International Trypanotolerance Centre (ITC)

ANNUAL PROJECT PROGRESS REPORT 2003

February 2004

International Trypanotolerance Centre

Banjul, The Gambia

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INTRODUCTION

The Annual Progress Report for 2003 contains summaries of results obtained from the implementation of the ITC Workplan 2003, required for the achievement of outputs for Year 3 of the on-going ITC Medium Term Plan (MTP 2001-2004). The MTP (2001-2004) itself is the first to be implemented under the re-organised ITC Research and Development Agenda that came into operation in January 2001. The re-organisation was instituted with a view of integrating the various restricted-funded projects on-going at the Centre into a few, more focused, number of Programmes, each with few medium term (4-5 years) projects addressing issues (constraints and opportunities) considered as priorities by stakeholders and partners in the region. Furthermore, the re-organisation was intended to provide ownership of the Research and Development by ITC and partners in ways that increase the "visibility" of the institution. In the re-organisation three programmes comprising 13 projects were initially proposed. The three programmes comprise the 11 projects that are listed in Table 1.

Table 1. Institutional Programmes and Projects of ITC

Programme	Project (short title)	Project code
Low-Input System Improvement Programme (LISIP)	1. Disease Risk Assessment	LISIP 01
	2. Disease Control Strategies	LISIP 02
	3. Stress factors and maintenance of disease resistance/resilience	LISIP 03
	4. Crop-agroforestry-livestock integration	LISIP 04
	5. Genetic improvement of indigenous ruminants	LISIP 05
Market-Oriented Systems Improvement Programme (MOSIP)	6. Development of Meat and Milk systems in peri-urban areas	MOSIP 06
	7. Feeds and feeding strategies	MOSIP 07
	8. Development and Application of novel techniques (biotechnology)	MOSIP 08
Systems' Overlaps and Linkages Improvement Programme (SOLIP)	9. Consumer safety and public health	SOLIP 09
	10. Socio-economics aspects of livestock production	SOLIP 10
	11. Training and information	SOLIP 11

A major goal of the third year workplans was the further consolidation of programmes, projects and working groups at ITC and the establishment of linkages with National systems and other regional-based projects. A second important goal was to institute activities (studies, experiments, surveys, etc) the outcomes of which would contribute to the realisation of the milestone outputs/indicators for 2003, and possibly to some of those expected for 2004.

In addition to the advances made at the programme and project levels for work implemented, the effectiveness and timeliness at which the results obtained were shared with stakeholders, and the achievements made in obtaining additional resources to support the Workplans and the MTP in general, are considered as progress and are highlighted below.

Research integration highlights:

- Institutional, Programme and Project-level Research leadership were established and confirmed

- Integrated Research planning and coordination at institutional level instituted under the Regional Research Coordinator. In the second half of 2003, an Interim Team for Regional Research Coordination (IT-RRC) was created to perform this function

- Institutional-wide overseeing body for Research and Development, the Programme Management Committee (PMC) created. Formal 'Terms of Reference' were developed for the PMC in 2003

Dissemination/Communication highlights

- 56 publications, comprising 3 book chapters, 13 Journals articles (in press, accepted, or submitted), 1 MSc thesis, 1 PhD thesis, 44 Conference presentations and 13 poster presentations, and the first 3 of the ITC Working paper series were recorded (see full list in Appendix 1). The quarterly ITC newsletter was produced in 2003, the first issue coming out in March, followed by two later issues

- Work and activities of ITC were broadcast in the media (radio, television) in the sub-region

- 8 internal scientific seminars were given (see Appendix 2)

- Livestock from ITC breeding programmes and those from outreach programmes were exhibited at National and Regional Livestock Shows

- ITC dairy products were exhibited at National shows and the first International Trade Fair and are being sold at supermarkets in The Gambia

- An ITC Emphasis Week was organised in November 2003 which culminated with an Open Day, with the President of The Gambia as Guest of Honour

- 3 National Conferences on PROCORDEL (Theme: *Livestock Research for Development*) jointly organised by ITC and National Partners in The Gambia, Guinea, and Senegal

Highlights on acquisition of financial support

- 16 Concept Notes/Research proposals submitted.
- 5 proposals funded

Research and capacity building highlights

- Eight out of eleven Year 3 (2003) milestone outputs fully realised, 2 partly achieved
- Two of the 5 higher degree candidates progressed to thesis defence
- 574 individuals from National and Regional institutions trained

LOW INPUT SYSTEMS IMPROVEMENT PROGRAMME (LISIP)

Background and Justification:

Although several recent analyses on trends in the evolution of livestock production systems in sub-Saharan Africa show a dynamic, continuous process with patterns towards integrated, intensive production, a considerably large segment of the livestock systems will continue to rely on low inputs in the foreseeable future. The latter systems referred to variously as traditional, local, unimproved or low-input are targets of ITC and partners, as the systems are believed to be well-placed to respond to interventions that can increase their performance and efficiency.

The objectives of the Low-Input Systems Improvement Programme are to improve the livelihoods of farmers dependent on livestock production and associated enterprises in areas where low-input agriculture is practiced, through the reduction of stress factors limiting livestock productivity in extensive systems.

In order to achieve this objective, LISIP activities are focused on:

- Assessment of disease risks
- Development of integrated vector and parasite control strategies
- Genetic improvement of indigenous domestic ruminant resources
- Integration of farm and on-farm resources to obtain synergies in farming enterprises

Highlights and Achievements in 2003

Details of progress made are in the specific project reports. Below are listed highlights of the achievements:

Disease risk assessment and vector/parasite control

- Disease risk in F1 crossbred cattle with respect to trypanosomosis was established for the Kombos area, The Gambia. The Kombos remain under challenge from *G. p. gambiensis.* The results showed that the risk is high for trypanosusceptible crosses (annual period trypanosome prevalence of up to 30%) in some areas. Management practices and health control measures were formulated for crossbred cattle being introduced in the Kombos.
- Additional investigations on the Woula syndrome confirm the suspected aetiology of a mixed infection complex
- Serological evidence of the existence of cowdriosis in The Gambia was demonstrated, with a possible vertical transmission of *E. ruminantium*. A local *E. ruminantium* stock was isolated. There was no protection to a local isolate of *E. ruminantium* using the current vaccine candidate (Gardel isolate)

- Recommendations to control equine diseases and to alleviate husbandry constraints were formulated.

- Trypanocidal drug resistance could not be fully confirmed in Mandiana in Guinea in trypanotolerant cattle that need lower intensity of therapeutic treatment and that have an innate ability to clear trypanosome infections.

Impact of stress factors on maintenance of tolerance to diseases

Lactation is an additional stress that underlines the tolerance of crossbred cows to trypanosome infections. Milk yield is seriously affected by trypanosome infections. Trypanosome infection significantly affects the work performance of crossbred oxen. The use of prophylactic trypanocides or pour-on formulations is recommended for lactating and working F1s.

Crop-agroforestry – livestock integration and resource management

There have been significant advances in ITC efforts, in collaboration with partners, to introduce through local communities tree (*Moringa*, *Leucaena*) and herbaceous (cowpea) fodder cultivations to support ruminant production and as a means of reducing pressure on forest resources.

Genetic improvement of indigenous animal genetic resources

- Genetic parameters were estimated and will be used to further optimise the breeding programme. The genetic gains were also estimated, showing that selection is proceeding in the right direction. The dissemination of genetic improvement realised at the nucleus flocks and herds at ITC into farmer multiplier flocks, and to the general farming communities in The Gambia was expanded in 2003. Strong, well structured breeding associations are emerging and are playing key roles in the dissemination of the genetic progress.

- Methodologies and approaches developed in The Gambia were successfully applied to situations in Boké, Guinea.

- Screening operations to identify village outstanding animals were resumed in The Gambia and in Guinea.

- A new Livestock producers' Association (GILMA) formed in the framework of this project in The Gambia received external support.

Collaborative Activities and Dissemination of Results

Linkages with Advanced Research Institutes, International and Regional Institutes, Regionally based donor-funded projects and in NARS on the sub-region are considered essential for the realisation of outputs and in their dissemination to grassroots beneficiaries. Several of such linkages were made in the course of planning and implementation in 2003. Among them were the ILRI-led project on chemoresistance to trypanocidal drugs, the EU-funded project PACE, the Global Environmental facility/GEF project on biodiversity conservation. Collaboration

with Wageningen Institute of Animal Science (Netherlands) and Humboldt University (Germany) were on breeding and genetics. Collaboration with CIRAD was established.

POTENTIAL IMPACT:

The outcomes of ITC-led research and development in collaboration with the NARS have been valuable inputs in the development of projects of regional significance such as the project on "*in-situ* conservation of ruminant livestock in West Africa".

INSTITUTIONAL PROJECT 1

Full project title:	Disease Risk Assessment in Ruminant Livestock and in Parasite Reservoir Mammals
Short title:	Disease Risk Assessment
Programme:	Low-Input Systems Improvement Programme
Project number:	LISIP 01
Location(s) of research:	The Gambia (ITC) Kerr Serigne,
Start date:	January 2001
Project end date:	December 2004

OBJECTIVES:

The identification and application of appropriate disease control strategies for domestic ruminant livestock depends upon an accurate evaluation of disease risk and an assessment of disease epidemiology for any specific area. It is also recognised that the presence of non-livestock mammals that harbour parasites and constitute reservoirs for given parasites and vectors can influence disease patterns and prevalence in a locality.
The outputs of the project include:

- Quantified assessment of disease risk in terms of species and seasonal/spatial abundance of vectors and prevalence/incidence of infection in the livestock hosts
- Quantified assessment of the role of wild animal reservoir hosts of parasitic infections
- Data contributing to Decision-makers to aid in selecting appropriate control strategies
- Disease risk assessment approaches/models applicable at a sub-regional scale

IMPLEMENTED WORK PROGRAMME:

Activities of the Disease Risk Assessment project included:
Activity 1: Continuation of the assessment of disease risk to newly established crossbred dairy cattle herds in The Gambia i) In the Kombos Districts; ii) in Nuimi and Foni Districts
Activity 2: Additional entomological investigations in CAE Boké (Guinea)
Activity 3: Additional investigations on the Woula syndrome (Guinea)
Activity 4: Epidemiology and genetic characterisation of Cowdria ruminantium infections in small ruminants (The Gambia)
Activity 6: Termination of equine disease and husbandry constraints study (The Gambia)
Activity 5: Assessment of vector-borne disease risk for F1 animals in comparison to N'Dama in Labé (Guinea)

Assessments of risk are reported with respect to hosts (livestock) and vectors (tsetse flies and ticks) and by location or site.

Activity 1: Disease risk assessment for crossbred dairy cattle herds in The Gambia

a) Tsetse monitoring

i) Kombos Districts

Other than where additional details for specific sites are given, the protocols used for assessing parasite and vector populations and disease risk in the crossbred dairy herds were the same as those used in previous years as this is a continuation of previous years activities. Trapping was carried out for three days each month using unbaited blue biconical traps. The traps were harvested once a day and live tsetse were dissected and examined for trypanosome infection s after first recording the species and sex. The number and species of tsetse and other biting flies were also recorded. Trap sites and F1 locations were geo-referenced using GPS instruments.

ii) Tsetse Monitoring in Nuimi and Foni

The extension of monitoring to these areas was collaboration between ITC and DLS under the HIPC programme following the introduction of F1 cattle. Lower Nuimi is towards the Senegal border and is generally open with little vegetation. However, F1 cattle are located in villages lying near a stretch of streams. Village animals feed and water at these streams during the dry season. Upper Nuimi has more vegetation cover and a long stretch of heavy woodland lies near the villages of Pakau Njogu and Chilla. This woodland is an important grazing area for livestock from all the surrounding villages and it has several drinking points situated in it. According to villagers, this woodland is heavily infested with tsetse during the early dry season.

b) F1 dairy cattle in The Kombos

Fifty-two F1 cattle on farm (11 cows, 16 calves, 14 weaners, 5 heifers and 6 bulls) and 40 F1 cows on station were monitored monthly. All calves born under the A.I. programme are being included in this investigation.

- Haemoparasitic infections

All experimental animals were bled monthly into 4.5 ml EDTA vacutainers. Blood samples were examined microscopically using the buffy-coat/dark ground technique following centrifugation and measurement of the packed red cell volume (PCV). Thick and thin blood smears were stained with Giemsa from samples that tested positive for haemoparasitic infections in order to confirm species identification.

- Helminth infections

Faecal samples were collected from a sub-sample of the experimental animals and were examined to determine the helminth egg output per gram of faeces using a modified MacMaster technique.

- Ticks and tick-borne diseases

Half body counts were made monthly, of all ticks observed from a sub-sample of experimental animals. All ticks were identified and preserved in alcohol.

Activity 2: Additional entomological investigations in CAE Boké (Guinea)

Following the *disease risk assessment* survey in Boké during 2001/2002, it was concluded that a tsetse survey should be carried out as a follow-up study from April to June 2003 also in that part of CAE station, where animals were not herded.

Activity 3: Additional investigations on the Woula syndrome (Guinea)

Following an inconclusive survey in 2002 on the epidemiology of the Woula syndrome, a PRA with farmers was carried out to understand more about their perception of the disease. Furthermore, blood samples were taken from approximately 80 sick animals during the period March to May 2003 and these were examined for haemoparasites.

Activity 4: Epidemiology and genetic characterisation of Cowdria ruminantium *infections in small ruminants (The Gambia)*
This study, which was carried out in the Sudano-Guinean, Western Sudano-Sahelian and Eastern Sudano-Sahelian zones, investigated the serological evidence of cowdriosis in small ruminants in The Gambia.

Activity 5: Assessment of vector-borne disease risk for F1 animals in comparison to N'Dama in Labé (Guinea)
F1 cattle were followed regularly and any case reported was treated. Animals were vaccinated against pasteurellosis and anthrax and were dewormed strategically. The disease level was therefore very low and no losses were incurred.

Activity 6: Termination of equine disease and husbandry constraints study (The Gambia)
Fifteen horses and 15 donkeys each in 9 villages in 4 districts with a high equine density (census data) were sampled monthly from April 2002 to March 2003. In addition, samples were taken from *lumo*s and *gate clinics* of the Veterinary Department.

RESULTS:

Activity 1: Disease Risk Assessment
i). Tsetse - Kombo Districts: The Gambia
Only *Glossina palpalis gambiensis* has been detected in the Kombos area of The Gambia, and its overall mean apparent density is low (<3 f/t/d). The overall mean apparent density of 2.4 flies/trap/day in 2003 is not significantly different from earlier records. The area was designated a low tsetse challenge area in the 1980s and 1990s. However, there are areas of high risk associated with remnants of forest and riparian habitat. These areas include the Abuko Nature Reserve, where the apparent density ranges between 7.2 and 26.4 f/t/d and Mandinaring (apparent density 11.4- 14.6 f/t/d). Apparent densities were also high (7.2 - 10.0 f/t/d) in the south-west forest region of Kombo around the villages of Kitty, Sala and Kabekel. Due to their greater susceptibility to trypanosomosis, F1 crossbred cattle in these areas of high tsetse density are under a significant trypanosomosis risk, especially as they graze and drink near the tsetse "hot spots". Tsetse flies were caught in backyards of villages in the high-risk areas. However, there are many areas of very low density (<1f/t/d) particularly in and around the big towns. Cattle kept under intensive or semi-intensive conditions, in these relatively built-up areas with little suitable tsetse habitat, are under low trypanosomosis risk. Nonetheless, high numbers of *Stomoxys* spp. were occasionally recorded in Kololi, Sukuta and Nemakunku. These could pose a risk of mechanically transmitted trypanosomosis. Close to the ITC Kerr Serigne station, in the Bijilo forest, there is a low-density tsetse infestation, resulting in a low prevalence of trypanosomosis in F1 crossbred cattle on-station.

Trypanosoma congolense and *T. vivax* were the only trypanosome species pathogenic to livestock that were detected in dissected tsetse. However, *T. brucei* was detected in cattle and had been found in tsetse previously using DNA probes. The mean trypanosome infection rate in tsetse was high, (40% at Abuko and 31% at Kitty and Sala). Seventy-five per cent of these infections were *T. vivax*-type based on the locations of infections in the fly. Four

species of Tabanidae, *Tabanus taeniola, T. sufis, T. bigutattus* and *Atylotus agrestis,* were captured and identified.

It is clear that although there are some small areas of the Kombos that could be classed as zero challenge, overall, the Kombos remains under low to medium tsetse challenge from *G. p. gambiensis* with respect to trypanotolerant livestock but this would be classed as medium challenge for trypanosusceptible crosses.

ii) Tsetse Monitoring in Nuimi and Foni

Nuimi is a mixed infested area. Low densities (<1 fly/trap/day) of *G. submorsitans* were found at Amdalie and Pakau Njogu; and generally low densities (<3 f/t/d) *of G. gambiensis* were found in the area except at Bakindick, where a relatively high density (7.5 f/t/d) was recorded. However the heavy woodland area of Upper Nuimi was not densely tsetse infested, probably because trapping was carried out during a season of low density. It was not possible to visit the area in the early dry season, which is the time of peak tsetse abundance.

Monitoring in the Fonis was limited because of the large area and the fact that few F1 cattle exist there and these are sparsely distributed. Little data could be obtained during the two visits made in 2002 and 2003. The area is exclusively infested with *Glossina palpalis gambiensis,* notably north of the main road, towards the river. South of the main road is more open farmland and tsetse are mostly detected there during the rains.

Few conclusions can be drawn for these areas because of the sporadic monitoring.

2. F1 dairy cattle – Kombos Districts; The Gambia

Crossbred N'Dama x Holstein cattle showed a higher degree of susceptibility to trypanosomosis compared to that in N'Dama cattle. Overall mean trypanosomosis prevalence in on-farm animals was 2.2%, with a peak prevalence of 7.4% in the early dry season (January), however, the annual period trypanosome prevalence was 30% in 2002, compared to 16% in N'Dama cattle in 2001 (the only year in which N'Dama were monitored), representing a relatively high risk to both breeds of cattle. The F1 animals had a significantly lower PCV than the N'Dama. Clearly management practices need to be introduced to cope with that challenge otherwise attempts to introduce crosses for improved dairy production are likely to fail following high mortality of susceptible animals. Tsetse control under a medium challenge situation would not be cost effective unless it also provided benefits from tick and nuisance fly control. Pour-on insecticides could be considered for such an integrated approach to disease control; however, the costs and technical feasibility would need to be assessed. Options for modified management/production practices that need to be considered are the introduction of a zero-grazing system in which fodder is brought to crossbred animals that are kept in one of the zero to low challenge sites. It is essential that distribution of F1 dairy cattle should only be carried out based on an assessment of the local disease risk now available for the Kombos, the ability of the farmer to put into practice and maintain a zero-grazing system and the ability of the farmer to provide sufficient fodder and water throughout the year. Regarding helminth infections no significantly greater degree of risk was noted in F1 cattle and current control methods, based on anthelmintics will suffice to maintain adequate control.

-Ticks and tick-borne diseases

The overall mean tick burden was 4.8. *Rhipicephalus* spp., *Hyalomma* spp., *Amblyomma variegatum*, and *Boophilus* spp., were the tick species found in decreasing order of abundance during this period. No tick-borne disease parasite was detected from blood samples.

The risk from Cowdriosis is reported elsewhere.

Activity 2: Additional entomological investigations in CAE Boké (Guinea)
Results were that in these areas, medium apparent densities of tsetse were found, predominantly of *G. palpalis gambiensis*, with an apparent density peak in April (9.4 flies/trap/day) and a mean of 5.1. A mean trypanosome infection rate of 2% was detected in dissected flies.
These results will be integrated into the overall report on the activity.
Activity 3: Additional investigations into the Woula syndrome (Guinea)
Of the samples examined, 40% were found positive for mixed infections of trypanosomes and *Babesia* or *Anaplasma*, confirming the suspected aetiology of a mixed infection complex. In addition, 310 faecal samples were examined for infections of *Fasciola* spp. Nine percent of those samples were found to be infected with *Fasciola*.

Activity 4: Epidemiology and genetic characterisation of Cowdria ruminantium *infections in small ruminants (The Gambia)*
This study, which was carried out in the Sudano-Guinean, Western Sudano-Sahelian and Eastern Sudano-Sahelian zones, demonstrated the serological evidence of cowdriosis in small ruminants in The Gambia. A cumulative seroprevalence of 49.8% was recorded for the country. The highest prevalence of 56% was recorded in the Western Sudano-Sahelian zone, which also had the highest mean *Amblyomma variegatum* count, and an *E. ruminantium* tick infection rate of 8%. An overall tick infection rate of 6% was recorded in the country. Studies of traditionally managed newborn small ruminants using a semi-nested pCS20 PCR assay indicated the possible vertical transmission of *E. ruminantium*. A local *E. ruminantium* stock (Kerr Serigne) was isolated and established in cell culture for the first time.
This study is being carried out in the framework of a PhD work at University of Utrecht. An application has been made to become member of the INCO group working on cowdriosis

Activity 5: Assessment of vector-borne disease risk for F1 animals in comparison to N'Dama in Labé (Guinea)
F1 cattle were followed regularly and any case reported was treated. Animals were vaccinated against pasteurellosis and anthrax and were dewormed strategically. The disease level is therefore very low and no losses were incurred.

Activity 6: Termination of equine disease and husbandry constraints study (The Gambia)
An increase in the horse population under study was observed, whereas the donkey population decreased. Trypanosomosis prevalence was below 5% throughout, except during November to January, when prevalences rose to 20%. GIP infection rates were generally high, particularly with strongylus and triodontophorus. Serological results show an enzootic situation for African Horse Sickness, with some areas were low antibody levels were found and vaccination is highly recommended. Questionnaires on all aspects of equine husbandry were administered and a full report has been prepared.
The study of trypanosomosis in equines resulted in a Doctoral Thesis (Diplome d'Etat) at the EISMV, Dakar, by Dr Alfred Diouf.

