which will improve the accuracy of estimation of the breeding values and will ultimately lead to improved accuracy of selection. The evaluation of the genetic progress will also guide the breeding programme for the way forward.

Great progress has been made in the dissemination of the genetic progress but these efforts need to be sustained to assure greater impact of the breeding programmes. The newly established livestock breeders associations need further support technically and financially to play critical roles in the breeding process. The programme is still relying on donor funds to continue operating. It will take few years before farmers could contribute significantly towards the cost of the breeding programme. If pure breeding programmes for low and medium input systems have to operate for years to come, it is essential that public resources support these programmes in terms of staff training, personnel and running costs at the nucleus level.

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PREVAILING DISEASES AND CONTROL OPTIONS:
COWDRIOSIS IN THE GAMBIA: SOME EPIDEMIOLOGICAL ASPECTS

Bonto Faburay, Susanne Munstermann, Abdou Fall, Dirk Geysen, Frans Jongejan
Presented by Bonto Faburay

1. Introduction

Ehrlichia ruminantium, formerly *Cowdria ruminantium* (Dumler et al., 2001), is a tick transmitted rickettsial pathogen that predominantly infects vascular endothelial cells. It is the causative agent of cowdriosis (heartwater) in domestic and wild ruminants in sub-Saharan Africa, where it is a serious constraint to ruminant livestock production (Uilenberg, 1983). Ticks of the genus *Amblyomma* transmit *E. ruminantium* and *A. variegatum* is the major vector in West Africa (Walker and Olwage, 1987; Gueye et al., 1993). This tick species is also the most abundant infesting cattle in West Africa (Koney et al., 1994; Konstantinov et al., 1990).

In The Gambia, mortality due to heartwater has been reported in Gobra zebu cattle undergoing *Trypanosoma congolense* experimental infection (Mattioli et al., 1994), in Holstein x N'Dama crossbred calves (Faburay and Munstermann, personal observation) and in small ruminants. Despite the occurrence of heartwater in The Gambia, no systematic epidemiological studies have ever been carried out to recommend possible control strategies for the disease. We therefore carried out a series of studies to help elucidate the epidemiology of heartwater in The Gambia with emphasis on small ruminants: a) Serological transect study of heartwater infection in small ruminants; b) determination of tick infection rates; c) genetic characterization of *Ehrlichia ruminantium* in The Gambia.

2. Materials and Methods

2.1 Serological transect study of *E. ruminantium* infection in small ruminants

The survey was carried out in 3 major agroecological zones of The Gambia, namely the Sudano-Guinean zone, Western Sudano-Sahelian zone and Eastern Sudano-Sahelian zone. A cross-sectional sampling was carried out. Blood samples were collected in plain siliconized vacutainer tubes for serum from 550 randomly selected indigenous small ruminants (Djallonké sheep and West African dwarf goats) aged 6 months and above. The indirect MAP1-B ELISA assay (van Vliet 1995; Mboloi et al., 1999) was used to test the serum samples. Data on the monthly/seasonal dynamics of *A. variegatum* was collected from a selected sample of the study animals. Similar tick data were collected from N'Dama cattle at the same study sites.

2.2 Molecular detection of *Ehrlichia ruminantium* infection in ticks

We extracted genomic DNA from 145 flat and semiengorged adult *A. variegatum* ticks collected from 3 different agroecological zones mentioned above. DNA was extracted using the Qiamp Tissue Kit protocol. We used the seminested pCS20, map1 and reverse line blot to determine *E. ruminantium* infection rates in *A. variegatum* ticks. For the seminested

pCS20 assay we used the following primer combinations: ITM130/AB129/AB128; whereas for the seminested map1 assay we used the primers: ERF1/ERR1/ERR3. The assay for the reverse line blot was carried out as described by Gubbels et al.with some modifications.

2.3 Genetic diversity of *Ehrlichia ruminantium* in ticks and small ruminants

We carried out characterisation of diversity of *E. ruminantium* using genomic DNA samples from *A. variegatum* ticks and small ruminants (sheep and goats). Initial PCR was carried out using specific primers (mentioned above) that amplify the gene encoding the immunodominant major antigenic protein 1 (*map*1) of *E. ruminantium*. The PCR products were subsequently characterised using restriction fragment length polymorphism (RFLP).

3. Results and Discussion

3.1 Serological transect study of *Ehrlichia ruminantium* infection in small ruminants

Serological prevalence of antibodies against *E. ruminantium* infection in small ruminants in the different agroecological zones differed (P = 0.076). Animals in the WSS zone showed the highest cumulative prevalence of 56 %. The SG and ESS zones showed cumulative prevalence of 48.6 % and 44.3 % respectively. Similarly, the tick data indicated the highest monthly mean count of *A. variegatum* in the WSS zone of 0.76 ticks per animal. This zone also showed the highest *E. ruminantium* tick infection rate consistently detected by three different diagnostic assays. Thus the existence of gradient of *E. ruminantium* infection is indicative of a variable risk of cowdriosis for susceptible livestock especially introduced from heartwater-free areas.

An overall cumulative prevalence of 49.8 (CI: ± 8.5) was recorded with the overall proportion of samples testing positive for goats (41.2 %) and sheep (58.6 %) differing significantly (P = 0.00004). In general, at all sites the proportion of seropositives was consistently higher (with the exception of Keneba region) in sheep than in goats. Overall cumulative seroprevalence was 17.5 % higher in sheep than in goats.

3.2 Molecular detection of *Ehrlichia ruminantium* infection in ticks

Figure 1 shows the specific amplification of pCS20 and *map*1 target sequences by seminested PCR of *E. ruminantium* in ticks collected from the 3 different agroecological zones.

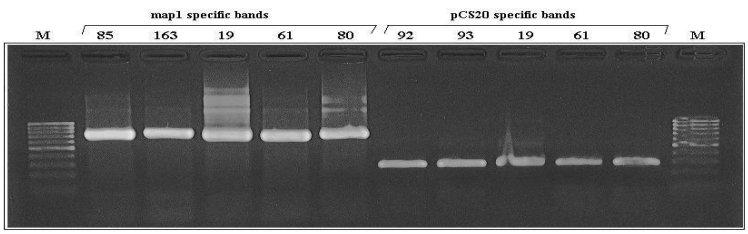

Figure 1. Specific amplification of map1 and Pcs20 target sequences of *E. ruminantium* in A. variegatum ticks

The combined results of the 3 assays showed an overall *Ehrlichia ruminantium* tick infection rate of 22%, with tick samples collected in the Sudano-Guinean zone showing an infection rate of 10%, the Western Sudano-Sahelian zone 38 % and the Eastern Sudano-Sahelian zone 18%. The pCS20 assay detected the highest cumulative rate of infection of 17% compared to the rate of 11% by the MAP1 assay and 6% by the reverse line blot. Comparative evaluation of semi nested pCS20 and *map*1 PCR assays showed that the pCS20 assay was more sensitive than *map*1. Although the proportion of samples detected positive by the pCS20 assay did not differ significantly from that detected by the *map*1 assay ($\chi^2 = 2.23$; $P > 0.05$), the odds ratio showed that the proportion of samples detected by the former assay was higher ($P > 0.05$) than the latter and that ticks in this sample were twice more likely to be positive to pCS20 than *map*1. A case of co-infection with *naplasma marginale* and *E. ruminantium* was detected in a tick sample collected from the WSS, whereas one of the tick samples from the latter zone produced a positive *E. canis/ovina* specific signal. Additionally, 4 samples, all originating in the WSS zone, produced signals whose sequence data showed homology with the 16S sequences of *Ehrlichia canis/ovina.* Thus the detection of *Anaplasma marginale* and *Ehrlichia ovina* sequences in A. variegatum ticks in the WSS zone suggests the presence of these organisms in resident ruminant livestock populations. This is the first time the 3 assays (semi nested pCS20, map1 and RLB assays) have been applied simultaneously to tick samples to detect infection rates. Importantly, it is the first time the *Anaplasma*/*Ehrlichia* RLB has been applied broadly to field samples and the results indicated that this test requires a broader application on field samples for further improvement. Although the pCS20 showed the highest sensitivity, the combined performance of the 3 assays in detecting *E. ruminantium* infection rates in this study showed that any epidemiological investigation should use, if available, all 3 assays simultaneously.

3.3 Genetic diversity of *Ehrlichia ruminantium* in ticks and small ruminants

Comparison of the restriction profiles of the *map*1 genes detected in tick and animal samples originating in the 3 agroecological zones showed remarkable variation. The analysis showed 8 different profiles. The WSS zone showed 3 distinct (4 different) profiles. Three different profiles were identified in the Sudano-Guinean agroecological zone whereas the Eastern Sudano-Sahelian zone showed 2 different. One of these profiles (profile #2, sample ID 61) was identical to the profile of Kerr Serigne (KS) whereas two of the profiles (profiles #3 and #6) were identical to the 2 profiles characterised in the ESS zone (profiles #3 and #6; Table 1). This led us to postulate that the Kerr Serigne stock, isolated in the SG zone was introduced from the WSS zone, whereas the 2 profiles (#3 and #6 in the WSS zone) are ´genotypes´ introduced from the ESS zone. Interestingly, the WSS is host to an ITC station for Open Nucleus Ruminant Pure Breeding Programme characterised by regular introduction of breeding stock from diverse areas.

The SG zone showed 3 distinct profiles (4 different profiles). Although these profiles did not show similarity with any of the other profiles, we attributed this diversity to the effect of multiple introductions of carrier animals to this zone from other parts of the country and beyond its borders. This zone, importantly, is the largest centre for trade in ruminant livestock in the country. The results so far suggest that multiple genotypes of *E. ruminantium* exist in The Gambia.

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HUSBANDRY AND HEALTH CONSTRAINTS OF EQUINES IN THE GAMBIA

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Presented by Arss Secka

1. Introduction

According to the national livestock census (1993/94), the population of horses and donkeys in the Gambia is reported at 17,556 and 33,448 respectively. Draught animals used in this country consist of horses, donkeys and cattle. Two-thirds of these animals are comprised of equines.

Sixty-three percent of Gambian farmers use draught animals for farming (Cham, 1990) with equines forming the majority. Hence, equines play a significant role in food security and socio-economic development of farming communities through provision of animal traction, organic manure, means of transportation and as trade commodity.

Past studies have shown that high mortality rates and low foaling rates (Sowe *et al.*, 1987), disease outbreaks, feed shortages, and poor management are among the major constraints affecting the equine population and productivity.

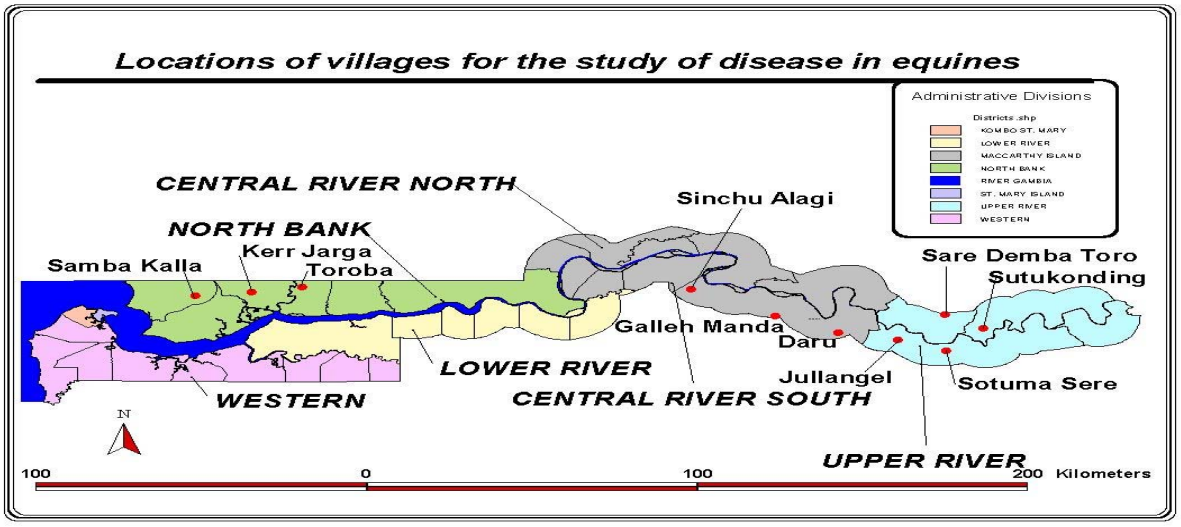
2. Objectives

1. To gain a better understanding of the husbandry and health constraints of equines;
2. To formulate recommendations for improved equine health and management strategies.

3. Materials and methods

3.1 Materials

15 horses and 15 donkeys from 9 villages in 7 districts and 3 divisions as shown in the map below (except Kerr Jarga) were monitored monthly from March 2002 to February 2003.



10 horses and 10 donkeys from 3 weekly-markets 'lumos' were also monitored in June, September, and December 2002.

3.2 Methods

The following samples were collected and analyzed:

Samples	Laboratory techniques		
Blood	Packed cell volume (PCV)	Dark ground buffy coat	Giemsa-stained thin blood smear
Faeces	McMaster (EPG)	Sedimentation	Larva culture and differentiation
Sera	Serum neutralization and complement fixation test for African horse sickness		
Ticks	Identification at genera level		

Records of clinical treatments of horses and donkeys at five Department of Livestock Services clinics were analyzed. Four questionnaire sets dealing with population changes, feeds and feeding pattern, breeding, and management practices were administered in the nine study villages.

4. Results

4.1 Trypanosomosis prevalence rates

Trypanosomosis is a major problem among horses and donkeys in the 9 study villages and three weekly-markets 'lumos' throughout the year as shown in figure 1 below.

4.2 Packed cell volume (PCV)

PCV values were generally above 26% throughout the year. However, the values for donkeys were higher than horses as trypanosome infection rates negatively correlated (-0.52) to PCV as shown in figure 2.

4.3 Other blood parasites

Blood samples with a PCV of 25% and below were Giemsa-stained and examined for *Babesia equi* and/or *B. caballi.* There were no positive cases found.

4.4 Tick infestations

Four genera of ticks in decreasing order *(Rhipicephalus spp, Hyalomma spp, Amblyoma spp, and Boophilus spp)* infest horses, whilst only the first two genera infest donkeys. The average *Rhipicephalus spp* count for horses and donkeys were 4.21 and 1.09, respectively.

4.5 Gastrointestinal (GIT) parasites

GIT parasites prevalence rates were higher in donkeys than horses but generally remain above 60% except for January and February when these animals were dewormed with

albendazole as an incentive for farmers whose animals were used during this study as shown in figure 3.

Identified helminth ova include *Strongyles (Strongylus spp, Trichonema spp,* and *Triodontophorus spp), Trihostrongylus axei, Strongyloides spp, Parascaris equorum, and Dictyocaulus arnfieldi.* One case of *Fasciola spp* was detected.

Figure 1. Monthly trypanosomosis prevalence rates in 9 villages

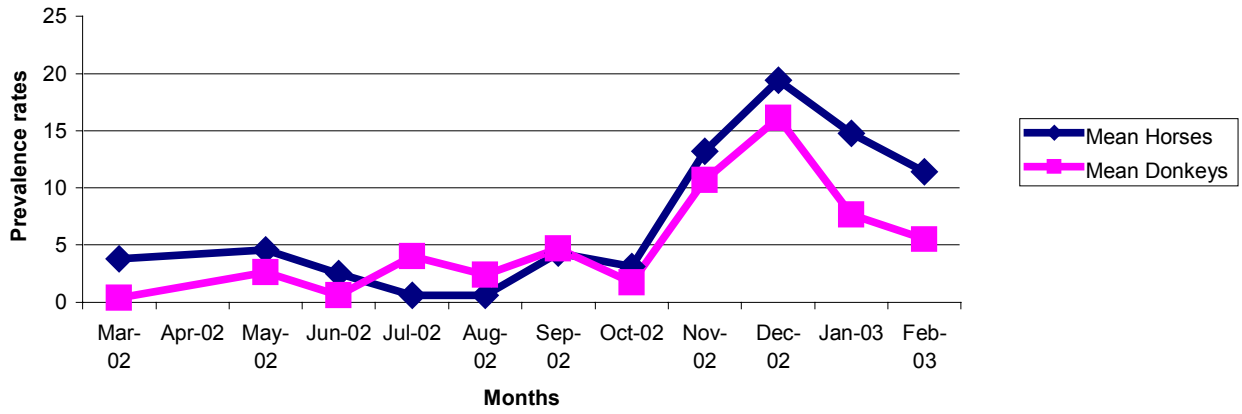


Figure 2. Mean monthly PCV values

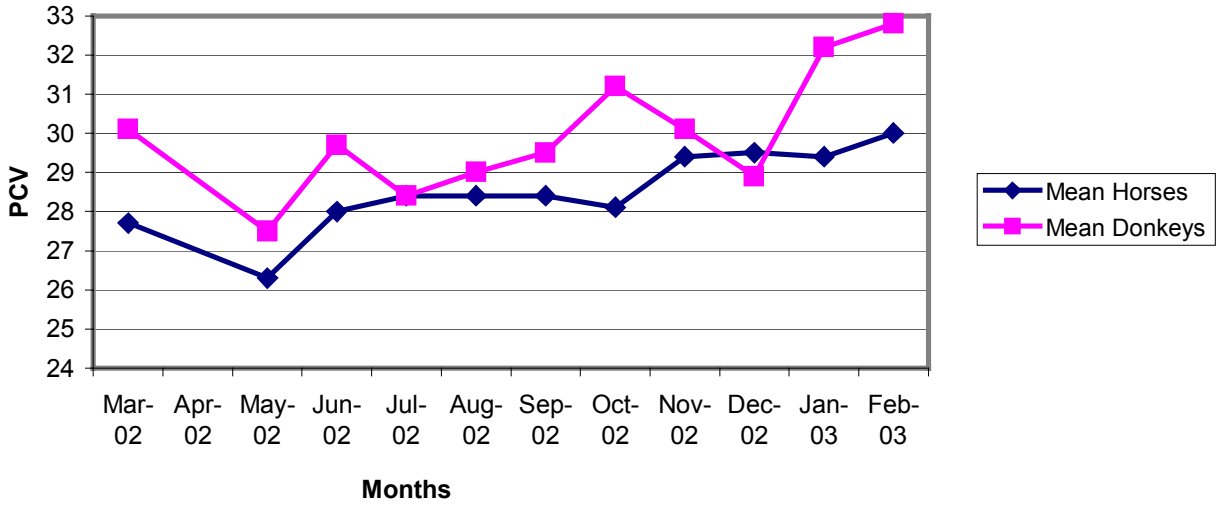
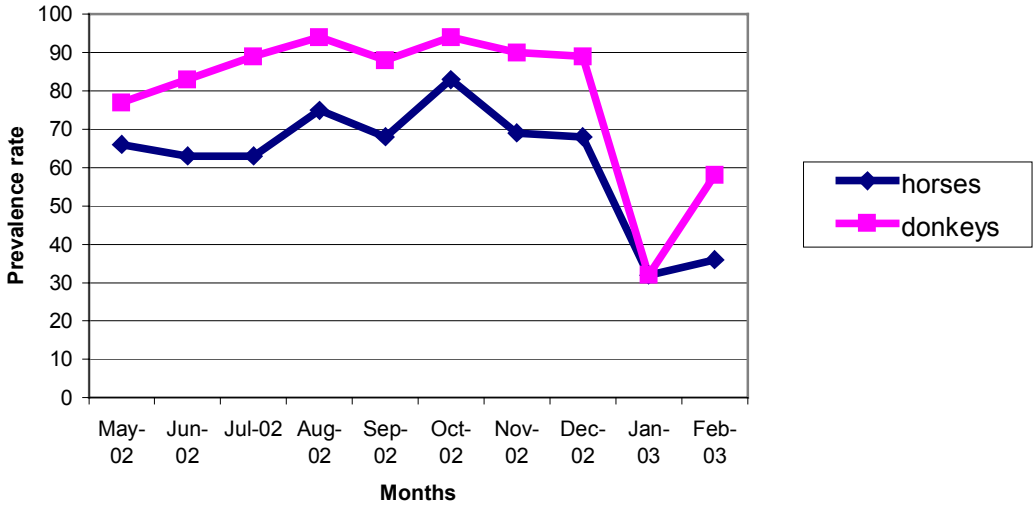


Figure 3. Monthly GIT parasites prevalence



Identified Strongyle larvae were small *strongylides* 43%, *Strongylus equinus* 38%, *Strongylus vulgaris* 11%, and *Strongyloides westeri* 10%.

The serum neutralization test for African horse sickness indicates a seroprevalence rate of 83% and 69% in horses and donkeys, respectively.

4.6 Questionnaire surveys

Set one: The population dynamics of equines in the 9 study villages from January 2002 to December 2002 is shown in table 1 with the horse population increasing significantly.

Table 1. Population dynamics

Species	Horses	Donkeys
Foaling rate (%)	43.5	15.7
Foal mortality rate (%)	17.9	18.2
Mortality rate (%)	8	7.2
Population increase (%)	10.9	-1.2

Set two: Feeds and feeding patterns of equines during the rainy and dry seasons are shown in table 2.

Table 2. Feeds and feeding patterns

Seasons	Feeds	Feeding patterns
Rainy	Grasses (major); sorghum/millet grains /bran, groundnut/sesame cake, and household feed leftovers as supplement.	Zero grazing with supplementation; free range with supplementation; or free range without supplementation.
Dry	Groundnut hay (major); sorghum/ millet grains/bran, groundnut/sesame cake, and household feed leftovers as supplement.	Zero grazing with tethering and supplementation; tethering with supplementation; or tethering without supplementation.

Set three: Reproductive performance of equines from 1997 to 2001 as given in table 3 shows that most equine owners do not possess studs, and abortion rates and foal mortality rates are very high.

Table 3. Reproductive performance

	Horses	Donkeys
Possession of studs (%)	15	8
Abortion rates (%)	36	30
Congenital defect rates (%)	2	0
Foal mortality rate (%)	24	29
Annual foaling interval (%)	54	21

Set four: Some management practices adopted by equine owners indicate that horses are more cared for with regards to shelter provision, deworming, and treatments for trypanosomosis than donkeys as shown in table 4.

Table 4. Management practices for equines

	Horses	Donkeys
Shelter provision (%)	66.7	47.2
Care by sons (%)	50	57.7
Deworming (%)	83.3	45.3
African Horse Sickness vaccination (%)	0	0
Use of trypanocides (%)	44.4	15.1

5. Discussion

Reported trypanosomosis prevalence rate in this study (6.7% in horses and 4.4% in donkeys) is slightly lower than 9.2% as reported by Mattioli *et al.,* (1994), and 6.2% in donkeys and 45.5% in horses as reported by Faye *et al.,* (2001). This prevalence rate is somehow similar to the prevalence rate of 5.5% in horses and donkeys reported by Loum and Mbacke, 1989. The differences could emanate from the different tsetse challenges in study areas, and the diagnostic method used. Only dark ground buffy coat technique was used in this study while Mattioli *et al* used double centrifugation, and Faye *et al* used dark ground buffycoat and PCR. *Trypanosoma congolense* was the predominant trypanosome affecting equines. This finding is in line with previous observations by these other authors.

Prevalence rates of gastrointestinal infections were very high for both horses and donkeys indicating that equine owners are not deworming their animals regularly. The *Strongyles* spp, *Strongyloides* spp, and *Trichostrongylus* spp were the most frequent identified ova.

Lack of confirmed cases of babesiosis in this study does not necessarily rule out the existence of the disease in equines since its vector, *Rhipicephalus* spp is highly prevalent among horses.

The high seroprevalence rates of African horse sickness suggest it is enzootic in The Gambia. In fact, some sporadic outbreaks have been reported in the year 2000.

From this study, the breeding performance of horses were better than that of donkeys as shown by an overall increase of 10.9% in the horse population and –1.2% in the donkey population. These figures also reflect that horses are generally better managed, fed, and bred than donkeys.

6. Conclusions

6.1 Health constraints

Equine diseases encountered during this study in decreasing order include helminthosis, tick infestations, trypanosomsosis, respiratory diseases, epizootic lymphangitis, pappilomatosis, melanoma, sarcoids, eye infections, urinary tract infections, and mange infestations. Other encountered equine disorders include injuries, musculoskeletal disorders, abortion, 'fistulous withers', animal bites, colic, bees stung, snakebite, paraphimosis, accidents, and predators (hyenas) injuries in decreasing order.

Vaccination against African horse sickness or treatment of respiratory diseases is not commonly practiced. Very few equine owners also practice proper endo- and ectoparasites control strategies. Lack of sufficient diagnostic kits hinder accurate and prompt diagnosis of equine diseases at the department of livestock services laboratories, and similarly the clinics are not adequately equipped to handle major surgeries.

6.2 Husbandry constraints

The lack of proper shelters especially during the rainy season, and generally unbalanced feed rations or feed scarcities during the late dry season hinder equine productivity. Low reproductive performances, especially in donkeys, reflect the lack of proper breeding and management strategies. The low number of farmers possessing breeding studs also negatively impacts on the breeding performances.

7. Recommendations

Farmers' awareness on the need to adopt control strategies for African horse sickness, respiratory diseases, endoparasites, and ectoparasites should be raised. Continued education programs should also be designed for both veterinarians and livestock assistants and implemented regularly.

Equine owners should also be trained on improved shelter provision, breeding and management practices. Outstanding stallions of critically selected breeds of horses could be used to upgrade native horses. In addition, laws promoting the welfare of equines should be enforced in order to stop the ongoing abuses of equines.

Facilities at the department of livestock services laboratories and clinics should be improved for rapid diagnosis and treatment of equine diseases.

The results of this study have been made available to an NGO that has just started work on welfare, health and production improvement in The Gambia.

Follow up studies are necessary to formulate feed rations for different classes of equines, and common equine respiratory diseases be properly investigated so that proper control strategies could be instituted.

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COUNTRY REPORT: PROCORDEL IN SIERRA LEONE: Introduction of work-oxen into selected communities in the Bombali District, Northern Region

Gudush Jallow, Susanne Münstermann

Presented by Gudush Jallow

1. Background

Sierra Leone is presently recovering from 11 years of civil conflict which prevented the start of collaboration between ITC and the NARS and the start of Procordel until the first contacts were established in October 2002. ITC senior staff and the TA Procordel visited the country and met with officials from the Ministry of Agriculture, Forestry and Food Security and Department of Livestock Services. Suitable areas for an intervention, limited in time up to the end of the project, that were discussed are the reintroduction of work oxen in an area where formerly farmers used to own them.

The livestock in Sierra Leone has virtually been used as "living supplies" by the fighting forces and the National Herd was reduced over time to the negligible amounts of today as shown in Table 1. The Northern Region held 90% of the National cattle and 60% of the small ruminant herd before the war, but the long stay of the rebels in this area reduced numbers also. Insecurity and lack of working animals reduced cropping activities also to mere gardening around the homesteads. The situation now, after the war, is difficult, as livestock is small in number and the support services do no longer exist, as their infrastructure has been largely destroyed.

Type of animal	National herd 1990/1	National herd 1999/2000	No of animals lost during war	% loss of livestock	Estimated cost per animal ($)	Total loss due to war (Mill $)
Cattle	340,000	28,800	311,200	91,5	350	108.9
Sheep	420,000	12,850	407,150	96	80	32.6
Goats	460,000	7,785	452,215	98,3	80	36.2
Oxen	2,200	0	2,200	100	450	1
Pigs	400,000	52,000	348,000	87	100	34.8
Poultry	4,300,000	33,000	4,267,000	99.2	2	8.53
Total						222

Table 1: Changes in the National Herds from before to after the war

2. Justification

In the cropping areas of the North, namely Kambia, Bombali, Port-Loko, Koinadugu about 5% of the farming households had working oxen and implements. The loss of these animals has led to reduced agricultural outputs and increased human drudgery, particularly in the valley water swamp rice fields. It was felt that restocking with working oxen with selected pilot farmers would have the fastest impact, given the shortness of the project period of 9 months.

3. Material and Methods

The project is located in the Bombali District. Seven farmers in 5 communities were chosen on the basis of set criteria:

- They owned work oxen before
- They are able and committed to store crop by-products after the harvest as dry season feed for the animals
- They are willing to construct a shelter and provide fresh water and feed
- They have seeds and manpower for cropping the 2003 cropping season
- They are willing to participate in the training courses planned during the project

One pair of oxen was also given to the Makeni Veterinary Station to serve as a demonstration unit.

Eight pairs of oxen were bought from Guinea. They were quarantined at the Makeni Veterinary Station for 4 weeks, treated against endo- and ectoparasites, before they were transferred to the farmers. A basic set of implements was purchased for each farmer and was handed over together with the animals.
Regular weekly monitoring visits were paid to these farmers by the project team. 10 farmers without oxen served as control. For this purpose 5 bicycles were bought to facilitate the extension work. The following data were collected:

- Size of land ploughed by oxen
- Yield on this land
- Inputs (feed, housing, drugs)
- Outputs (income through loan of animals to neighbours)

Given the limited time of this intervention, Training was a very important component, which consisted of the combined Module *Train the Trainer* and *Train the Farmer.*

4. Preliminary results

The training course was held in May 2003. Five extension agents were trained by an ITC specialist on management of draught oxen, harnessing, health care, housing and feeding. Thereafter, the extension agents trained 16 farmers for 5 days in the practical application of the same topics, in local languages, assisted by the ITC specialists. Feedback from this training was very positive.

The farmers now owning working oxen formed an association to use the extra money earned from loaned animals for the purchase of better implements and additional animals.

Table 2 shows the acreage ploughed with the oxen and the direct and indirect beneficiaries. From the reintroduction of the animals, farmers used the manure to fertilise their plots and they strongly emphasised that their human drudgery has reduced a lot.

Table 2: Crop production using oxen in the Bombali District

Community	Direct Beneficiaries			Indirect Beneficiaries			Totals			Yield/ Acre
	N° of HH	A	Y	N°of HH	A	Y	N° of HH	A	Y	
1	1	4.0	28.0	5	6.0	43.5	6	10.0	71.5	7.2
2	1	7.0	39.0	9	10.5	65.0	10	17.5	104.0	5.9
3	1	10.0	60.0	2	1.0	6.0	3	11.0	66.0	6.0
4	1	3.0	29.0	6	12.0	51.0	7	15.0	80.0	5.3
5	1	6.0	36.0	6	11.5	69.0	7	17.5	105.0	6.0
6	1	2.0	13.5	3	3.5	13.0	4	5.5	26.5	4.8
7	1	6.0	35.0	5	11.0	55.0	6	17.0	90.0	5.3
8	1	5.0	30.0	4	8.0	45.0	5	13.0	75.0	4.8
Total	**8**	**43.0**	**270.5**	**40**	**63.5**	**347.5**	**48**	**106.5**	**618.0**	
Average/ HH		**5.4**	**33.8**		**7.9**	**43.4**		**13.3**	**77.3**	**5.8**

1 bushel=27.5kg A=Acreage Y=Yield in bushels

Table 3 : Yields by farmers' without oxen in the same area

Farmer	Acreage Ploughed	Yield
1	3	10
2	5.5	3
3	6	13
4	6.5	5
5	2	3
6	1	2.5
7	3	3
8	4	3.5
Total	**31**	**43**
Average	**3.9**	**5.4**

Table 4 : Comparison of acreages ploughed and harvest between farmer without and with oxen

Description	Unit	Without Oxen	With Oxen
Total acreages ploughed	Acre	31.0	106.5
Total Yield (ploughing season)	Bushels	43.0	618.0
Average acreages ploughed/Ben	Acres	3.9	13.3
Harvest/Beneficiary (Average)	Bushels	5.4	77.3

5. Conclusion

The project was able to "kick-off" the re-establishment of livestock-agriculture integration in five communities of two chiefdoms in the Bombali District. Because of the efficient implementation of the project, the responsiveness of the farmers and their motivation to organise themselves, the project has made an immediate impact. This impact was so visible that the project was able to solicit continuous funding for another year by the EU funded SLRRP, under which the additional provision of 20 sets of oxen and implements has been approved.

AN OVERVIEW OF THE PACE PROGRAMME

Presented by Eunice Forster

1. Introduction

In an attempt to give a brief overview of the PACE Programme, answers to the following questions will be provided:

- What is PACE?
- What are the aims and objectives of the Programme?
- What are the expected outputs?
- What was the situation before PACE?
- Where are we now?
- What is our action plan for the rest of the Programme?
- What has been our constraint?
- What are our recommendations?

PACE, an acronym for Pan African Control of Epizootics, is a continent-wide investigation and disease control programme which is being implemented in 32 sub-Saharan African countries by the AU-IBAR and funded by the EU. In The Gambia, PACE is being implemented by DLS through the PCU on behalf of DOSA.

The programme has the following four main components:

- **Support to National Animal Services** through the establishment of a National Coordinating Unit and the setting up of national and continental epidemio-surveillance networks for animal diseases;
- **Improved drug distribution** through the privatization of veterinary services and drug delivery;
- **Eradication of Rinderpest** through the completion of the O.I.E Pathway
- **Greater control of CBPP and other epizootic diseases**.

The overall goal of the programme is to:

- Contribute to poverty reduction in the livestock farming community by improving productivity

The project purpose is to:

- Safeguard animal health in participating countries against major transboundary animal diseases
- Strengthen the capability of national and regional veterinary services to assess the technical and economic aspects of diseases and generate appropriate programmes for their control.

The expected results are:

- Animal health services reinforced to be able to control major animal diseases
- Veterinary services privatised in order to improve clinical services and drug delivery systems
- Final eradication of Rinderpest through completion of the O.I.E Pathway
- Improved control of other major epizootics

In aiming to achieve these expected results, PACE (Gambia) had to put in place a series of planned activities:

- Strengthening capability of DLS

    - Capacity building
    - Provision of necessary goods and services

- Setting up of a sustainable epidemio-surveillance network for transboundary diseases like CBPP, FMD, LSD, ASF, PPR and NCD

Epidemio-surveillance is a method of observation based on a continuous recording of the health status or risk factors within a given population in order to detect the emergence of a disease and study their development in time and space in order to adopt appropriate control measures. The personnel and institution involved in these activities are what make up the epidemio-surveillance network. In The Gambia they include:

- Auxiliary Farmers
- 20 Field Agents
- 6 Disease Monitoring Officers
- Private Veterinarians
- 2 Data Entry Clerks
- I Epidemiologist
- A 4-man mobile team

- Completion of the O.I.E Pathway

3 phases of serum sampling from 1% of the national herd to establish the absence of Rinderpest from the national herd;
Development of an emergency preparedness plan for Rinderpest;
Formal application of freedom from Rinderpest to the O.I.E

- Establishment of an effective privatisation of services and drug distribution

Set up a guaranty fund;
Conduct studies

2. Main achievements and results during the year (2002)

Internal: The following were provided by the project to ensure smooth functioning of activities:
Logistics: fuel and allowances were provided to carry out field activities; laboratory reagents and consumables for diagnosis.
Personnel: A National Coordinator, Monitoring and Evaluation Officer, Accounts Clerk, Secretary, 3 Disease monitoring officers, 6 Field agents and 5 component heads (epidemiology, communications and Training, wildlife surveillance, sero-surveillance and Privatization) were mobilized from within and outside the programme.
Equipment: 4 vehicles, 6 motor bicycles,

External: results in terms of output:

- An epidemio-surveillance network for Rinderpest and other transboundary diseases of national interest e.g. African Swine Fever, Foot and Mouth Disease was developed;
- Farmers' awareness and knowledge on the network, the diseases and their involvement in the surveillance network were increased;
- Diagnostic capacity for Rinderpest was established
- A wildlife disease epidemio-surveillance network was established and carried out sampling in the national wildlife parks;
- A mobile team was established which dealt with emergency situations like the Rift Valley Fever outbreak.
- A Monitoring and Evaluation team visit from Brussels to evaluate the Programme
- Considerable progress down the OIE Pathway i.e. first phase of sero-surveillance conducted.

3. Issues and constraints

Maintaining an epidemio-surveillance network requires a core of well-trained, well-equipped, motivated staff moving in the field in a coordinated way. This requires a considerable amount of resources, both human and financial. A considerable amount of fuel especially is also required and a lot of movement both planned and unplanned is envisaged. However, before the onset of PACE these were not adequately available at the Department of Livestock Services and will therefore require a lot of resources to put.

The greatest constraint therefore is that the PACE budget is limited and inadequate for a surveillance network for all transboundary diseases. Furthermore, EDF procedures and guidelines sometimes hamper swift intervention, which is essential for a disease control programme. The rate of replenishment was extremely slow. Often, there is a clash of interest between project implementation, which should be the major focus of the programme in order to achieve the desired impact, and compliance with financial procedures.

The Data Management Unit is not yet fully operational and the prescribed PACE integrated data management software is yet to be installed at the unit. However, 2 of the programme staff have been trained on the use and application of the software. There is still a need to further train the data entry clerks to at least HND level. The Programme however does not intend to offer long-term training to its staff.

ELISA Reader and computer were not budgeted for in the 1st year, so sample analysis could not be carried out.

The late start of the programme (August 2001) and the extension of the 1st year Work Programme have placed PACE (Gambia) at a comparative disadvantage with other participating countries when comparing progress. Furthermore, PARC, the precursor programme upon which PACE is expected to build upon, made minimal achievements as it was discontinued in The Gambia after the 1st phase.

The M & E system is weak and is currently being supported by the M & E Technical Assistant at the E C Support Unit. However, there is a need for it to be strengthened through capacity building of the M & E Officer.

4. Decision/actions to be taken

- Policy on privatization of veterinary services to be developed
- Policy on control strategy for transboundary diseases to be developed
- Sourcing for additional funding for the privatization process as amount allocated for this activity under PACE will not yield adequate impact
- Emergency preparedness plan for Rinderpest to be developed
- Review of the programme to justify extension because of late start-up.

SESSION TWO (1)

This session comprises, after a brief introduction to the *Market-oriented system*, some key results and findings from the R & D activities carried out in support of the Gambian dairy sector development.

PERI-URBAN/MARKET-ORIENTED AGRICULTURE: AN INTRODUCTION

Presented by Yemi Akinbamijo

The Market Oriented Production System (MOPS) has evolved out of necessity to provide a coping strategy that can match the new trends of food needs among the growing human populations. Changes in demographic trends and feeding habits have necessitated the need for more aggressive but sustainable approaches to food production in a way that begs appropriate technological innovations to meet demands for human nutrition.

The activities of the MOPS of PROCORDEL complement the existing trends in animal agriculture in the sub-region. The dichotomy in the systems and the different *modus operandi* of the production systems is the basis of the need to differentiate the low input system from the market-oriented system accordingly.
The MOPS is geared towards income generation and the maximization of profit. The implication is that the approaches and concepts employed to operate within the MOPS are different from the conventional low-input strategies. In the Gambian context, the introduction of new animal genetic resources and the accompanying need to feed and manage them implies that new technological innovations in animal agriculture would be required to operate a MOPS successfully. In addition, management, marketing and the necessity for processing animal products are important descriptors of the system.

Under the auspices of PROCORDEL, major issues of interest addressed in the MOPS include the following

Animal Genetic Resources
The use of high-yielding animal genetic resources is one of the growing attributes of the system. The objective is to exploit the genetic merits offered by crossbreeding exotic breeds (e.g. Holstein-Friesian) with the N'Dama with a view to increasing the local dairy production. Results from ITC's work on the continuous F1 production scheme has already indicated the potentials of crossbreeding animals in fitting the MOPS profile for dairy production – especially the peri-urban system of production.

High Inputs
The genetic potential of crossbred animals is only expressed when the environmental conditions are conducive. In this context, good nutrition, health, housing and management cannot be compromised if the production objectives of the MOPS enterprise are to be attained.
MOPS depends on the heavy input of resources before the high yields of outputs are realized. Inputs are generally in the form of labour, veterinary services and health care such as

vaccination, etc. As most of these animals are raised in high population density areas, appropriate feeding and management strategies need to be put in place.

Processing and Consumer Safety
Where output is in considerable volume, usually in excess of household consumption requirements, conservation and safety of produce become a relevant issue and a cause for concern. Because of the perishable nature and the high volume of produce anticipated in the MOPS, the system depends on adequate processing, preservation and marketing strategies to avert market glut and losses. If these produce are not properly transformed and preserved, the risk for compromising consumer health and safety becomes very high.

Marketing
The essence of the MOPS is to generate income from the farming enterprise. The marketing facilities need to be adequate as this is the end of the chain where the producers' efforts are translated into income. Good marketing strategies and structures are therefore very central to produce as well as for services within the context of the MOPS.

In conclusion, the training and capacity building of the ultimate beneficiaries of the MOPS technologies is imperative in order to accomplish the objectives of the system. The demands of the system are more or less specialized and it would be necessary that the operators of the system be well informed on the peculiarities, principles and practices they are supposed to operate.

DEVELOPMENT OF SMALLHOLDER MILK PRODUCTION IN PERI-URBAN AREAS OF THE GAMBIA BASED ON A CONTINUOUS F1 BREEDING SCHEME.

Famara.Sanyang, Duto Fofana, Aladji Diack
Presented by Famara Sanyang

1. Introduction

The supply of milk from local production does not meet the demand especially in the urban/growth centres. Sour milk which normally was made from fresh full cream cow milk is now made from imported powdered milk especially when one has to serve large numbers of people such as in traditional festivals/ceremonies. The explanation for this low supply is that the predominant N'dama cattle breed is genetically a low milk producer yielding about 400kg per lactation. A greater proportion of the milk is produced and consumed in the rural areas because of difficulties in transporting it to urban areas where the human population and demand is highest. According to FAO production and trade data 1991-2001(FAOSTAT/WAICENT) from the year 1999 to 2001 the gap between demand and local production of milk range from 20,000 to 25,000 metric tones in other to meet the nutritional requirement of the population. This demand/supply gap had to be filled by importation which is a burden on the meager foreign exchange earnings.