POTENTIAL IMPACT:

The assessment of disease risk is an essential step towards the development of appropriate disease control strategies and provision of the necessary information to enable decision- and policy makers to determine the most appropriate livestock production practices and natural resource management mechanisms in the region. As environmental management becomes

increasingly important in West Africa, the availability of information on prevailing epidemiological trends will likewise become increasingly important. Further steps required are the field-testing of recommended disease control strategies and the further identification and epidemiological analyses of long-term trends for natural resource management.

SCIENTISTS INVOLVED:

Institutional Project Leader: S.G.A. Leak

Other ITC Scientists: S. Münstermann, B. Faburay, D. Fofana, M.L. Ceesay, S. Heuwinkel

Senior ITC Technical staff: J. Faye, A. Jarju, A. Ceesay,

Collaborating ITC Special Projects: PROCORDEL, Small Ruminant Research Project

Collaborating institutes and scientists: The Gambia: Department of Livestock Services (DLS), B. Jabang, B. Janneh, S. Mendy; Guinea: Direction National d'Elevage (DNE)/Institut Recherche Agricole (IRAG); Institute of Tropical Medicine (ITM), Antwerp, Belgium; Institute for Parasitology, Veterinary Faculty Free University of Berlin, Germany.

MEETINGS:

PROCORDEL National Conference, Banjul, The Gambia. November 2003.
Presentations on: 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

ECOWAS Meeting of Tsetse Experts on AU/Pan African Tsetse Control at Abuja, Nigeria in March 2003: Tsetse Situation in The Gambia: Country Report. M.L. Ceesay.

ATTAINMENT OF MEDIUM TERM PLAN MILESTONES:

Milestone 2003: By the end of 2003 the activities undertaken within the project contributed to the realisation of the MTP milestones for the year. Disease risk for F1 cattle in the Kombos Districts of The Gambia was assessed and recommendations for future management and control of disease constraints were made.

INSTITUTIONAL PROJECT 2

Full project title:	Development and evaluation of control measures against vector and vector-borne diseases
Short title:	Disease control strategies
Programme:	Low-Input Systems Improvement Programme
Project number:	LISIP 02
Location(s) of research:	The Gambia (ITC), Guinea: Mandiana, Haute Guinea
Start date:	January 2001
Project end date:	December 2004

OBJECTIVES:

Tsetse-transmitted trypanosomosis, tick-borne diseases and tick-associated infections, such as dermatophilosis, together with gastrointestinal parasites constitute the major pathological parasitic complex responsible for limiting animal production in sub-Saharan Africa. Control of these disease problems is mainly carried out by the use of drugs, a strategy for which limitations have been identified. Therefore, integrated strategic control measures based on key epidemiological features of vectors and parasites, need to be developed.

Project outputs include:

- Best bet control strategies for trypanosomosis in the cotton zone of West Africa
- Preliminary characterisation of national policies, institutions, and regulations that affect the delivery and use of trypanocides
- Formulation and transfer of disease control strategies to NARS and extension agencies

IMPLEMENTED WORK PROGRAMME:

Key objectives of the Project include the assessment of the impact of parasites on animal health and production and the development of integrated strategic disease control measures.

Activity 1: Rapid resistance testing in Mandiana in the framework of a coordinated regional study on the management of trypanocide resistance in the cotton zone of West Africa
In 2002, results of 3 block treatment studies using isometamidium (ISMM) in the villages of Saladou, Dialakoro and Kanifara (Mandiana District) in the Cotton Zone of Haute Guinea indicated the possibility of drug resistance. The total number of breakthrough infections was small, however, and were insufficient to verify the presence of drug resistant strains of trypanosomes. In order to further investigate the occurrence of trypanocide resistance in

Mandiana, additional *rapid resistance testing* was carried in the field out in 2003. These investigations consisted of the following:

- A rapid appraisal of farmers views of periods of peak challenge and efficiency of trypanocides, carried out in 10 villages around Saladou (high suspicion of resistance) and around Dialakoro (low suspicion of resistance).
- Eighty animals > 1 year of age were selected in each of the 15 villages. Following the standard protocol as established in 2002, ISMM block treatment was applied to 40 animals on D0, with subsequent visits and testing of treatment and control group animals on D14 and D28. Block treatment was applied using 1 mg/kg ISMM. Animals found positive thereafter were given 3.5 mg/kg diminazene aceturate (DIM) in the case of *Trypanosoma congolense* and *T. vivax* infections, and 7 mg/kg in case of *T. brucei* infections. Field isolates were prepared from any breakthrough infection occurring on D14 and D28 for subsequent testing.
- Preparation of Reference DNA (positive controls) for trypanosome PCR were prepared, and specialised training on PCR techniques was given to Mr Barry, a PhD student on this project, at the Institute for Parasitology, Veterinary Faculty, FU Berlin.

Activity 2: Vaccination trial with Gardel and Welgevonden inactivated cowdriosis vaccine to study cross-protection

Background

The first infective material of the Gambian isolate of *E. ruminantium* was prepared from an indigenous West African Dwarf goat No. 1946 in the form of a blood stabilate before death. The goat originated from Kerr Serigne and manifested symptoms characteristic of heartwater. The Giemsa-stained brain smear was positive for *E. ruminantium.* A blood-DMSO mixture was prepared and divided into sub-samples and stored at -80^{o}C.

The aliquots were later shipped under cold chain to the Institute of Tropical Medicine (ITM) in Antwerp, Belgium. An aliquot of one of the infective stabilates was inoculated into goat No. 4639 in which it caused clinical heartwater. An infective blood stabilate was subsequently prepared and aliquoted as above and stored in dry ice.

In July 2002, 2 ml of the infective blood stabilates prepared from goat No. 4369 was taken to Utrecht University, The Netherlands and stored in liquid nitrogen. In June 2003, the stabilate was inoculated into sheep No. 229 of the Tarselaar breed. The stabilate caused hyperthermia in the sheep in the first passage. An infective blood stabilate and samples of plain EDTA blood were prepared when the temperature of the sheep reached 41.5^{o} C on day 9-post inoculation. The DMSO blood stabilate was aliquoted in 2 ml tubes and snap frozen in liquid nitrogen for later use in a cross-protection vaccination trial in The Gambia. The infective plain EDTA blood was used to inoculate bovine aortal endothelial cell culture for subsequent parasite isolation.

Vaccination trial

Twenty Sahelian sheep originating from *Amblyomma* and heartwater-free areas in northern Senegal were initially bought for the experiment. Six of the animals died prior to the start of the experiment. The animals were tested by MAP 1B ELISA to confirm their seronegative status. The remaining 14 animals were divided into 2 groups of 7 and were all dewormed using albendazole. Animals of group 1 constituting the experimental group were vaccinated subcutaneously with 2 ml of the inactivated Gardel strain vaccine, whereas the control group received a placebo. One month after vaccination animals in the experimental group were given a second booster vaccination of 2 ml of the same inactivated vaccine. Pre-vaccination sera and sera obtained 2 weeks after the first and second vaccinations were collected from all

animals to assess sero-conversion. Thereafter collections were made weekly until the end of the experiment.

Two weeks after the second vaccination, animals in both groups were challenged intravenously with an infective blood stabilate containing the Kerr Serigne strain of *E. ruminantium*. Daily rectal temperature readings and clinical symptoms of disease were monitored in all animals. All dead animals were examined post mortem and their brain smears stained with Giemsa to confirm the cause of death. The experiment ended about 3 weeks post challenge infection.

Activity 3: Transformation of disease risk assessment results into disease control strategies

3.1. Key results of a survey on prevailing diseases of equines were presented at several conferences and meetings in The Gambia. The final report including recommendations for disease prevention and control was given to an upcoming NGO supported project on welfare of equines in The Gambia.

3.2. In the course of regular monitoring of the health status of ITC's small ruminant breeding flock in Keneba, an outbreak of abortions was observed after the 2003 rainy season. Serum samples were taken from animals that had aborted and tested for brucellosis and Rift Valley Fever.

3.3 In the course of assessing the prevailing diseases and their importance for the newly introduced F1 crossbred cattle in the GBA, 13 F1 cows (3-5 years) and 18 F1 calves from birth to one year, were serologically tested for the presence of antibodies to the tick-borne diseases caused by *Babesia bigemina, B. bovis* and *Anaplasma marginale*, using an indirect ELISA test kit.

3.4. Any outcome of technical studies, whether updating or confirm previous findings or providing new findings, is being translated into "messages". These messages are presented either in form of training modules, training booklets or posters. The training modules are presented mainly using the method of *Train the trainer* (ToT) courses for extension workers, for them to present the contents subsequently to farmers as *Train the Farmers* (ToF) courses.

RESULTS:

Activity 1: Rapid resistance testing in Mandiana in the framework of a coordinated regional study on the management of trypanocide resistance in the cotton zone of West Africa

A rapid assessment of trypanocide resistance, carried out over a period of 48 days in June and July 2003, in 10 villages around Saladou and 5 villages around Dialakoro, revealed only 4 breakthrough infections (3 *T. congolense* and one mixed *T. congolense*/*T. vivax* infection) were detected. The breakthrough infections were detected in 4 villages around Saladou, the area of suspected resistance. No breakthrough infections were observed in the 5 villages around Dialakoro.

At the time of the block treatment, the trypanosomosis challenge was low, based on the trypanosome prevalence observed in the control groups. Three out of 15 village herds had a trypanosome prevalence of 5-10%, whereas that in the 12 control groups was between 0 – 5%.

Activity 2: Vaccination trial with Gardel and Welgevonden inactivated cowdriosis vaccine to study cross-protection

A local Gambian strain was successfully isolated in bovine aortal endothelial cell culture at Utrecht University. The stock of *E. ruminantium,* originated from Kerr Serigne and the isolate was named KS.

A vaccination trial was recently concluded and the data is yet to be fully analysed. However, preliminary results indicated that 1 out of 7 animals in the control group survived, whereas 3 out of 7 animals in the vaccinated group survived. All the dead animals showed clinical signs typically associated with cowdriosis prior to death and their brain smears were all positive for *E. ruminantium*. Thus animals in the control group had a mortality of 86% and those in the vaccinated group had a mortality rate of 52%. This represents a vaccine efficacy of 43%. Serum samples will be tested later, using the MAP 1B ELISA to assess seroconversion. The results indicated that the Gardel isolate could not protect sheep against cowdriosis caused by the Kerr Serigne isolate.

Activity 3: Transformation of disease risk assessment results into disease control strategies

3.1. Some key results from the equine study can be transformed to recommendation for disease control:

- Trypanosomosis was frequent with a mean prevalence of 6.7% in horses and 4.4% in donkeys. These findings correspond well with earlier studies. The peak trypanosome prevalence was 19% and 16% for horses and donkeys respectively and occurred at the beginning of the dry season (November and December) when animals were most needed for transportation of harvests. Prophylactic treatments to protect animals from infection are recommended for this period.
- The prevalences of gastro-intestinal parasites were extremely high in both species, as anthelmintic treatments were rarely given. Greater awareness of the detrimental effects of these helminth burdens, particularly on working animals, must be created amongst farmers so that they follow recommended de-worming procedures.
- The rates of detection of antibodies to *African Horse Sickness,* determined using the CFT and Serum neutralisation tests, of 83% and 69% in horses and donkey respectively, indicate that the disease is enzootic. In 11 locations where serum samples were tested during the end of the dry season, high levels of complement fixating antibodies indicated a recent circulation of the virus, whereas in 4 villages higher levels of seroneutralising antibodies indicated a fading degree of acquired immuno-protection and an urgent need for vaccination. This is supported by regular reports of clinical cases, as confirmed recently at the Senegal/Gambia border (Dr Sall, ISRA, pers. comm. Dec. 2003). It is highly recommended that horses should be vaccinated annually before the rainy season to protect them from AHS.
- Generally, very poor management was observed during this study and the provision of better housing, feeding and harnessing needs to be discussed with animal owners in order to improve equine health and productivity.

3.2. The high incidence of abortions in the small ruminant breeding flock in Keneba did not result from brucellosis infections, as was established by the RBPT. Following the latest warning message of the EMPRES (FAO) group on the increased risk of *Rift Valley Fever* in West Africa during the 2003 rainy season, the high abortion incidence led to suspicions of RVF. Samples from 38 ewes and 38 does were taken to ISRA and 90% were found positive for RVF by virus neutralisation test. It is important that staff on the station are aware of the zoonotic character of the disease and that preventive measures are taken. The recent outbreaks of RVF in Gambia, Senegal and Mauritania were addressed by the regional, FAO supported,

RVF surveillance system. PACE will organise a workshop in January 2004 in Dakar to consider the best control strategies for the disease.

3.3. Results of disease risk assessment activities in the region were described in the 2002 Progress report; however, preliminary results of serological tests only became available in 2003. High proportions of seroreactors were detected in adult cows, far exceeding the prevalences found in N'Dama cattle during a one-year survey in 1994/95. An average prevalence of 64% was found for *Babesia bigemina* (N'Dama 44.7%), 27% for *B. bovis* (5.2% for N'Dama) and 94% for *Anaplasma marginale* (29.6% for N'Dama). Seroprevalences in calves from birth to one year were 49% for *B. bigemina* with a persistence of 5 months. *B. bovis* seroprevalence was 14% and persisted for 4 months. A 45% seroprevalence of *A. marginale* was found in calves, and persisted for 8 months. The latter results indicate the presence of maternal antibodies, the former, that high exposure to the predominant transmitting tick species is taking place and that F1 cattle contract infections. As shown in previous ITC reports, very low prevalences of haemoparasites were found in blood smears and clinical manifestations of anaplasmosis or Babesiosis were rare.
Seroprevalences of approximately 25% for *A. marginale* and 50% for *B. bigemina* in cattle > 1 year, together with very low occurrence of overt tick-borne disease are considered to indicate situations of endemic stability.
It was concluded that tick control in F1 cattle should be applied strategically during peak tick abundance to reduce exposure to tick-borne diseases and to reduce tick damage, which in itself is considered as a disease factor by Gambian farmers.

3.4. The transformation of technology-packages containing the results of technical research, continued in 2003 using the dual Module *ToT-ToF* approach, as described in more detail in Institutional Project 11. The following topics were offered:

- Hand milking techniques and hygienic handling of milk (Guinea)
  Train the farmers (91 milk vendors and milk producers)
- Hand milking techniques and hygienic handling of milk (Senegal)
  Train the farmers (33 milk vendors and producers)
- Management strategies for F1 crossbred cattle (Senegal)
  Train the farmers (16 farmers)
- Stabling technology for local cattle (Guinea Bissau)
  Train the Trainer (11 extension workers)
- Management of working cattle and implements (Sierra Leone)
  Train the Trainer (7 extension workers)
- Management of working cattle and implements (Sierra Leone)
  Train the Farmer (16 farmers)
- Management of working cattle and implements (Guinea)
  Train the Farmer (90 farmers)

Guidelines on the general management of F1 cattle, including disease prevention and control, were also disseminated in the form of an extension manual (*Cahier des élèveurs F1*) with the assistance of the Labé CFEL, Guinea in French and Arabic. This manual is now being adapted to the Gambia situation and translated into English and Wolof. Recommendations for best dairying practices, including health of dairy cows were also compiled in an extension manual. In addition, the Small Ruminant Research Project produced a draft document containing guidelines for improved management of small ruminants, including diseases and health control that will be finalised in a manual to be available in 2004.

POTENTIAL IMPACT:

Resistance to trypanocidal drugs has been widely reported, particularly in East Africa. Reports from West Africa are fewer, and rare for trypanotolerant animals. A report of trypanocidal drug resistance in one area of Mandiana district, in 2002, could not be fully confirmed as only 4 cases of breakthrough infections were found in a rapid assessment of 15 herds. It is speculated that the low rate of relapse infections is due to a lower intensity of therapeutic treatment in trypanotolerant cattle. Furthermore, the innate ability of their immune system to clear trypanosome infections may enhance the efficacy of trypanocidal drugs, thus delaying the development of resistant trypanosome strains. Trypanotolerant cattle in the cotton zone of West Africa are consequently more productive than their Zebu counterparts in Mali (and Burkina Faso, confirmed in previous project) where trypanocide resistance was confirmed during rapid assessment surveys in 2003.

At present, effective control of heartwater depends on the availability of a protective vaccine. The development of the latter is complicated by the enormous antigenic and genotypic diversity resulting in lack of protection between heterologous strains. A trial using the current vaccine candidate (Gardel isolate) indicated that it does not confer full protection to a local (Kerr Serigne) isolate of *Ehrlichia ruminantium.* A Gambian isolate of a strain of *E. ruminantium* was therefore prepared, thus creating the opportunity for the development of a protective vaccine suitable for local use. The search for a protective vaccine should continue as this could result in a significant reduction of mortality due to cowdriosis in susceptible species of livestock. This would help to increase food security among resource-poor farmers.

The translation of results from technical research activities into recommendations for end-users and policy makers is a continuous process. During 2003, a "vehicle" (dual Module *ToT – ToF*) was further established and complemented with relevant training and extension materials/manuals.

SCIENTISTS INVOLVED:

Institutional Project Leader: S. Münstermann

Other ITC Scientists: B. Faburay, M.L. Ceesay, J. Somda, A. Schönefeld, M. Mbake, S. Leak

Senior ITC Technical Staff: J. Faye, K. Mboge, S. Kora

Collaborating ITC Special Projects: PROCORDEL, Small Ruminant Research Project, BMZ-ILRI

Collaborating Institutes and Scientists: The Gambia: Department of Livestock Services (DLS); Guinea: Direction National d'Elevage (DNE)/Institut Recherche Agricole (IRAG); Institute of Tropical Medicine (ITM), Antwerp, Belgium; Institute for Parasitology, Veterinary Faculty Free University of Berlin, Germany.

MEETINGS:

Annual Workshop: "Pour une meilleur gestion de la chimiorésistance contre les trypanocides de l'Afrique dans la zone cotonnière de l'Afrique de l'Ouest: une étude régionale. Sikasso, Mali, February 2003.

Commonwealth Veterinary Association Regional Conference, 13-15 October 2003, Bijilo, Gambia. *Health and Husbandry constraints for equines in The Gambia*, A. Secka and S. Münstermann.

ATTAINMENT OF MEDIUM TERM PLAN MILESTONES:

Milestone 2003: Application of the developed control measures to village-based animals and socio-economic evaluation of opportunities and constraints for their adoption by the extension services and livestock-producer community.

In 2003, ITC increased its collaboration with the extension services of the Department of Livestock Services in order to transfer results of technical studies to livestock producers. The large number of extension workers and farmers that participated in training contributed to advise on disease control for village-based animals.

Socio-economic evaluation was particularly directed at the investigation of farmers willingness to contribute to trypanosomosis control as reported in "*Evaluating farmers' willingness to adopt integrated packages for trypanosomosis control in The Gambia: Application of demand revealing mechanisms"* (Somda *et al*., 2003). However, further economic analyses will be carried out during the PROCORDEL extension period.

INSTITUTIONAL PROJECT 3

Project title:	Impact of levels of production (including traction) and nutrition on the maintenance of disease resistance/resilience in ruminant livestock
Short Title:	Stress factors affecting the maintenance of disease resistance/resilience
Programme:	Low-Input Systems Improvement Programme
Project number:	LISIP 03
Location(s) of research:	The Gambia,
Start date:	January 2001
Project end date:	December 2004

OBJECTIVES:

The exploitation of resistance/resilience of local stock to trypanosomosis, helminthosis and tick and tick-borne diseases constitutes an economically profitable and an environmentally sound strategy for control of these diseases compared to the use of conventional chemotherapeutic drugs or vector control measures for the development of animal agriculture in sub-Saharan Africa. However, a number of stress factors including poor nutrition, physiological status, (lactation, pregnancy) may influence the ability of livestock to express their genetically based attribute of resistance/resilience to parasitic diseases. In addition, in the process of intensification of farming systems, an increasing number of trypanotolerant cattle (especially the N'Dama) both male and female are being used for work purposes in sub-Saharan Africa and it has been shown that work can compromise the immune response to trypanosome infection. Moreover, the introduction of exotic genes for crossbreeding to meet the rapidly growing demand of animal products is likely to dilute the indigenous gene pool and might therefore erode the ability of genetic resources to adapt to diseases. The objectives of this project are:

- To investigate the interactive relationship between the stability of disease resistance /resilience and known stress factors such as nutrition, level of production, physiological status and work in local ruminant livestock
- To study the resistance/resilience of crossbred ruminants to vector-borne diseases and to assess conditions under which susceptible genotypes may be used in traditional low input systems

IMPLEMENTED WORK PROGRAMME:

Activity 1: Investigation of the effect of lactation on tolerance to trypanosomosis in F1 crossbred cows

The study was conducted between April and June 2003 at ITC headquarters. A total of 18 cows were used in the trial. They were assigned to three groups: 6 lactating F1 cows (4

Holstein*N'Dama, 2 Jersey*N'Dama) in Group 1; 6 non-lactating F1 crossbred cows (4 Jersey*N'Dama and 2 Holstein*N'Dama) in Group 2 and 6 non-lactating pure N'Dama cows in Group 3. All cows were vaccinated and dewormed. A pour-on insecticide (Butox) was regularly applied to reduce the possibility of natural infection with trypanosomes. All animals were kept in the same pen and were fed sufficient groundnut hay and concentrates to meet their requirements for maintenance and milk production.