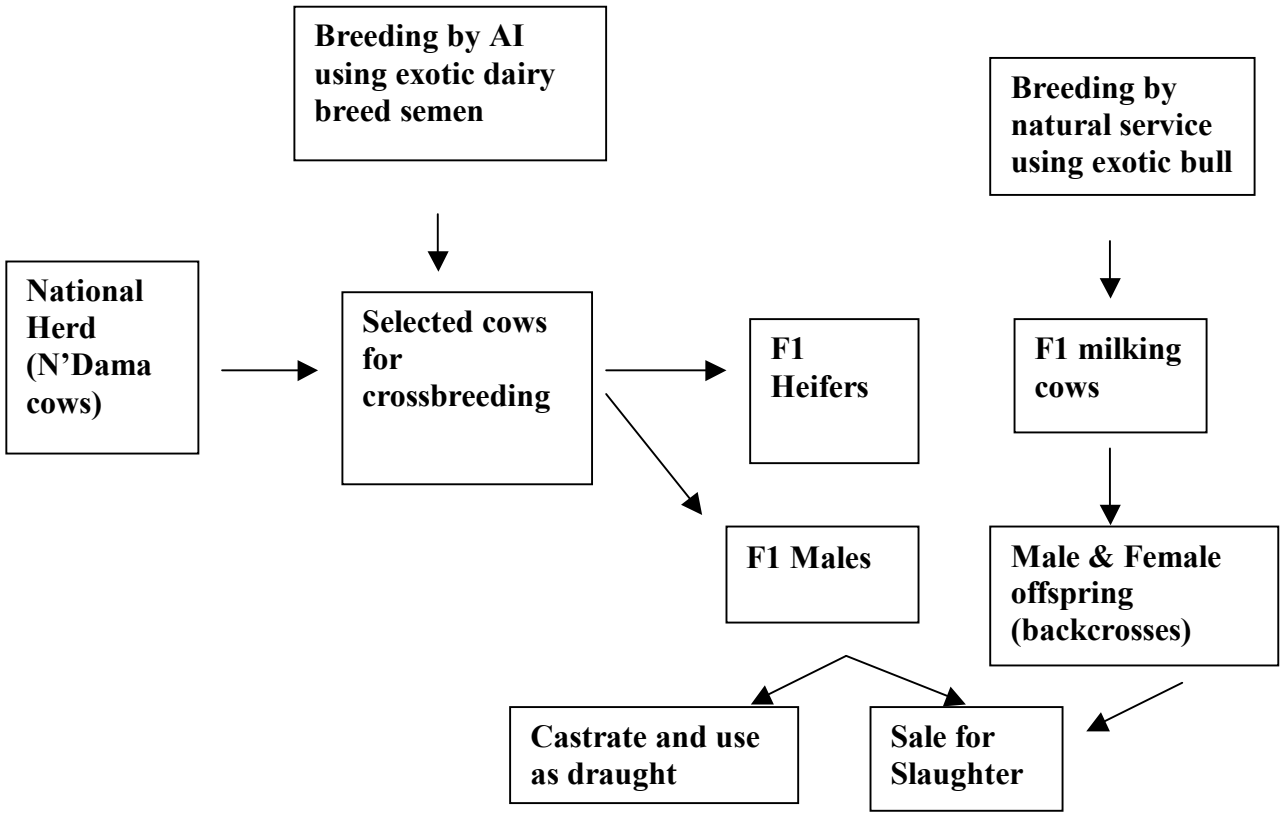
In recognisition of the above and with the profound knowledge of the prevailing farming system, the ITC in 1994 started a crossbreeding program as an on-station pilot trial which, if successful, could be introduced as an alternative approach to improving local milk production around the urban areas.

2. Purpose and Objectives

The purpose of the program was to improve the livelihoods and nutrition of small-scale peri-urban dairy farmers through increased milk off-take for home use and sales to consumers. To achieve this, activities were conducted both on-station and later on-farm with the following objectives:

- Carry out research to establish the productivity/production potential of F1 crossbred (exotic dairy breed x N'Dama) cows under simulated on-farm management conditions.
- Implement the breeding scheme on-farm by establishing production units with farmers in selected sites in peri-urban areas.

About the continuous F1 scheme



It was presumed that each year a small portion of the national herd could be available for the production of the F1 crossbreds. The female F1s will be reared in an improved/intensive system to become dairy cows while males and all backcrosses will be used as draught or for

slaughter. At full implementation, the program is expected to increase the off-take rate and impact positively on average meat consumption in the project areas.

Implementation of this scheme requires :

(a) A good understanding and reliable means of producing the crossbred cattle with a view to making them available to smallholder farmers at affordable costs

(b) Skills/experience in cattle rearing/husbandry practices to minimize mortality/morbidity and maximize on production potentials

(c) Profound knowledge of the nutritional requirements and the adoption of strategic feeding practices for all categories of the production cycle e.g. calves, young males and heifers, lactating and dry cows.

3. Activities carried out

3.1 On-station

Some 142 F1 calves were produced in three crops (1995, 1996, 1997) by artificial insemination of N'Dama cows following oestrus synchronization. The ear implant method of oestrus synchronization was used and each cow received a double insemination at 48hrs and 65hrs after removal of the implant. A N'Dama service bull was introduced to cover any cows in any subsequent to oestrus post insemination. The average calving rate achieved ranged from 40% to 55%. The conditions required to achieve higher rates were attributed to the following:

- weaning of the suckling calve for at least 2 months before the start of the synchronization treatments.
- cows respond better than heifers; therefore it was advisable to use only cows.
- cows in good body condition are likely to be cycling and would respond to the treatment

The calves produced were reared on-station under a simulated traditional management system. Records of data on productivity parameters were kept in computers for future analysis. Experiments were also conducted geared towards better understanding aspects of their husbandry, feeding and disease management.

3.2 On farm

Based on the results and experiences of the on-station work, the program was extended to on farm. This involved a mass sensitization campaign to raise the awareness of the farming community on the program especially the type of cows required for the production of the crossbreds. Between 1999 and 2003 some 618 cows in 10 districts were inseminated using Holstein Frisian semen. Due to operational logistics of grouping cows of different owners and from different herds, the mobile system of visiting all farms for all the sequence of activities involved in the synchronization treatment was practiced. The average calving rate obtained was 35%. Because of the low numbers of cows involved and the calving rates achieved the numbers of F1s on farm was small and sparsely distributed. The constraints were generally related to the poor adherence by farmers to the set of management conditions required for successful insemination.

A loan scheme was also introduced in which a pregnant heifer was given to farmers in selected sites. The objective of the exercise was to involve the farmer in the process of rearing cows in an intensive system as a way of preparing him for the future challenges. Also the presence of a lactating crossbred cow will be a sensitization/extension aid for interested farmers in the locality. The on farm cattle in the Kombo districts were closely monitored to determine their performance and provide advice on improve management practices.

4. Results

The following productivity parameters were obtained for cattle reared on-station:

- Av. daily weight gain up to 3 years = 210gm
- Av. adult weight of F1 cow = 360kg
- age at 1st calving = 30 months
- calving interval = 14 months
- calving rate = 90%
- calf mortality (1st week & prematures) = 4.8 -22%
- later deaths = 17 – 27%
- Average lactation (over 4 lact.) =1,400 litres
- Average daily off-take = 4.5 litres

It is to be noted that lactation does not cease upon the death of the calf as is the case with N'Dama cows.

5. Achievement

- Knowledge on the production potential of F1 cattle
- A well sensitized farming community is now attending the program
- Some 24-farm units established with about 77 F1 crossbred cattle in the Kombo districts. Some units are also found in Foni and Nuimi districts.
- Farmers were trained on aspects of husbandry of F1
- Extension aids materials (e.g. Manual) were developed for use by field officers and farmers.

6. Recommendations/useful messages

1. Farmers should adopt the recommended improved husbandry practices which are a pre-requisite to successful insemination
2. A monitoring system for F1s on farm should be developed and adhered to by the Department of Livestock Services (DLS) to better understand the constraints in the new farming system.
3. Training of farmers and field officers involved in the program should be a continuous process and be supported by DLS
4. Government to consider the program as a long-term investment and therefore develop a policy and implementation strategy in order to achieve the purpose.

PREVAILING DISEASES AND CONTROL OPTIONS FOR F1 CATTLE IN THE KOMBOS DISTRICTS OF THE GAMBIA

Stephen G. A. Leak, M.L. Ceesay, D. Fofana, S. Münstermann
Presented by Stephen Leak

1. Introduction

There is a high demand for fresh milk and milk products, particularly in the Greater Banjul area of The Gambia. This area is inhabited by a large proportion of the human population of the country and is the main area of economic activity. The tourism industry, in particular, provides a large existing and potential demand for fresh milk products. For those reasons, in the early 1990s ITC started a programme breeding F1 crossbred dairy cattle using imported Jersey and Holstein semen. Following on-station testing of these F1 crosses, a programme was initiated to introduce the F1 crosses to suitable farmers in the Kombos Districts. One of the main reasons for establishing crossbred dairy cattle keeping here was the assumption that the Kombos Districts represented a low trypanosomosis risk area, and would therefore be the area in which more susceptible cattle would be most likely to survive. This assumption was based on the belief that a low tsetse density means a low risk to cattle of contracting trypanosomosis. An assessment of the performance of the F1 cattle and of the disease risk to which they were subjected was carried out as an activity of PROCORDEL, with the objective of providing participating farmers with recommendations for economically viable disease management strategies. The results of that study are presented here.

2. Trypanosomosis risk

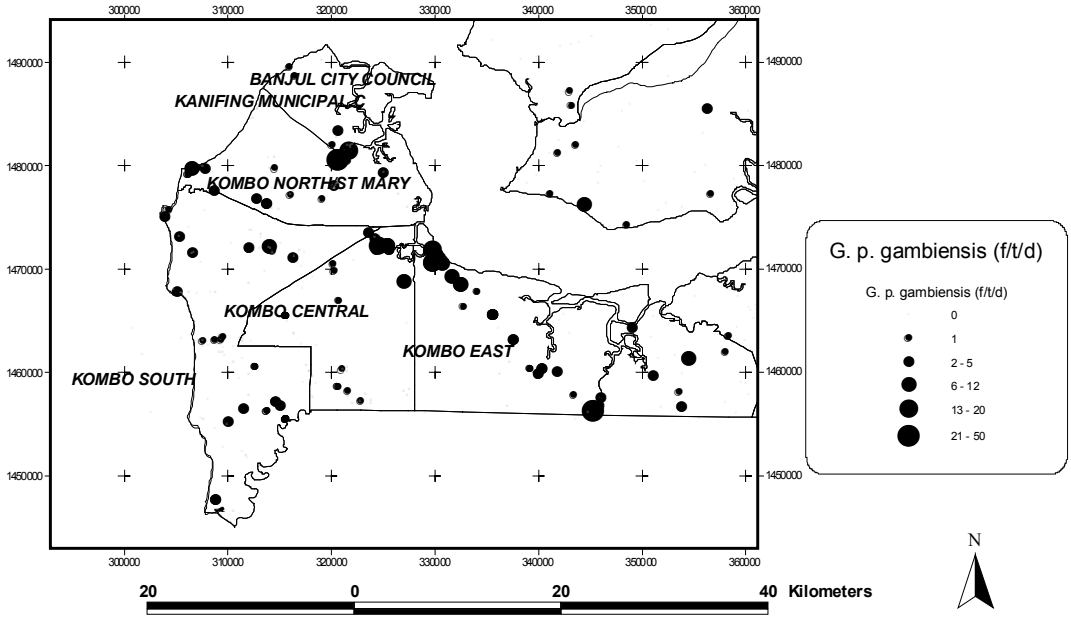
It has been argued that human population growth and environmental factors have led to a decrease in the tsetse density in the coastal area south of the River Gambia (Snow *et al*., 1996). Certainly, human population growth has taken place and is associated with a decreased cover of woodland and habitat for tsetse flies and their hosts (Bourn *et al*., 2001). There are two species of tsetse in the Gambia; *Glossina morsitans submorsitans* and *G. palpalis gambiensis*, and the main host of *G. m. submorsitans*, the warthog, is much more susceptible to environmental change than the monitor lizard, which is the main host of *G. p. gambiensis.* The former species is also more susceptible to habitat change associated with human population increase than *G. p. gambiensis*, which can live in close proximity with humans.

Predictions have been made about the effect of human population increase on tsetse populations, and these predictions indicate that tsetse will decrease, but not disappear in the near future (Reid *et al*., 1999). In areas such as the Kombos, where human population density is high, tsetse density has gone down in some areas but they are still present over much of the region.

The distributions of the two tsetse species were determined in 1993 through a national tsetse survey carried out by ITC (Rawlings *et al.,* 1993). The 1993 distribution of *G. p. gambiensis* in the Kombos Districts is shown in Figure 1. There are now apparently no *G. m. submorsitans* in the Kombos; that species is generally not found in areas with a high human population density.

Figure 1:

G. p. gambiensis distribution in Kombos Districts (Rawlings et al., 1993)



As a result of the demand for land for cultivation and tree-cutting for firewood, both related to the increasing human population, the area of the country covered by forest and closed-canopy woodland, including primary and secondary tsetse habitat, fell from 60% in 1946 to 3% in 1993 (Bourn et al, 2001).

Associated with the human population density increases, and the reduction in forest cover, the main hosts of *G. m. submorsitans*, the warthog, become scarcer as its habitat becomes fragmented or disappears completely. *Glossina p. gambiensis* is much less affected by high population density. It is also adaptable in its choice of hosts, and in a situation such as the Kombos, it will feed more on domestic livestock, particularly cattle, if its wild hosts, such as the monitor lizard, becomes scarce. One of the other reasons why this species can easily persist in relatively densely inhabited areas, is that its host, the monitor lizard, can also continue to survive in populated areas where there is water.

A factor that may not always be appreciated by those involved in livestock production is that tsetse density is only one parameter determining trypanosomosis risk. A long time ago, John Ford (1964), one of the pioneers of trypanosomosis epidemiology, noted the paradox that where there are tsetse flies to be found, there is usually very little trypanosomosis in domestic livestock, whereas, in areas where trypanosomosis in cattle is a serious problem, it was often hard, or impossible to find tsetse flies. The explanation for that paradox is that where there were many tsetse flies, that could be detected using the rather inefficient monitoring methods of those times, the challenge would be so high that cattle could not be kept in the area. This was especially so before the widespread use of trypanocides; hence, there was no trypanosomosis of domestic livestock. Cattle were kept "outside" the tsetse infested areas. This is clearly seen from the inverse relationship between tsetse distribution and cattle distribution. In the fringe areas, apparently outside, but situated at the edge of tsetse infestation, trypanosomosis was generally a serious problem with livestock production. That was particularly the case with trypanosusceptible livestock

although it may be somewhat different with N'Dama cattle, or in circumstances where trypanocides are regularly used; both those factors allow cattle to be kept close or within tsetse infested areas.
The relevance of this is that a low tsetse density does not equal low challenge. Trypanosome transmission is complex, and there have been several sophisticated mathematical models to describe it (*e.g*. Milligan & Baker, 1988) that have revealed the importance of some of the components other than tsetse density reviewed by Leak (1998). A simple definition of challenge is and can be estimated from the product of the apparent density of tsetse, the trypanosome infection rate in tsetse and the proportion of feeds taken by those tsetse from the livestock under study. Where the last two parameters do not change very much, which is generally the case in a stable situation, the apparent density alone may give a reasonable indication of seasonal changes in challenge or in similar locations it may give an indication of differences in the relative challenge, however it alone cannot give an absolute indication of whether challenge is high or low.

The feeding preferences of tsetse and their trypanosome infection rates are closely linked. Jordan *et al.,* (1965) showed that when tsetse feed more on livestock (cattle) they tended to have higher trypanosome infection rates (Figure 2). There was a direct relationship between the proportion of feeds from cattle or bovidae, and the trypanosome infection rate.

Therefore, in an area such as the Kombos, the tsetse whilst at a lower density, are likely to feed more on cattle and are likely to have higher trypanosome infection rates, therefore the trypanosomosis risk or challenge, estimated as the product of density, infection rates and proportion of feeds from cattle can be higher than in a situation where there is a much higher density of tsetse, but those tsetse take the majority of their feeds from, for example, warthogs, which are refractory to infection with *Trypanosoma vivax*, and as previous work at ITC has shown are reservoirs of *T. simiae*, which is mistaken for *T. congolense* when found in tsetse flies, but which is not pathogenic to cattle.

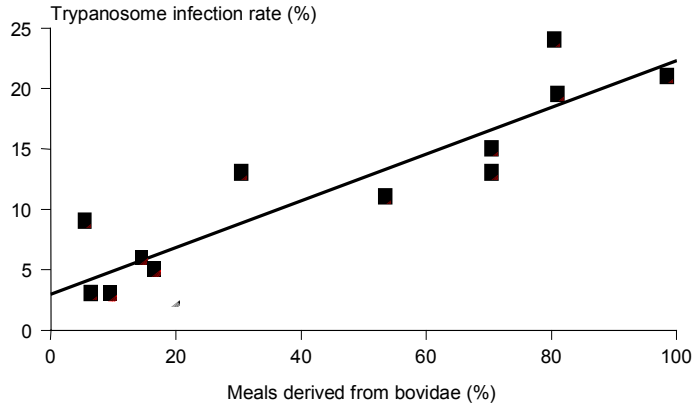


Figure 2: Relationship between the bloodmeals derived from bovidae and trypanosome infection rates in tsetse

2.1 Blood meals

One of the essential parameters necessary to accurately estimate challenge is the proportion of feeds taken from domestic livestock being studied. At present such data are difficult to

obtain. There is a clearly identified research need for a blood-meal analysis service; preferably using more sophisticated techniques than were previously employed.

3. Results of PROCORDEL disease risk assessment studies:

3.1. Tsetse

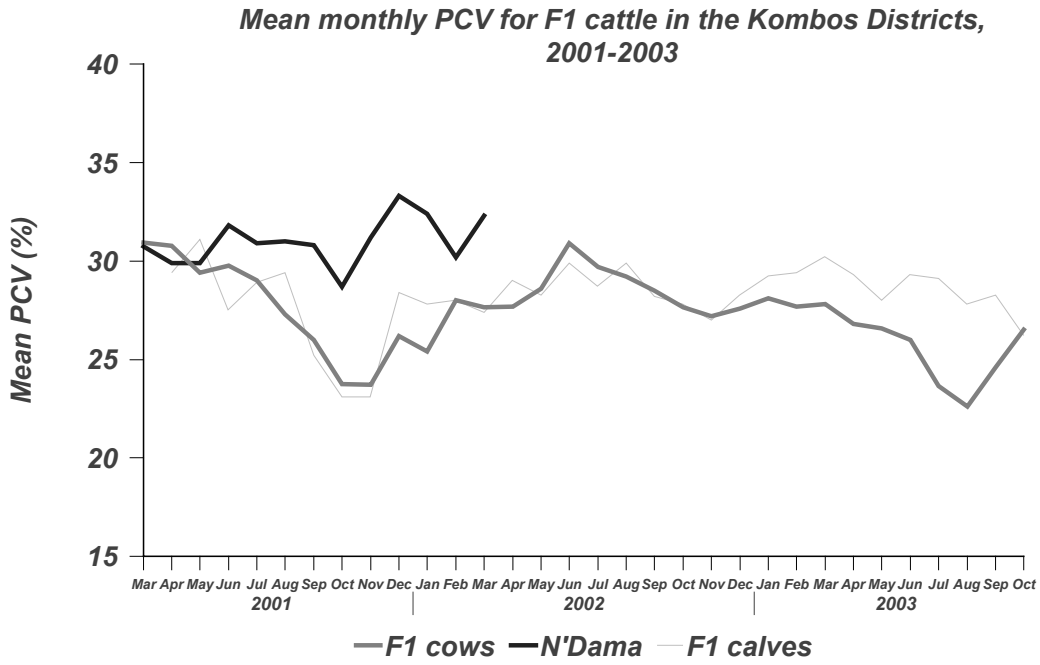
The mean apparent density of *G. p. gambiensis* is relatively low, at approximately 3 flies per trap per day. However, the distribution is not even, there are some areas, predominantly areas with a high human population density, with no tsetse detectable, and other areas, such as Abuko and Kitty, where the tsetse apparent density is quite high. Those areas still have a significant amount of natural habitat, either because they are conservation areas in the case of the Abuko Park or because they are still undeveloped areas on the outskirts of the more populated areas of the Kombos districts. The apparent density of *G. p. gambiensis* ranged from 8.1 flies/trap/day at Abuko to >0.03 f/t/d at Kerr Serigne and 0 at Kololi/Nemakunku. The mean trypanosome infection rate in *G. p. gambiensis* was 19.6% in 2001 and reached even higher levels in 2003. That represents a high infection rate in comparison to trypanosome infection rates reported from other studies. It is not possible to compare trypanosome infections between different locations in the Kombos as insufficient flies were dissected in many locations for reliable estimates to be made.

3.2. Livestock

3.2.1 Trypanosome infections and anaemia

Data from the PROCORDEL study has shown that trypanosomosis in F1 cattle is a significant problem. Although the mean monthly prevalence is not high (around 3 or 4%), the annual period prevalence was approximately 30% indicating that in a period of 1 year, almost a third of the F1 cattle would become infected. Despite the tsetse being clustered in so-called “hot-spots”, analyses of the distribution of the infected F1s showed that they were not similarly clustered, nor was it the same group of animals becoming repeatedly infected. Indeed, the infected animals were distributed throughout the Kombos farms holding F1 cattle, including an area where no tsetse had been caught. The results of regular monthly parasitological monitoring in 2001 showed that there was also a significantly high prevalence of trypanosomosis of 16% in N’Dama cattle despite their trypanotolerance and the supposed low challenge in the Kombos, however, the trypanosome prevalence in F1 cattle was significantly higher and represented a moderately high risk. As can be seen from figure 3, the N’Dama maintained a higher mean packed cell volume (PCV) than the F1 calves or cows, indicating that they were better able to control anaemia. The F1 cattle showed a tendency for decreased PCV at the end of the rainy season, in October and November, whilst PCV tended to be higher in the late dry season. Possible reasons for the higher PCV at that time could be both because trypanosomosis risk is lowest at that time as tsetse populations have contracted in both abundance and distribution, and secondly because water balance maintained by the cattle at that time could be expected to be at its worst due to lack of sufficient water and due to the high environmental temperature.