The experiment was carried out for 10 weeks divided in three periods. The pre-infection period, Period 1, lasted 4 weeks. At the beginning of Period 2, all cows were subjected to artificial challenge with an injection in the jugular vein of a clone of *Trypanosoma congolense* (ITC84) at a dose of 3ml/animal of blood containing about 10^5 trypanosomes/ml. Lactating cows were about 4 weeks post-partum at the beginning of the trial. The termination of the infection was scheduled 4 weeks following the artificial challenge using diminazene aceturate at a dose of 3.5mg/kg live-weight. During the course of infection, cows that exhibited a packed cell volume (PCV) less than or equal to 20% or cows with severe clinical symptoms were treated with diminazene aceturate to terminate the infection. Blood samples were taken three times a week for the first week and weekly thereafter until the end of the experiment in EDTA tubes for parasitological examination. PCV was determined and parasitaemia was assessed and scored using the dark ground (DG) method. Other observations included weekly live weight and milk yield.

Activity 2: Investigation of the effect of work on resistance to trypanosomosis in crossbred oxen

The experiment took place between April and July 2003 at ITC headquarters. A total of 12 oxen were used and were assigned to two groups: 6 crossbred (Holstein*N'Dama) oxen (3 pairs) in Group 1 and 6 N'Dama oxen (3 pairs) in Group 2. All oxen were vaccinated and dewormed. A pour-on pesticide (Butox) was regularly applied to reduce the possibility of natural infection with trypanosomes. All animals were kept in the same pen and were fed sufficient groundnut hay and concentrates to meet their requirements for maintenance and work.

The experiment was carried out for 16 weeks divided in two periods with respect to activities carried out by the animals. All animals were at rest during period 1, whereas they were all subjected to work during period 2. Work done consisted of pulling sledges with draught forces equivalent to 11% of the team live weight, or ploughing soils. Draught forces were set to simulate a heavy workload such as ploughing for 2 weeks. Animals worked 3 hours per day in the morning. Each period was further divided into two phases with respect to the health status of animals. During phase 1 in each period, animals were free of trypanosomes. Thereafter, all animals were artificially challenged during phase 2 of each period with a clone of *Trypanosoma congolense* (ITC84). Following each artificial challenge, animals were treated with diminazene aceturate at a dose of 3.5 mg/kg after 4 weeks during period 1 and after 2 weeks of work during period 2 or when the PCV declined to less than 20%. The same clone was used in the two artificial challenges. The following sequences of treatments were applied to animals: 1. Rest-non-infected; 2. Rest-infected with trypanosomes; 3. Work-non-infected; 4. Work-infected.

Animals were rested for 4 weeks between periods 1 and 2 to allow them to recover from the previous infection. Observations and laboratory determinations were as for the first trial. In addition, the time animals spent working and the distance they walked were monitored.

RESULTS:

Activity 1: Effect of lactation on tolerance of crossbred cows to experimental trypanosome challenge

The mean PCV declined in both the lactating and non-lactating F1s during the infection period compared to the pre-infection period, but remained relatively stable in pure N'Dama cows. The highest decline in PCV seen for non-lactating F1s did not, however, reflect the rate at which anaemia developed. Although all cows experienced a drop in their PCV, the rate of decline of PCV was more pronounced in lactating F1 cows. The decline in PCV occurred earlier in lactating F1 than in non-lactating F1 cows. As expected, pure N'Dama cows showed a delayed drop in PCV as compared to crossbred cows. In addition, the regression of PCV over days post-infection gave regression coefficients of -0.104, -0.034 and 0.05 units per day for lactating, non-lactating F1s cows and pure N'Dama cows, respectively, indicating a sharper decline in PCV in lactating F1 cows. In conclusion, anaemia developed earlier in lactating F1 cows compared to non-lactating F1s or pure non-lactating N'Dama cows.

The trial was designed to terminate the artificial infection when an animals PCV reached a level of 20% or less. Therefore different infection durations were seen reflecting the sensitivity of individual animals to the *T. congolense* clone used. The application of this rule led to the following duration of the infection period: 15.5±2.6, 24.7±2.6 and 25.4±2.8 days for lactating F1, non-lactating F1 and pure N'Dama cows, respectively. The need to treat lactating cows earlier than other categories of cows reflects their higher sensitivity to the trypanosome infection.

The frequency of parasitaemia scores for days 4, 5 and 12 post-partum did not indicate any clear difference in the pattern of multiplication of trypanosomes between lactating and non-lactating F1 cows

There was a decline of daily milk yield as a result of trypanosome infection. Average daily milk yield decreased on average from 4.7 litres/day 3 weeks before infection to 1.7 litre/day during the 2-week period when cows were infected.

Both lactating and non-lactating F1 cows lost live-weight at the same rate as a result of trypanosome infection, whereas N'Dama cows maintained stable live weights throughout the experiment. Increases of the serum non-esterified fatty acids (NEFA) in trypanosome-infected animals suggested that lipolysis was the major mechanism for supplying the high energy demand due to fever following trypanosome infection. The combination of trypanosome infection and lactation may lead to a severe energy shortage that was reflected in live weight losses and decrease in milk yield. The energy shortage in lactating and infected animals is compounded by the anorexia caused by the infection.

Activity 2: Effect of work on the resistance to trypanosomosis in crossbred and N'Dama oxen

Both the artificial infection and work depressed PCV in crossbred and N'Dama oxen. The magnitude of anaemia caused by work and infection were similar for both breeds. The number of days oxen remained infected before the end of the set time of the experiment or if treatment with diminazene aceturate was required because PCV was less than 20%, was similar for both breeds during the first and the second period (27 days for F1s and 26 days for N'Dama oxen during the first infection; 15 days for F1 and 15 days for N'Dama oxen during the second infection).

Parasitaemia scores in oxen between days 5 and 14 post-infection were higher during the first infection in both breeds despite the additional stress in the form of work, imposed during the second infection period. The difference in parasitaemia between the first and the second infection may be due to acquired resistance to the clone of trypanosome used. The parasitaemia was greater in crossbred than in pure N'Dama oxen.

Both infection and work caused weight losses in both crossbred and N'Dama oxen. The rate of change of liveweight was higher in N'Dama than in crossbred oxen during the periods when oxen were at rest. A similar level of weight change was seen when animals were subjected to trypanosome infection and work. N'Dama oxen performed the set amount of work despite infection (working 3 hours a day pulling a draught force equivalent to 11% of the team live weight). Crossbred oxen suffered more from the infection as reflected in their work performance. Not only did they need more rest to complete the walking circuit, thus taking more time to complete the laps, but they also had to stop work as a result of fatigue before completing three hours of work.

POTENTIAL IMPACT:

The results of trial 1 indicated that the stress of lactation undermines trypanotolerance in crossbred cows. The trial also showed that infection seriously affects milk yield of crossbred F1 lactating cows. Although, crossbred cows are produced under low trypanosomosis risk, the high infection rate seen in the Kombos districts suggests that owners should apply preventive measures such as prophylactic trypanocides or pour-on formulations for lactating animals.

Levels of anaemia and parasitaemia exhibited by crossbred and N'Dama oxen subjected to trypanosome infection and work gave insufficient evidence that work was a stress factor undermining their capacity to resist infection. However, signs of fatigue seen in the crossbred oxen during work suggested that they were more affected by infection than the N'Dama oxen; the latter were able to complete a set amount of work for two weeks whilst infected. Crossbred oxen suffered more from infection as reflected in their work performance. Not only did they need more rest to complete the walking circuit, thus taking more time to complete the laps, but they also had to stop work due to fatigue before completing three hours of work. Previous work at ITC showed the great potential for crossbred oxen to contribute to farm power supply. However, it is recommended that preventive measures against trypanosomosis are applied before they are used for work.

SCIENTISTS INVOLVED:

Institutional Project Leader: A. Fall

Other ITC Scientists: A. Diouf

Senior ITC Technical Staff: J. Faye

Collaborating ITC Special Projects: Small Ruminant Research Project, PROCORDEL

ATTAINMENT OF MEDIUM TERM PLAN MILESTONES:

For 2003, the milestone was to establish the impact of interaction of nutrition and work on indicators of Trypanotolerance. This milestone was attained in the form of a book chapter in the European Association of Animal Production (EAAP) reviewing interactions between nutrition, work and tolerance in various types of infection. The outcomes of experiments conducted in 2003 into the effects of stress factors (lactation and work) on tolerance to trypanosome infections in crosses will contribute towards the 2003 milestone.

INSTITUTIONAL PROJECT 4

Full Title:	Crop-agroforestry-livestock integration and resource management under varying disease risk
Short title:	Crop-agroforestry livestock integration
Programme:	Low Input System Improvement Programmed.
Project number:	LISIP 04
Location(s) of research:	The Gambia (CRD, LRD), Guinea (Labé)
Start date:	January 2002
Projected end date:	December 2004

OBJECTIVES:

Throughout sub-Saharan Africa increasing human and livestock populations are putting pressure on the available cultivable land and other natural resources. Increasingly, agroforestry practices, crop residues from farming activities, new browse plants and agro-industrial by-products are being used to augment the feed supplies to livestock. Livestock are a key component of integrated, mixed crop-livestock farming systems. All the aforementioned changes are contributing to an agricultural intensification process in the region, a phenomenon, which is considered to be a natural consequence of severe resource competition. Thus, integration of cropping, agroforestry, and livestock will become essential in the region.

The general objective of the project is to develop research strategies that promote the maturation of the emerging production systems that are consequences of integration and intensification.

Specific objectives:

- To propose options for efficient use of available and alternative feed resources across systems
- To propose options for efficient establishment and use of the *Moringa* tree as an alternative feed resource for smallholder and peri-urban dairy systems in West Africa
- Develop research strategies, which reduce degradation of the natural resource base through the promotion of community based joint forest management
- Evaluate the productivity of stabled cows in comparison with those of extensively managed animals
- Evaluate the economic returns of stabulation technology in financial terms

IMPLEMENTED WORK PROGRAMME:

Activity 1: Investigation of different varieties of Moringa oleifera as a protein supplement for peri-urban dairy production systems, on-station and on-farm, in The Gambia
- Improving household and livestock nutrition in low-income mixed farming systems in The Gambia.
In collaboration with the National Nutrition Agency, (NaNA), an on-station *Moringa oleifera* establishment trial was conducted. Eight communities that demonstrated willingness to participate and in which animal agriculture was well practiced were selected. These were Jenoi, Sankwia, Japineh-Tambeto and Pakaliba in the Jaras as well as Kwinella sansankonno, Kaiaf, Manduar and Buronh in the Kiangs.

Land preparation was conducted by communal effort, coordinated mostly by the Village Development Committees (VDC) and village youths. Ploughing and tilling commenced at different times depending on the farming calendar of each community. All sites (except Sankwia) had concluded land preparation by mid-august. Each community received 15 kg seeds of *M. oleifera* to be planted at a spacing of 20 cm between rows and columns in 2m x 20m beds in August (except for Sankwia where it was planted on the periphery of the rice fields by women). Nearly all the communities planted late.

As a backstop, additional 1.5 ha and 0.5 ha facilities were put in place in Banjul and Keneba respectively, to produce Moringa leaves required for training and the anticipated dry season nutrition trials. In Keneba, 500 kg DM was produced during one cut and stored for dry season on-station feeding trial. In Kerr Serigne, about 500 kg DM was produced for further research.

During the reporting period, there was a modification of the original workplan, to focus on capacity building (training) and the use of *Moringa* in small ruminant nutrition. This was a deviation from the initial plan to work with large ruminants. The low biomass yields and the inadequate areas planted would have led to difficulties in meeting the needs of cattle nutrition from the community fields established.

Activity 2: Establishment, expansion and evaluation of Intensive Feed Gardens for small ruminant production (Gambia)
Continued activities with the Intensive Feeding Garden Project focussed on feed production to supplement producing animals as well as to improve access to horticultural produce in the communities. A quarter of an hectare of *Leucaena* was planted in each of six villages; Fellin Koto and Madina Sancha in LRD, Korup, Dramman and Touba in CRD-south and Tamba in CRD-north. Regular monitoring was carried out by communities members, ITC, DLS and RFCIP personnel. Technical and material support (fencing wire, potting bags, gardening tools) was provided to the communities. Wells in Fellin Koto and Dramman have been improved and a well is being dug in Madina Sancha using funds from the Rural Finance and Community Initiatives Project (RFCIP).

In April 2003, a 3-day workshop was organised and conducted by ITC, DLS and NARI at YBK. It was attended by 33 farmers (men and women) and representaives from the partner institutions. Topics covered included vegetable production, seed collection, integrated pest management (IPM) fodder production harvesting, drying and nutrient block making. *Leucaena* drying beds and moulding boxes were designed and constructed by the Agricultural Engineering Unit of NARI. Eleven communities were provided with drying beds, moulding boxes and ingredients for block-making.

Activity 3: Establishment and management of fodder trees under livestock-forestry integrated systems (Gambia)

Further activities took place in the second year of collaboration between the CRDFP and livestock partners. By September 2003, ten new joint management agreements (JFPM) for forest parks had been signed with another five scheduled. Three evaluations of the ITC/DLS/CRDFP collaboration took place by the joint partners during the year. The contributions of the livestock partners were highly commended. A new concept note for a regional forestry project between The Gambia, Senegal and Guinea Bissau was prepared and submitted for funding through GTZ to BMZ.

After sensitisation, Jamali Musa, a JFPM partner community for the Tanu forest park, requested support to establish a feed garden for livestock. The objective was to create an alternative feed resource area closer to the community, to provide a venue for soil improvement, reduce soil degradation, improve feed and food production and ultimately to reduce grazing pressure on the forest.

Activity 4: Expansion of the establishment of fodder trees in forest parks and communities in The Gambia

Nurseries of fodder trees were established at all the forest stations in CRD in collaboration with the project partners. Established seedlings included *Leucaena leucocephala, Cajanus cajan, Moringa oleifera, Acacia senegal, Acacia leata* and *Prosopis juliflora.* The choice of fodder species in 2003 was influenced by the performance of species planted in 2002, which featured more live-fence species. A similar nursery of about 2000 seedlings was established at ITC Sololo. During 2003, requests for seeds of herbaceous legumes were received from many communities in CRD (Fugah, Boraba, Kiberi, Bankuba, Kolikunda and the ITC Keneba station in LRD) and these seeds were supplied.

In order to encourage on-farm feed production, reduce soil fertility problems, reduce pressure on the forests and as a support measure to partner communities, grain and herbaceous legumes were introduced into the farming system. Two legume species, *Centrosema pascuorum* and *Stylosanthes hamata,* that performed well in the screening exercise in 2002 were introduced to farmers through a series of sensitisations. The hay and seeds of both legumes were also displayed at a 5-day stakeholder's workshop in March 2003. A request for the establishment of a plot of fodder trees for teaching and demonstration purpose in YBK forest station was also met. It should be noted with appreciation that ILRI and IITA, through Dr. S. Tarawali, donated 25 kg of seeds to the project. As a response to the economic needs of farmers under the project, two varieties of cowpea *Vigna unguiculata,* were distributed to multiplier farmers for seed production and subsequent distribution to others during the next planting season.

Activity 5: Establishment of selected grazing reserves in CRDN, The Gambia

Livestock owners were sensitised and their willingness and readiness to work together for the revitalization of the Kerr Maila Grazing Reserve (KMGR) was assessed. During the early rainy season, several exploratory trips were made with the Divisional Livestock Officer for CRD north and LOA members to the grazing site in order to identify options for improvement.

Activity 6: Dry season stabling in Guinea Bissau; Evaluation of productivity and economics of the intervention in Guinea Bissau

This study was conducted in 10 villages Bafata and Oio regions. Fifteen stables were established (10 in Bafata and 5 in Oio). Sixty early lactating cows with their offspring were under the stabling management system. The same number of 60 cows and their offspring but

that did not benefit from the stabling package were also selected in the same herd for monitoring of live weight, body condition and milk offtake from April to June 2003. Stabled cows were supplemented with cottonseed, groundnut hay and rice straw. They were also dewormed. Non-stabled animals did not benefit from the package. Quantity and costs of inputs were also measured.

RESULTS:

Activity 1: Moringa in Low-income mixed farming systems:
Communal *Moringa* plots were established in nine of the ten sites. In five of the villages, survival of the plants was poor due to unrestricted access by grazing animals. Accompanying technologies for the utilization of *M. oleifera* leaf powder were developed and tested on-station. However, due to the low biomass obtained at the different sites, a modification in the research process was necessary resulting in the dry season nutrition plan being directed at small, rather than large ruminants. In addition, it became necessary to produce *Moringa* leaves for farmer training and the trials anticipated during the dry season.

Activity 2: Establishment, expansion and evaluation of Intensive Feed Gardens (IFG) for small ruminant production (Gambia)
The IFGs in six communities were monitored and improved with respect to horticultural activities, access to water and technology for drying and feed block fabrication. Thirty-three farmers and national extension staff benefited from a training workshop to strengthen farmers' appreciation and extension skills of livestock assistants on the use of fodder trees, nutrient block fabrication and livestock horticulture management.

Activity 3: Establishment and management of fodder trees under livestock-forestry integrated systems (Gambia)
One hundred seedlings of assorted fodder trees were distributed to each of twelve partner communities of M. Demba FP. An additional 800 assorted fodder tree seedlings were distributed for planting to the JFPM partner communities in Kaolang FP.

Fourteen people selected from twelve communities by the forest committees of four forest parks received seeds of two varieties of cowpea for multiplication. Technical support and inputs were given to some of these farmers to ensure a good harvest. A 0.5 ha plot of land was planted with fodder trees incorporated with farmland (alley farm) provided by Jamali Musa.

Activity 4: Expansion of the establishment of fodder trees in forest parks and communities in The Gambia
In four forest stations in CRD north and south banks, 24,100 fodder tree seedlings were grown. This constitutes 30% of the estimated 50,000 seedlings planted in the nurseries. Of these, 13,400 were distributed to 33 interested communities for enriching existing forests or grazing areas, as internal breaks, live-fences and as alleys in farmlands. Fodder trees were also planted in six forest parks; Kaolong, Sikunda, Medina Demba, Bankuba, and Kunkilling in the CRD south, and Belel CRD north. Thirty-seven people in 16 communities also established intensive feed gardens of fodder trees in the division.

Activity 5: Establishment of selected grazing reserves in CRDN, The Gambia
Four hectares of the deferred grazing land in Kerr Maila were planted with improved pasture species. In addition, 500 seedlings of *Leucaena leucocephala* were planted as a live-fence

around the boundary. At the request of the community of Kolikunda-sotokoi, joint partners in the Sao FP, another grazing resource was established in existing natural rangeland. Nine hundred and fifty seedlings of *Leucaena, Prosopis juliflora and Acacia laeta* were planted by the community. These were planted in existing traditional rangeland of the community to improve the range, quality, soil fertility, fuel wood biomass and ultimately to reduce grazing pressure on adjacent state forest and forest park.

After evaluation of a request for support from communities in Karantaba Tenda and other stakeholders, 600 assorted varieties of fodder trees and multipurpose seedlings were supplied and planted as a live-fence around the boundary of the Jalubeh Grazing reserve in Sami district.

Activity 6: Dry season stabulation: evaluation of productivity and economics of the intervention in Guinea Bissau

In general, live weight growth performances were better in Oio region than Bafata, reflecting the higher availability of feed resources in Oio than in Bafata. Stabled cows maintained their liveweight (0.012 ± 0.018 kg DWG) while non-stabled cows lost weight at a rate of 0.073 ± 0.021 kg per day. Milk offtake was higher in stabled cows (584 ml/day) than in non-stabled cows (430 ml/day). The growth rate of calves from stabled cows (0.160 ± 0.013 kg) was higher than that of calves from non-stabled cows (0.109 ± 0.015 kg).

Impact:

In collaboration with NaNA/CWS, ITC ways of determining biomass evaluation of *Moringa oleifera* and integrating *Moringa* production as a fodder resource in the Lower River Division of The Gambia are being investigated. *Moringa* leaf meal will be evaluated as a component of weaning foods and the effect on anthropometrical indices will be measured in post-weaning children. The farmers are sufficiently sensitised on the need for *Moringa* as a sustainable means of reducing malnutrition at the farm level and in homesteads, especially with respect to post-weaning children and nursing mothers.

The significant contribution of the ITC/DLS team was in the improved awareness of communities of the interrelationship between forestry and livestock production, which led to sustained interest in JFPM and the signing of a JFPM agreement for 15 forest parks in addition to the 3 signed in 2002. The reduced incidence of uncontrolled bushfires contributed to improved feed availability to livestock in CRD during the last dry season. Two seed multiplication and model demonstration plots for herbaceous legumes and fodder trees were established in the ITC Sololo station and YBK forest station.

The joint project with the forestry department also contributed to the reclaiming of encroached land. Fodder trees and herbaceous legumes were successfully introduced as an essential component of the farming systems in CRD Gambia. The team also facilitated better collaboration between the participating groups including Government departments, NGO's and other stakeholders. The team contributed to capacity building of department staff and farmers through training.

MEETINGS:

2nd Triennial Conference of the Global Forum for Agricultural Research, 22-24 May 2003. Agyemang, K.

SCIENTISTS INVOLVED:

Institutional Project Leader: S.A. Adediran

Scientists: Y. Akinbamijo, J. Saecker, S. Leak, E. Hoeven, S. Nouala

Technicians: L. Fofana, L. Darboe, S. Kora, M. Gaye, M. Sanneh

Collaborators Institutions and Scientists:

Ebrimma A., D. Jallow (DLS), A. Cham, S. Ndow (CRDFP), P. Hess (KfW), C. Chade (GTZ), A. Joof, S. Touray, K. Jobe, K. Wally, S. Conteh, (DLS, The Gambia), B. Jobe, (NARI), M. Sambou-Pjai, F. Touray, S. Sonko (Rural Finance and Community Initiatives Project), F. Correia, INPA (Guinea Bissau)

ATTAINMENT OF MEDIUM TERM PLAN MILESTONES:

In 2003, three posters were presented at the Deutscher Tropentag 2003 Conference in Göttingen. These posters highlighted the key elements of the collaboration among partners in the CRDFP-II project, identifying critical issues and proposing technological options for intervention in community based resource management. Guidelines for improved small ruminant production are being produced by the Small Ruminant Research Project. A draft manuscript is available and publication is expected in 2004. These publications contributed to the 2003 project milestone, which states that: “methodologies and tools for conducting research in integrated crop-livestock farming will be developed”.