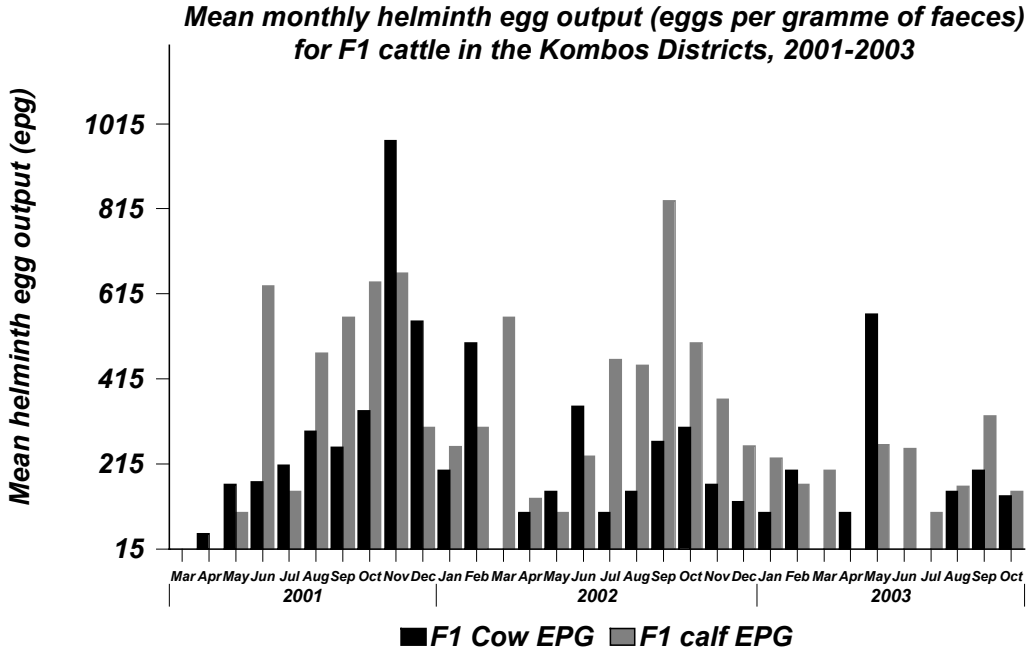
Figure 3:



3.2.2 Helminth infections

Selected animals under investigation were monitored for faecal gastro-intestinal egg output assessed using the MacMaster technique. Figure 4 shows the mean monthly egg outputs recorded for F1 cows and calves during the period of study. This figure clearly shows the seasonality of helminth infections in The Gambia, which has been well described previously. Highest egg output occurs towards the end of the rainy season. There was no evidence that F1 cattle were especially affected by gastro-intestinal helminth infections or that such infections would not be manageable through routine anthelmintic treatments.

Figure 4:



3.2.3 Tick burdens and tick-borne diseases

It is likely that F1 cattle will be under an increased risk of Heartwater (*Ehrlichia ruminantium*) compared to indigenous N'Dama cattle. Studies on the risks of heartwater, transmitted by *Amblyomma variegatum*, which is one of the most frequently detected tick species, are reported separately (Faburay *et al*., these proceedings).

4. Assessment of current disease risk:

Former work at ITC led to a ranking system for trypanosomosis risk shown in Table 1 (Snow & Rawlings, 1999).

Table 1: Ranking system for trypanosomosis risk

TRYPANOSOMOSIS RISK RANKING: Based on Snow & Rawlings, 1999.		
Zero	*No tsetse caught/seen*	*Prevalence in village cattle (N'Dama) = 0*
Low	*Tsetse AD ≤ 3 CI ≤ 9*	*Prevalence ≤ 3.0%*
Medium	*Tsetse AD 3.1 – 7.0 CI 9.1 – 20.0*	*Prevalence 3.1 – 10.0%*
High	*Tsetse AD 7.1 – 20.0 CI 20.1 – 60.0*	*Prevalence 10.1 – 20.0%*
Very Severe	*Tsetse AD > 20.0 CI > 60.0*	*Prevalence > 20.0%*

* CI = Challenge Index

That ranking, and associated management strategy recommendations shown in Tables 2 and 3, were developed for trypanotolerant cattle production systems and therefore are not directly applicable to more susceptible crossbred animals. The authors did, however, make recommendations regarding the possibility of keeping improved, crossbred animals at low levels of risk. Based on the data obtained in the PROCORDEL survey, the trypanosomosis risk can be assessed as high, rather than the low risk category assigned previously.

The conclusions that can be drawn from this study are that it might be incorrect to assume that the tsetse and trypanosomosis problem in the coastal region of The Gambia will disappear naturally due to increasing human population growth. Certainly, tsetse populations will reduce (Reid *et al*., 2000) but as argued above, this does not necessarily mean that challenge decreases. Theoretically it could even mean that challenge became higher, at least for a limited time as domestic ruminants become the main host for *G. p. gambiensis*, leading to higher trypanosome infection rates. A similar situation in which a high human population and a high level of human activity have not resulted in the disappearance of tsetse and trypanosomosis is the Niayes region in Senegal. The tsetse population in that region was thought to have been eradicated in the 1970s (Toure *et al*., 1973), but *G. p. gambiensis* still inhabits that area, even in areas of suitable habitat in the heart of Dakar city, and despite an extremely high human population density and pollution from vehicles. In cattle herds around the Niayes there is a trypanosome prevalence of around 5% average, and as high as 18% in some herds of Zebu cattle (S. Leak, unpublished data).

5. Recommendations for management strategies for rearing crossbred cattle:

The following list provides the potential recommendations from which choices could be made by farmers rearing, or wishing to rear improved cattle in the Kombos Districts, depending upon their location.

1. Keep F1 dairy cattle under zero-grazing conditions
2. Consider netted housing – studies have shown that netting sides (no roof) can be effective in protecting cattle from tsetse as tsetse are generally low fliers.
3. Consider the use of pour-on insecticides – **but,** bear in mind the frequently overlooked fact that, a) pour-ons don't stop tsetse flies feeding and therefore do not stop them transmitting trypanosomes to treated cattle, and b) a small number of sparsely distributed treated F1 cattle would have no impact on the overall tsetse population
4. Trypanocides – Curative treatments of infected animals with diminazene aceturate would be one possible control strategy allowing F1 dairy cattle to be kept if facilities were available for animals to be monitored regular for trypanosome infections – however, such facilities (microscope, centrifuge, capillaries, trained personnel) are not generally available. This leaves the possibility of using a prophylactic treatment of Isometamidium every three months as this treatment would not depend upon infection status. Cost-benefit analyses would be necessary to determine the economic feasibility of both chemotherapeutic approaches.
5. Do not keep F1 dairy cattle in the Kombos Districts because the risk of trypanosomosis is too high to be able to rear them under economically viable conditions.

These possibilities have to be considered alongside other management factors. As should be well known to all, with F1 dairy cattle having a high genetic potential, what comes out still depends on what is put in. Despite the high genetic potential of crossbred dairy cattle, if the farmer only provides a poor quality diet and insufficient water, milk production will be correspondingly low and may therefore not justify the higher level of management required, zero-grazing, netting, pour-ons that would be needed to keep the animals healthy or alive.

6. Conclusions

Certain locations within the Kombos may be tsetse free and F1's could be kept there, but this may not be very convenient or practical if the interested and capable owners happen to live or have their land in or close to, one of the other areas of high risk. The tsetse free areas will probably be those locations with a greater degree of human activity in which it might be more difficult for the livestock owner to acquire sufficient fodder for his animals.

Finally, trypanosomosis is not the only animal health constraint; increased susceptibility to *Cowdria* may represent an important additional constraint that has been addressed in complementary disease risk assessment studies.

Table 2: Risk categories and management strategies according to Snow & Rawlings, 1999.

	Chemotherapy	Chemoprophylaxis	Tsetse Control	Intensification options	Livestock Breeds
Zero	Do nothing	NA	NA	Intensify production systems, e.g. peri-urban dairying	Introduce new breeds, *e.g.* exotic and crosses
Low	Treat as and when required	NA	Cost of vector control not justified at this level	Intensify both improved and village-level systems. Improved management could further reduce risk.	Introduce new breeds, *e.g.* Zebu.
Medium	Treat as and when required but frequency of treatment will increase as problem ranking increases.	NA	Tsetse control may work technically at this level but would not be cost effective: consider also, benefits for tick and nuisance fly control.	Village-level intensification, *e.g.* draught cows, compost pens etc.	Keep trypanotolerant breeds.
High	Treat as and when required.	Prophylactic treatment should be considered for animals important to the farming system such as oxen, horses and donkeys.	Tsetse, tick and nuisance-fly control using pour-ons, although costs may be high and benefits small.	Village-level intensification, *e.g.* draught cows, compost pens. In-village management can reduce animal's exposure to tsetse; compare herd cattle and equids.	Keep trypanotolerant breeds.
Very Severe	Treatment on demand may be insufficient to prevent significant production losses.	Make prophylactics available for all livestock including herd cattle, oxen and donkeys.	Use of insecticide-impregnated targets may be justified. Effective vector control would facilitate development options.	Impact on livestock may restrict agricultural development and consequently intensification options are very limited.	Keep trypanotolerant breeds – whichever will survive.

NA: Not considered appropriate at this problem level. Source: Snow & Rawlings, 1999.

Table 3: ***CONTROL/MANAGEMENT OPTIONS FOR F1 CATTLE***

Severity	Chemotherapy	Chemoprophylaxis	Tsetse Control	Intensification options	Livestock Breeds
Low	Treat as and when required. How and by whom will it be determined that treatment is required?	Might be a necessity for keeping F1 cattle alive but would it be economically justifiable?	Could be justifiable in an isolated infestation in an area of high market potential e.g. the Niayes of Dakar region in Senegal, but not Kombos	Production of F1s is the intensification option the additional management measure necessary would be zero-grazing and perhaps fly-proof housing	F1 exotic dairy breed crosses
Medium	Treat as and when required but frequency of treatment will increase as problem ranking increases.	As a control strategy, this will be a more essential option but less economically justifiable.	Tsetse control may work technically at this level and would provide benefits for tick and nuisance fly control but conventional tsetse control is never sustainable.		
High	***KEEPING F1 CATTLE IS NOT AN OPTION***				
Very Severe					

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SOCIO-ECONOMIC CHARACTERISATION OF SMALLHOLDER DAIRY SYSTEMS IN THE GAMBIA: MILK PRODUCTION, MARKETING AND CONSUMPTION

Jacques Somda, Mulumba Kamuanga, Susannne Münstermann, Alieu Bittaye

1. Introduction

The Gambian government with the assistance of donors is involved in the promotion of the local milk and dairy products sub-sector. The farming system in this country is characterised by the predominance of mixed crop-livestock production. The cattle stock is mainly composed of N'Dama, a breed described as trypanotolerant, but low milk

producer. With a large number of cattle, a substantial increase of the domestic milk supply seems possible, provided a thorough approach of research-development. In order to provide insight on the current production, marketing and consumption of the domestic milk and milk products in The Gambia, a micro-economic-based approach is used.

Furthermore, instead of the traditional system-based approach (intensive, semi-intensive and extensive) used in milk production studies in Africa, few studies have addressed the problem in a farmer-based approach. Similarly, dairy marketing studies usually distinguish between formal and informal marketing systems of dairy products in Africa. We believe the "meso-economic" approach (system-based) is limited in identifying what constraints resource-based farmers face in milk production if system constraints are identified and then attributed to the farmer operating in the system. The difference between both approaches is that the former considers the system in which milk production takes place as determinant of the performance of the domestic dairy sub-sector. In other words, individual farmers own production factors and they are the very persons who decide for or against an orientation towards milk production in the livestock-based agricultural system. The decision to produce is taken in relation to the resources at the farmer's disposal. Ultimately, the farmer decides what technology to use in the production process.

As increased milk production is viewed as a means to alleviate poverty, particularly for smallholders, it is important to develop other approaches in order to effectively capture the limiting factors of the domestic milk sub-sector. This study attempts to analyse constraints and potentials to local milk production, marketing and consumption; and to identify paths for its development. The overall objective is to evaluate the cost-effectiveness and the sustainability of the local milk sub-sector. The specific objectives are: (1) to characterise livestock production with focus on milk-oriented producers; (2) to typify milk production-marketing-consumption patterns; and (3) to evaluate the economic viability of the current system.

2. Material and methods

Primary data were gathered through surveys at the farm, market and consumers' household level. These surveys covered the period from 2001 to 2002. At the production level, a baseline survey of 501 farmers was carried out in 2001, in order to collect information on farm household resource endowment, their production objectives and their needs for improved technology in the mixed crop-livestock system. Following this, a sub-sample of 90 farm households with milk production as objective was selected for an in-depth survey on each component of milk production (resources, herd structure, feeding, health care, genetic improvement, milk production and management, etc.). At the marketing level, surveys were conducted in 2001 and 2002 in order to identify the structure of dairy product markets, the conduct of the economic agents involved and the performance achieved. Seventy local milk sellers and 35 shops of various sizes were enumerated. Finally, surveys on the consumption of dairy products were realised in 2001 and 2002 at both individual and household levels. Two hundred individuals were enumerated on their preferences of dairy products, the amount purchased and their socio-economic background as well. Thirty-five heads of households were enumerated on the same variables in order to evaluate the consumption patterns at the household level.

Data were analysed using the SPSS package. Descriptive statistics allowed assessing the variability among milk producers, sellers and consumers. Cluster and discriminant analyses were applied to the producers' data to investigate the similarities (dissimilarities) of milk producers in terms of their resource endowment, and the factors contributing to the smallholders' discrimination. Partial budgeting methods were applied to evaluate the economic viability of the current milk production and marketing systems. A simple log-linear demand function for dairy products was estimated to provide insight into the effect of change in the household income and dairy products price on the demand of these products.

3. Results

Two types of resource-based farmers were identified. A large number of farmers (about 81% of the sample) are poorly endowed in resources (in terms of manpower-equivalent, cattle, land). The second group of farmers representing 19% of the sample are relatively well endowed. Despite the limited resources and technology, milk production is shown to be economically viable. On average, smallholders are cost-effectively operating in milk production. The average gross margins are evaluated to Dalasi 17,006 and 10,886 p.a. for the resource-rich and resource-poor, respectively.

Milk sellers are performing well and consumers are demanding more milk and milk products. There is however, no formal structure for domestic milk marketing, and this makes any technical and policy intervention at this stage difficult. Several constraints, such as inadequate equipment, lack of transportation and financial support, are hampering the marketing of milk products. These have been identified as entry-points to improve the quality of milk products supplied to consumers, and increase the quantity and subsequently the performance of the system.

Third, the results show that demand for both imported and local dairy products exists. Although, preferences are for local milk products, consumers in general combine several dairy products to satisfy their nutritional needs and their tastes. Because of the traditional consumption pattern of local milk, the demand for this type of product is inelastic to chance in prices. Likewise, demand for local dairy products is inelastic to change in income. Put together, all these facts indicate that domestic dairy production is facing potential demand that is far from being satisfied. The existence of growing demand is proven by the increasing imports of dairy products.

4. Conclusions and implications

Several conclusions can be derived from this study at all three stages: production, marketing and consumption. First and most importantly features the analytical approach. At the production level, the use of a producer-based approach appears to be more instructive. The implication of such approach is that technology transfer should be targeted at the smallholders level if it is to impact agricultural production in general and dairy production in particular. Because of the difference in resource endowment, needs for technology differ, and so is the capacity to uptake them.

At the market level, there is need to assist in organising the marketing systems for milk. The assistance should be directed particularly towards the processing in order to increase the shelf live of milk products and reduce risks of losing revenue for the sellers

and of public health for consumers. This will create more opportunities for milk producers to sell their products. Finally, organising the systems will lead to increased quantity of milk available for the consumers, particularly in the peri-urban and urban areas.

As indicated by the results on the consumption patterns, the demand for local dairy products remains totally unsatisfied. These products benefit from traditional consumption habits and could therefore be further exploited.

FEEDING FOR MILK: AN EVALUATION OF GAMBIAN PERI-URBAN FEEDING STRATEGIES BASED ON LOCALLY AVAILABLE MATERIALS

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Presented by Yemi Akinbamijo

1. Introduction

Since the turn of the present millennium, global population has risen above the 6 billion mark and the trend shall continue for a long time to come. It has also been postulated that most of the changes in demographic trends will take place in developing countries. The shift in population dynamics also shows that most of the urban agglomerations in the developing countries will experience an upward move. Meeting the food needs will require new food production techniques and natural resource strategies to cope with the increasing demand for food especially of animal origin. Given the persistent growth in urban population, poverty and food insecurity there is a continuous shift from rural to the urban-based production system to cope with the increasing demand for animal protein. The implication is that the food production system is changing and the accompanying technologies to support the upturn need to be appropriate.

The peri-urban dairy system is one of such sectors that will certainly have to match the increasing demand with commensurate supply strategies. Meeting the feed requirements on a year-round basis of the dairy sub-sector in quality and quantity has for a long time been an uphill task for farmers and ruminant nutritionists alike. Efforts have been put in place to take advantage of heterosis by introducing a continuous F1 production scheme but it must be well understood that the genetic merits will only be exploited to the extent at which the environmental factors permit. In this regard, nutrition, housing and management are some of such crucial factors.

Because of the unique attribute of peri-urban dairy schemes where extensive grazing is likely to be impossible, feeding strategies must be well articulated in a way that physiological functions and production functions are not impaired by malnutrition and/or under-nutrition.

The need for a balanced diet

The ultimate animal product (meat, milk or draught) is a function of the efficiency of conversion of the feed available to the animals. The entire nutrient requirement for every function of life is sourced from the food consumed by the animal. These include

maintenance of all life forms and functions, growth, reproduction, disease resistance, power output etc. It is therefore logical to commence by understanding the animal's resources in the context of the physico-chemical properties of the available feed resources.

Animal resources

In The Gambia, the N'Dama (and isolated presence of the Gobra) is the most abundant cattle breed from which the largest part of the population derives their milk. This breed is well adapted to tsetse-infested locations and being trypanotolerant, it is expected to retain some degree of productivity without the use of chemotherapeutic measures.

However, the productivity of the N'Dama is not strong enough to match the growing demands for animal products. In order to address this widening gap between human animal protein demands and supply, commensurate strategies based on crossbreeding with exotic breeds have emerged. The intention is to capitalise on the genetic principle of 'hybrid vigour' for the augmentation of meat and milk production.

This is the basis of the continuous F1 production scheme as a basis for the peri-urban dairy scheme. Good as it sounds, the expression of the genetic potential of the crosses is function of good nutrition (among others).

Feed Resources

In the context of the local dairy farming systems where milk is an important production objective, the reinforcement of the feeding system with minimal recourse to the use of body reserve for milk production is very important. The animals need to be fed in a way that the maintenance requirement and the net energy for lactation are covered from outside resources.

In order to achieve this, two classes of feedstuff based on the chemical properties (Table 1) are necessary.

Basal – whatever the animal is offered in large quantities. This can be grazed natural or cultivated fodder offered *in situ* or on a cut and carry basis.

Supplements – are concentrate feedstuffs of whatever the farmer gives as 'top-up' to complement or improve the absolute available nutrients.

Table 1: Chemical properties of some common feed resources in The Gambia

Feedstuff	**OM**	**ADF**	**NDF**	**Protein**	**IVTDMD**
Bean vines	88.5	24.4	33.4	18	70.1
Bitter tomato	84.3	32.8	40.9	21.9	72.1
Cabbage	84	19.6	28.1	19.2	Nd
Cassia leaves	91.2	15	23.3	22.5	87.5
Cassia pods	94.9	28.6	44	15	79.2
Concentrate	89	27.7	33.9	30.7	Nd
Elephant Grass	91.8	41	70.2	8.7	65.7
GNH	91.6	47.3	52.3	11.5	66.5
Maize stalk	95.35	40.5	69.8	5.7	62.8
Potato leaves	89.6	39.8	43.7	11.7	73.88
Radish leaves	80.7	26.4	30.2	24.5	81.5
Yaffal	86.2	22.7	39	19.5	72.1

Nd= not determined

Yaffal= Locally available concentrate feed

2. Feeding for milk

The dairy herd has a very dynamic structure. The different phases of the cow's life should be properly monitored with adequate provision of the required nutrients according to the respective phases. It is good to note that all these phases are brought about by endocrinological processes in the cow. Once these changes are effected, the appropriate nutrient requirement is imperative if the production cycle will not be aborted.

In the female animal, three phases are crucial for an efficient dairy production system. These are:

Cyclicity: This is the onset of the process of reproduction. The heifer manifests the pubertal maturity as an indication of its preparedness to commence the reproduction cycle. The onset of cyclicity in the heifer is known to be affected by many environmental factors of which nutrition is very crucial. It is thus recommended that in order to encourage cyclicity in the adult open female, sub-maintenance level of nutrition should be avoided at all costs.

Pregnancy: Following the establishment of pregnancy, it is pertinent that all forms of nutritional stresses be avoided as much as possible. As the process of gestation involves a dynamic process of body mass accretion, protein, energy and minerals should be in appropriate quantities. Considering the fact that parturition is central to the initiation of the lactation phase, nutrition-related stresses that can lead to abortion should be avoided.

Lactation: This is the essence of the milk production system. The calf as an offtake of the system should be well reared to avoid post natal complication and mortality. Depending on the system in use, the death of the calf may imply the cessation or a reduction in the milk offtake due to the farmer. Where crossbred animals are involved, it is proven that the death of the calf would not result in cessation of lactation. Consequently, the successful rearing of the calf is imperative for realisation of the production objectives of the dairy farmer as well as meat production.

Setting the stage
In the West African dairy production system, two distinct systems of husbandry have been identified including an infinite spectrum of the combination of both systems of husbandry.

- Traditional setting

  Feeding for milk: Starving the milking dam should be avoided at all costs. This is because immediately following parturition, the dam is physiologically committed to the production of milk. Thus in the first few weeks following lactation, the cow produces milk with full recourse to endogenous catabolism. Consequently, loss of body weight and condition becomes inevitable. Although this situation is to be anticipated, the degree to which the endogenous resources are conserved are the degree to which the milk produced is covered by the exogenous resources. After the first 6-8 weeks post partum, the milk offtake begins to decline. In the first place, this is nature's way of ensuring calf survival and the arrest of declining body

condition. The suckling calf will interfere with the cow's endocrinology in a way that the return to post partum oestrus is delayed until the suckling stimulus is absent.

In general, the natural pasture is the main source of feeding for all categories of livestock. The natural pasture is notorious for its varying quality and quantity of available fodder throughout the year with alternating periods of scarcity and abundance during the dry and wet seasons respectively. Irrespective of the season of calving, nursing dams should always be supplemented with additional fodder like groundnut hay at the least.

- Intensive setting: Animals in the intensive production systems are basically space constrained. This is the ideal system for urban and peri-urban settings where grazing lands are hardly available. The implication is that the animals raised in this system of husbandry are zero grazed implying that all their food and water requirements are provided in situ. A second attribute is the use of high yielding animals such as genetically improved and crossbred animals.

  The milk off take pattern in this system is a function of the genotype used and the quality of feed offered provided that management and other factors are optimum. It is recommended that lactating animals be offered at least twice their maintenance requirements to allow for the intake of adequate nutrients for milk production. Very often, the feed intake does not cover the needs of the milking animal. The result is the breaking down of body reserves to synthesise milk. Although the crossbred animal is genetically primed for high milk yield, the stress of lactation can often be compounded by various forms of nutritional stresses. As result of the expected mobilisation of body reserves especially in early lactation, it is recommended that dairy animals retain above average body condition prior to parturition. Metabolites studies have indicated that crossbred animals offered groundnut hay could not arrest their declining body condition but rather increased their milk yields and delayed the resumption of post-partum return to oestrus. This is an attribute to be valued by all dairy farmers.

Traditional feeding system

Basal: The basal diet is sourced from natural pastures that are grazed for up to twelve hours of the day. In some cases, improved pastures are introduced offering a combination of grass/legume mixtures and other improved fodder resources such as the Pannicum spp. var.C1, Stylosanthes spp, Pennisetum spp

Straw treatment: The use of chemical and physical methods to treat straws in a way that the nutritive values are improved has been advocated for high producing animals. Such strategies include the treatment with urea and ammonia.

Supplements are provided to compliment the nutrients furnished by the basal diet. The use of solidified blocks containing urea to supplement the fibrous feed resources despite the fact that it has been outstandingly successful in other countries, is not yet to be introduced in The Gambia. Among the advantages of the blocks are their convenience in

terms of packing, storage, transport and ease of feeding. These are in the form of non protein nitrogen (NPN strategy), urea treatment and the use of multi nutrient blocks to supply concentrated form of energy and mineral sources. Table 2 shows a composition of such nutrient blocks.

Intensive dairy system
Basal diet in the intensive system is usually fodder resources that are supplied on a cut and carry /zero grazing basis. In The Gambia, the use of groundnut hay is predominant. Where funds are not limiting, Andropogon grass can be cut and chopped and treated with urea solution. Baby corn is also a new type of high quality basal diet with exceptional nutritive values.

Supplements in the intensive system are basically a combination of oilseed cakes and cereal brans. A 1:1 (w/w) combination offered at not more than 20% of the voluntary feed intake is ideal for lactating animals. Very recently, *Moringa* spp. is known to have outstanding nutritive values.

3. Conclusion and useful messages

In order to keep a safe limit for good health and productivity, the following guidelines should be adequate for a dairy production system provided there are no underlying sub clinical conditions.

- Recommended Basal diets on dry matter basis
  - Groundnut Hay (5kg and 7kg for N'Dama and crossbred lactating animals)
  - Baby corn stover (5kg and 7kg for N'Dama and crossbred lactating animals)

- Recommended supplements
  - Rice bran: Groundnut Cake 1:1 (2kg 3kg)
  - Moringa fodder (fresh) (6kg 9kg)
  - Specially formulated nutrient blocks ad lib (see Table 2)

Energy Requirements of a dairy cow (Chesworth, 1992).
- Maintenance energy (E_m) in MJ = $0.78 (W/1.08)^{0.67} + 0.013 \times W$
  Where W = body weight in kg.
  If estimated body weight equals 400kg, then E_m = 46.2 MJ per day
- Production energy (E_p) for milk = 5.3 x MY
  Where MY = milk yield in litres per day.
  If milk yield equals 8 litres per day (Akinbamijo, 1999) then E_p for milk production equals 42.4 MJ per day.
- Energy (MJ of metabolisable energy/day)= $E_m + E_p$ = 88.6 MJ

Protein requirements of a dairy cow
- Amount of digestible crude protein needed for maintenance for a 400 kg lactating cow = 243 g/day
- Amountof protein needed to produce 8 litres of milk = 480 g
- Total amount of protein required during lactation = 623 g/day

Ingredients	% incorporation
Rice bran	47
Moringa spp/Leucaena dried leaves	15
Urea	8
Salt	10
Bone meal	5
Cement	15
Water (litres)	40-50

Table 2: Composition of the Blocks.

Reference:

CHESWORTH, J. 1992.Ruminant Nutrition. *The Tropical Agriculturalist*. pp 85, 132-137 Technical Centre for Agricultural and rural Co-operation, Macmillan. (ed. A. J. Smith).

THE *VILLAGE MILK SYSTEM* INTRODUCTION IN THE GAMBIA

Jabel Sowe, Michaela Hempen, Patu Jume, Tek B. Thapa
Presented by Tek B. Thapa

1. Introduction

General description of the Gambian Dairy Industry:

The Gambia has an area of 10,689 square kilometres. According to the Population and Housing Census of 1993, the estimated population is 1,025,867 (1983-93 growth rate 4.1% per annum). Agriculture plays a significant role as food producer, employer and income earner, providing livelihood to about 75% of the Gambian population, contributing 28% to the national GDP, and generates about 40% export earnings. The per capita gross national product for 1994 is about US $ 330.

Annual milk production of the Gambia is 7,153 MT, and the per capita availability of milk is around 7 litres per annum. But The Gambia imports large quantities of high quality dairy products specially to cater for the tourist trade, expatriate community and part re-exportation to the neighbouring countries like Senegal, Guinea Bissau and Mali. In 2000, Gambia imported a total of 26 286 tons of dairy products, composed of 97% milk and cream in liquid and solid form. The other 3% are concentrated or sweetened milk and cream, yoghurt, butter, fat, oils, cheese and others. (Department of Statistics, 2002) The total value of import amounted to nearly 40,2 million GMD. The re-export is quite sizeable, but the accurate figures are not available at the moment.

Traditionally, raw milk and unprocessed milk products like sour milk are consumed in The Gambia. Even the sour milk products marketed in the urban centres like Serrekunda are produced from raw milk. Sour milk is the most popular dairy product produced and consumed in the Gambia. Calabash, a gourd shell, is used as a milking cum storing utensil. Raw milk is either consumed as such or with couscous or allowed to sour naturally in the calabash without any starter cultures. After natural souring, some skim off the top creamy portion called "Fenne". "Fenne" is also churned into butter, and later clarified into Ghee (Thapa, 1997).

Sour milk is sold using 50-100 ml calabash cup measure. Rural milk producer communities believe that if milk is heated, the cow will experience pain in the udder.

In the framework of the EU-funded PROCORDEL project, studies on the hygienic status of milk were carried out in The Gambia and the neighbouring countries. These studies revealed that up to 96% of all collected samples of fresh and sour milk were highly contaminated with bacteria, some of which are also human pathogenic. Short shelf life, contamination with dirt and flies were other characteristics found. Consequently, the program initiated training for milk vendors and handlers and proposed introduction of pasteurisation to improve on the bacteria contamination. Till date, few milk processing facilities and infrastructures have been established in the past, most of which are no longer functioning. To make a new start, the support of a FAO-TCP was solicited to help improve milk safety and farmers' income through the introduction of the *Village Milk System* in the Greater Banjul Area (GBA).

2. Objectives and the Background of the Dairy Project

The aim of this pilot project is to improve the safety of milk and dairy products in the Greater Banjul Area (GBA), and in particular (1) to establish a demonstration in-pouch milk pasteurising (Milk Pro) unit *cum* Training Centre at ITC and one Milk Pro Unit with a local cooperative.; (2) to introduce the Lactoperoxidase system to farmers to enable them to supply surplus milk to Collection Centres and; (3) to demonstrate the low cost and appropriate type of milk processing systems for the women's groups/milk vendors, at the village level.

It is expected that the project will trigger off a demand in the private sector to take up the technology/approach and spread it to other parts of the Gambia (growing centres) and to the Sub-region. Other expected outputs include: the *Village Milk System* applied and commercially operating at pilot locations in GBA, demonstration in-pouch milk pasteurising and Training Unit established at ITC, running training courses in milk processing technologies and improved dairy animal husbandry for farmers.

3. Achievements made so far

- Pilot Dairy Training and demonstration facility at ITC established and functional
- Five dairy cooperatives have been formed, and registered under the Department of Co-operatives. Four in Kombo Central and one in Kombo North.

- Kombo North Dairy Cooperative Society (based in Yundum). This cooperative will operate the Milk-Pro Unit
  Low-cost pasteurisation units have been received by:
- Fedde Sippobe Dairy Co-operative Society (based in Brikama)
- Fankanta Keddam Kafo – Dairy Co-operative Society (based in Darsilami)
- Kasakunda Keddam Kafo – K3 Dairy Cooperative Society (based in Kasakunda)
- Fandema Keddam Kafo – FaKeKa Dairy Cooperative Society (based in Penyem)

- Training programmes started for herdsmen, women processors, DLS core group trainers, and quality management personnel, at ITC and in the field.
- So far around 150 herdsmen, women processors, members of dairy co-operative society, DLS core group trainers attended the training programme organised under the project.

3.1 Training/workshops completed:

The training programme under the *Village Milk System Program* applies the same principles as described earlier. A "Core group" composed of 5 DLS livestock assistants and dairy personnel as well as staff from NaNa were trained during several occasions, to become "trainers" for the final target group: the members of the newly established dairy cooperatives, the milk vendors and handlers and finally, the herdsmen. Though the courses listed hereafter were all carried out under the supervision and guidance of the FAO expert, the Core group was increasingly involved in the practical training of the participants. During the training the women milk processors and the herdsmen were also given equipment (milk cans, filters) to improve their milking hygiene.

1. Three week Dairy Technology Training for the Core group of trainers from DLS/ITC/NaNA (10 participants)
2. A two-week training was organised for the Core group (DLS) on general record keeping, group business management techniques, preparation of balance sheets, cash flow, profit and loss.
3. Two-day Training Programme for the Women Milk Processors on "Clean / Hygienic milk handling and Milk processing and fermented milk production" (19-20.5.03, 28 women, 6 Core group)
4. Two-day Training Programme for the herdsmen on "Clean/Hygienic milk production and handling" (26-27,5,03, 23 herdsmen, 7 Core group)
5. One-week Training Programme for Women Processors on yoghurt and flavoured milk production (13 women, trained by Core group)
6. One-day Observation Tour cum Awareness Training Programme for the Herdsmen, Milk Collectors/Processors and Vendors (5.5.03, 24 participants, Core group)
7. Four–day training programme for the cooperative's secretaries and treasurers/auditors covering general record keeping, group business management techniques and business planning at milk collection points.
8. Media campaign to raise awareness on hazards of consuming raw milk or unpasteurised milk and milk products.

3.2 Other achievements:

- Minimum mandatory standard for milk and milk products have been formulated and are being enforced for the dairy cooperative
- Awareness campaign on the need and use of pasteurized milk products by the consumers.

4. Conclusion

The introduction of pasteurisation and the formation of dairy cooperatives in the GBA can be seen as a very successful first step towards the establishment of a formal dairy sector for locally produced milk and milk products. It is an effective means of improving hygienic milk quality, which was found to be poor in those products offered in informal markets in this area.
A socio-economic market assessment carried out in parallel showed that there is an increasing demand for locally produced dairy products of proven high quality. Dairy enterprising in the present economic environment has been shown to be economic.

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SESSION TWO (2)

This session comprised presentations from investigations into the safety of milk and meat products produced in The Gambia.

THE HYGIENIC STATUS OF RAW AND SOUR MILK FROM SMALL-HOLDER DAIRY FARMS AND LOCAL MARKETS AND POTENTIAL PUBLIC HEALTH RISK

Michaela Hempen, Fred Unger, Susanne Münstermann, Karl-Hans Zessin

Presented by Michaela Hempen

1. Introduction

Milk is rich in proteins, energy, vitamins and calcium and in many parts of the world, it makes a significant contribution to the human diet especially during childhood. A study on the suitability of cow's milk for the dietary supplementation of rural Gambian children showed that milk availability and the ability to afford it are the most important factors which regulate its use as a food for children. Milk is considered to be an attractive source of energy, proteins and calcium for infants and young children where few alternative sources of these nutrients exist (Erinoso, H., *et al*., 1992)

Besides the beneficial effects on nutrition, milk can also act as a vehicle for the transmission of diseases of bacterial, viral or parasitological origin. Milk is an excellent culture and protective medium for certain microorganisms, particularly bacterial pathogens, whose multiplication depends mainly on temperature and competing micro organisms and their metabolic products. Where milk is produced under poor hygienic conditions and is not cooled, the main contaminants are usually lactic acid producers, which cause rapid souring. Lactic acid has an inhibitory effect on pathogenic bacteria but this cannot be depended upon to provide a safe milk product (Heeschen, 1994).

The diseases transmissible to humans through the consumption of milk, like brucellosis, tuberculosis, salmonellosis, listeriosis, *E.coli* infections and many others, were described extensively in 1962 by Kaplan *et al*.

Pathogenic organisms in milk can derive from the cow itself, the human handler and the environment. Cows suffering from mastitis discharge large numbers of pathogens like *Staphylococcus aureus*, *E.coli* and *Clostridium perfringens* into the milk,. Microorganisms from soil, litter, feed, water, faeces and other items in a farm environment commonly contaminate the surface of the udder and teats and the hair and skins of cows. From these sources they can get into the milk during milking. Equipment used for milking, filtering, cooling, storing or distributing milk is also an important source of microorganisms. This situation is aggravated if the equipment is not properly cleaned and disinfected after use. Milk residues left on the surfaces of equipment and utensil provide nutrients to support the growth of many microorganisms, including pathogens (Bryan, 1983).

Individuals, who either milk animals or handle milk, milking or storage equipment, can contribute additional organisms to the milk.

Pasteurisation or more severe heat-treatments applied to raw milk is the only way to ensure that pathogens likely to be present are killed and that the milk is safe. It also improves the shelf life of milk by reducing the number of non-pathogenic microorganisms that would otherwise cause spoilage (Burton, H., 1986).

2. Objectives

The objective of this study was the assessment of hygienic quality of milk and associated public health risks that originate from the consumption of milk and milk products.

The specific objectives were to gather an overview of milk production, processing and market systems and the identification of bacterial contamination and zoonotic agents in raw milk and sour milk samples. Furthermore the study intended to increase information about milking hygiene and to create baseline information for improvement of milk quality and the establishment of a quality control system.

3. Material and Methods

Prior to the collection of biological samples, 53 milk producers, 16 milk collectors and 54 milk vendors were interviewed to gather information about herd size and structure, animal health, milk production and marketing.

Fresh and sour milk samples were then collected from 127 milk vendors, 48 milk collectors and 203 milk producers supplying four markets (Brikama, Soma, Brikamaba, and Basse) over a period of 12 months. On spot, pH-value, temperature and visible purity were recorded. Afterwards they were transported to the laboratory in a cool box and immediately inoculated on culturing media.

In order to get more information on the points of contamination, a follow-up study was carried out. 20 milk chains were selected, 5 per study area. A milk chain consists of the milk producer, the collector who transports the milk to the market and the vendor at the market. The milk from one herd was followed along the marketing way and milk samples were collected from individual cows (3 per herd), from the bulk milk immediately after milking, from the bulk milk at collector's level and from the milk sold at the market. This way, 93 milk samples have been collected. Additionally, swab samples were taken from the utensils that come in contact with milk (n=60).

Milk samples were tested for total mesophilic bacteria, coliform bacteria, *E.coli*, coagulase-positive *Staphylococci spp., Listeria spp., Salmonella spp., Bacillus cereus* and H_2S-reducing *Clostridia spp.*
From the swab samples, mesophilic bacteria and coliform bacteria were isolated and quantified.
All methods used for culturing and identification of microorganisms complied with the International Standardisation Organisation (ISO) or the International Dairy Federation (IDF).

Results were evaluated (where applicable) according to Standards set by the Council of the European Communities (Council Directive 92/46/EEC of 16 June 1992) and/ or set

by Kenya Bureau of Standards (KEBS, Kenya standard 05-04, 1996) for unprocessed whole milk for human consumption.

Table 1: Standards applied in this study

	Council Directive 92/46/EEC	**KEBS**
Plate count 30°C (per ml)	≤ 100,000	≤ 2,000,000
Coliform bacteria 30°C (per ml)	m= 0, M= 5, n=5, c= 2 (Guideline)	≤ 50,000
Staphylococcus aureus (per ml)	m= 500, M= 2,000, n= 5, c=2	
Escherichia coli (per ml)	In raw milk cheese: m= 10,000, M=100,000, n=5, c= 2	
Salmonella spp. (in 25g)	Absent	
Listeria monocytogenes (in 1 g)	Absent	
	m= threshold value for the number of bacteria; the result is considered satisfactory if the number of bacteria in all sample units does not exceed m; M= maximum value for the number of bacteria; the result is considered unsatisfactory if the number of bacteria in one or more sample units is M or more; n= number of sample units comprising the sample; c= number of sample units where the bacterial count may be between 'm' and 'M', the sample still being considered acceptable if the bacterial count of the other sample units is 'm' or less;	

4. Results

4.1 Results of questionnaires

Cattle owners are mainly agro-pastoralists (79.2%), who are either herding the animals themselves (9.4%) or through a member of their family (22.4%). But it is more common (66%) to employ a herdsman who is taking care of the animals. These herdsmen often gather animals from different owners in one herd. They are usually paid in form of milk, which they partly consume at home or sell at local markets as fermented milk.
The producers sell milk either as raw milk (34%) or as fermented milk (11.3%) or both.

In most cases (81.1%) milk collectors buy milk directly from the producers who are transporting it to the markets. Milk is also sold directly to the market vendors (15.1%), if the distances to the markets are short.
Bicycles and public transport are often used to transport milk to the market. In the rural areas horse and donkey carts are used as well.
Milk collectors travel far distances, 30 km or more, to transport milk from dairy farms to local markets. More collectors are involved in the marketing, if the distances are far.
Milk collectors usually sell raw milk to market vendors (43.6%) but also fermented milk (31.3%) or both (31.3%). Most of them are able to sell all their milk the same day.
Milk vendors at the local markets are usually women. They get their milk either from collectors or directly from the producers, some from both of them.
Raw milk is usually not sold the same day, but left to ferment and sold the following day. They take off the cream and sell it at a higher price.
The vendors spend four to nine hours at the market to sell all their fermented milk. 31.5% of them stated that they could not sell all milk at one day.
The most common method to clean milking equipment is the use of cold water and soap (99.2%). Only 0.8% use hot water with soap. Cleaning of udders prior to milking is practised by only 5.7% of the milk producers.

4.2 Results of laboratory analysis

A total of 378 samples were collected, 236 raw milk and 142 sour milk samples.
Table 2 gives an overview of the numbers and percentages of samples positive for the various microorganisms. Coliform bacteria and *Escherichia coli* were considered positive, when their counts exceeded $5x10^4$ colony forming units per millilitre of sample (cfu/ml), whereas *Staphylococci spp.* was considered positive when counts exceeded $5x10^4$ cfu/ml. For the other bacteria only absence or presence was investigated.

Table 2: Presence of microorganisms in raw and sour milk (The Gambia)

	coliform bacteria	*E.coli*	Staph. spp.	*Salmonella* spp.	*Listeria* spp.	*B.cereus*	*Clostridia*
Raw	209 (88.6%)	56 (24.8%)	69 (29.2%)	1 (0.42%)	5 (2.12%)	40 (16.95%)	41 (22.28%)
Sour	78 (54.9%)	78 (38.0%)	27 (48.6%)	0	0	18 (12.68%)	17 (14.41%)

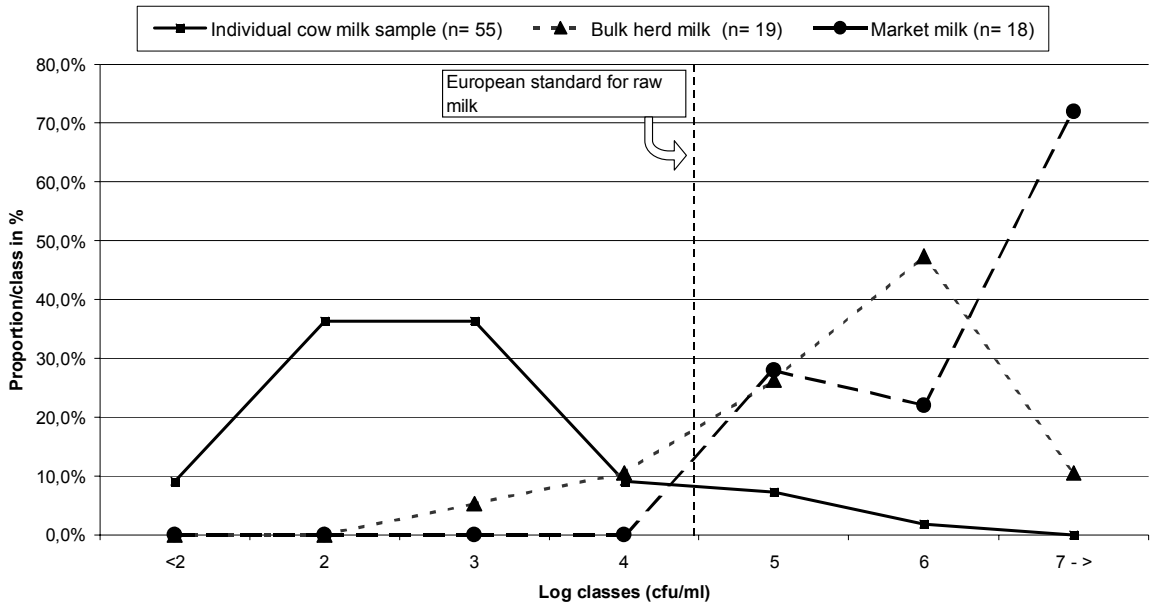
Only 9.13% of the samples had total bacterial counts within the Kenyan limits of acceptance which is $2x10^6$cfu/ml. That means that 90.88% of all samples would not have been acceptable according to Kenyan standards.
88.6% of the raw milk samples and 54.9% of the sour milk samples had coliform bacteria counts above $5x10^4$ cfu/ml, which is the Kenyan acceptance limit. The percentage of *E.coli* (counts above $5x10^4$cfu/ml) was higher in sour milk (38.0%) than in raw milk (24.8%). Coagulase-positive *Staphylococci* counts were above $5x10^2$cfu/ml (EU standard) in 48.6% of the raw milk samples and 29.2% of sour milk samples. *Salmonella* spp. and *Listeria* spp. were only isolated in raw milk (0.42% and 2.12% respectively). The presence of *B.cereus* was more frequent in raw milk (16.95%) than in sour milk

(12.68%) and the same applied to H_2S-reducing *Clostridia* spp. with 22.28% and 14.41% respectively.