INSTITUTIONAL PROJECT 5

Full title:	Genetic improvement (breeding and selection) of ruminant livestock for low-input and emerging systems
Short title:	Genetic improvement of indigenous ruminants
Programme:	Low Input Systems Improvement Programme
Project number:	LISIP 05
Location(s) of research:	The Gambia, Guinea Conakry
Start Date:	January 2001
Project end date:	December 2004

OBJECTIVES:

The demand for meat and milk in developing countries is expected to double by 2020, principally due to population growth and urbanization occurring in these countries. Meeting the anticipated demand for livestock products will have to come from increased productivity of individual animals rather than from expansion of animal numbers. For tsetse-infested areas in West and Central Africa, the use of trypanotolerant livestock remains one of the few viable options for bridging the gap between demand and supply. Genetic improvement through selection and breeding represents one of the sustainable methods of increasing productivity and efficiency of production. The objective of the genetic improvement programme at ITC is to increase animal output per head among trypanotolerant cattle and small ruminants while retaining their resistance to diseases. The breeding programme, tailored to involve stakeholder participation, including the definition of breeding goals, uses simple infrastructure and logistics and is therefore deemed inexpensive for implementation by NARS.
Outputs of the Project for 2003 include:

- Superior rams, bucks and bulls delivered to multiplier and producers' flocks/herds
- Improved NARS capacity to operate breeding programme and in particular to disseminate genetic progress
- Breeding programme in Guinea is productive with operational animal recording system and data analysis and collaboration with other projects strengthen mechanisms to disseminate the genetic progress
- Selection of exceptional high performing animals in Gambia and Guinea through village screening

IMPLEMENTED WORK PROGRAMME:

Activities were implemented in four general areas:

Activity 1: Consolidation of pure breeding programmes for N'Dama cattle, Djallonké sheep and West African Dwarf goats in The Gambia including herd maintenance, performance testing and selection with strong emphasis on the establishment and support to multiplication facilities

In 2003, gains made in the establishment and running of the nucleus for cattle, sheep and goats in previous years were further consolidated. At the multiplier and producer tiers, formation of multiplier groups, sensitisation, training of trainers and/of farmers, mobilisation of external sources of funding to finance credit schemes to enable more people to benefit from the programmes, were undertaken.

Activity 2: Consolidation of N'Dama cattle pure breeding programme in Guinea including performance testing, selection and training

Through funds made available from the EU-funded regional project, PROCORDEL, the N'Dama nucleus herd at Boké, Guinea, was consolidated in 2003. The re-organization needed to effectively deliver improved genetic material to neighbouring private (farmer) herds was made. Efforts were directed at the improvement in the performance testing, selection and training of staff in data collection, management and analyses.

Activity 3: Village screening for selection of superior females N'Dama in the Gambia and the Boké area (Guinea)

The OPEC Fund for International Development was used to support ITC, the governmental institution (Department of Livestock Services, DLS), NGOs and Farmers' Organizations to continue the screening operations that were on-going since 1996 but stopped in 2000 due to financial constraints.

Two inception workshops on screening for superior animals were held in The Gambia (Abuko on 29 March 2003) and in Guinea (Boké (Guinea Maritime), April 10, 2003) with the objectives to: discuss with farmers the objectives and operation of the screening programme being planned by ITC, set up modalities of the operation with the involvement of farmers and to review the time plan of action to fit farmers cropping activities schedule, identify constraints and opportunities of the livestock breeder associations.

Prior to the inception workshop, a tour was made to sensitise Divisional Livestock Officers and Livestock Assistants about the forthcoming screening operation. During the sensitisation tour, Livestock Assistants who were responsible for the screening operation administered a questionnaire in all Divisions. The questions were designed to assess farmers' perceptions and willingness to participate and subsequently sell offspring of the selected animals to ITC. Another objective was to provide an overview on the expected number of pregnant cows from which selection will be made.

Activity 4: Estimation of genetic parameters to optimise the selection programmes

In addition to the routine half-yearly prediction of genetic breeding values of individual animals in the herds and flocks, as a means of identifying superior animals for replacement and for diffusion into multiplier facilities, data collected on animals in the nucleus were subjected to genetic analyses. The analyses were carried out in order to calculate genetic parameters such as heritability, genetic variances and covariances, which are useful in designing new, and optimising on-going breeding programmes.

Data for West African Dwarf goat and Djallonké sheep were used to estimate genetic parameters and to evaluate genetic trends for birth weight (BW), weaning weight (W120), yearling weight (W360), pre-weaning (GR0-4) and post-weaning (GR4-12) growth rate, using an animal model.

RESULTS:

Activity 1: Consolidation of pure breeding schemes for cattle, sheep and goats in The Gambia.

The dissemination of improved breeding males is on-going. Additional multipliers for small ruminants were established, including NARI, which started multiplication of sheep in October 2003. Six (6) replacements (3 rams and 3 bucks) were made between June and December 2003. In June 2003 consultative meetings were held in Kaur and Sololo to try to identify constraints of the multiplier farmers.

Based on the constraints listed by the multipliers, training workshops were held in August, to improve the organisational and managerial skills of the Gambia Indigenous Livestock Multiplier Association (GILMA) executives. During the training the participants expressed their wish to see GILMA split in two. This led to the creation of GILMA Saloum and GILMA Fulladu. Both are registered associations and are now responsible for all transactions dealing with the purchase and marketing of breeding stock from ITC and multipliers units to other farmers. The main objectives of GILMA are: (1) to 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 enable farmers to be more involved in the breeding schemes. They are also involved in the supply of veterinary inputs to improve management of multipliers. The associations are currently constrained by a lack of proper communication, lack of publicity, lack of organizational and managerial skills and the lack of funds for self-maintenance.

Public sensitisation of GILMA was done through the community radio at Basse, with the objective of making farmers aware of GILMA's existence, activities and areas of operation. The radio broadcast provided an opportunity to make the public aware of the ITC led pure breeding programme.

In September 2003, an in-service workshop for livestock assistants on the management of multiplier herds and flocks was conducted. At this forum, issues pertaining to accurate and proper data collection from multipliers were discussed.

Other activities carried out in connection with the consolidation of the breeding schemes included a 3-month study of ecto/endo-parasites and a pasture improvement project, both in Keneba, conducted by staff brought from Guinea under the 'regional mobility' scheme.

Activity 2: Re-organisation of the N'Dama cattle-breeding programme in Guinea

Old cows (more than 15 years old) were culled from the breeding herd during the year. Twenty heifers were transferred to the 'cow' herd in 2003 for cow replacement and one new bull was put into service. The recording of performances to develop the database for selection included regular measurements of milk off-take, weight, calving and exits was performed using procedures set up in 2001. Analyses of data on live weights of adult animals are planned for the first quarter of 2004. Performance records of animals born since 2000 as well as data on milk off-take for cows that calved from 2001 onward were collected and stored. It is now possible to use these data to conduct basic selection of young males and to provide advice on management and culling.

Activity 3: Village screening for selection of superior females N'Dama in the Gambia and the Boké area (Guinea)

Approval of a request for bridging funds by OPEC was critical to the continuation of activities associated with the village-based screening aimed at optimising the breeding schemes led by ITC with a increasing participation of farmers. The project activities were successfully implemented between October 2002 and November 2003.

The Agenda for the workshops included presentation of breeding programs, review of past screening operations, introduction to the current screening activity followed by discussions on details of the operation, and achievements and constraints of breeders associations.

Main outcomes of the Gambian workshop included the determination of detailed material and methods of the screening operation. The material and methods took into account farmers' and technicians' contributions, the set up of the time plan of action and the analysis of constraints faced by the newly formed Gambia Indigenous Livestock Multiplier Association (GILMA).

In Guinea, it was decided during the inception workshop to do the screening operation in two sous-préfetures: Tanéné and Kolaboui of Boké District. The same operational procedures as for The Gambia were agreed upon.

Analyses of the questionnaire administrated during the sensitisation showed that 98.6% of all herd owners and 99% of all flock owners interviewed were willing to participate in the screening activities and to sell offspring from identified cows, sheep and goats. Only twenty eight percent (28%) of the flock owners milked their goats and 21% milked sheep. Therefore, most of the screening of small ruminants was focussed on weight measurements.

The screening operation covered all 5 divisions in the Gambia. Livestock assistants from DLS were able to interview 150-herd owners, keeping 3648 adult females of which 1297 were either lactating or in late pregnancy. A total of 489 cows were identified by farmers as good milk producers and were subjected to milk recording. The top 15 cows in the production system where cows were milked once were identified during the present screening operation in The Gambia. They produced on average 1650ml per day; for those cows managed in systems where milk is extracted twice daily, the milk off-take from the top 15 cows averaged 2500ml per day. In Guinea, where milking once daily is practised, the daily milk yield of the top 15 cows was similar to that found in The Gambia. For the present screening, milk off-take from early lactating cows was compared to average 12-month milk off-take reported from previous studies.

One of the recommendations of the inception workshop of the OPEC-funded project was the formation of breeders association for N'Dama cattle in Boké, Guinea. The Association des Eleveurs Sélectionneurs was established in April 2003 with a management committee of 8 members. The association started with a total of 55 members, all of whom participated in the training course for milk recording and in the screening operation in Guinea.

Activity 4: Estimation of genetic parameters to optimise the selection programmes

The purpose of this study was to estimate genetic parameters for growth traits and to evaluate genetic trends in WAD goat and Djallonké sheep resulting from the breeding programme under low input production environment. Data on birth weight (BW), weaning weight (W120), yearling weight (W360), pre-weaning (GR0-4) and post-weaning (GR4-12) growth rate, of West African Dwarf goats and Djallonké sheep were used in an animal model. Estimates of heritability for BW, W120, W360, GR0-4 and GR4-12 were 0.5, 0.43, 0.30, 0.32 and 0.11 for goats and 0.39, 0.54, 0.21, 0.54 and 0.23 for sheep respectively. For both species, the genetic correlations between BW and W120 were high and positive (0.74 for goats and

0.47 for sheep). Genetic correlations between W120 and GR4-12 were high and positive (0.92) for goats and moderate (0.49) for sheep. Between GR0-4 and BW the correlation was positive but low for sheep (0.26) and positive and moderate for goats (0.60). Genetic trends exhibited a positive annual fluctuation between 1995 and 2002. The results demonstrate that breeding programmes for improved growth traits in WAD goat and Djallonké sheep are feasible and positive under village circumstances in The Gambia. The results indicate that estimates of heritabilities for birth and weaning weights and growth in the pre-weaning period are in the medium range. They also indicate that comparatively high genetic variability exists for the traits considered and if exploited, progress could be achieved through selection in the respective species. The moderate to high genetic correlations among these traits suggest that selection for any one of them would result in positive changes in the other traits. Litter size is an important economic trait in sheep and goat. Selection for birth weight, without taking litter size into account, may result in an undesirable decrease in litter size. The overall genetic gain indicates that under low-input management systems, reasonable genetic gains could be achieved for WAD goat and Djallonké sheep.

POTENTIAL IMPACT:

The breeding programmes implemented demonstrate that long-term genetic improvement programmes aimed at bringing genetic progress from research stations to farm level producers are feasible, by combining technical, socio-economic and policy considerations. The visibility of the project, its outcomes and outputs were high. Beneficiaries and Government functionaries have acknowledged the present and potential future impact of the project outputs. At the international level, the project and structures developed at the multiplier level will contribute to a project about to be implemented on "*in-situ* conservation of ruminant livestock in West Africa"

There is a growing trend among multiplier/farmers to use improved strains from ITC. Nevertheless, many issues need to be evaluated more extensively. These issues include: 1) the determination of the economic value of the different traits considered in the programme; 2) the economic evaluation of the breeding programmes; 3) the level of capacity building and resources required to use and maintain the programme; 4) the establishment of the potential impact that the programmes have on socio-economic conditions and livelihoods (including asset building, poverty reduction and employment) of beneficiaries (primary and secondary).

SCIENTISTS INVOLVED:

Institutional Project Leader: K. Agyemang

Other ITC Scientists: A. Fall, A. Bosso

Senior ITC Technical Staff: N. Corr, M. Njie

Collaborating ITC Special Projects: BMZ/GTZ-funded Genetic Improvement Project, EU-funded PROCORDEL, Belgian-funded Small Ruminant Research Project, OPEC Fund for International Development.

Collaborating Institutions and Scientists/technicians: Gambia: Department of Livestock Services, J. Sowe, M. Njie, E. A. B. Jammeh, D. Jallow, K. Daffeh, S. Konteh, D. Bojang, M.

Lemon, B. Jatta, M. Jeng, M. Touray, I. Sanyang. Guinea: Direction National de l'Elevage, M.B. Diallo; Institut Recherche Agricole du Guinea, B. Diallo, A. Ousmane, B. Camara, P. Guilavogui, S. Camara.

MEETINGS:

54th Annual Meeting of European Association for Animal Production. Rome, Italy, 31 August -3 September 2003. N. A. Bosso.

Environmental and genetic effects on growth of N'Dama cattle raised under tsetse challenge. 27th meeting of the International Scientific Council for Trypanosomiasis Research and Control (ISCTRC), Pretoria, South Africa. September 29 - 3 October 2003. N. A. Bosso.

ATTAINMENT OF MEDIUM TERM PLAN MILESTONES:

By the end of 2003, the activities undertaken within the Project had contributed to the realisation of the Medium Term Plan (2001-2004) Milestones for the years 2002 and 2003, namely: Documentation on breeding, selection, data collection and analysis available to NARS scientists.

MARKET-ORIENTED SYSTEMS IMPROVEMENT PROGRAMME (MOSIP)

Background and justification:

The Market-Oriented system (MOS) evolved out of a necessity to provide a coping strategy to match the evolving 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, necessitating appropriate technological innovations in order to meet demands for human nutrition.

Market-oriented systems are functionally geared towards income generation and the maximization of profit. The implication is that the approaches and concepts employed to operate within the system are different from the conventional low-input strategies. The introduction of new animal genetic resources and the accompanying need to feed and manage them, implies that new production strategies and scenarios in animal agriculture would be required for successful operation.

The MOSIP programme is structured to addresses these core concerns of production systems-in-transition that are geared towards meeting the growing demands resulting from changing population dynamics. The production of high value crossbred animals is, for example, increasing in appropriate locations and ecologies. Changes observed in herd and flock dynamics require the development of complementary technologies and system support. Efforts on feeding, management and disease control were strengthened as reflected in the milestones attained for the reporting period.

To achieve these goals, MOSIP focussed on:

- The development of technologies that promote efficiency of production from a better match of inputs against production targets
- Application of biotechnology tools for increased production
- Developing profitable and economical integrated strategies for control of diseases

Highlights of Achievements 2003

The details of progress made during the year 2003 are given in the respective institutional project reports for IP 6, 7 and 8.

Development of feeding, health and management strategies for meat/milk systems in urban areas

- The establishment of a dairy Training and Demonstration Centre at ITC, Kerr Serigne. The Centre is equipped with one in-pouch pasteuriser, a sealing machine, chilling tank, cream separator and a butter churn. The unit now regularly produces pasteurised milk and yoghurt.
- Nutrition research progressively refined peri-urban feeding strategies targeting the dairy production system. Thirty-six rations were tested using a cohort of indices including IVDMD, Gas production potential, ammonia production, and microbial

population characterisation to arrive at the best-bet supplementation strategy according to production system and animal genetic resources within such systems.

- A short-term *in-vivo* study was conducted to assess the animals' response using N'Dama bull calves and backcrossed N'Dama x Holstein-Freisian F1 animals. The study indicated no significant difference in the response of N'Dama bull calves offered *Moringa* compared with their control counterparts offered conventional groundnut cake-based supplements. In addition, the microbial population has indicated genotype-specific responses to the different diets.

Biotechnology

- Three PCR based assays, semi-nested pCS20, *map*1 PCR and reverse line blot (RLB) assays, were used to test *A. variegatum* tick samples collected from different agro-ecological zones of The Gambia. 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%.

- Characterisation of the diversity of *E. ruminantium* in 3 different agro-ecological zones of The Gambia was carried out using genomic DNA samples from *A. variegatum* ticks and small ruminants (sheep and goats). There was remarkable diversity among the various *map*1 genes in the different agro-ecological zones. *Map*1 profiles in the Western Sudano-Sahelian zone showed the greatest diversity of 4 different profiles.

Collaborative activities and dissemination of results

Although at the end of the chain, the ITC diary Training and demonstration Centre was set up at ITC with good collaboration from FAO (TCP) with ATS officers spending three months at ITC. The installation of the dairy centre stimulated the activities of MOSIP with regard to production of crossbred animals, feeding strategies and resources as well as disease control. Key strategic partner institutions are the Institute for Animal Production in the Tropics and Subtropics of the University of Hohenheim, and the University of Utrecht. The former facilitated the doctoral thesis of an ITC research associate and enabled further analytical procedures to be carried out, especially VFAs and rumen micro flora and associated molecular biology techniques. The technical support of ITM and RUU towards the doctoral programme of an ITC research associate in the development of biotechnological approaches to disease control is recognised.

Finally, the programme benefited from contributions in terms of human resources and technical know-how from NARS partners; DIREL, ISRA, DNE, DLS and NARI.

Potential impacts from the activities carried out under MOSIP in 2003 are that:

- The direct beneficiaries of the project will be the NARS and the smallholder peri-urban livestock farmers. ITC collaborates with the NARS in executing the on-farm production and monitoring of F1 calves, thereby involving the farmers in all the processes of adapting their management to an emerging farming system. The scientific support of ITC is seen to be vital for the future smooth transfer and sustainability of the technology.

- Nutrition research has continued to underscore the high potential of *Moringa* as a supplement for ruminants, especially in intensive production systems such as peri-urban dairy systems and as an ameliorative dry season feeding strategy in the traditional extensive system of husbandry. It is clear that *Moringa* can replace the rather scarce groundnut cake.

The availability of modern biotechnological tools in the field of animal health to better understand the epidemiology of endemic diseases such as heartwater and trypanosomiasis is a prerequisite to the development of appropriate disease control measures and strategies. Genetic characterization, of indigenous livestock using markers such as microsatellite variation will also help determine the level of genetic purity of these breeds especially with respect to tolerance.

INSTITUTIONAL PROJECT 6

Full title:	Development and evaluation of crossbreeds and other improved breeds for milk and meat production in urban/peri- urban areas
Short title:	Development of milk and meat production in urban/peri-urban areas
Programme:	Market Oriented Systems Improvement Programme
Project number:	MOSIP 06
Location(s) of research:	The Gambia (Kombo, Foni & Nuimi); Guinea (Labé, Coyah & Dubreka).
Start Date:	January 2001
Project End Date:	December 2004

OBJECTIVES:

The demand for milk and meat far exceeds supply from local production in sub-Saharan African countries. This is especially so for West Africa where the population growth and urbanisation are highest and the milk production systems the least developed. It is believed that the low milking capacity of the indigenous breeds and the fluctuations in feed supplies constitute major constraints to the improvement of local production. Macro-economic policies in the countries of the sub-region have created opportunities for profitable domestic production especially in urban and peri-urban centres. In these areas of high demand, crossbreeding of indigenous ruminants with the high producing exotic breeds is considered justified.
The main project objectives were: the development of more productive crossbred animals; to evaluate their performance under various conditions; to quantify their contribution to household welfare; to identify and exploit factors that favour profitable crossbreed rearing enterprises in urban areas.

The major project outputs are:

- Community- based breeding schemes in selected areas in the sub-region established
- Viable, small – scale F1 production units developed in selected sites in urban / peri-urban areas
- Technological and socio-economic options in support of crossbred-based dairying and meat production systems

IMPLEMENTED WORK PROGRAMME:

Activity 1: F1 crossbred cattle production by Artificial Insemination of N'Dama cows in Gambia and Guinea with respect to smallholder dairy development

The on-farm production of F1 (N'Dama x Friesian) crossbred cattle by oestrus synchronisation of N'Dama cows followed by artificial insemination is an activity continuing from 2002.

Eighty cows, belonging to 24 farmers in The Gambia (North Bank Division and a few farms in the Kombos Districts), and 94 cows from 31 farms and backyards in Guinea Conakry (Coyah, Dubreka and Labé) were inseminated. The inseminations were carried out on cows selected by field officers of collaborating NARS following the same procedure as outlined in previous reports.

Activity 2: Management of on-station dairy herd and data analysis of production parameters of the F1 cattle

A total of 139 cattle, comprising 39 cows, 32 suckling calves, 24 backcross weaners, 12 F1 adult males and 32 others in experimental groups were monitored on-station. All animals were kept in separate pens/kraals according to category and were reared in an intensive system in which all feed was purchased and brought to the herd. Groundnut hay was the standard feed and was offered *ad libitum,* whilst a concentrate ration, given as a supplement, was offered twice daily to milking cows (after each milking) and once daily to the others.

At calving the cow and calf stayed together for one week, after which, milking began. Hand milking was carried out twice daily (morning and evening). The traditional practice of using the calf to suckle for stimulation of milk let-down was followed. In cases in which the calf died, the stockmen conditioned the cow and were able to continue extracting milk. Cows were dried for 8 weeks before parturition. A service bull was always present within the cows and all matings were recorded.

Prophylactic treatment for control of gastrointestinal parasites was administered twice during the rainy seasons (June to October) to calves and heifers and acaricide treatment was given for ectoparasites (mainly ticks) for all animal categories throughout the year except in late dry season (March to May). Vaccinations against the common/enzootic diseases such as Anthrax, BlackQuarter and Haemorrhagic septicaemia were administered regularly and clinical cases of other diseases were treated as necessary. All animals were identified by numbered ear-tags. The animals were weighed monthly, and milking cows were monitored for milk yield weekly on a routine basis. A weekly report on all events *e.g*. matings, deaths, treatments during the week were recorded on prescribed forms and later computerised.

Activity 3: Monitoring and evaluation of productivity of F1 cattle on-farm in The Gambia

Sixty-three F1 cattle, comprising 29 calves, 22 weaners, and 12 cows from 18 farms were monitored and assessed to determine individual performance and their general productivity. The farms were categorised into four groups (A, B, C or D) as described in previous reports. All animals were weighed monthly, using an electronic scale, and their body conditions were scored simultaneously.

Activity 4: Monitoring the reproductive performance of F1 cows on farm

Reproductive parameters (age at first calving, calving interval, length of dry period and total numbers of calves weaned in the lives of cows) were monitored in 12 F1 crossbred cows (loaned to farmers) and 6 heifers (produced on-farm) in the Kombo Districts with the objective of linking herd performance to the level of improved management practiced on the farm.

All animals were visited weekly and examined for pregnancy and cyclicity status by rectal palpation. Blood samples were taken from all non-pregnant cows for extraction of plasma, which was stored in a deep freezer awaiting P4 assay. The animal body condition was scored and a note was made on the presence/availability of a service bull.

*Activity 5: Health and productivity of West African Dwarf*Saanen crossbred goats managed in an integrated farming system in a tsetse infested area of The Gambia*

The specific objective of this study was to study health and productivity of West African Dwarf goats (WADs) and their Saanen crosses managed in an intensified, zero-grazing farming system in a tsetse-infested area of the Gambia. Two experiments were carried out to evaluate the ability of the crosses to perform under natural and experimental trypanosome and gastrointestinal helminth infections.

5a) Parasitic infections and productivity of West African Dwarf goats and their Saanen crosses in an intensified farming system in The Gambia

The first study aimed to determine the impact of important parasitic infections, such as trypanosomosis and gastro-intestinal parasites on the productivity of WADs and their Saanen crosses, managed in an intensified zero grazing farming system in The Gambia.

Over a period of one year, samples were taken from 20 Saanen*WAD crossbred goats and 15 WAD-goats, born at the beginning of the rainy season 2002. The helminth egg output and coccidia oocyst output per gram of faeces; packed cell volume and trypanosome parasitaemia of the goats were determined.

*5b) Susceptibility of West African Dwarf goats and WAD*Saanen crosses to experimental infection with* Trypanosoma congolense

In a second experiment, WADs and their Saanen crosses were experimentally infected with *Trypanosoma congolense*. Their response to artificial infection was assessed in comparison to that of "pure" WADs in order to assess their susceptibility to trypanosomosis.

Activity 6: Milk processing technology in support of development of dairy system in the Gambia

A Dairy Training and Demonstration Centre was established at ITC, Kerr Serigne, with support from FAO within the TCP for The Gambia. The Centre is equipped with one in-pouch pasteuriser, a sealing machine, a chilling tank, a cream separator and a butter churn. The unit is now regularly producing pasteurised milk and yoghurt. Other products such as flavoured milk, cream and butter were produced for training purposes. Several training courses on hygienic milking practices, milk collection and processing were conducted with herdsmen and milk traders.

Five Dairy Co-operative Societies were organized: four in Kombo Central (Brikama, Darsilami, Penyem and Kasakunda) and one in Kombo North. The groups received training on hygienic milking, milk collection and handling as well as milk processing (pasteurisation, yoghurt production) and business skills. The co-operatives received small-scale milk processing kits and are now producing and marketing pasteurised milk and yoghurt. The Kombo North Dairy Co-operative Society will receive an in-pouch pasteuriser with other equipment in February 2004.

RESULTS:

Activity 1: F1 crossbred cattle production of N'Dama cows in Gambia and Guinea by Artificial Insemination for smallholder dairy development

The overall conception rate was to be determined after a pregnancy check of all inseminated cows by rectal palpation. This could not be done, however, because most of the cows were either only recently inseminated (October to December) or were taken back to their traditionally managed parent herds, which were not easily accessible. However, of the 75 cows inseminated in the Nuimi in January/February, 17 were reported to have calved (22% calving rate). The low conception rate was associated with poor preparation of the cows for the insemination. Most of the cows were believed to be acyclic and did not respond to the drug treatment.

Activity 2: Evaluation of performance of crossbred cattle reared on-station

A slight improvement of the traditional husbandry system used for N'Dama and adapted for the crossbreds, revealed a large productivity potential of the crossbreds. Their survival rate to one year of 90% (Jersey x N'Dama) and 71% (Friesian x N'Dama) was considered high in comparison with other situations elsewhere in Africa. With an overall mean birth weight of 17.7 ± 4.1 kg (s.d.), and an overall mean daily weight gain of 0.220 ± 0.104 kg, calves attained an average weight of 100.6 ± 29.9 kg at one year. Their relatively retarded growth suggests that improved management is required. Puberty was attained at 478.2 ± 13.9 days, age at first calving 970.5 ± 94.1 days and the overall mean calving interval and open period were 400.1 ± 82.5 and 117.1 ± 83.2 days, respectively.

The lactation performance of 47 Friesian and Jersey crosses over 1 to 5 calvings on station was evaluated. The overall total lactation and daily milk yields were 1,188.4 ± 458.3 kg and 3.784 ± 1.105 kg respectively. The mean daily milk peak yield, time to peak and persistency were 4.165 ± 2.510 kg, 3.8 ± 4.7 weeks and 84.0 ± 32.3 %, respectively. In addition, restricted suckling or the death of the calf did not cause the lactation to cease.

These figures equated four to five times that of the N'Dama but were probably below their potential due to management limits.

Activity 3: Monitoring and evaluation of productivity of F1 cattle on-farm in The Gambia

Average birth weights and body weights at 3, 6, and 9 months of age were 21.0 kg, 57.3 kg, 93.1 kg and 107 kg respectively. The mean monthly weight gains for calves and weaners were 9.6 and 9.4kg respectively. The average daily weight gains for all categories were higher in animals reared under farm category A than in the others.

All animals had their poorest body condition scores (2.5) during the dry season from April to June and their best condition by September to December when grazing and crop residues were abundant. It was concluded that farmers should provide nutritional supplements to their stock as the dry season advances to optimise production throughout the year.

Activity 4: Monitoring the reproductive performance of F1 cows on farm

The average age at first calving of four (4) of the six heifers monitored was 35 months ranging from 35.9 months to 36.5 months. The two heifers that had not calved were pregnant at the time of writing this report. Only 3 of the 12 cows have calved twice with an average calving interval of 366 days ranging from 326 to 404 days. The rest of the cows were empty. It was realised that the cows were mostly kept in the backyards during lactation and had no access to a bull for mating while the heifers were allowed to go out for grazing and were in contact with straying bulls.

*Activity 5: Health and productivity of West African Dwarf*Saanen crossbred goats managed in an integrated farming system in a tsetse infested area of The Gambia*

5a) Parasitic infections and productivity of West African Dwarf goats and their Saanen crosses in an intensified farming system in The Gambia

High oocyst outputs occurred from September to December. The goats were moderately infested with helminths from the middle of the rainy season until the early dry season. Trypanosome infections were not detected in blood samples from either the local or the crossbred goats using the buffy coat technique. The average birth weights of the crossbred and the local kids were 2.4 kg and 2.0 kg, respectively. The growth rate of the crossbred kids was significantly higher than that of the local kids. The pre-weaning growth rates of the crossbred and local kids were 114.8 g/day and 65.6 g/day, whereas the post-weaning growth rates were 58.8 g/day and 36.4 g/day, respectively. The fast growth rate of the crossbred goats compared to the local goats indicated that rearing Saanen*WAD crosses in an intensive farming system, could increase productivity. The risk of trypanosome infections was negligible. Coccidiosis was, however, a persistent burden causing a high pre-weaning mortality of 20% in both breeds. When practicing a zero-grazing farming system, strict hygiene in the goat sheds is indispensable and the use of coccidiostat can be recommended.

*5b) Susceptibility of West African Dwarf goats and WAD*Saanen crosses to experimental infection with* Trypanosoma congolense

There was no evidence of any difference in susceptibility to *T. congolense* between the WAD-goats and their Saanen crosses. This finding was based on the similar antibody response; a comparable course of trypanosome parasitaemia and a parallel drop in PCV following infection in both breeds. The trypanosome infection caused a decrease in the growth rate of both breeds although this reduction was not statistically significant. The crossbred goats showed a significantly higher growth rate than the local goats. Crossbreeding trypanotolerant WADs with trypanosusceptible Saanen goats, might therefore, be an effective means of increasing productivity whilst retaining some degree of trypanotolerance.

Both experiments indicated that the Saanen*WAD crosses were more productive than WADs in a zero-grazing farming system, when challenged with natural gastro-intestinal parasite burden or artificial trypanosome infection. It is however, necessary to evaluate the performance of the crosses further, in a larger group of animals and study their susceptibility to different strains of trypanosomes. In addition to the characterisation of other parameters, such as milk production and quality of the crosses under an optimal feeding strategy, additional research on broader aspects of the farming system is needed. Financial, sociological, and environmental implications of the intensified zero-grazing farming system need to be addressed.

Activity 6: Milk processing technology in support of development of dairy system in the Gambia

The Dairy Training and Demonstration Centre (DTDC) at ITC is now fully operational. Members of the five dairy co-operative societies that were organized during this project were trained at the DTDC on appropriate dairy technology. Two FAO International Consultants assisted the co-operatives on group organization and milk processing. The co-operatives are now producing pasteurised milk and yoghurt regularly (at least once a week) and the profit of the sales return to the co-operatives' bank accounts. In this way, they were able to steadily increase their capital. The assistance to the group will continue with the help of DLS extension staff who worked with them since May 2003.

POTENTIAL IMPACT:

The farming community in the targeted peri-urban/urban areas became aware of the project's objectives and mode of operation through a rigorous sensitisation campaign. The method of oestrus synchronisation and AI as the appropriate means of producing F1 crossbred cattle on farm was made available to both the farmers through participatory activities on farm and the NARS through training of technicians. The improved husbandry practices required for optimum production are being documented and brochures, leaflets and other training/information transfer aids are being developed for use by the beneficiaries; farmers, field officers and policy makers.

There are currently over 100 F1 cattle of all age categories reared on farms or backyards under ITC's monitoring scheme in the Gambia and about 14 in Labé in Guinea Conakry. The dairy cooperative societies are operating and providing marketing opportunities for farmers and milk vendors alike. Consumers now have access to fresh and safe hygienic milk at competitive prices.

The direct beneficiaries of the project are the NARS and the smallholder peri-urban livestock farmers. ITC collaborates with the NARS in executing the on-farm production and monitoring of F1 calves, thereby involving the farmers in all the processes of adapting their management to an emerging farming system. The scientific support of ITC is seen to be vital for the future smooth transfer and sustainability of the technology. The F1 programme was received with great enthusiasm by a cross-section of the peri-urban community. Following the funding of 1.5m Dalasi by the Government of The Gambia last year, the Canada Fund for Local Initiatives (CFLI) recently approved funding of about C$50,000 for project activities in 2004; indicating that donors also foresee a large potential impact from these activities.

SCIENTISTS INVOLVED:

Project Leader: F. B. Sanyang

Other ITC Scientists: D. S. Fofana, A. Diack, A. Fall, S. Dhollander, M. Hempen

Technicians: L. Janneh, J. Njie, M. Sanneh, M. Gaye, S. Kora

Collaborating ITC Special Projects:
EU funded PROCORDEL, FUB, Belgian funded Small Ruminant Research Project.

Collaborating Institutions and Scientists/technicians:
Alhagie Faal (DLS); Edouard Williams, Lansana II Souma, Kante (DNE/IRAG).

MEETINGS:

ATTAINMENT OF MEDIUM TERM PLAN MILESTONES:

Seventy-eight F1 cattle, including 21 cows, are now available on 22 farms and backyards in the Greater Banjul Area, and have been monitored by ITC. Fewer cattle were produced in other locations such as Foni and Nuimi districts, which fall under the Department of Livestock Services. The production of F1 cattle is continuing and the numbers of animals and farms will increase with time.

INSTITUTIONAL PROJECT 7

Full title:	Establishment of feeding standards and strategies for urban and peri-urban ruminant production
Short title:	Feeds and feeding strategies
Programme:	Market-Oriented Systems Improvement Programme
Project number:	MOSIP 07
Location(s) of research:	The Gambia, Guinea, Senegal
Start date:	January 2001
Projected end date:	October 2004

OBJECTIVES:

There is a growing demand for animal protein due to the evolving demographic trends especially around urban centres. This growing food demands will only be met by commensurate production technologies guided by research. Access to good quality and quantity of feed for urban and peri-urban stock at all times has been recognised as one of the major production constraints. Consequently, appropriate guidelines and balanced feeding strategies especially in the incorporation of alternative feed resources are imperative for peri-urban based stock. The objective of the project is to develop feeding and management strategies in support of the evolving systems. Specific outputs for the Project for 2002/2003 include:

- Strengthening of the feed resource base of urban integrated farming systems
- Evaluation of in vitro dietary combinations for urban livestock nutrition
- On-farm testing and technology transfer of non-protein nitrogen supplementation

IMPLEMENTED WORK PROGRAMME:

Activity 1: Feeding strategies for cattle production in The Gambia and Senegal: optimum level of supplementation

The study progressively refined peri-urban feeding strategies targeting the dairy production system. Dietary combinations were continuously evaluated *in-vitro* in order to conclude the array of potential dietary combinations initiated in 2002. The *in-vitro* study, which commenced in 2002, was aimed at further comparative investigations of the nutritive value of the *Moringa* spp and baby corn residues as alternative feed resources in relation to the conventional supplements and the determination of their optimum levels of supplementation in the feed resource base for Gambian livestock. Although biochemical assessments and screening for secondary anti-nutritive compounds have supported their potential utilisation in

ruminant nutrition, they are not sufficient to determine their optimum mode of utilisation. Thirty-six rations were tested using a cohort of indices including IVDMD, gas production potential, ammonia production, and microbial population characterisation to arrive at the "best-bet" supplementation strategy according to production system and animal genetic resources within such systems. Instead of time consuming and laborious conventional feed testing practices, combination diets were tested precisely and rapidly using *in-vitro* biochemical procedures. The diets were based on locally available concentrate feedstuff, baby corn stover, groundnut hay and *Moringa oleifera* leaves.

Following the *in-vitro* studies, a short-term *in-vivo* study was conducted to assess the animal response to the top candidate combination obtained *in-vitro*. The animals' response trial was conducted using N'Dama bull calves and backcrossed N'Dama X Holstein-Friesian F1 animals. In collaboration with the University of Hohenheim, the concentration of VFAs and microbial population were evaluated in the two cattle genotypes.

Activity 2: Testing of alternative feed resources for ruminant nutrition in The Gambia
2a). Biomass production of different accessions of Moringa oleifera *under the Gambian ecosystem*
The agronomy of *Moringa oleifera* as fodder crop was further investigated on-station using a high-density cultivation method. The two major parameters investigated on the Moringa plantation at ITC were cutting height and cutting interval. Evaluation of biomass production for the cutting height study was completed during the reporting period. The cutting height trial was replicated two times bring the total number of replicates in the study to four. In addition, a second cutting interval (100-day cycle was carried out to determine the optimum cutting interval for harvesting of fodder from Moringa plants.

Activity 3: *The improvement of available fodder resources in the Groundnut basin of Senegal*
The study was designed to follow up to work on cultivated fodders in the groundnut basin started in 2002. An attempt was made to produce seed in some irrigated plots in Northern Senegal. The seed multiplication sites are St Louis, Ndiol, Ross Bethio and Boundoum.

At the Ndiol Seed Production Centre six forage species were tested for seed production including: *Niebe, Panicum maximum, C1 and C58, Marcrptilium spp., Adropogon gayanus, Arachide hypogea.* Two other seed production sites were Ross Bethio and Boundum some 100 km along the River Senegal bank. They included farmers participating in the production of cultivated fodders as part of their agronomic activities on a year round basis. Although these farmers received some support, one of them was unable to undertake land preparation due to equipment failure and consequently removed from the programme.

Activity 4: Evaluation of locally available feed resources for ruminants in Guinea Bissau
Staff of the Livestock Department were trained in procedures of sampling and handling fodder resources. Thereafter, available fodder materials were sampled from the Oio, Bafata and Gabu regions of Guinea Bissau on a monthly basis, by field staff in the three regions. The feed survey was conducted between March and August inclusive. During this period, 147 samples were collected at different times and spaces. The dried samples were preserved in Bissau and transported to Banjul for proximate analyses.

*Activity 5: Development of supplementation strategies based on locally available products (*Moringa *spp) in CRA Bareng, Moyen Guinea*
At the onset of the rainy season in June 2003, *Moringa oleifera* establishment was attempted in five different locations with different altitudes in Moyen Guinea. These were three village

sites in the compound of agro-pastoralists, at the Groupement Nafaya de Pita and on-Station in Bareng. A high planting density approach was adopted in all of these sites.

RESULTS:

Activity 1: Feeding strategies for cattle production in The Gambia and Senegal: optimum level of supplementation

In-vivo validation of the *in-vitro* predictions confirmed the benefits of Moringa-based supplements on live-weight changes of N'Dama bull claves. The study indicated no significant difference in the response of N'Dama bull calves offered Moringa compared with their control counterparts offered conventional groundnut cake-based supplements.

Characterisation of the microbial population has indicated genotype-specific responses to the different diets. When animals were offered baby corn stover and 20% concentrate, bacterial population was higher in N'Dama compared with the crossbred animals while the eukaryotes population was higher in crossbred compared with the local animals. The higher eukarya population also explains the higher ammonia production observed *in-vitro* by crossbred animals, implying that the N'Dama are more efficient at using nitrogen. Further details are available in a PhD thesis of S. Nouala.

Activity 2: Testing of alternative feed resources for ruminant nutrition in The Gambia

The range of biomass yield of *Moringa oleifera* was significantly influenced by the period of evaluation and the accession. It is known that the plant has exceptional physicochemical properties with possibilities of a high biomass yield of up to 15-20 tonnes DM/ha, as obtained at ITC. In addition, it contains no known anti-nutritive factors and has an insignificant tannin content. The plant contains at least 25% protein. Compared with other conventional ruminant feedstuffs in The Gambia, it therefore has a very high biological value and considerable potential for adoption as food for humans as well as a ruminant fodder resource. The average height of the *Moringa* plants obtained in 2002 indicated the vigour with which the plant grows under optimum conditions. On station, it was possible to obtain biomass yields of up to 16 tonnes dry matter in a growing cycle of 50 days.

The watering regime appears to be the most important factor for the production of Moringa biomass. At the third and fourth re-growths, biomass yield declined significantly varying from 2000 to 5000 kg fresh matter per hectare per cut i.e. 1-3 tonnes DM/hectare. This study resulted in recommendations for establishing and managing cultivated *Moringa oleifera* as an animal feed under the Gambian ecosystem and also updated knowledge on the benefits of *Moringa oleifera* as a supplement in the rumen environment of N'Dama and crossbred F1 dairy cattle and its effects on animal productivity.

Preliminary results from biomass evaluation based on a $1m^2$ quadrat sampling, showed that yields in terms of dry matter could reach up to 20 tonnes DM/ha in a 50 day growing cycle. However, for the purposes of easy communication to the ultimate beneficiaries, it is recommended that the cutting cycle be rounded to once in two months rather than every fifty days. With a cutting interval of only 60 days before it is used as fodder, the nutritive value of the fodder was very high with very low likelihood of lignification. Nonetheless, optimum growing conditions such as continuous irrigation, high planting density and a fertiliser regime of 50 kg/ha/month are essential if such high biomass yields are to be obtained.

In order to improve our understanding of the nutritive value of *Moringa*, comparisons were made with other *in vitro*-simulated combination diets in a series of laboratory-based studies. Initial results indicate that the *Moringa* option has a very high gas production potential yielding up to 36 ml gas compared with 28 ml of VFAs at 40% inclusion in the diet.

Use of the Hohenheim Gas test has contributed to our understanding of the comparative advantages of Moringa compared to groundnut hay.

Animal responses measured during a trial using a supplement of *Moringa* with a groundnut hay based diet showed that there was no significant difference in performance when compared with animals supplemented with a groundnut cake based concentrate.

Activity 3: The improvement of available fodder resources in the Groundnut basin of Senegal
Farmers in the groundnut basin suffered a major setback due to inadequate planting materials. Despite the efforts made to produce seeds under irrigation during the dry season, the quantity produced was not enough to conduct the anticipated study.

Activity 4: Evaluation of locally available feed resources for ruminants in Guinea Bissau
A feed survey of the three intervention regions of Guinea Bissau indicated that there was an ample variety of fodder resources that can be used for feeding ruminant livestock during the late dry and rainy seasons. During this period, 147 entries of fodder samples were recorded and are being stored for eventual proximate analyses.

*Activity 5: Development of supplementation strategies based on locally available products (*Moringa *spp) in CRA Bareng, Moyen Guinea*
Although all inputs in terms of labour and fertiliser were provided, the establishment of *Moringa oleifera* fodder gardens failed due to local agronomic conditions believed to be due to high aluminium concentrations in the soil. Biomass evaluation was not feasible as a result of this failure. Consequently the study on *Moringa* supplementation strategies was aborted.