4.3 Results of the follow-up study

In total 93 milk samples (raw milk 82, sour milk 11) and 60 swab samples have been collected. 38.2% of the raw milk samples had total bacterial counts above 10^5cfu/ml. In 34.0% of all milk samples the coliform count was above 10^4cfu/ml. The counts of *E.coli* were higher than 10^4cfu/ml in 4.1% of the samples. Coagulase-positive *Staphylococci* in counts above 10^3cfu/ml were found in 32.0% of the samples.
Bacillus cereus has been isolated in 46 samples (49.5%) and H_2S-reducing *Clostridia spp.* in 17 (18.3%). *Salmonella spp.* has been identified in only two samples (2.2%), one herd's milk sample and one collector's milk sample. *Listera spp.* has not been found in any of the samples.
The average total bacterial count and count of *Staphylococci spp.* in milk from individual cows are low ($2x10^3$ cfu/ml and $<1x10^2$ cfu/ml respectively) and meet European standards. The coliform counts are also quite low at this level with less than $1x10^2$ cfu/ml. But after approximately one hour, when the whole herd has been milked, the coliform counts are already much higher and above $5x10^4$ cfu/ml. As the milk passes on to collectors and finally to market vendors, the bacteria counts increase.
Figure 2 shows the results for total mesophilic bacteria counts in individual cow milk, in bulk herd milk and in milk sold at the market stratified by log classes (cfu/ml).

Figure 2: Total bacteria count (cfu/ml) stratified by log classes along producer-market chain



5. Conclusion

The results of this study clearly indicate that milk, which is locally produced and offered as raw or fermented milk, poses a public health risk for consumers. A high number of samples were highly contaminated with coliform bacteria as well as potentially pathogenic bacteria.

The sources of contamination are manifold. Starting from the milking procedure, bacteria enter into the milk from the cow's udder or the milker's hands. It is not common to clean the udder or wash the hands thoroughly before milking. Also very important is contamination through flies falling into the milk. Another important factor throughout the commodity chain is the milking equipment. Commonly used are calabashes for milking and plastic buckets with a lid for milk storage. Large volumes of milk are usually transported in 20 litres jerry cans for practical reasons (no spillage). The problem with those jerry cans is the difficulty to clean them properly. Some milkers and milk traders use a cloth to strain out the flies and dirt, but those cloths are not washed adequately. The milk vendors at the markets use spoons or cups as measuring tools, which are not cleaned properly during the day. They are mostly just wiped with a piece of cloth. Some would even give a spoon of sour milk to a sceptical customer to boost their product. This way, the milk vendors increase the bacterial load of their products throughout the day. All materials used to collect or handle milk are usually washed with cold water and soap and dried in the sun. The use of disinfectants is not practiced at all.
Additional to these sources of contamination, high ambient temperatures around 30°C and the lack of cooling facilities give favourable conditions to bacteria, which consequently multiply at high rates. Therefore, fresh milk ferments very quickly in only two to three hours and pathogenic bacteria quickly reach infective doses.

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SELECTED RESULTS OF STUDIES ON ZOONOSES AND THE RELATED PUBLIC HEALTH RISK (2000 – 2003):

BOVINE TUBERCULOSIS AND BRUCELLOSIS IN CATTLE; SALMONELLOSIS IN CATTLE AND CHICKEN

Fred Unger, Michaela Hempen, Susanne Münstermann, Sandra Heuwinkel, Denis Carayol

Presented by Fred Unger

1. Introduction

Zoonoses are of public health importance through direct infection or consumption of contaminated animal products and are an occupational hazard. With increasing demand for milk and meat derived products the possible spread of zoonotic diseases like

brucellosis, tuberculosis and salmonellosis also increases. However, data on the prevalence of these zoonoses are very limited or not up to date.

Almost all milk in The Gambia is consumed raw or fermented, hence is an ideal medium for the spread of bovine tuberculosis (BTB) and brucellosis.
The main source of BTB infection in man is the consumption of unpasteurised milk. Therefore abdominal, bone and joint tuberculosis as well as infection of the cervical and mesenteric lymph nodes are the classical symptoms in man (Ashford et al., 2001). BTB in cattle is a chronic and wasting disease.
The pathognomonic symptoms for brucellosis in cattle are hygromas, abortions and infertility. Human brucellosis is characterised by a febrile reaction and usually associated with splenomegalie and osteoarticular manifestations. Further complications are hepatitis, endocarditis, orchitis and meningoencephalitis (Djordjevic, et al., 2003; Masouridou et al., 2003). In developing countries in particular, diagnostic difficulties exist, since the main symptoms (fever and back/joint pain) are often similar to other widespread diseases like malaria and specific tests are not available.
Measures against brucellosis and BTB aim at the control and, if possible, the eradication of the agent in the animal reservoir. As the disease often goes undetected, the identification of infected herds and animals is of prime importance.

Salmonella spp are ubiquitous and each isolate should be considered as potentially virulent for man. Infection in man causing serious dysentery, septicaemia and childhood deaths are well known to exist in The Gambia (MRC, 2002). No information is available on the prevalence of salmonellosis in cattle and chicken, but food-borne infection due to chicken and chicken products sold at local markets are reported (FAO, 1999).

In order to assess the prevalence of bovine brucellosis, BTB, and salmonellosis in cattle and salmonellosis in chicken, several pilot studies were carried out between October 2000 and August 2003 in selected districts of The Gambia.

2. Objective

- To evaluate the importance of bovine brucellosis and tuberculosis and the associated public health risk
- To evaluate the importance of salmonella infections and contaminations in slaughter cattle, chicken and chicken products and the associated public health risk

3. Materiel and Methods

3.1 Tuberculosis

For the diagnosis of BTB in cattle two different approaches were applied: (1) c*lassical meat inspection* and (2) on-farm tuberculinization.
Classical meat inspection to detect tubercle like lesions in lymph nodes and lungs due to *M. bovis* was applied in two main abattoirs located in the Greater Banjul Area (GBA), Abuko and Banjul. During November 2000 to March 2001 a total of 1595 cattle were investigated. Suspected lesions (i.e. nodular and/or caseating lesions) were transported to

the laboratory and screened using acid-fast Ziehl Neelsen stain for the presence of tubercle like bacilli. In case of positive results in Ziehl Neelson, samples would have been sent to the Medical Research Council (MRC) for specific cultivation for *M. tuberculosis* and *M. bovis*.
During May to October 2001 *on-farm screening* using *tuberculinisation* was carried out on 20 randomly selected herds chosen from a bigger sampling frame in the Central River Division (CRD) a district, which is known for its high cattle density in a traditional farming system. The predominant breed is the N´Dama. Tuberculinisation was carried out in form of the comparative intradermal tuberculin test (CIDT) using PPD (Purified Protein Derivate) *M. avium* and *M. bovis* and applied in cattle older than six months. Application and evaluation of the test was according to the O.I.E. and the German Tuberculosis Prescription (version 13.3.1997).

3.2 Brucellosis

During the period May 2001 to October 2001 a total of 465 cattle from 20 randomly selected herds in the CRD of The Gambia were enrolled in a herd screening survey. On herd level only cattle older than 6 months were sampled. Assuming a prevalence of at least 5% (95 % confidence interval) up to 45 animals (according to herd size) were selected randomly and stratified by age on herd base (Thrusfield, 1995). In addition, bulk milk samples were collected from the selected herds**.** According to O.I.E. standards, blood samples were tested using Rose Bengal Plate Test (RBT) and confirmed by the Complement Fixation Test (CFT). Bulk milk samples were tested using Milk Ring Test (MRT). In a subsequent step a questionnaire was carried out with farmers on their knowledge related to brucellosis.

3.3 Salmonellosis in cattle

During the period of November 2002 to April 2003, two abattoirs in the GBA (Banjul and Abuko) and supplied markets were visited on a weekly interval. The study population consisted of 120 randomly selected cattle at the two abattoirs (each 60). That included samples of faeces and mesenterial lymph nodes, abdominal and diaphragmatic muscle. At the selected local markets (n= 3) and supermarkets (n= 4) a total of 200 beef meat cuts (supermarkets: 80; local markets 120) were collected. All methods used for culturing and identification of micro-organisms did conform with the International Standards (ISO). Detected strains were then serotyped and tested for antibiotic susceptibility in a regional Reference Laboratory (Pasteur Institute Dakar, Senegal).

3.4 Salmonellosis in chicken

In a Pilot survey, the prevalence of Salmonella in chicken and poultry meat in smallholder and semi-intensified production schemes was investigated. During the 3-month survey (July-September 2003) samples were collected from a semi-intensive broiler farm, located in the GBA. In addition, samples were taken from slaughter chicken (n= 30) and chicken products (frozen imported chicken legs, n= 24) sold at Serekunda market.

At the market and semi-intensive farms faecal, skin and meat cuts were taken. All methods used for culturing and identification of micro-organisms did conform with the International Standards (ISO). Detected strains were then serotyped and tested for antibiotic susceptibility in a regional Reference Laboratory (Pasteur Institute Dakar, Senegal).

4. Results

4.1 Tuberculosis

Results for *M. bovis* stratified by the location are presented in table 1.

Table 1: *M. bovis* and *M. avium* infections in cattle

Abattoir survey (meat inspection)	Banjul (n= 450)	Abuko (n= 1144)	Overall (n= 1594)
Suspected cases in meat inspection	1	0	1
Confirmed cases of *M. bovis*	0	0	0
On-farm tuberculinization (IDCT)	CRD south (n =20 farms with 465 cattle)		
Herds with doubtful reaction to *M bovis*	-	-	3
Total cattle with doubtful reactions to *M. bovis*	-	-	5
Confirmed* positive reactor to *M. bovis*	-	-	0
% of cattle reacting positive to *M. avium*	-		52%

*Retested after 3-5 months

No confirmed case of *M. bovis* infection was found. The few cases that showed a doubtful reaction in the skin test (n= 5) could not be confirmed in repeated skin test after a period of 3 months and were therefore considered negative. Similar findings for *M. bovis* (absence of the infection) were found in a regional context in selected districts of Senegal (Bassin Arachidier), Guinea (Kankan) and Guinea Bissau (Bissau).

4.2 Brucellosis

Results for brucellosis for The Gambia (on-farm screening and questionnaire) are presented in table 2. In addition, results in a regional context are shown in the same table.

Table 2: Results for brucellosis presented for The Gambia and in a regional context

Results	The Gambia	Senegal	Guinea Bissau	Guinea	Guinea
District/region	CRD	Bassin Arachidier	Bafata	Boké	Dubrek a
Herds sampled	20	30	15	19	17
Cattle sampled	465	479	539	675	749
Individual animal prevalence (%)	1.1[a]	0.6[a]	18.6[d]	6.3[b]	12.7[c]
Herd prevalence based on serum (%)	15[a]	10[a]	100[b]	73.7[b]	94.1[b]
Herd prevalence based on bulk milk (%)	15[a]	10[a]	87[b]	69[b]	80[b]
Farmers knowledge on brucellosis	poor	poor	good	medium	
Brucellosis in man (confirmed)	No information				7/20

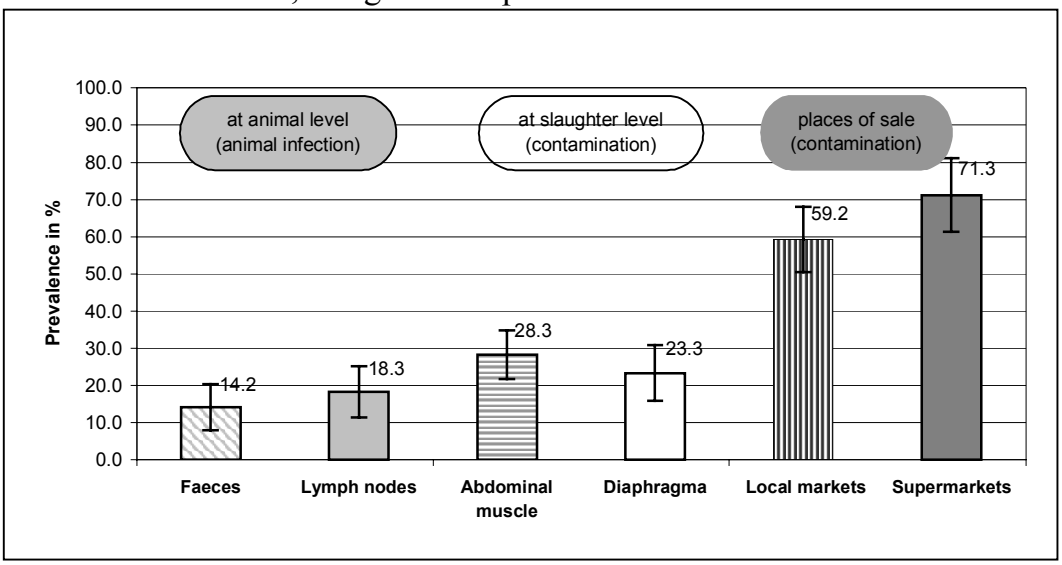
a:b:c:d (<0.05)

Individual prevalences for brucellosis in cattle were found low in the sampled districts of The Gambia. The few positive reactors were located on three different farms, resulting in a herd prevalence of 15%. These herds were also positive in their bulk milk.
In a regional context results indicate different epidemiological situations for brucellosis in the four countries with similar results for The Gambia and Senegal but high prevalence areas in Guinea and Guinea Bissau.

4.3 Salmonellosis in cattle

Results for the prevalence of salmonellosis are presented according to animal, slaughter and place of sale in graph 1. Prevalences were found already high at abattoir level and increased further along the food chain.

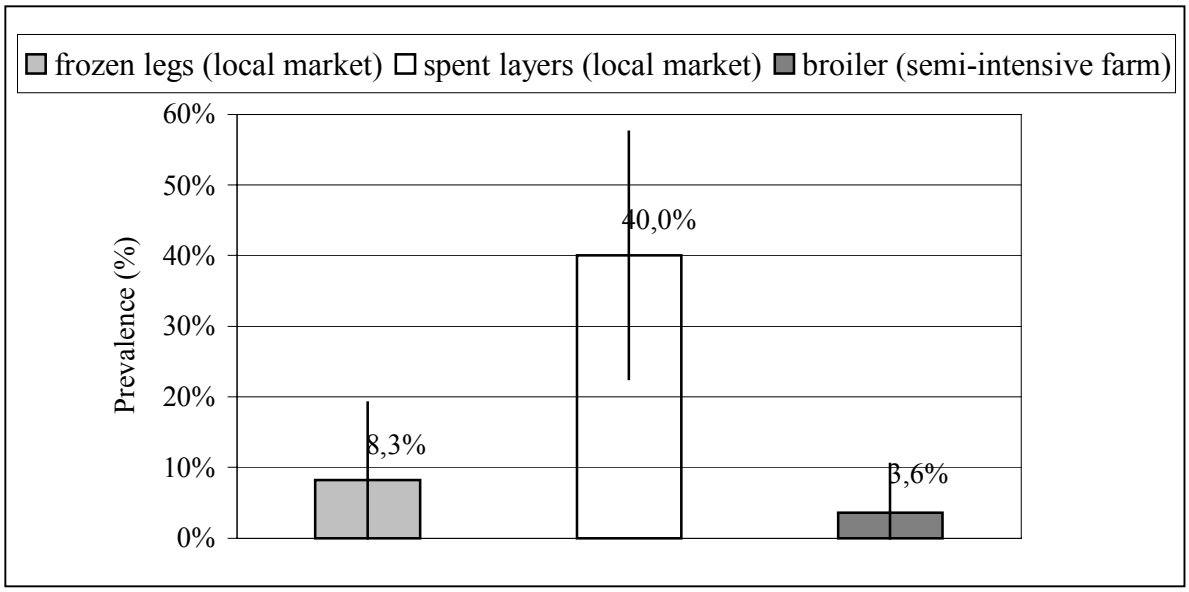
Graph 1: Prevalences for salmonellosis in slaughter cattle and beef stratified by animal, slaughter and place of sale



4.4 Salmonellosis in chicken

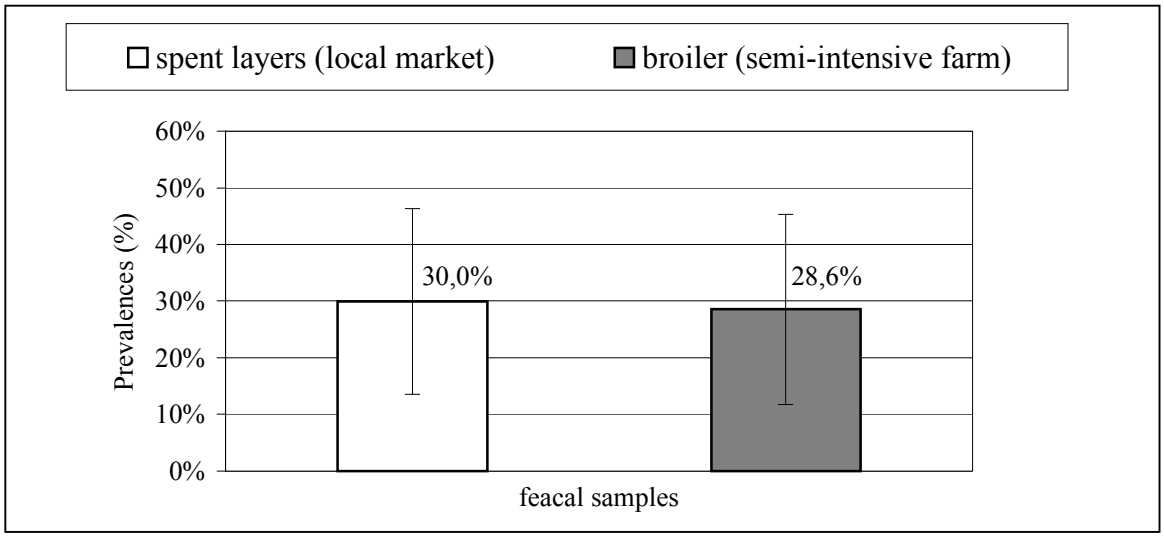
Results for the prevalence of salmonellosis in skin cuts of chicken and chicken products sold in the GBA on a local market or on a semi-intensive farm are presented in graph 2. Graph 3 shows the Salmonella prevalence in faecal drops collected from spent layers at the local market and broilers from the semi-intensive farm.

Graph 2: Salmonella prevalence in skin cuts from frozen chicken legs, spent layers and broiler



Salmonella prevalence were found significantly higher in skin cuts from spent layers sold and slaughtered at the local market than from frozen layers and broilers. Salmonella prevalence in faecal drops did not differ between spent layers and broiler indicating that differences observed in skin cuts are mainly caused by contamination due to unhygienic handling.

Graph 3: Salmonella prevalences in faecal drops collected from spent layers (local market) and broilers (semi-intensive farm)



5. Conclusions

5.1 Tuberculosis

Based on the large number of cattle sampled in the different regions in this study, it can be concluded that clinical and immunological infection due to *M. bovis* are very rare. To confirm these observations, further investigations using more sensitive test methods are highly recommended. Future studies should in particular be directed to research on the influence of exposure to environmental mycobacteria and their influence on manifestation of *M. bovis* infections.
The recommended control strategy is the test and slaughter method based on a nationwide disease surveillance system.

5.2 Brucellosis

Results indicate that brucellosis infections in the study population are not frequent. However, results still indicate a risk for the consumer as 3 of the 20 farms sampled reacted serologically positive in serum as well as in their bulk milk. Pasteurisation of raw milk is highly recommended. According to recommendations of the "Task Force, Subgroup Bovine Brucellosis" (EU, 2000) a test and slaughter policy is the recommended control option. As the knowledge of farmers on the transmission of the disease in cattle and on its zoonotic aspect is poor, there is an urgent need to improve knowledge about the disease. Moreover, public health authorities have to be mobilized in a similar manner.