POTENTIAL IMPACT:

In-vitro results showed a strong correlation with intake figures as a basis of developing robust polynomial models that could predict feed intake from gas production values *in-vitro* with a reasonable degree of accuracy. The results confirmed the high potential of *Moringa* as a supplement for ruminants, especially in intensive production systems such as peri-urban dairy systems and as an ameliorative dry season feeding strategy in the traditional extensive system of husbandry.

A short-term animal response study was set up to validate *in-vitro* results using crossbred animals. The animals offered *Moringa* leaves as a supplement performed as well as control animals offered locally available conventional concentrates (1:1 mixture of GNC and rice bran). The results showed that the use of *Moringa* as a feed resource would broaden the choice of supplements available to owners of small and large ruminants. This is of particular interest to peri-urban dairy farmers where high-density nutrients are essential for profitable production. *Moringa* is likely to provide an economic edge over groundnut cake-based supplements.

SCIENTISTS INVOLVED:

Institutional Project Leader: O. O. Akinbamijo

Other ITC Scientists: S. Nouala, J. Saecker, S. A. Adediran

Senior ITC Technical Staff: Ade Adesina

Collaborating ITC Special Projects: IDRC-funded project

MEETINGS:

Global Forum for Agricultural Research, Dakar, May 22-24, 2003
Joint PAG/ICPTV meeting, Pretoria, South Africa, Sept 23-26, 2003. Y. Akinbamijo.
Deutscher Tropentag, Göttingen, Germany, October 8-10, 2003. Y. Akinbamijo, N. Adediran
ISCTRC Meeting, Pretoria, South Africa, Sept 29-4 Oct, 2003. Y. Akinbamijo.

ATTAINMENT OF MEDIUM TERM PLAN MILESTONES:

The inventory of the locally available feedstuffs base (including alternative feed resources) was broadened. Characterisation of the collected feed resources continued throughout the year. Screening at the laboratory level reinforced the milestone for 2003 for IP 7. A deeper insight into chemical and nutritive properties of the feedstuffs is a prerequisite to on-farm testing and extension to other farmer groups**.**

INSTITUTIONAL PROJECT 8

Full project title:	Development and application of novel techniques in Health, reproduction and genetics (biotechnology) in support of market-oriented production systems
Short title:	Development and application of novel techniques (biotechnology)
Programme:	Market Oriented Systems Improvement Programme
Project number:	MOSIP 08
Location of Research:	The Gambia (Kombo, Keneba, Bansang, Niamina), Senegal (Kaolack, St. Louis, Kolda-Sedhiou, Fatick), Guinea (Boké, Labé), Guinea Bissau (Bafata, Gabu)
Start Date:	January 2002
Projected end date:	December 2004

OBJECTIVES:

Among agricultural and allied fields, animal health has benefited tremendously from biotechnology, which offers great prospects for improved livestock productivity in meeting the growing demand for products of animal origin in sub-Saharan Africa. Advances in biotechnology have made possible the wide use of monoclonal antibodies and polymerase chain reaction (PCR)-based techniques for efficient diagnostics, leading to safe and specific treatment. Through genetic engineering and molecular cloning of genes, vaccines for the prevention of viral, bacterial and parasitic animal diseases have been developed and rendered more effective and safer. Genetic characterisation of indigenous livestock using recombinant DNA technology provides information on the genetic purity of the local breeds, which is vital to improving their exploitation in breeding programmes. Development and application of recent advances in Geographical information systems, integrated with the use of improved diagnostic tools for epidemiological studies would lead to a better understanding of the epidemiology of animal diseases, thus resulting in the development of better disease control measures.

Specific Objectives

- To develop, test and/or use diagnostic tools (e.g. improved ELISA, PCR)
- To assess genetic diversity of *E. ruminantium* in The Gambia
- To genetically characterise domestic indigenous small ruminants in West African regional countries
- To introduce and integrate GIS into livestock research activities

IMPLEMENTED WORK PROGRAMME:

Activity 1: Detection of Ehrlichia ruminantium infection in ticks using PCR
Three PCR based assays, semi-nested pCS20, *map*1 PCR and reverse line blot (RLB) assays, were used to test *A. variegatum* tick samples collected from different agro-ecological zones of The Gambia.

Initial extraction of DNA from a total of 145 ticks was carried out using the QiaAmp DNeasy mini-kit with some modifications. For the semi-nested pCS20 assay, the primer combinations ITM130/AB129/AB128 were used whilst for the semi-nested *map*1 assay, primers ERF1/ERR1/ERR3 were used. The PCR products were visualized on 1.5% agarose gel following ethidium bromide staining.

For the reverse line blot, the initial amplification of PCR products was carried out in a nested approach using the primers AnEhF1/AnEhR1/AnEhF2/AnEhR2 that specifically amplify the 16S rRNA gene sequence. The PCR amplicons were subsequently prepared and hybridised on the RLB membrane as prescribed. Sequences of the above-mentioned primers will be published in scientific journals.

Activity 2: Genetic characterisation of E. ruminantium *using recombinant DNA technology*
Characterisation of the diversity of *E. ruminantium* in 3 different agro-ecological zones of The Gambia was carried out using genomic DNA samples from *A. variegatum* ticks and small ruminants (sheep and goats). The gene encoding the major antigenic protein 1 (*map*1) of *E. ruminantium* was targeted for characterisation using PCR-restriction fragment length polymorphism.

Activity 3: Molecular genetic characterisation of goats in ITC mandate countries
Four hundred and forty eight West African Dwarf (WAD) goats from the West African region (Gambia, Senegal, Guinea and Guinea-Bissau) were individually sampled for blood on FTA filter papers in 2002. One hundred and ninety six animals were sampled in The Gambia in Kombo, Keneba, Niamina and Bansang areas, and one hundred and twenty were sampled from Senegal in the Sedhiou/Kolda, Fatick and St. Louis regions. Samples were collected from 48 animals from Guinea Bissau in Gabu and Bafata regions and 80 samples from Guinea, in Labé and Boké). In addition, samples were collected from 36 Sahelian goats in The Gambia for use as reference controls. An ITC scientist was sent to the International Livestock Research Institute in Nairobi, Kenya, from September to December 2003 to participate in the genetic analysis of the samples and to start data-analysis.

DNA was extracted from the FTA-papers and PCR was carried out using 16 markers for the Gambia populations and 12 markers for the Senegal and Guinea-Bissau populations. A set of 19 microsatellite markers was available. All PCR products were sequenced to determine the numbers and lengths of the different alleles in each population. Preliminary data-analysis using specific software was carried out with the so far incomplete data.

RESULTS:

Activity 1: Detection of Ehrlichia ruminantium *infection in ticks using PCR*
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%.

Activity 2: Genetic characterisation of E. ruminantium *using recombinant DNA technology*
There was remarkable diversity among the various *map*1 genes in the different agro-ecological zones. *Map*1 profiles in the Western Sudano-Sahelian zone showed the greatest diversity of 4 different profiles. Three different profiles were identified in the Sudano-Guinean agro-ecological zone whereas profiles characterised in the Eastern Sudano-Sahelian zone appeared to originate in the WSS zone.

Activity 3: Molecular genetic characterisation of goats in ITC mandate countries
To date populations in 3 of the 4 countries are undergoing analysis and goat populations originating in The Gambia have been analysed with 16 microsatellite markers, which is still ongoing. Similarly, populations in Guinea and Senegal have been analysed with 12 microsatellite and the analysis is still ongoing. A statistical software has been obtained from ILRI is being used for the analysis.

POTENTIAL IMPACT:

In The Gambia and the subregion of West Africa as a whole, improvement of the livestock industry, which is dominated by ruminant livestock species, to meet the growing challenge of food and nutritional security is severely constrained by disease, principally heartwater. Thus the use of modern biotechnological tools in the field of animal health to better understand the epidemiology of the disease is a prerequisite to the development of appropriate disease control measures and strategies. This would ultimately result in increased livestock productivity, which would impact positively on the welfare of resource-poor farmers.

Indigenous livestock in the sub-humid and humid zones of West Africa are characterised by a high degree of tolerance to endemic diseases particularly to trypanosomosis. This unique trait is threatened by the introgression on non-trypanotolerant genes through the introduction Zebu and Sahelian sheep and goats from tsetse free areas in the north of Africa. Genetic characterization, therefore, of indigenous livestock using markers such as microsatellite variation will help determine the level of genetic purity of these breeds especially with respect to trypanotolerance and to a great extent other endemic diseases as well. Information derived from such research would contribute better utilisation of indigenous breeds in breeding programmes and to better conservation of indigenous livestock genetic resources.

MEETINGS:

PROCORDEL National Conference, The Gambia, November 2003. Cowdriosis: Some epidemiological aspects. Faburay, B., Münstermann, S., Jongejaan, F., Geysen, D.

SCIENTISTS INVOLVED:

Institutional Project Leader:	B. Faburay
Other ITC Scientists:	S. Leak, E. Hoeven, S. Münstermann
Senior ITC Technical Staff:	J. Faye, S. Kora, L. Fofana, M. Gaye, B. Drammeh, N. Bojang, T. Tamba, E. Colley

Collaborating ITC Special Projects: PROCORDEL; Small Ruminant Research Project

Collaborating Institutes and Scientists/technicians: University of Utrecht, The Netherlands, F. Jongejaan; Institute of Tropical Medicine, Antwerp, Belgium, D. Geysen; International Livestock Research Institute, Kenya, O. Hanotte.

ATTAINMENT OF MEDIUM TERM PLAN MILESTONES:

The important milestones set for the year 2003 in this institutional project were largely achieved. Using modern biotechnology a better understanding of the epidemiology of cowdriosis in The Gambia was acquired through determination of tick infection rates and genetic diversity of *E. ruminantium*. Information on the degree of Sahelian gene introgression into the trypanotolerant gene pool of indigenous West African Dwarf goats will soon be available for the first time.

SYSTEMS' OVERLAP & LINKAGES IMPROVEMENT PROGRAMME (SOLIP)

Background and justification

The Systems' Overlaps and Linkages Improvement Programme (SOLIP) targets the low-input and market-oriented systems and addresses issues that are relevant to both. The main objectives of the Programme are to improve the livelihoods of producers through increased incomes from improved marketing of quality livestock products that assure better incomes for the producers and public health to the consumers while developing and strengthening local capacity to sustain technology delivery to the end users.

In order to achieve these objectives SOLIP, with its three crosscutting Institutional Projects is focusing on:

- Development of epidemiological tools and control methods that identify and render zoonotic agents and microbial contaminants of livestock and their products less harmful for humans, the producers as well as the consumers (IP 9)

- Quantifying impact of disease, nutrition and management stress on economic viability of livestock enterprises, and identifying solutions for reducing the impact of these factors (IP 10)

- Enhancement of the research and development capacity of scientific and technical personnel within collaborative NARS in the region, with emphasis on training, improved networking and information exchange (IP 11)

Highlights and achievements in 2003

Under the Consumer Safety and Public Health Project, IP 9, all but one of the research activities was completed in 2003. The results are important elements for building up awareness among policy makers, livestock producers and other professional groups as well the consumers. They may have implications for within country and regional trade and may help in the identification of feasible and effective control measures in the future.

The outcome of prevalence and risk assessment studies on selected zoonotic agents, (*Mycobacterium*, *Brucella*, *Salmonella* spp.) were published in two ITC Working Papers (TB abattoir survey, Brucellosis on farm-screening in Guinea-Bissau). Scientific publications on these and the milk contamination study will follow in 2004. Moreover, the results may be useful as a basis for setting national standards (*e.g.* on microbiological contamination) or identification of high-risk areas (*e.g.* brucellosis) through National Codex Committees (The Gambia) or Reference Laboratories (Guinea Bissau), which includes the reinforcement of already existing veterinary regulations.

Beyond the laboratory-based investigations, a "*scoping study*" based on PRA and semi-structured interviews on farmers' perceptions of selected zoonoses and health risks in all four partner countries contributed to a better understanding of the potential impact and importance of these diseases in livestock and people.

The year 2003 saw the start of intensive training and related activities of various groups of beneficiaries for improved milk safety, milk handling and income from local milk

production. The full operation of the milk pasteurisation cum training unit at ITC, the organisation of local cooperatives for generating income from locally produced and marketed milk, and the introduction of more productive crossbred F1 cows are convincing examples of the complementary and collaborative work of ITC, donor-assisted activities (FAO-TCP; GTZ; PROCORDEL) and national partners. Under the higher hygienic standards of locally produced milk, a range of dairy products (fresh, flavoured milk, yoghurt) will stimulate the expansion of the local dairy sector.

The Project Leader of IP 9, Dr. Fred Unger, left ITC at the end of the year because of the end of the funding of his contract.

The Socio-economics Project (IP 10) continued to investigate and analyse socio-economic aspects of various technical activities, with the objective of providing key stakeholders with information that could be used to define appropriate policies, develop suitable technologies, and transfer knowledge to farmers.

A number of activities in The Gambia and other partner countries were pursued according to the agreed workplans, *e.g.* on factors affecting livestock production systems and characteristics of local milk production systems. A regional training workshop was organised to assist national counterparts in the data processing, analysis and presentation of results. However, most studies could not be completely exploited and evaluated in 2003 as data processing and analysis were still in progress.

IP 11 contributed to the attainment of the milestones of the MTP through assistance in training, information exchange and capacity building of the other IP's and the different target groups. It continued to (co) organise and support training activities of the Centre and its partner institutions, which were implemented at ITC or elsewhere in The Gambia, in Senegal, Guinea, Guinea Bissau, and, for the first time, in Sierra Leone.

The *Train the Trainer (ToT)* and *Training of Farmers (ToF)* approach again received much support in 2003. The production of appropriate training and extension materials was initiated, but was partly delayed into the following year, mainly due to manpower shortages.

Individual training was provided as short/medium-term, supervised on-the-job/on-site instructions and exercises, study attachments, or assistance to postgraduate training for MSc or PhD. Ongoing PhD studies of research associates received full support for further advancements towards completion of practical studies in The Gambia and at the various collaborative academic institutions. Another highlight of improved networking was the boosting of the regional dialogue and training under PROCORDEL's "Regional Mobility Scheme". Further achievements were the opening of a new computer training facility and the launching of the ITC Newsletter.

Collaborative Activities and Dissemination of results

The collaborative links with various partners at the national, regional and international level continued to play their prominent role in all activities under SOLIP.

Through IP 11, SOLIP contributed and closely collaborated with DLS and NARI in the preparation and implementation of the PROCORDEL National Conference in The Gambia on "Livestock Research for Development" in November 2003, contributing to the consolidation and dissemination of R&D results at national level.

Following the creation of an ITC Internet website in 2002, the quarterly ITC Newsletter will give the Centre more visibility among collaborators and a wider public in the sub-region and internationally.

As in the previous year, ITC continued to reinforce NARS' and its own research capacity through targeted training of technical and scientific staff. Besides collaborative training for professionals and livestock technicians, a trend that was initiated in 2002,

continued to fully incorporate and apply the *ToT*- and *ToF*-approach that addressed producers via extension agents, thus increasing the "multiplier effect" by improving the capacity of local trainers.

POTENTIAL IMPACT

Potential impact of the activities carried out in 2003 under SOLIP:

- Better understanding of epidemiological situations concerning important zoonoses, their impact on public health and consumer safety, and background information for future control measures
- Improved milk handling and hygienic standards for increased local production
- More socio-economic information available for appropriate livestock policies, development of appropriate technologies, and transfer knowledge to farmers
- More skills and knowledge through selected training measures passed on to intermediate and ultimate target groups for adoption of more productive technologies and self-help at the producer level
- Training inputs and improved networking and information exchange will impact on the capacity building and human resource development of collaborating NARS

INSTITUTIONAL PROJECT 9

Full title:	Epidemiology and risk assessment of diseases associated with consumption of livestock products and public health issues
Short title:	Consumer safety and public health
Programme:	Overlaps and systems´ interphase
Project number:	SOLIP 9
Location(s) of research:	The Gambia (Greater Banjul Area and Central River Division) Senegal (Bassin Arachidier, Kolda & Tambacounda) Guinea (Dubreka &Coyah) Guinea Bissau (Bissau, Bafata & Gabu)
Start date:	July 2001
Project end date:	December 2004

OBJECTIVES:

In all West African countries, zoonoses transmitted from live animals to humans, have been recognised as emerging and increasing public health problems. In addition, post-harvest contamination of products of animal origin through poor hygiene practices and inadequate food handling are common. Zoonotic infections such as bovine tuberculosis and brucellosis are important examples of emerging or re-emerging zoonoses. Contamination of milk with bacterial or zoonotic agents, leading to important and widespread food-borne diseases in humans is a prime example of product quality/safety problems. However, only little and sketchy information on the distribution, epidemiology and public health impacts of zoonoses in livestock and humans exists for West Africa. Identification of livestock herds serving as sources of infections, magnitudes of infection in livestock herds and livestock products and understanding the entry and spread of agents in food chains are thus the first essential steps needed to formulate programs to reduce the exposure of humans to hazardous diseases and agents. For the process of evaluating the risk of such diseases and the disease-agent-husbandry interactions, epidemiological studies aimed at providing baseline data on prevalence, incidence and risk factors are the essential first prerequisite. The overall objective of the project is the identification and assessment of the importance of public health hazards (zoonotic diseases) and their impact on consumer safety.

IMPLEMENTED WORK PROGRAMME:

The following activities were implemented:

Activity 1: Investigations of the origin of microbiological contamination in milk produced and consumed in the District of Dubréka in Guinea
The objective of this study was to identify critical points of bacterial contamination along the

milk production chain. From July to September 2003, milk samples were collected at different levels of the milk commodity chain: beginning from individual cows (three per herd), herd milk, milk collected by trader and finally at the local market (mostly then as sour milk). The sampling procedure was designed in such a way as to follow the same milk from the farm to the market in order to compare the bacterial counts. Additionally, swabs were taken from empty milk containers at all levels to estimate their bacterial load, which affects the bacterial counts in the milk. Twenty producer-collector-vendor chains were selected and sampled.

Activity 2: Control of milk quality in newly established milk processing plants in The Gambia
In order to improve the quality of milk and milk products sold to consumers, training and organization of milk producers and traders is necessary. Hygienic milking practices and proper cleaning of utensils are as important as respecting cooling and quick delivery of milk. Therefore, many meetings were held with dairy farmers and milk traders in order to organize them into co-operatives. As an organization, the producers can establish a functional milk collection system and have easy access to training. They also attended many different training courses on hygienic milking practices, milk processing, record keeping, management and marketing. Extension workers assisted the groups throughout giving advice concerning group organization and milk processing.

Activity 3: Investigations of the public health risk derived from zoonoses in Guinea Bissau (Tuberculosis: Mycobacterium bovis; Brucellosis: Brucella abortus)
In order to generate the baseline data necessary for the development of strategies to minimise risks of transmission of bovine tuberculosis and brucellosis to humans, a pilot study aimed at providing estimates of the prevalence of these infections was designed and carried out in Guinea Bissau in the form of an abattoir survey (*M. bovis*) and by on-farm screening surveys (*B. abortus*). For the *M. bovis* survey (Tuberculinisation followed by meat inspection) the city abattoir of Bissau (Guinea Bissau) was selected and visited for 3 months (January – March 2003). On-farm screening for brucellosis in cattle was carried out between February and June 2003 in the 2 Districts of Guinea Bissau, Bafata and Gabu. To assess the prevalence of *B. abortus,* up to 28 cattle per farm were serologically sampled. In addition, bulk herd milk samples were collected from some herds in Bafata. All test procedures used for diagnosis of *M. bovis* and *B. abortus* were carried out according to OIE standards.

Activity 4: Investigation on the presence of Salmonella in slaughter cattle and meat sold at selected markets in The Gambia
Based on results of a pilot study, the prevalence of *Salmonella spp*. in slaughter cattle at animal, abattoir and market level was investigated in a follow up study. During the period from November 2002 to April 2003 the Banjul and Abuko abattoirs and markets that were supplied, were visited on a weekly interval. The study population consisted of 120 randomly sampled cattle at the two abattoirs (60 each). 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 (mince and steak) were collected. All methods used for culturing and identification of micro-organisms conformed to the International Standards (ISO). Detected strains were then serotyped and tested for antibiotic susceptibility in a regional reference laboratory.
Activity 5: Pilot study on the prevalence of Salmonella in on-farm chicken and in slaughter chicken and poultry meat sold at Serekunda market in The Gambia
In a Pilot survey, the presence 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 semi-intensive broiler farms (n= 2), located in

the Greater Banjul Area (GBA) and from thirty randomly selected small holders in the Central River Division south (CRD) of The Gambia. In addition samples were taken from slaughter chicken (n= 30) and chicken products (frozen imported chicken legs, n= 24) sold at Serekunda market. Faecal, skin and meat cut samples were taken at the market and semi-intensive farms, while on local farms only faecal drops were collected. The study population consisted of a total of 309 specimens. All methods used for culturing and identification of micro-organisms conformed to the International Standards (ISO). Detected strains were serotyped and tested for antibiotic susceptibility in a regional reference laboratory.