5.3 – 5.4 Salmonellosis in cattle and chicken

Each Salmonella isolate has to be considered as potential pathogen for man with a higher susceptibility for diseases in young, old, pregnant and immuno-compromised individuals (so called Y.O.P.I.'s). However, a meat core temperature (cooking etc.) of 70º C for 10 min is sufficient to avoid consumer infection. More likely and common as a source of infection is unhygienic handling of meat during processing, causing severe cross-contamination in particular at producer and seller levels. Therefore hygienic handling of meat has to be strictly applied to avoid cross-contamination. This could be achieved through reinforcement of existing veterinary regulations, training of personnel (abattoirs and markets) on food hygiene and the establishment of appropriate facilities along the food chain.

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A PROJECT REPORT:
THE PERI-URBAN SMALLHOLDER IMPROVEMENT PROJECT

Presented by Alieu Joof

1. Background Information

The Peri-Urban Smallholder Improvement Project (PSIP) is an integrated agricultural project funded by the African Development Bank and The Government of the Gambia. The Project operates principally in the North Bank and Western Divisions although the Kanifing Municipality has recently been included due to the high demand for assistance from farmers around the KMC.

It is a five year Project executed by the Department of State for Agriculture implemented by the Department of Agriculture and the Department of Livestock Services with the following institutions as collaborating partners:- Department of Planning, Department of Community Development, Department of Water Resources, National Agriculture Research Institution, and the Indigenous Business Advisory Services.

The Project started in 2001 and activities under the Project include:

1. Horticulture – development of irrigation infrastructure, marketing, provision of potable water supply and improved sanitation.
2. Livestock – setting up of small-scale production units, development of fodder and water supply, construction of small-scale slaughter houses.
3. Capacity Building – strengthening of women groups, training of women auxiliaries, and extension workers.

4. Project Coordination – establishment of a project coordination unit, provision of technical and logistical support.

The main beneficiaries are women and youth groups engaged in small-scale horticulture and livestock production.

2. Project Objectives

The overall objective of the PSIP is to increase on a sustainable basis the production of horticultural and livestock products by smallholders in the North Bank and Western Divisions.

The specific objectives of the livestock component are:

a. to improve livestock feed and water supplies
b. to increase livestock production
c. to improve the health delivery system of the livestock sector in the two divisions
d. to improve livestock processing and marketing facilities in the two divisions.

Under the livestock component, developmental activities to be undertaken to improve the production system include:

A. Development of Livestock Watering Points
Under this activity, 9 concrete lined wells in Western Division and 7 in North Bank are to be constructed and equipped with two hand pumps and 10 meter long drink troughs.

B. Fodder Tree Plantation
One fodder tree nursery in each division will be established for the production of seedlings for fodder trees.

C. Support to small-scale livestock production activities
Eighty women groups will be assisted to establish small-scale livestock production enterprises through the provision of credit. The programme will set up 80 ram fattening units, 50 sheep and goat breeding units, 40 rabbit production units, 50 rural poultry units, and 15 commercial poultry units

D. Livestock Processing and Marketing
Under this subcomponent, 6 small-sized slaughterhouses will be constructed and equipped. The capacity of the facility will be laid out to slaughter an appropriate number of cattle and 20-30 goats daily.

3. Accomplishments

1. Livestock Feed Development
   - Two fodder tree plantations have been established in the division for the supplies of fodder tree seedlings to communities
   - Seventy-two backyard/horticultural fodder gardens have been planted with Luceana and pigeon pea fodder crops.
2. Improved Health Delivery
   - Three regional laboratories have been rehabilitated to improve on the disease diagnostic capabilities of the facilities.

- Nine Livestock Owner Associations have been assisted with ascaricidal, trypanocidal and anthelmintic drugs on a revolving fund basis.

3. Improved 25 Livestock Production
    - Ten small ruminant breeding units have been with supplied with breeding stock and improved housing
    - Ten rabbit breeders have been supported with breeding stock, cages and veterinary drugs.
    - Thirty-one groups have has assisted with fattening stocks and improved houses. A total of 268 animals were fattened.
    - Thirty-five groups have established improved rural poultry production system through improved housing and the cockerel exchange program.
    - Ten communities/groups are engaged in improved pig production through improved housing and improved breeding program.

4. Capacity Building

- Butcher Training: Eleven butchers have been trained to improve their knowledge and skills in environmental sanitation and proper meat handling practices.
- Laboratory Training: Fifteen Livestock Assistants have been trained in basic laboratory management techniques and disease diagnosis.
- Auxiliary Training: One hundred and thirty-six farmers have been trained to enhance their knowledge and skills in livestock management particularly poultry and small ruminants.
- Business Management Training: Ninety-one core members of the kaffos engaged in livestock production have received training in business management.
- Study Tour: Twenty farmers went to Senegal on a visit to study the management of livestock as well as to increase their organizational and managerial skills for improved group management.

5. Conclusions

This project is well positioned to have a major impact on the improvement of the output of the livestock sector in The Gambia. It has been realised that more coordination and collaboration with other ongoing initiatives will further this process. Therefore the following fields of cooperation with ITC/Procordel are suggested.

a) Small Ruminant Breeding
b) F1 Cross Breeding Program
c) Feed Resource Development
d) Milk Processing
e) Farmer Training
f) Staff Training

A PROJECT REPORT: RURAL FINANCE AND COMMUNITY INITIATIVE PROJECT- LIVESTOCK SUB-COMPONENT

Presented by Fatou Gaye

1. Introduction and background information.

There were discussions between the Government of The Gambia and IFAD (International Fund for Agricultural Development) in the 1990s which resulted in a project to improve household food security and incomes in the rural areas, thereby alleviating endemic poverty among the rural dwellers in LRD, CRDN and CRDS.

The project is geared towards: Strengthening, revitalizing and consolidating the gains of the steadily emerging rural finance sector through the improvement of village based savings and credit schemes (VISACAS)

1.1 Critical areas of intervention

1. Utilization of appropriate rural finance services
2. Improvement in household food security
3. Improved on-farm and off-farm production activities
4. Enhance rural micro-finance and technical support.
5. Provide support to locally identified infrastructural and other types of initiatives that will enhance household food security and help alleviate poverty.

1.2 The Livestock sub-component.

In The Gambia, indigenous small ruminants comprise trypanotolerant Djallonke sheep and the West African Dwarf goats. According to the 1993/1994 census figures, the sheep population is 158,773 while the goats are 213,917.
In the livestock sector, small ruminants and poultry contribute a lot to the income generation capacity and boost the nutritional status of the majority of rural families as evidenced by their high off-take rates through sales and slaughter when food supplies are low.

There are constraints to improve small ruminant and poultry production, which include poor management practices (e.g. no supplementary feeding during the periods of scarcity), and the outbreaks of diseases.

Small ruminant and poultry diseases are prevalent in The Gambia, but the highest morbidity and mortality rates are attributed to Peste de Petite Ruminants (PPR) and Newcastle Disease (NCD).

These diseases are a major obstacle to small ruminant and poultry production respectively, and they are a threat to food security in the rural areas and eventually hamper the livestock industry.

The continuous growth of the animal population, reduced available rangeland, desert encroachment due to climate change and environmental degradation has caused inadequate feed supply to animals.

In the dry season, small ruminants feed on forage from natural pastures and crop residues of harvested fields. These are more accessible and the cheapest main source of feed. They are sometimes supplemented with kitchen waste and salt.
During the rains and the early dry season, sufficient feed is provided through the traditional extensive system.

2. Objective

The Livestock Sub-Component under the umbrella of the Agricultural support is designed to:

- Control and eventually eradicate PPR and NCD in small ruminants and poultry respectively.
- Conduct feed garden research activities (using multipurpose trees characterized by rapid growth with high production, high palatability, high digestibility, high quality foliage and drought tolerant) in vegetable gardens, and disseminate environmentally friendly technologies.
- Strengthen the service delivery for livestock to increase extension outreach to farmers.

2.1 Specific Objectives.

- To improve production and increase the productivity of small ruminants and poultry by reducing the morbidity and mortality rates due to PPR and NCD.
- To vaccinate the right category of small ruminants and poultry against PPR and NCD.
- To address climate change impacts by improving production and technologies available.
- Train Village Auxiliaries on livestock production, health care techniques and utilization of fodder trees in the intensive feed gardens.
- Conduct mass vaccination campaigns for the control of the diseases above.
- Rehabilitation of the Department of Livestock Services (DLS), Divisional Veterinary Offices and the Livestock Show grounds.
- Increase feed availability in the future, through the propagation, nursery establishment, harvesting, processing, conservation, drying and utilization of fodder trees in intensive feed gardens.

3. Activities Performed

3.1 Vaccination Campaigns

Three vaccinations have so far been carried out. One pilot vaccination campaign in the three divisions, and two mass vaccination campaigns in all the divisions were carried out because:

- Some of the animals that were not vaccinated during the pilot phase experienced outbreaks and farmers in the non-vaccinated areas requested DLS and RFCIP to organize other vaccination campaigns.
- Secondly, the effective control of NCD and PPR requires about 70% of the population to be vaccinated. This will boost the immunity levels within the flocks.
- Thirdly, the movement of small ruminants and poultry in the weekly markets (lumos) contributes greatly to the spread of the disease, therefore, a greater vaccination coverage area was agreed on.

For the effective and sustainable vaccination campaign, the RFCIP purchased: 750,000 doses of ITA_NEW, NCD vaccines and 500,000 doses of homologous PPR vaccine.
RFCIP also provided funds for the logistical support to the teams for the proper implementation of the vaccination.

Cost recovery is instituted and the money is used as a revolving fund for subsequent vaccinations. D1.is charged for each sheep or goat vaccinated and D0.50bts. for each bird vaccinated.
The proceeds are saved in VISACAS and banks.

All village auxiliaries trained are selected by their communities (Kafo's)
The training of the auxiliaries will help:
1. Impart knowledge and production skills to other farmers.
2. Bridge the gap between extension staff and the numbers of farmers/animals.
3. Alleviate to some extent, the workload of field staff and their maintenance cost because the Veterinary Auxiliary staff require lower running costs.

3.2 Results of the Vaccinations.

Percentages of the vaccination figures are based on the 1993/1994 National Livestock census figures.

	% Pilot vaccination			% 1st. vaccination			% 2nd.vaccination		
	sheep	goats	poultry	sheep	goats	poultry	sheep	goats	poultry
CRDN	22	37	2	33	39	5	21	26	2
CRDS	14	22	1	26	25	6	28	23	3
LRD	16	19	2	27	17	1	22	15	-
NBD	-	-	-	23	19	15	14	10	6
URD	-	-	-	38	37	15	18	13	-
WD	-	-	-	38	26	11	-	-	3

According to the figures above, the overall vaccination coverage was very low. The first campaign covered 30% and 27% of the sheep and goat population respectively. Some of the causes of the low coverage are:
1. Female farmers who usually take care of small ruminants and poultry are busy in the morning when the vaccinations are conducted, therefore, being active in the vaccination process is a problem.
2. Low turn-out of farmers which may be due to a number of factors e.g.:

a. the duration of the sensitization campaign was short for effective dissemination of the information.
b. farmers may not have had funds to pay for the vaccines at the time of the campaign.

3. Maintenance of the cold chain for the efficient keeping of the vaccines at +4°C.

3.3 Training

The training took a very participatory approach: farmers were asked to volunteer information, i.e. everything they know about diseases, housing and feeding. After the farmers' interventions, resource persons presented their papers in the local languages.
There were practical sessions and farmers prepared different feeds and mineral blocks.
On a separate day farmers in 3 groups, on their own, discussed the 3 themes of the workshop (animal health, housing, feeds and feeding). They wrote down notes which were later presented by the rapporteur of the group.
A total of 120 village auxiliaries were trained in livestock production, animal health care techniques and a total of 45 trained in intensive feed gardens.

Topics covered include:

- **IFGs**

Horticulture production, fodder production, nursery establishment, harvesting, processing, conservation, improved drying, utilization and feed block making. Animal nutrition in relation to the IFGS.

- **Animal Health Package**

The importance of housing animals, why and how they are housed, was also discussed. Other topics covered include the general description of the most common diseases, their modes of transmission, signs and symptoms, treatment, prevention and control.
The feeds and feeding theme detailed the economic importance of all the feed ingredients used in feed formulation. Different animal production systems with their different feed requirements were discussed. Why and how animals are fed was stressed.

Six intensive feed gardens were established, two in each division to provide supplementary fodder to small ruminants for increased productivity by improving the quality of milk and meat. It also improves the nutritional status of rural communities by accessing fresh vegetables. IFGS also help communities generate income and produce their own vegetable seeds.

4. Recommendations

- Farmers should extend the intensive feed gardens in their backyards, as it may be difficult to extend the gardens
- All farmers involved in the project are interested in keeping improved poultry, which requires the regular supply of feed and day-old chicks among other things. Day-old chicks and feed used in the different poultry production systems come from either Senegal or Europe, therefore there is need for the project to provide a hatchery and a feed-mill for the sustainability of the productions.

- The idea of the decentralized vaccination campaign in the divisions may help to increase the coverage area and the numbers of animals vaccinated.

SESSION THREE

This session comprised an account of the training component of PROCORDEL for human resource development and capacity building, and short institutional reports by the two NARS partners in The Gambia: NARI and DLS.

TRAINING AND CAPACITY BUILDING TO ENHANCE THE DEVELOPMENT PROCESS IN LIVESTOCK AGRICULTURE – WITH PARTICULAR REFERENCE TO PROCORDEL

Andreas Schönefeld, Susanne Münstermann
Presented by Andreas Schönefeld

The EU-funded collaborative research and development programme for livestock farming in West Africa PROCORDEL was launched in 2000 in a development context in which limited capacities of technical, scientific and extension personnel, frequent isolation from sources of information and lack of opportunities for collaborative research could not be ignored as key constraints to the effective generation and dissemination of research outputs to the benefit of the livestock producers. The known weak linkages between research, extension services and farmers have long been identified as key problems in many African countries (Eponou, 1996). Conscious of these constraints, ITC has been instrumental in developing a training and human resource development concept that could meet the objectives of PROCORDEL to strengthen such linkages both at the national and regional levels.

Since its inception in 1984, ITC had given emphasis to capacity building of technical, scientific and extension personnel of the NARS (National Agricultural Research System) and national Livestock Departments, particularly in The Gambia. Over the years the Centre has strengthened its regional mandate and activities, much boosted by the conceptual approach and substantial financial support of PROCORDEL, namely in Senegal, Guinea, Guinea-Bissau and, more recently, also in Sierra Leone.

The implementation strategy for the ambitious research and development programme as reflected in the ITC Medium Term Plan 2001-04 and in the annual PROCORDEL Cost Estimates puts emphasis on training and information exchange with national partners such as DLS and NARI in The Gambia, to increase the critical mass of human resources and inter-institutional networking.

To exemplify this, the PROCORDEL Annual Cost Estimate 2 (2000) attributed high priority to HRD and strengthening of NARS' as well as ITC´s research capacity in areas of mutual interest (livestock), with particular attention to the promotion of academic qualifications (MSc and PhD programmes) in collaboration with African and northern institutes, in subjects mutually recognised as priorities by the NARS and the Centre, and relevant to the regional livestock research/development objectives identified by CORAF-WECARD, and to the promotion of transfer of developed technologies to the beneficiaries.

ITC's own commitment to HRD and capacity building is mirrored in the role of Institutional Project 11 "Training, Information Exchange and Capacity Building" with its crosscutting functions to support R&D activities of the Centre, facilitate the transfer of their results to the ultimate users, and help to build up critical mass for research and information exchange among NARS.

A number of the challenges in training and capacity building cooperation with collaborating institutions were to be met:

- Bridging existing differences in national backgrounds/systems among partners
- Different national languages and technical capacities
- Following a team-approach, i.e. promotion of multiple skills rather than highly specialised skills of individuals
- Transfer of R&D results to the beneficiaries under prevailing ineffective linkages between "Research" and "Extension"-Services

What has been achieved so far?

With a training budget of 230.000 Euro over a 4-year period (about 8% of the project's global budget), PROCORDEL gave a major boost to ITC's training programme.

The annual workplans of ITC and PROCORDEL that were developed in a consultative process (e.g. joint planning workshops at ITC and in partner countries) formed the basis for the analysis of specific training needs, selection of training subjects and the application of training methods. A training concept that took a systems' approach consisting of analytic programme formulation and priority setting has been developed and implemented in close collaboration with NARS partners at the national and regional levels.

Appropriate training was offered for individuals as well as groups of targeted persons. The categories of individual, national and regional needs were addressed using different methods and schemes to train professional, technical and managerial staff. Training contents were designed with a view to harmonising research protocols, data entry forms and data management and analysis directly relevant to the research programmes and workplans in the partner countries.

Annual workplans addressed nationally or regionally identified research and development needs. Collaborators that were appointed to execute the programmed activities revealed individual qualifications and training needs to carry out specific tasks. An analysis of the national capacities for implementation of the research topics at the level of the NARS/Livestock Departments allowed assessing national training needs. The analysis of the national workplans of all countries and their national training needs helped reveal common or regional training needs. The assessment of training needs was a continuous activity and its results fed back into the planning of future training interventions. Information on trainees' professional and training background were collected and entered into a training database for reference and production of reports.

The training programme had put emphasis on the following objectives:

Short-term:	Immediate support to ongoing research activities through professional, technical and managerial training of personnel involved, taking cultural, educational and sociological country differences into account, with emphasis on the harmonisation of methodologies.
Medium-term:	"Packaging" of research results by scientists/professionals and transfer to intermediate beneficiaries (*Train the Trainer*) and ultimate beneficiaries (*Train the Farmer*), assuring achievement of medium-term institution/project objectives.
Long-term:	Career development and institutional capacity building through post-graduate training for selected scientists.

Individual training was organised on the basis of a personal task analysis. It was provided either as short-term, supervised on-the-job/on-site instructions and exercises, study attachments, as training out-of-region, or assistance to postgraduate training for MSc or PhD. Supervised on-the job training was organised mainly for technicians, study attachments at ITC such as the PROCORDEL Regional Mobility Scheme for professionals from partner countries who engaged into specific research assignments, and postgraduate research and study opportunities including scholarships for obtaining MSc or PhD degrees, for long-term career development of younger scientists.

In 2003, the Regional Mobility Scheme had offered assignments of 2-7 months duration at ITC to six young professionals from Guinea and Senegal who worked on a variety of themes, i.e.:

- Assessment of trypanotolerance in crossbred cattle under artificial challenge
- Production and utilisation of *Moringa oleifera* and *in-sacco* digestibility of feed stuff from Guinea
- Genetic and phenotypic parameters for growth traits in small ruminant populations in The Gambia
- Control of ectoparasites (mange) in the pure breeding herds and flocks at Keneba station
- Pasture improvement at ITC's Keneba Station
- Salmonella prevalence in chicken and chicken meat in The Gambia

Since 2000, support has been given to five Research Associates for PhD studies (4 currently ongoing), one Doctorat d'Etat and one MSc study, undertaken in collaboration with Universities and Advanced Research Institutes in the Sub-region and in Europe. The research themes were carefully selected essential elements of the ITC-NARS-PROCORDEL R&D agenda, e.g.:

- Optimum strategies for pure breeds improvement programmes (academic support: University of Wageningen)
- Feeding strategies for cattle in The Gambia and Senegal: optimum level of supplementation (University of Hohenheim)
- Epidemiology of *Cowdria ruminantium* infections in small ruminants in The Gambia (University of Utrecht and ITM Antwerp)
- Effects of policy reforms on the performance of livestock systems (Catholic University Leuven)

- Optimisation of crossbred cattle production for small-scale dairying in The Gambia (EISMV Dakar)

The **group** training delivered to the professional, technician, extension and farmers groups in form of national or regional courses focused on key topics in animal health (diagnostics, epidemiology, disease risk assessment, meat and milk hygiene), animal production (breeding, feeding, reproduction), socio-economics (methodologies and policy studies), research management tools and data management.

Group training at "national" level was based on an assessment of specific needs and capacities of the NARS/Livestock Departments for the implementation of R&D activities supported by PROCORDEL within its national work programmes. Courses of typically 2-5 days duration were organised in the respective country in a setting suitable for the topic of the training, usually combining instructions with practical sessions. National instructors alongside with one or two ITC scientists were engaged for this type of training.

From 2001-2003, a total of 11 national courses with 108 participants (Gambia: 5 courses, 59 participants) were conducted at partner NARS and ITC for professionals and technicians, of which 10 courses were directly supported by PROCORDEL. The theme list of courses conducted with PROCORDEL support included:

- Monitoring purebred ruminant multiplier facilities
- Pure breeding and animal husbandry
- Purebreeding - selection methods, schemes and data recording
- Refresher training on selected laboratory diagnostic techniques
- Refresher training on coproscopic helminth diagnosis
- Project cycle management & logical framework approach
- Tsetse/trypanosomosis survey & diagnostic techniques
- Monitoring animal productivity and health
- Database management and statistical analysis

A number of "ITC in-house" training courses mainly for ITC staff were also conducted, e.g.:

- Introduction to ArcView GIS
- MS Access: introductory training
- Epi-Info: introduction to data entry & database creation
- Power Point: presentation making
- Basic training on MS office applications (Windows, Word, Excel, Access)

Besides these courses for professionals and livestock technicians, ITC/PROCORDEL started to apply the *Train the Trainer (ToT)* and *Training of Farmers (ToF)* approach that addressed the producers via extension agents. Courses in support of technological transfers to ultimate beneficiaries such as livestock farmers and milk handling persons were increasingly organised by ITC and partner NARS with PROCORDEL support in the local languages, in which scientists played an important role as mediators.

Research results that were "packaged" to address a specific topic were, in a first step, transferred by scientists to groups of intermediate beneficiaries, either livestock assistants/extensionists or educated farmers (e.g. leaders of livestock associations) using the *Train the Trainer (ToT)* approach. This group in turn trained groups of livestock producers, using techniques and adapted training materials in local languages available for *Training of Farmers (ToF)*.

In 2002-2003, a total of 9 ToT-courses with 123 participants (Gambia: 3 courses, 47 participants) and 14 ToF-courses with 641 participants were conducted (Gambia: 11 courses, 374 participants), of which altogether 13 courses were directly supported by PROCORDEL. The theme list of courses included:

- Pure breeding management and animal husbandry
- F1 crossbred cattle production and animal husbandry
- Nutrition/feeding of F1 crossbred cattle
- Health management of crossbred cattle and milking hygiene
- Management of working cattle and implements
- Stabling technology for cattle
- Farmer Field School management

Two of the above ToT courses and 8 of the ToF courses were organised for milk handling persons (herdsmen, milk collectors, processors, vendors, women milk processors; trainers/supervisors) by ITC and partner NARS in The Gambia (6 courses, 159 participants), Senegal and Guinea, with funding from FAO, GTZ and/or PROCORDEL. The theme list of courses conducted in The Gambia included:

- Clean/hygienic milk production and handling
- Hygienic milking and handling of milk
- Milk handling and processing
- Milk processing, product making, quality management (ToT)
- Yoghurt and flavoured milk production

Group training at <u>regional</u> level was initiated mainly for professionals and senior technicians on themes of common or shared interest. ITC or, exceptionally, another NARS Centre was chosen to host these courses of typically 5-10 days duration in which usually 2-4 delegates from each country participated. Bi-lingual preparation of training and teaching material was essential to overcome communication barriers. Subject matter specialists from ITC, the Sub-region or other countries (ARIs) were appointed for this type of training.

From 2001-2003, a total of 13 regional courses with 163 participants (Gambia/ITC: 93 participants) were conducted for professionals and senior technicians, all but one directly supported by PROCORDEL. The theme list of regional courses included:

- Tsetse/trypanosomosis, tick/tick-borne diseases
- ELISA- and PCR-techniques for disease diagnosis
- Serological diagnosis of *Brucella abortus*-infections
- Milk hygiene and microbiology
- Oestrus synchronisation & A.I. for F1-crossbred cattle production
- Scientific and proposal writing

- Statistics with veterinary applications
- Productivity & health data management
- Database management & statistical analysis
- Data Management and GIS (for PACE data managers)
- Animal health & production data processing and statistical analysis
- Socio-economic survey methods
- Socio-economic data processing & statistical analysis

The immediate post-course evaluations of training inputs revealed generally a high degree of acceptance by participants concerning their expectations into the training, the relevance and immediate practical importance of topics, competence of resource persons, training methods and materials, and the overall training organisation and management. Though many participants considered the duration of some training courses too short, it is concluded that training has contributed to better job performance and satisfaction.

Full investigations on the impact assessment of training are planned for the last phase of PROCORDEL in 2004, with a range of criteria such as research implementation capacity of partner institutions with reference to the milestones formulated in the workplans, application of recommended and harmonised methods in the field, regional collaboration and information exchange, personal performance and career development.
Figure 1 provides the number of participants during short-term training courses and study attachments between 2001 and July 2003 and illustrates the increasing shift of different target groups in the training activities developed over time. While courses in 2001 exclusively dealt with professionals and technicians, courses in 2002 and 2003 also addressed farmers and milk handling persons, signifying the increasing participation in the training of ultimate beneficiaries for the transfer of R&D results.

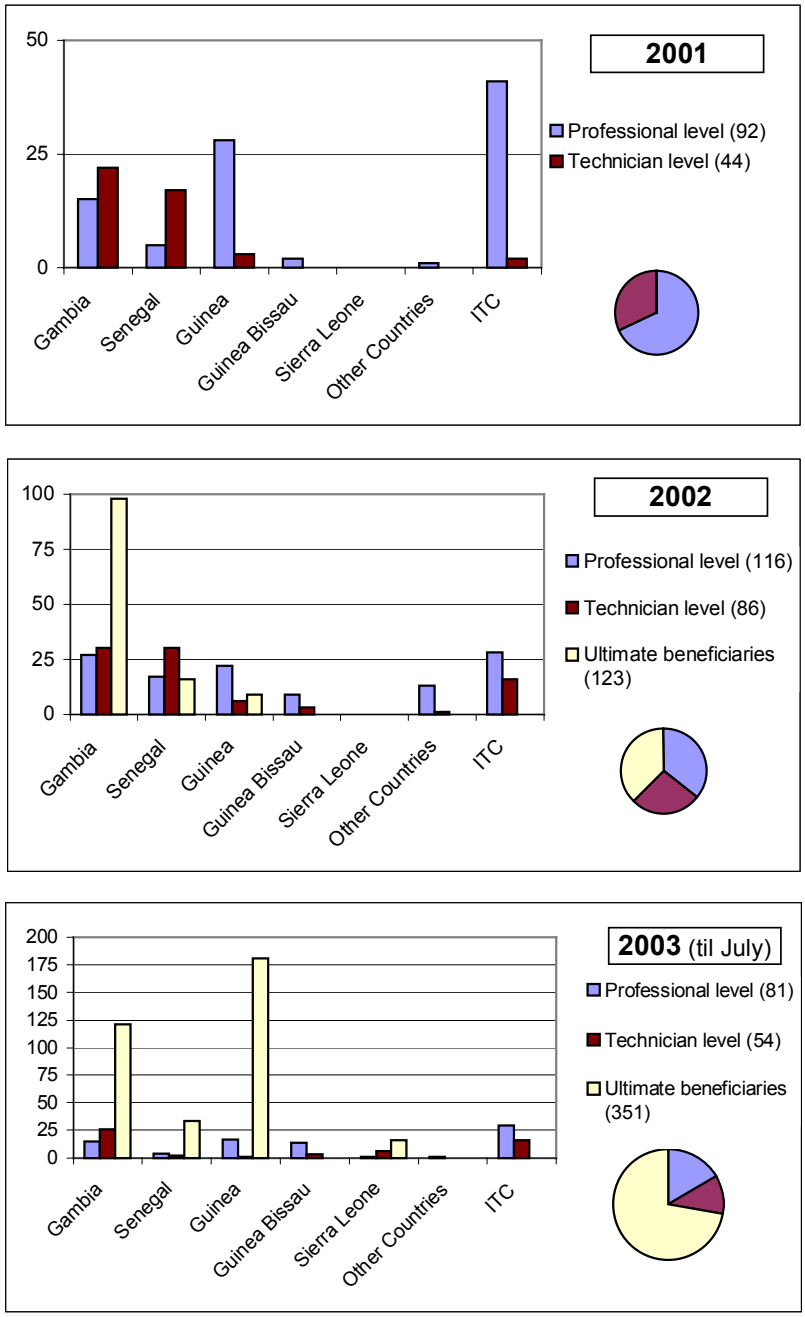

Fig.1: Number of persons trained by ITC and Collaborators
(Short-term courses and attachments 2001-2003)

Conclusions

Training of individuals at the researcher and technician level has made major contributions to strengthening institutional capacity building and networking between ITC and partner NARS. Various training modules have been developed which are ready for further usage. The concept of ToT and ToF with the development of appropriate extension materials has gained momentum for the transfer and wider dissemination of technology packages.

The ITC–NARS regional initiative for livestock research and development under the EU-funded PROCORDEL and its training components are a valid practical example for a successful integration and harmonisation of livestock R&D and for South-South as well as North-South partnerships. Researchers were encouraged to play a new, active role at two levels: (1) the formulation of research results into useable recommendations for farmers and (2) the engagement in training of extension agents and/or farmers. It has to be realised, however, that the gains made so far could easily be lost, unless the new concepts are further consolidated, the technology packages further disseminated among the ultimate beneficiaries with the help of appropriate extension materials and methods, and networking with major stakeholders in the livestock sector at national and regional level is continued.

Reference

Eponou, T. (1996): Linkages between research and technology users: some issues from Africa. Briefing Paper 30, The Hague: International Service for National Agricultural Research

Münstermann, S; Schönefeld: A; Capacity Building Applied to a Livestock Research Network in West Africa to Enhance the Development Process. Proceedings, Deutscher Tropentag Göttingen, 8-10 October, 2003

INSTITUTIONAL REPORT: NATIONAL AGRICULTURAL RESEARCH INSTITUTION (NARI)

Presented by Musa Bojang

1. Background

NARI developed from the research and special services of the Department of Agriculture to the Departmental of Agricultural Research until it reached its present form. The Research Mandate of NARI encompasses three major domains:

- Agriculture: crops and livestock
- Natural Resources: forestry and fisheries
- Environment

However, institutional history gives prominence to crop research.

The main Research Thrust lies with

- Crop improvement: mainly through the evaluation of varieties
- Soil fertility maintenance: combination of organic and inorganic fertiliser evaluation
- Agroforestry: crop rotation with legumes
- Pest management:
    - Pesticide efficacy studies

    - Plant extracts evaluation as pesticides in field crops and stored products
    - Impact assessment of pesticides on environment
    - Weed management studies
- Farm machinery: evaluation of tillage implements and design, construction and evaluation of processing equipment

2. Activities implemented under the Research Program

Within the areas of competence of NARI, the following specific items are addressed:

- Horticulture: vegetables, root and tubers, fruit trees
- Grain legumes/oil seeds: groundnuts, sunflower, cowpea, sesame, cotton
- Cereals: rice, maize, millet, sorghum, findo
- CSRM: fertility maintenance, multiple cropping
- Agroforestry: tree species evaluation, fertility improvement using trees, conservation studies, reforestation, erosion control
- Pest management: crop protection against insects and diseases, weed control, pesticide evaluation
- Agricultural engineering: tillage and processing equipment development and evaluation
- Seed Technology: seed quality control, seed multiplication
- Socio Economics: base line studies to assess existing resources on-farm, adaptation and impact assessment of introduced technologies
- Livestock research: Procordel; modest lock of sheep for later studies
- Fisheries: agriculture with species evaluation in rice ecologies – this programme was discontinued

From these research activities, some technologies have been derived, which are being tested and implemented in the field:

- Pest management
- Striga control using tethering
- Neem extracts for field and stored products pests
- Fertility maintenance
- Fertilizer regime for manured fields
- Live fencing with economic trees
- Cover cropping with dual purpose legumes

3. Institutional assets

3.1 Human resources

NARI has the following human resources at its disposal to implement its ambitious research programme:

Professional staff:

6 PhD holders
6 PhD candidates
18 MSc holders
4 BSc holders

Technical staff:

28 Certificate holders

3.2 Facilities

- Pest management laboratory
- Food chemistry laboratory
- Soils laboratory
- Seed drying and processing plant

3.3 Contract research carried out for:

CRS/NAWFA:	sesame research
SAFALU:	sunflower research
GAFDP:	socio economic study on fishery
RFCIP:	cassava and sweet potato
LADEP:	farmer initiated research and development

3.4 Partnership research carried out with:

ITC:	livestock
UNDP/FAO	seed multiplication
CILSS	seed regulation laws
IITA	cassava and cowpeas
ICRISAT	bio reclamation of saline soils
ICRAF	agroforestry
Wageningen Agricultural University:	irrigation studies
University of Reading:	crop model on effects of climate change on groundnuts
WARDA	rice research

4. Outlook

NARI will rearrange its priorities in response to changing needs. These priorities will encompass the following:

- Field crops
- Horticulture
- Agricultural engineering and farm management
- Agroforestry and environment
- Post harvest technology
- Pest management
- Fisheries
- Livestock
- Socio economics and farming systems
- Seed and biotechnology
- Communication and information

INSTITUTIONAL REPORT: THE DEPARTMENT OF LIVESTOCK SERVICES

Presented by Eunice Forster

The Department was established in 1935 as the Veterinary Services Department to control Rinderpest & CBPP. In 1976 the name changed to Department of Animal Health and Production and later in 1986 to its current name.

The Department has the mandate to:

- Control all livestock diseases specially notifiable ones
- Pubic health inspection of products of animal origin
- Extension and training of livestock farmers on animal health, production and range management
- Implement livestock related development activities

To carry out this mandate, the Department has 5 units and a staff strength of 132 personnel comprising:

9 Veterinarians
6 Animal Scientists
2 Range management Scientists
115 Technicians and support staff

The Department is currently implementing the following livestock related programmes:

- PACE - a 5-year disease control programme which is being funded by the European Union
- PUSHIP a 5-year programme being funded by The African Development Bank
- A crossbreeding programme to improve milk production of the local N'Dama breed. This programme is being funded by the Gambia Government through the HIPC fund and implemented in collaboration with ITC
- Special Food Programme being funded by the FAO

The Department is also collaborating with the ITC through:

- PROCODEL
- Pure breeding scheme
- Capacity building through various training programmes
- Disease risk assessment

Conclusion

The Department is poised in the boundary interphase between research institutions and farmers trying to improve their livelihood by transforming research findings into technological packages.

CONCLUSIONS AND RECOMMENDATIONS

Session One – Low input systems

The low-input extensive livestock husbandry system is prevailing in most of The Gambia and the trypanotolerant breeds, adapted to the environment, have been studied extensively. Their limitations, but also their advantages have been well appreciated, particularly their disease resistance to trypanosomosis, endemic in the country. However, *cowdriosis (Heartwater)* in small ruminants poses a problem, as the endemic situation differs in different agro-ecological zones and losses do occur due to this disease. Research is well advanced and the available vaccines have been tested for their protection against a strain that was for the first time isolated from The Gambia and maintained in cell culture. The tests revealed that the vaccine is not fully protective and that more research is needed to find a more specific vaccine for the existing strains. This research is ongoing and has been enhanced through cooperation with the INCO network on Cowdriosis research.

It has been shown from long-term research carried out by ITC that the productivity of the N'Dama can be improved through a breeding scheme aiming at genetical improvement for productivity increase under tsetse challenge. This programme has reached a stage where improved male breeding animals can be distributed to multiplier herds and flocks to breed with village animals and to produce superior offspring. The transfer of this process to the local farmers is the novum in this breeding programme. Ownership of this programme by farmers is now enhanced through the formation of a farmers association GILMA, who will promote the purchase, distribution and utilisation of improved breeding animals.

During discussions it was revealed that these associations will, during the phase of full establishment, need continuous support from other sources than ITC and its projects. The EC has offered to come in and give this support, provided continuous monitoring of the associations' performance can be assured. The conservation of the trypanotolerant breeds through utilisation should receive full support from the Gambian Government authorities in order to retain the significant progress made on their productivity improvement.

The N'Dama as a draught animal has shown its suitability also in Sierra Leone, where animals have virtually disappeared during war times. Few adaptation problems were quickly overcome under good husbandry and disease monitoring. Human drudgery was reduced significantly and crop production increased consequently. Successful securing of follow-up funding for this activity from the national EC will help to increase numbers of animals in the Makeni Region again, with the continued monitoring support by the field teams established under Procordel.

It has been realised that the importance of equines as draught animals is increasing in The Gambia, yet there is little research into the major constraints for their presently sub-optimal performance. A study revealed that trypanosomosis, gastro-intestinal parasites and tick infestation and generally poor management of these animals are the major obstacles. Trypanosomosis has a peak occurrence during the period November to February and prophylactic treatments could curb this phenomenon. Strategic GIP treatments as recommended by the Veterinary Services should be enforced, hand in hand with ecto-parasite control. Vaccination against the enzootic *African Horse Sickness* is highly recommended. Increased awareness about the importance of regular watering and supplement feeding to working animals as well as welfare issues (changes in attitude

particularly to donkeys) should be a challenge to the Veterinary Service and NGOs that are prepared to give specialised input to equines.

Session Two – Emerging Market-oriented systems

In The Gambia farmers have made their choice to opt for intensification mainly in the Greater Banjul Area, which is characterised by urban agglomeration of an increasing population with increasing buying power, and by reduced availability of land for free range grazing. Livestock keeping adapted to the circumstances is now developing towards the integration of crossbred cattle into the N'dama herds and the utilisation of supplementation feeds, either readily manufactured or from crop by-products.
The ITC has supported this development with long-time research on the suitability of crosses between N'dama and Holstein Freisian and Jersey dairy cattle (F1), with the objective to retain trypanotolerance to the highest possible level and at the same time to increase productivity, particularly of milk. During the Procordel project period, the technology previously tested on ITC station was taken on-farm and at present some 77 F1 crosses are already established with 24 farmers in the GBA. ITC gives back-up to the transition process from extensive to intensive cattle rearing through monthly monitoring visits. Farmers need to be aware of the higher susceptibility of the F1 animals to diseases, particularly to trypanosomosis, and of the higher nutritional requirements of these animals.
This process, just like the support to the conservation of the trypanotolerant breeds, needs policy support. Inputs such as imported feeds and veterinary drugs are needed, veterinary service supply is essential to allow this alternative to become a viable option for farmers who have made the choice to intensify. Farmers owning F1 crosses have also decided to form a farmers association and they also deserve continuous support, particularly in terms of training on the special needs of these animals.
Besides the commercially available supplement feeds, ITC has tested various options for the utilisation of locally available feeds, mainly horticultural and crop by products. Different diet compositions and means of conservation, e.g. in form of multinutrient blocs, have been tested and, provided these feeds are within reach of the farmer, they can provide adequate nutrition for the higher demands of crossbred cattle. An indigenous tree, *Moringa oleifera*, has attracted a lot of attention as a possible alternative source of feed, easy to grow for most farmers, with superior nutritional characteristics. More research will be carried out in the next year.
The dairy sector in The Gambia has been characterised and found to be informal. Economic analyses on the performance within this setting have shown its viability and profitability. However, the margins could be increased significantly, if the sector would be developed and appropriate policy support be given to all key players in the *filière laitière.* Presently, the local production is not in the position to satisfy the demand for fresh milk, hence dairy products are largely imported. A study carried out on the hygienic quality of the milk offered on the local markets revealed that 91% of all samples collected had such a high bacterial count, that they would not have been acceptable if taken the Kenya Quality Standard as a measure. Bacterial contamination comprised contamination with human pathogen bacteria to an extent that these products pose a risk to consumer's health. In a study on the critical entry points within the milk chain of these contaminations, it could be shown clearly that the dairy cow is not the source of the

contaminations, but that hygienic handling of milk, starting from the milker to the collector and the vendor at the market, is not practised. Consequently there are two main options to improve the quality of the presently produced local milk: (1) increase awareness on the dangers of consuming raw milk and introduce pasteurisation of milk, (2) increase awareness on the side of milkers, collectors and vendors on the necessity to apply hygienic measures when dealing with milk. The second approach should be a challenge to the Public Health agencies and the National Nutrition agencies. Standards for bacterial contamination need to be set and reinforced in order to protect the consumers.

Pasteurisation as an option not only to improve hygienic quality but also to offer attractive local products in an effort to develop the dairy market, has been started through the introduction of the *Village Milk System*, a joint effort of DLS/ITC and FAO. A Core group of DLS staff has been well trained to act as trainers of members of 5 dairy cooperatives which have been formed in the course of 2003. These groups have received all the necessary equipment to produce high quality fresh milk and other dairy products, such as yoghurt, butter and ghee. One of these groups will receive a semi-mechanised MILK PRO pasteurisation, which, once the milk collection system is be well established, can produce up to 1000 litres pasteurised milk per day.

These first steps towards the development of a commercial, local dairy sector need careful monitoring and full support from the Government authorities, in order to be able to compete with imported products.

In a society where people and animals live in close contact with each other and where milk is consumed raw, as it is the case in The Gambia, diseases like bovine brucellosis and tuberculosis often manifest themselves as zoonoses. The prevalence of these diseases in animals, however, was not known. Studies revealed that bovine brucellosis and tuberculosis do not pose a risk in The Gambia, but that alarmingly high prevalences were found in Guinea and Guinea Bissau. These results are important to remember in case of animal trade with these countries. Control options have been proposed as a result of these studies.

Session Three – NARS, Capacity Building

The analysis of the development process in the agricultural sector of developing countries has often identified the limited capacity and/or lack of competent technical, scientific and extension personnel, isolation from sources of scientific information and limited opportunities for collaborative research as key constraints to the effective generation and dissemination of research outputs in form of improved and novel techniques and innovations for the benefit of the agriculture and livestock producer.

ITC, together with its national partners and financial support from the project, has put major emphasis on addressing these issues by developing training courses in direct support to the ongoing research activities, thereby enhancing knowledge that could be put to use without delay.

Linkages between research, technology-transfer agencies and farmers are far from effective in African countries and have been identified as key problems and this has led to research results often not being transferred to the end-users. Conscious of these

problems, ITC has introduced the Module *Train the Trainer – Train the Farmer* in which the national partners are the focus of attention. The CORE group of DLS staff assisting the dairy cooperatives is a good example of this process. They were trained intensively and were asked to have multiple training sessions, in the local languages and with the aid of good manuals that were also developed by the project, with the dairy cooperative members. With this approach, a critical mass for the distribution of certain messages can be reached much faster, while also making use of local expertise and experience (language, behaviour, beliefs).

The production of information material with the objective to translate scientific results into "usable messages" is another good tool for technology transfer, which has been applied by the project, not only for The Gambia, but also for the other countries. In a recent evaluation of Procordel, ITC's efforts have been commended; however, more needs to be done in this regard and the experts have proposed to include also multi-media information into the range of products to be produced for this technology transfer.

The statements made by the two main national partners, DLS and NARI, take up these intentions and point out that close collaboration, most particularly in the area of research result transfer, is essential to make an impact on farmers' livelihoods. Their willingness to collaborate with the ITC has once again been confirmed.

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