Activity 6: Assessment of the impact of zoonotic infections (bovine tuberculosis and brucellosis) in selected regions of The Gambia, Senegal, Guinea, and Guinea Bissau
In order to evaluate the direct and indirect impact of brucellosis and bovine tuberculosis and other zoonoses on livestock and human health, a scoping study was carried out in selected areas of The Gambia, Senegal, Guinea Bissau and Guinea Conakry over a six-month period from March to August 2003. The study was carried out in the form of a Participatory Rural Appraisal (PRA) that took place in 2 Districts of The Gambia (Central River Division south, CRD and Greater Banjul Area, GBA), Senegal (Kaolack and Fatick), Guinea (Dubréka and Boké), and in one District (Bafata) of Guinea Bissau. In each District between 3 (GBA) and 4 (all other) half-day PRA sessions were carried out in randomly selected locations. For each PRA session 10-24 responders (mean, 14) were selected, consisting of herd owners, herdsmen and milk vendors from between 1 and 4 surrounding villages. In addition to gaining information during the PRA, a semi-structured questionnaire was applied in each District on farmers (n= 20), the Veterinary health authorities, local butchers/meat inspectors (up to five) and Public health authorities. Key issues such as observations on diseases transmissible to humans, observations after slaughter or in post-mortem and awareness of diseases that affect the quality and quantity of milk and meat were considered in these questionnaires. To investigate correlations with results of previous studies on the prevalence of *brucellosis,* bulk milk samples from each village/farm participating in the study were collected and tested for *B. abortus*. In addition serological sampling of humans (herd owners, veterinarians and herders) was carried out in Dubréka, a District known to have a high prevalence of brucellosis.

RESULTS:

Activity 1: Investigations of the origin of microbiological contamination in milk produced and consumed in Dubréka, Guinea
In total, 100 milk samples (raw milk 80, sour milk 20) and 48 swab samples were collected. Fifty-five percent of the raw milk samples and 45% of the sour milk had total bacterial counts above $5x10^4$cfu/ml. The counts of *E. coli* were higher than $5x10^4$cfu/ml in 28.8% of the raw milk and in 45% of the sour milk samples. Counts of coagulase-positive Staphylococci above $2x10^5$cfu/ml were found in 32.5% of the raw milk samples and in 45% of the sour milk samples. *Bacillus cereus* was isolated in 65 samples (65%) and H_2S-reducing *Clostridia* in 26 (26%).

The total bacterial counts were high in milk samples from individual cows; more than half of which exceeded European standards (TBC: $5x10^4$ cfu/ml). The coliform counts were also quite high at this level with 53.3% of samples above $5x10^4$ cfu/ml. This was most likely to be due to contamination during sampling. As the cows could only be handled by their milkers, the sampling had to be carried out by them without any formal knowledge of clean sampling techniques.

Samples collected from the bulk milk (milk of the whole herd taken directly after

milking) also showed very high counts; 50% had total bacteria counts above 10^8 and 60% showed coliform counts above $1x10^5$. The high number of bacteria increased in fermented milk, in which coliform counts were as high as $1x10^6$ (10%) and $1x10^7$ (10%).

In general, it can be concluded that the conditions of hygiene under which milk was collected were extremely poor. Especially critical was the fact that milk was usually consumed without any heat treatment and was therefore certainly a public health hazard. Much sensitisation and training is required in order to improve the hygienic quality of milk. Pasteurisation should be introduced urgently, especially with in view of the high prevalence of bovine brucellosis.

Activity 2: Investigations of the public health risk derived from zoonoses in Guinea Bissau (Tuberculosis: Mycobacterium bovis and Brucellosis: Brucella abortus)

Results for Guinea Bissau suggest that infections caused by *M. bovis* at the selected abattoir are rare. Out of 239 cattle tuberculinized in 2003 at the Bissau city abattoir, no confirmed case of *M. bovis* was detected. The high rate (53%) of reaction related to *M. avium*, could be of epidemiological importance as recent findings have shown that environmental infection with other mycobacteria influence the immune response to *M. bovis* to an unknown extent. This needs further urgent investigation.

Herd screening results for Brucellosis indicated different epidemiological situations according to the region sampled. For Bafata (n= 288 cattle from 8 herds) and Gabu (n= 194 from 9 herds) significantly different individual animal prevalence rates for *B. abortus* of 20.1% and 5.7% were reported respectively. Highest herd prevalences were also detected in Bafata with all herds sampled (n= 8) testing at least one animal positive while in Gabu 7 of 9 herds were reported positive. Herds that tested serologically positive in Bafata were always positive in their bulk milk samples using milk-ELISA. According to the "epizootical rule" "small herds - low incidence, large herd - high incidence", the within-herd prevalences were significantly related to herd size. Frequencies of hygroma and abortions in individual animals were highly significant related to seropositivity. The farmer's knowledge of the zoonotic character of the disease was poor; only 3 out of 17 farmers knew that brucellosis could affect humans. On three farms people reported that they had apparently suffered from brucellosis-like symptoms previously. On all of these farms seropositive cattle for brucellosis were detected. Results of serological and milk testing for brucellosis and the reported brucellosis-like infections in man indicate a public health risk for consumers of milk, particularly where the milk is consumed untreated; a common practice in the study area.

Activity 3: Control of milk quality in newly established milk processing plants in The Gambia

One small-scale in-pouch milk pasteuriser has been installed at ITC. This facility will mainly serve as a training and demonstration centre. Many training courses have already been organized for milk processors and herdsmen.

Milk producer's groups were established with the help of FAO consultants and extension workers of the Department of Livestock Services. There are now five registered Co-operatives, four in Kombo Central and one in Kombo North. The groups were supplied with small-scale milk processing equipment, which enables them to pasteurise milk and to produce good quality yoghurt. The Kombo North group has the potential to process larger amounts of milk than the other groups as the members are able to supply enough milk. Some of their members' even own crossbred cattle. This group will receive a small-scale in-pouch pasteuriser, expected in February 2004. All groups are now producing pasteurised milk and yoghurt. The quality of these products is tested in the microbiology laboratory at ITC. The hygienic quality of the products has much improved compared to the traditionally fermented sour milk that is sold in the market.

Activity 4: Investigation on the presence of Salmonella in slaughter cattle and meat sold at selected markets in The Gambia

To separate *Salmonella* infections in cattle from contamination with *Salmonella* during slaughter, faeces and lymph nodes samples were collected from cattle. Prevalences of 14% and 18% were reported for faeces and lymph node samples respectively, indicating animal infection. All infections seemed to be unapparent or "symptomless carriers", as no clinical signs were observed during the ante-mortem and post-mortem inspection. With 28% of diaphragm meat cuts positive, *Salmonella* infections clearly increase during the slaughter process, mainly due to unhygienic handling. On meat cuts sold and collected at local markets and supermarkets significant further increases of *Salmonella* contamination occurred (64% overall) with a trend of higher contamination in supermarkets compared to local markets (60%). Each *Salmonella* isolate has to be considered as a potential human pathogen with a higher susceptibility for diseases in young, old, pregnant and immuno-compromised individuals (so called YOPI's). However, a meat core cooking temperature of 70º C for 10 minutes is sufficient to avoid consumer infection. Therefore, unhygienic handling of meat during processing (grating, cutting) causing cross-contamination at market and household level might be a more likely and common source of infection.

Activity 5: Pilot study on the prevalence of Salmonella in on-farm chicken and in slaughter chicken and poultry meat sold at Serekunda market in The Gambia

5a) Prevalence of Salmonella on semi-intensive broiler farms and in chickens and poultry sold at Serekunda market

Salmonella contamination of skin cuts from broilers (sold at the semi-intensive farm) was low (3%). In contrast, skin cuts of spent layers (slaughter and sold at local market) had a significantly higher rate of contamination (40%). As the prevalences in faecal samples were not significantly different between spent layers (30%) and broilers (29%) the differences observed in skin cuts were clearly related to contamination during slaughter. Observations during slaughter confirmed laboratory results. Chickens (spent layers) sold at the local market were slaughtered under extremely unhygienic conditions, while the broilers from the semi-intensive farm were slaughtered on a washable and clean tiled surface.

5b) Prevalence of Salmonella in smallholder chicken farms in the CRD

Faecal drops (1-4 pooled samples per farm depends on farm size) were taken from 30 selected local farms in the CRD south. On 23 farms at least one positive pooled sample was reported. This corresponds to a herd prevalence of 76.6% for Salmonella infections. Results obtained in both regions indicate a high public health risk for the consumer related to *Salmonella* infections.

Activity 6: Assessment of the impact of zoonotic infections (bovine tuberculosis and brucellosis) in selected regions of The Gambia, Senegal, Guinea, and Guinea Bissau

Results of disease prevalence ranking applied during the PRA sessions indicates for brucellosis clearly differences in ranking between the countries. Pathognomic or related symptoms for brucellosis like hygroma and abortions in cattle were higher ranked and more frequent in the selected Districts of Guinea and Guinea Bissau compared to Senegal and The Gambia. These findings coincide with the observed differences in seroprevalences from the previous studies with identified high prevalence areas in selected Districts of Guinea and Guinea Bissau while in Senegal and The Gambia infections are rare.

Despite regional differences in ranking of brucellosis as an animal disease and the differences in seroprevalences, the manner of consuming locally produced milk is nearly the same. Milk is mainly consumed fermented in the four countries and is therefore not heated. Different production systems (low-input; market-orientated) did not influence the consumption pattern.

Analysis of brucellosis infections indicated that at none of the public health centres surveyed was a diagnostic capacity to detect brucellosis available. Moreover, the diagnostic procedures for brucellosis infections in humans were totally unknown. Few respondents had any knowledge of the zoonotic character of the disease and no differences in perception could be observed between high and low prevalence areas.

In an attempt to obtain initial information on brucellosis in a high prevalence area in Guinea where milk was always consumed untreated, some people at risk (herder, herd owner and veterinarians) were sampled in a local health centre in Dubréka. Out of 20 people tested, 7 reacted positive for brucellosis. Similar testing will be continued at one health centre in Conakry (Guinea) and one in Bissau (Guinea Bissau). Results are expected at the end of October.

POTENTIAL IMPACT:

Results of a scoping study on farmer's perception of zoonoses contributed to a better understanding of the impact and importance of these diseases on livestock and people, and complement the information obtained for livestock. The results obtained from the investigations into the public health risk of zoonoses (prevalence studies on tuberculosis, brucellosis and salmonellosis) and milk hygiene in The Gambia, Guinea, Guinea Bissau and Senegal have implications for within country and regional trade. The results also provide a basis for identifying effective control measures and establishing future control programmes. This is particularly so for the control of bovine brucellosis. Based on the results of epidemiological studies, policy-makers are now capable of making decisions on the appropriate control strategy (i.e. vaccination). Moreover, the results are contributing to the setting of national standards (*e.g.* for microbiological contamination) or identification of high-risk areas (*e.g.* brucellosis) through national Codex Committees (The Gambia) or Reference Laboratories (Guinea Bissau). This includes the reinforcement of the application of existing veterinary regulations. These developments are likely to increase consumer confidence in livestock products, which in turn will increase demand for higher production, processing and marketing activities. Furthermore, under the higher hygienic conditions of locally produced milk, different processed dairy products can be introduced, thereby stimulating the expansion of the dairy sub-sector.

SCIENTISTS INVOLVED:

Institutional Project Leader: F. Unger

Other ITC scientists: M. Hempen, S. Münstermann, S. Heuwinkel

ITC Technical Staff: P. Kané

Collaborating ITC Special Projects: PROCORDEL, EFP, GTZ, FAO-TCP

Collaborating Scientists and Institutes:

Department for Livestock Services (DLS), The Gambia: J. Sowe, O. Njie, E. Mendy, L. Sanyang, D. Bojang, B. Baldeh, K. Bah; National Nutrition Agency (NaNA), The Gambia: I.

Semega-Janneh; Département National d´ Élevage (DNE)/IRAG, Guinea: B. Diallo, V. Niamey, M. Condé, A. Goumou; LNERV/ISRA, Senegal: M. Diop, M. Sissokho, A. Dioukou, A. Coly; Free University Berlin (FUB), Germany: K.H. Zessin; Federal Institute for Consumer Safety and Veterinary Medicine (Reference Laboratories for Brucellosis), BgVV, Berlin, Germany: J. Bräunig, K. Nöckler; Federal Institute for Consumer Safety and Veterinary Medicine (Reference laboratory for Veterinary Medicine for Tuberculoses), Jena, Germany: A. Martin

MEETINGS:

Hempen, M. *Quelques caractéristiques de la filière laitière informelle et l'hygiène du lait produit dans ce système en Gambie et au Sénégal* at a Conference on "Supply, Hygiene and Quality of milk and milk products in the Sahel", Bamako, Mali, 24 February to 2 March 2003.

Hempen, M. *Quelques caractéristiques de la filière laitière informelle et l'hygiène du lait produit dans ce système en Gambie et au Sénégal* at a Seminar on "Results from studies on the dairy sector in Tambacounda and Kolda", Kolda, Senegal, 4 to 6 June 2003.

Poster presentation:
Hempen, M., Unger, F., Münstermann, S., Seck, M.T., Zessin, K.-H. *Small Scale Milk Processing: a Business Benefiting both Dairy Farmers and Consumers* at the Conference "Deutscher Tropentag" in Goettingen, Germany from 8th to 10th October 2003.

ATTAINMENT OF MEDIUM TERM PLAN MILESTONE:

By the end of 2003, the activities undertaken within the project had contributed to the realization of the Medium Term Plan (2001-2004). First information on the risk related to selected zoonoses (bovine tuberculosis, brucellosis, Salmonellosis) for the consumer is available based on prevalence studies. A risk assessment based approach is now used for the quality control of newly established milk processing centres in The Gambia and for existing centres in Senegal. Results are now available on farmer's perceptions of bovine tuberculosis and brucellosis in The Gambia, Senegal, Guinea and Guinea-Bissau. A pilot study on the prevalence of salmonellosis in chickens in The Gambia (GBA and CRD) has been carried out and results are available.

INSTITUTIONAL PROJECT 10

Project title: Socio-economics, macroeconomics and policy aspects of livestock production, utilisation, conservation and marketing

Short title: Socio-economic factors of improved livestock production

Programme: Systems' Overlaps and Linkages Improvement Programme

Project number: SOLIP 10

Locations of research: The Gambia, Senegal, Guinea and Guinea Bissau

Start date: April 2001

Projected end date: December 2004

OBJECTIVES:

Agriculture represents the major employment sector in The Gambia, Senegal, Guinea and Guinea-Bissau and accounts for more than 20% of the gross domestic product. The share of livestock in the four economies varies widely, but they have the same constraints in meeting the high demand for animal products. The gap between domestic production and demand has for long been filled by imports, but recent economic difficulties have revealed the limitations of this approach, which is no longer sustainable. This resulted in policy reforms, initiated in the early 1980s that were enacted with inadequate knowledge of the production conditions within which farmers operated, or of their ability to adjust to external shocks.

The overall objective of this Institutional Project is to assist livestock stakeholders with information that can be used to define appropriate policies, develop suitable technologies, and transfer knowledge to farmers. The strategy put forward is a combination of macro- and micro-economic approaches in order to (1) capitalise on information on the farms household resources and their behaviour, and (2) identify potentials and constraints to development of the livestock sub-sector.

Expected outputs of the project include:

- Grading of potentials and constraints for improved livestock productivity at both macro and micro-economic levels;
- Better knowledge of the characteristics of livestock production systems for which improved technologies are intended;
- Evaluation of the potential to adopt improved technologies.

IMPLEMENTED WORK PROGRAMME:

In 2003, five research activities were undertaken in four countries, namely The Gambia, Senegal, Guinea and Guinea Bissau.

Activity 1: Study of livestock production systems in Guinea and Guinea Bissau
Livestock production systems in Guinea and Guinea Bissau are predominantly extensive with low productivity. Its economy-wide contribution is estimated at above 20% of the gross domestic product. However, information at the farm household level has remained scanty, making efforts to effectively impact on the livelihood of the livestock owners through development projects difficult. This activity aimed at assisting in targeting research-development efforts undertaken in both countries. The specific objectives were:
(1) to characterize the major production systems in their respective intervention areas; and
(2) to analyse the constraints, potential and the opportunities they can offer.
In Guinea, three ecological regions, Moyenne, Basse and Haute Guinée, were selected to conduct the activity. In Guinea Bissau, a survey was conducted in the northern region. In each country, about 200 livestock owners were questioned on different aspects of livestock production (livestock species and rearing), evaluation of the farm income as well as the socio-economic background of the farm household and its head, etc. Descriptive analysis was carried out.

Activity 2: Characterisation of milk production systems in Senegal and Guinea Bissau
Milk production represents an important component of the livestock production systems in Senegal and Guinea Bissau. Furthermore, dairy products play a major role at both macro- and micro-economic levels, as well as in human nutrition. As in the other West African countries, efforts are being made in Senegal and Guinea Bissau to increase domestic milk production. This activity was designed to provide background information on the characteristics of milk producers and the strengths and weaknesses of milk production at farm household level. Specifically, the activity aimed at (1) typifying the milk producers and (2) evaluating the economic performance. The surveys conducted at farm household level covered 89 livestock owners in Senegal and 200 in Guinea Bissau. Discriminant and gross margin analyses were used to compare milk producers' economic performance.

Activity 3: Impact of AI implementation on livestock rearing in Guinea
One of the options for improving milk productivity in Guinea has been the use of the artificial insemination (AI) technique. For this technology to have significant effects on milk production and to generate additional income to livestock owners, it is essential that farmers adopt it. Technology adoption implies changes in farmers' practices and subsequently in their investment portfolios. In order to monitor the changes in system productivity resulting from the introduction of AI, a multiple visit schedule was organised following the survey on characterisation of milk production systems. The objectives were: (1) to analyse changes in cattle management (feeding, health, etc), and (2) to evaluate the potential impact of the AI on livestock owners' income. Sixty livestock owners were monitored, of whom 30 were involved in the AI programme whilst the others used traditional practices. Data on variables, such as input and output allocation and the producers' socio-economic background were collected over a period of 12 months. Data were analysed using descriptive statistics.

Activity 4: Analysis of livestock feeds and veterinary input marketing systems in The Gambia
In the dry season, feed and veterinary inputs account for more than 35% of livestock farm production costs in The Gambia. Most farmers relied on markets for obtaining feeds and veterinary products. Markets therefore play an important role in input allocation in the economy. However, to contribute to optimal allocation of production factors, markets need to be cleared, and prices should reflect the social costs of these factors. Effectiveness of the marketing systems is an important factor in the process of achieving intensification of livestock production. Only scanty information is available on the operation and functioning of

marketing systems for livestock production inputs in The Gambia. The overall objective of this activity was, therefore, to evaluate the distribution systems for livestock inputs. Specific objectives were to (1) identify the structure of markets for feeds and veterinary inputs; (2) assess their mobility within country and associated costs; and (3) assess their efficiency. A survey was conducted at farm level in Western, Lower River, Central River and North Bank Divisions. The quantities of various crop residues available at each of the 233 farm households sampled were estimated and their different usages evaluated. Next, market surveys were conducted to evaluate the marketing systems for veterinary and feed inputs. Two companies were enumerated for veterinary inputs and 37 sellers for feeds in the Kombo. Data were analysed using descriptive statistics.

Activity 5: Policy reforms and the performance of livestock production systems: a farm household modelling in The Gambia
This activity is part of a large study on the changes in macro- and micro- level performance of livestock systems due to policy reforms. Collection of secondary data is being completed and will be pursued concurrently with market analysis and monthly monitoring of livestock production at the farm level. The secondary data already collected were used to advance the macroeconomic analysis of policy effects in The Gambia compared to Senegal and Guinea. Data from the 12-month study period will be used to develop a farm household model for The Gambia as a case study. The objectives were to evaluate the effects of policy reforms at the macroeconomic level and to assess their implications for livestock owners. At the macro level, co-integration and error correction models were developed to identify factors affecting the aggregate supply of milk and meat in The Gambia, Senegal and Guinea. At the micro level, the data collected were used in a farm household model that takes production and consumption activities into account. The activities selected included livestock (milk and meat) and major Gambian crops (millet, rice and groundnuts).

RESULTS:

Activity 1: Study of livestock production systems in Guinea and Guinea Bissau
Superficially, livestock production systems in Guinea and Guinea Bissau have characteristics that are not that different from their counterpart systems in other West African countries. A variety of species are reared in extensive systems, with small variations between ruminants and monogastrics. Because the fieldwork was delayed due to various constraints, data processing and analysis could not yet be completed.

Activity 2: Characterisation of milk production systems in Senegal and Guinea Bissau
In Senegal, two resource-based groups of milk producers were identified using discriminant analysis. Structural variables of dissimilarity between the two were land and cattle ownership, and the size of the farm household (man-equivalent). There were no significant differences in cattle breeding practices between resource-based groups; the major constraints to improving milk productivity were the availability and quality of feeds. Lactating cows were mainly grazed in the rainy season. In the dry season, they were supplemented with crop residues and agricultural by-products (groundnut cake). Economic analysis remains to be completed.
In Guinea Bissau, four resource-based groups of milk producers were identified. Five structural variables significantly determined the differences between farmers: the size of household (man-equivalent), the land and cattle ownership, the investment in intermediate (equipment) and permanent assets (buildings such as kraals). With respect to the sample average, these groups could be called: resource-poor (below average), medium (average) and

resource-rich (above average) farms. As in Senegal, the major constraint to improving milk productivity in Guinea Bissau was the availability and quality of feeds. Gross margin analysis indicated that milk production under current market conditions was profitable for the medium and resource-rich farmers, but not so for the resource-poor. In terms of cash generation (without labour opportunity cost), milk production was profitable for all groups of resource-based farmers in Guinea Bissau.

Activity 3: Impact of AI implementation on livestock rearing in Guinea
Data on the inputs and outputs were collected, as well as any changes in livestock management in two groups of milk producers in Labé, Guinea: those involved in the artificial insemination and those not involved. Data processing is in progress.

Activity 4: Analysis of livestock feeds and veterinary input marketing systems in The Gambia
Preliminary results on feeds inputs in The Gambia indicate there are a variety of feeds available at the farm level. Farmers produce millet bran and groundnut hay, in quantities averaging 240 kg/farm and 1324 kg/farm, respectively. Groundnut and sesame cake, rice bran, cotton seed, cereals straw and natural forage were also available. The most purchased feeds on farm were groundnut hay (168 kg/household) and rice bran (8 kg/household). At the market level, the results indicate three categories of sellers. Spontaneous (one time) sellers, farmers and livestock sellers are operating in feeds (mainly groundnut hay) marketing. There was also a very little market penetration from companies operating in agricultural input supply, including concentrates. The feeds markets in the Kombo are supplied from various locations in The Gambia, and from Casamance region in Senegal. On average, a seller purchases 56 tonnes of groundnut hay at D77,235 per year. This shows the importance of feeds transaction in the farm economy. The benefit from selling groundnut hay and the constraints associated with this activity from a seller point of view remains to be completed.

Unlike the feeds, veterinary inputs' marketing is more organised. Two private companies are leaders in this activity, but differ from each other in terms of market penetration. A veterinarian association operates one, while a private owner operates the second. Data analysis is still in progress.

Activity 5: Policy reforms and the performance of livestock production systems: a farm household modelling in The Gambia
Two groups of variables were collected: livestock and crop production and consumption. The livestock production variables included meat (cattle and small ruminant) and milk (cattle), herding and inputs (veterinary and feeds) investments. The crop production variables are related to rice, millet and groundnut, and included area cropped, quantity produced, farming labour and investments (fertiliser, equipment). On the consumption side, the quantities of each of these products that the farm household consumed were recorded. In addition, market survey allows gathering price information to estimate the value of each product. The objective is to develop a farm household model where consumption and production interact to define farmer behaviour toward policy reforms. The different models are being tested and are part of the PhD thesis under preparation by Jacques Somda (KLU Belgium).

POTENTIAL IMPACT:

The potential impact of these results can be assessed in different ways. The macroeconomic results of the determinants of domestic livestock products help to identify key issues that can assist policy makers in defining suitable macroeconomic adjustments to promote the

sustainable development of the livestock subsector. Policy makers should know that sector policies work but they are constrained by macroeconomic settings. There is potential for developing domestic livestock production through accumulation of productive assets unless efforts are devoted to improved technology uptake. There is an opportunity for encouraging private investment in livestock production activities.

SCIENTISTS INVOLVED:

***Project Leader*:** J. Somda

***Other ITC Scientists*:**

***Collaborating Scientists and Institutes*:**

M. Kamuanga (*International Livestock Research Institute*); E. Tollens (*Katholiek University of Leuven*); A. Bittaye (*National Agricultural Research Institute/Gambia*); F. Dia/Sow (*Institut Sénégalais de Recherches Agricoles/Sénégal*); K. Kéita (*Institut Guinéen de Recherches Agricoles/Guinée Conakry*), Mendes Antonio (INPA, Guinea Bissau).

MEETINGS:

ISCTRC 27th meeting, 29 September to 3 October 2003, Pretoria, South Africa. Somda, J., Kamuanga, M. and Tollens, E. 2003. Evaluating willingness to adopt integrated packages for trypanosomiasis control in The Gambia: Application of demand revealing mechanisms.

INSTITUTIONAL PROJECT 11

Project title: Training, information exchange and capacity building

Programme: System's Overlaps and Linkages Improvement Programme

Project number: SOLIP 03

Location(s) of activities: The Gambia, Senegal, Guinea, Guinea Bissau

Start date: January 2001

Projected end date: December 2004

OBJECTIVES:

Human resource development (HRD) is an integral part of any R&D programme. Cooperation between ITC and the NARS in terms of HRD has to give special attention to the needs of national partners. Limited funds, a shortage of well trained staff, frequent isolation from sources of information and limited opportunities for collaborative research continued to be major constraints to the effective generation and dissemination of agricultural-based adapted technologies and innovations in the region.

The implementation strategy for the ambitious research and development agenda of the ITC Medium Term Plan 2001-04 puts emphasis on training and information exchange with the NARS, to increase the critical mass for research and inter-institutional networking.

Institutional Project 11 continued to support ITC's mission, objectives and strategy through a range of activities and inputs. Institutional Projects and collaborating NARS were given support with the specific objectives of strengthening the research capacity of their technical and scientific personnel, to support networking and information exchange between NARS, regional and international research and academic institutions, to increase ITC's capacity to offer training at different levels, and to promote the dissemination of research results and technology transfer through targeted training, workshops, seminars and the production of training material.

In the Annual Workplan 2003, the major activities were listed, including: (1) to (co-) organise training courses for professionals and/or technicians pertaining to prioritised training needs; (2) to train extension personnel, livestock-producing farmers, and milk handling persons in improved breeding, nutrition and feeding strategies, management, disease control, and sanitary measures for consumer safety; (3) to support research for higher degree studies in collaboration with reputable regional and international universities; (4) to establish a database on training for the monitoring of immediate and longer-term impact on capacity building; (5) to establish a GIS and data management unit, and a nucleus PC-pool at ITC for training, research, and information exchange; (6) to reorganise and establish modern library and literature search facilities at ITC; and (7) to produce training materials such as videos, leaflets, posters, manuals for the use during training courses and for distribution.

IMPLEMENTED WORK PROGRAMME:

Regarding training, one of the main thrusts in 2003 was to facilitate and support the transfer of R&D results, innovative technologies and packages of intervention to the intermediate and ultimate beneficiaries through the training approach of "Train the trainers" and "Train the farmers" (farmers and other beneficiaries). IP 11 contributed to build up and facilitate exchange of local expertise and critical mass/capacity in the region, and promoted the transfer and availability of research results and integrated technological packages to the intermediate and ultimate beneficiaries, namely livestock producers. This was achieved primarily by providing support to targeted training on a variety of technical, scientific and managerial topics.

The training programme operated at national and regional levels in close collaboration with the NARS. It remained one of the main tools for the transfer and dissemination of results and recommendations deriving from R&D activities.

Activities in 2003 included the strengthening of information exchange and networking by inaugurating and circulating an ITC Newsletter and by providing support to the preparation and implementation of the PROCORDEL National Conferences in The Gambia.

Activities were implemented in the following areas:

Training courses

In 2003, IP 11 continued to (co) organise and support training activities of the Centre and its partner institutions, implemented at ITC or elsewhere in The Gambia, Senegal, Guinea, Guinea Bissau, and for the first time, in Sierra Leone.

The identification of needs and selection of training subjects was based on consultation between ITC and national and institutional partners, with the objective of strengthening the livestock-based agriculture research and development activities of ITC under LISIP and MOSIP, and of the NARS and national extension mechanisms. To ensure relevance and feasibility, the training programme was guided by the requirements of the Institutional Programmes and Projects and by the needs for the dissemination and transfer of technologies to the ultimate users, as described in the Annual Workplan 2003.

As in 2002, ITC continued to reinforce NARS' and its own research capacity through targeted training of technical and scientific staff. Besides training inputs for professionals and livestock technicians, the trend that was initiated in 2002, continued to fully incorporate and apply the *Train the Trainer (ToT)* and *Training of Farmers (ToF)* approach that addressed the producers via extension agents, thus increasing the "multiplier effect" by improving the capacity of local trainers. Courses in support of technology transfer to beneficiaries such as livestock farmers and milk handling persons were increasingly organised by ITC and partner NARS in local languages, in which the scientists played an important role as mediators. Research results that were “packaged” to address a specific topic were, initially transferred by scientists to groups of intermediate beneficiaries, either livestock assistants/extension workers or educated farmers (e.g. leaders of livestock associations) using the *ToT*-component. This group in turn trained groups of livestock producers, using techniques and adapted training materials in local languages available for the *ToF*-component of this approach.

In 2003, a total of 4 *ToT*-courses with 47 participants and 13 *ToF*-courses with 527 participants were conducted. Two of the 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, Senegal and Guinea, with support from FAO, GTZ and PROCORDEL.

Major inputs under the *ToT/ToF* scheme were provided by the FAO Technical Cooperation Programme (TCP) on "Improving milk safety and farmers income using the Village Milk System"), with important additional contributions from other ITC-managed resources.

The process for the initiation of "Farmers Field Schools" (FFS) for livestock farmers in The Gambia with financial and technical support from DFID and ILRI was supported by a two-week training course for 19 trainers/facilitators/extension workers on the concepts and methodology for establishing sustainable FFS.

A theme list of the *ToT/ToF*-courses includes:

- 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
- 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

Details of the group-training activities at regional and national levels are given in Tables 1-6.

Table 1: Regional training courses in 2003

Course title	Description	Duration & start date	Participants	Collaborators / Instructors
Processing and statistical analysis of socio-economic data from livestock-based agriculture (REG0301)	Harmonization of data analysis techniques and evaluation of results from Procordel R&D activities	6 days; 16 June	Regional: 9 professionals & technicians from Senegal (2), Guinea (2), Guinea Bissau (2), Gambia/ITC (3)	ITC, ILRI-CIRDES
Processing and statistical analysis of animal health and production data (REG0302)	Harmonization of data analysis techniques and evaluation of results from Procordel R&D activities	7 days; 30 June 2003	Regional: 7 professionals & technicians from Senegal (1), Guinea (2), Guinea Bissau (2), Gambia/ITC (2)	ITC, ISRA-LNERV
Oestrus synchronisation and A.I. for crossbred cattle production (REG0303)	Update knowledge and practical skills for F1 production	5 days; 14 July 2003	Regional: 8 professionals & technicians from Senegal (2), Guinea (2), Guinea Bissau (2), Gambia (2)	ITC

Table 2: Training courses in The Gambia/ITC in 2003

Course title	Description	Duration & start date	Participants	Collaborators /Instructors
Workshop and training on Intensive Feed Gardens (GAM0301)	Promote dialogue among IFG stakeholders and provide practical skills	3 days; 8 April 2003	ToT (5) and ToF (33) combined	ITC, DLS, NARI
Awareness training on clean & hygienic handling of milk ((GAM0302)	Improve local milk production, handling and safety	1 day; 5 May 2003	ToT (2) and ToF: 23 herdsmen, milk collectors, processors/ vendors	FAO, ITC
Clean & hygienic milk handling, processing and fermented milk production (GAM0303)	Improve local milk production, handling and safety	2 days; 19 May 2003	ToF: 28 women milk processors	FAO, ITC
Clean and hygienic milking and handling of milk (GAM0304)	Improve local milk production, handling and safety	2 days; 26 May 2003	ToT (5) and ToF: 21 herdsmen	FAO, ITC
Milk processing, product making, quality management, and training of trainers (GAM0305)	Improve local milk production, technology, handling and safety	15 days; 29 May 2003	ToT: 10 technicians of DLS/ITC core group	FAO, ITC
Yoghurt and flavoured milk production (GAM0306)	Improve local milk products technology	6days; 25 June 2003	ToF: 13 women milk processors	FAO, ITC
ITC-DLS sensitisation & training workshop for screening/selecting purebred livestock in The Gambia (GAM0307)	Build up knowledge and capacity in herd management, applied breeding, performance recording & selection	1 day in 6 locations; 3 May 2003	ToF: 116 pure-breeding farmers	ITC, DLS
Farmer Field School training of facilitators (GAM0308)	Training of facilitators – concept & methodology for establishing FFS for livestock farmers	10 days; 14 July 2003	ToT: 19 extension/field workers from DLS, NARI, WASDA, ITC	DFID-ILRI
Training workshop for Gambia indigenous livestock multiplier association-GILMA (GAM0309)	Purebred multiplier herd management, applied breeding, performance recording & selection	3 days; 27 August 2003	ToT (2) and ToF: 20 pure-breeding farmers of GILMA	ITC, DLS
In-service training of Livestock Assistants on the management of breed multiplication and breeding schemes (GAM0310)	Purebred multiplier herd management, applied breeding, performance recording & selection	5 days; 19 September 2003	ToT: 13 Livestock Assistants	ITC, DLS
Introduction to database Access (ITC0301)	Modular introduction to Access database	5 half days; 14 Feb. 2003	9 ITC and 1 DLS staff	MRC
Introduction to Epi-Info (ITC0302)	Introduction to Epi-Info database creation	3 half days; 22 April 2003	10 ITC and 2 DLS staff	MRC
Refresher Power Point (ITC0303)	Presentation preparation using master templates	1 half day; 19 Feb. 2003	7 ITC staff	ITC
Introduction to PC office applications 1 (ITC0304)	Basic training on MS Windows, Word, Excel	1.5 days; 8 May 2003	7 ITC staff	Peace Corps
Introduction to PC office applications 2 (ITC0305)	Basic training on Excel	1 day; 4 June 2003	8 ITC and 1 DLS staff	Peace Corps
Introduction to PC office applications 3 (ITC0306)	Basic training on Windows, Excel, Access	3 days; 13 October 2003	6 ITC staff	Peace Corps

Table 3: Training courses in Senegal in 2003

Course title	Description	Duration & start date	Participants	Collaborators / Instructors
Hand milking techniques and hygienic handling of milk (SEN0301)	Improve local milk production, hygienic handling and safety	1 day in 2 locations; 15 April 2003	33 cattle farmers, milk collectors & vendors	ITC
Management strategies for F1 cattle (Module 2)	Provide knowledge and skills in health management and milk hygiene for of crossbred (F1) cattle farmers in the groundnut basin of Senegal (ToF)	3 days; 23 Sept. 2003	20 crossbred cattle farmers	ISRA, DIREL

Table 4: Training courses in Guinea in 2003

Course title	Description	Duration & start date	Participants	Collaborators / Instructors
Oestrus synchronisation and A.I. for crossbred cattle production (GUC0301)	Update knowledge and skills for production of F1 crossbred cattle	4 days; 4 March 2003	7 professionals	ITC, DNE
Hand milking techniques and hygienic handling of milk (GUC0302)	Improve local milk production, hygienic handling and safety	1 day in 3 locations; 28 March 2003	91 cattle farmers, milkers, milk vendors	ITC
Feeding and management of F1 crossbred cattle (GUC0303)	Provide knowledge & skills in production & management of F1 crossbred cattle	3 days in 3 locations; 5 May 2003	90 crossbred cattle farmers	DNE/IRAG, PAE, (ITC)

Table 5: Training course in Guinea Bissau in 2003

Course title	Description	Duration & start date	Participants	Collaborators / Instructors
Stabling technology for cattle (GBI0301)	Improved housing and management of cattle	2 days; 28 April 2003	ToT: 11 professionals and technicians	ITC, DGP, INPA

Table 6: Training courses in Sierra Leone in 2003

Course title	Description	Duration & starting date	Participants	Collaborators / Instructors
Management of working cattle and of implements (SLE0301)	Managing N'Dama cattle reintroduced for draught purposes – Training of trainers	2 days; 19 May 2003	ToT: 7 Livestock Assistants	ITC
Management of working cattle and of implements (SLE0302)	Managing N'Dama cattle reintroduced for draught purposes – Training of farmers	2 days; 21 May 2003	ToF: 16 farmers	ITC, MoA

Some of the training themes proposed in the 2003 Workplan did not take place for technical reasons, which will be partly compensated for in 2004 (*e.g.* nutrition/feeding, research methodology, Internet-applications)

Individual training and promotion

Individual training was provided as short/medium-term, supervised on-the-job/on-site instruction and exercises, study attachment, or assistance to postgraduate training for MSc or PhD.

ITC continued to support the promotion/supervision of academic qualifications for long-term career development in collaboration with African and northern Universities and IARCs, particularly in the framework of PhD studies. Details of these higher degree studies, fully integrated into ITCs research and development programme, are summarised in Table 7. Four of the ITC/Procordel Research Associates continued their PhD studies and (re-) visited their supervisors at the Universities of Utrecht, Wageningen, Leuven and Hohenheim, respectively, for study periods of several months duration in 2003. Dr. Déthié Faye, veterinary research associate with the Small Ruminant Research Project, successfully submitted and defended his PhD-thesis at ITM, Antwerp in September 2003. Two EVP funded German veterinarians left ITC in October (S. Heuwinkel) and December (J. Saecker) after completion of their practical research work and assignments, to finalising their respective thesis work at the FU Berlin.

Table 7: Staff engaged in higher degree studies at ITC during 2003

Name & Country/ Nationality	Position & source of funding /sending institution	Theme	Progress	Collab. academic institution
N'guetta Austin Bosso (Ivory Coast)	ITC Biometrician, Geneticist / Research Associate (PROCORDEL)	Optimum strategies for the implementation of pure breed improvement programmes (PhD study)	3rd 3-month study period at Wageningen. Practical work & analysis of results in progress	University of Wageningen
Bonto Faburay (Gambia)	ITC Vet. / Research Associate (PROCORDEL)	Epidemiology of *Cowdria ruminantium* infection in small ruminants in The Gambia (Study for PhD)	2nd 3-month study period at Antwerp and Utrecht, for training and laboratory work. Practical work and analysis of results in progress	Utrecht University; ITM Antwerp
Déthié Faye (Senegal)	ITC Vet. / Research Associate (Small Ruminant Research Project)	Interaction et impact de la trypanosomose, des helminthoses gastrointestinales, du type génétique et du niveau de nutrition sur la santé et la productivité des chèvres naines en Gambie (PhD study)	Study period at ITM Antwerp and Univ. of Liège. Analysis of results, writing up, submission and defence of PhD thesis (Sept. 2003)	ITM Antwerp; University of Liège
Simplice Nouala (Cameroon)	ITC Nutritionist / Research Associate (PROCORDEL)	Feeding strategies for cattle production in The Gambia and Senegal: Optimum level of supplementation (PhD study)	6-month study period at Hohenheim. Practical work and analysis of results in progress; writing up thesis	University of Hohenheim
Jacques Somda (Burkina Faso)	ITC Agric. Economist / Research Associate (PROCORDEL)	The effects of policy reforms on the performance of livestock systems in The Gambia with comparative analysis of Senegal and Guinea (PhD study)	Second 3-month study period at KU Leuven. Practical work and analysis of results in progress	Leuven University
Michaela Hempen (Germany)	ITC Vet. (EVP/EFP)	The hygienic status of milk sold in local markets of The Gambia (PhD study)	Practical work and analysis of results completed; writing up in progress	FU Berlin
Sandra Heuwinkel (Germany)	ITC Vet. (EVP/EFP)	Study on the prevalence of Salmonellosis in slaughter cattle at abattoirs and markets in The Gambia (PhD study)	Sampling completed; practical research work and writing up for thesis in progress; left for Germany in October 2003	FU Berlin
Joerg Saecker (Germany)	ITC Vet. (EVP/EFP)	Evaluation of rumen microbial response and animal performance to *Moringa oleifera* as alternative protein source for cattle nutrition in The Gambia (PhD study)	Sampling completed; practical research work and writing up for thesis in progress; left for Germany in December 2003	FU&HU Berlin
Alfred Diouf (Senegal)	Final year student (EISMV)	Study on the prevalence and incidence of trypanosomosis in equines in The Gambia	Completed "Thèse de doctorat de médecine vétérinaire". Graduation at EISMV, August 2003	EISMV Dakar

Regional dialogue and training

For improved networking through regional dialogue and training, six younger professionals from Guinea (5) and Senegal (1) were attached to ITC in 2003 under the "Regional Mobility Scheme" funded by PROCORDEL. Embedded into the current research and development agenda they worked for a period of 2-7 months on a variety of themes (Table 8).

The study attachment of a Senegalese veterinary final year student, Mr. Alfred Diouf, of EISMV and his subsequent assignment under the regional mobility scheme ended in August 2003 with the successful defence of his thesis (Doctorat de médecine vétérinaire) and graduation.

Dr. Alpha Madiou Barry of DNE Conakry, and research associate under the BMZ-funded regional Project "Improving the management of trypanocide resistance in the cotton zone of West Africa", implemented by ILRI and ITC, visited ITC before proceeding for further studies at FU Berlin; he will continue his work on "Serological and PCR-based testing of trypanosome isolates from Guinea for drug resistance" at ITC in early 2004.

Mr. Saja Kora, ITC Livestock Assistant, spent one-month training on the FFS concept and methodology, hosted by ILRI Nairobi, Kenya. Dr. Florent Ngamuna of RD Congo visited ITC for short-term training on data management and GIS, with funding from PACE.

Table 8: Regional mobility attachments and short-term study visits at ITC in 2003

Name, Country	Period	Assignment
Alfred Diouf, Senegal	Feb.-August 2003	Assessment of trypanotolerance in crossbred cattle under artificial challenge
Yero Safe Barry, Guinea	March-April 2003	Production and utilisation of *Moringa oleifera* and *in-sacco* digestibility of feed stuff from Guinea
Mohamed Fatah Cissé, Guinea	March-May 2003	Genetic and phenotypic parameters for growth traits in small ruminant populations in The Gambia
Amadou Saimou Bah, Guinea	March-June 2003	Control of ecto- and endoparasitoses in the pure breeding herds and flocks at ITC Keneba Station
Momodou Yaya Barry, Guinea	May-August 2003	Pasture improvement at ITC Keneba Station
Mamadou Ramadan Diallo, Guinea	August-October 2003	Pilot study on the prevalence of *Salmonella* in chicken and poultry meat in smallholder and semi-intensified farm enterprises in The Gambia
Alpha Madiou Barry, Guinea	October-December 2003	Serological and PCR-based testing of trypanosome isolates from Guinea for drug resistance (in collaboration with FU Berlin)
Dr. Florent Ngamuna Data Manager / PACE Epidemiologist, RD Congo, Kinshasa	23 Jan. – 5 Feb. 2003	Individual training on data management and GIS, at ITC, DLS, and CSE Dakar

SCIENTIFIC SEMINARS AT ITC

In 2003, eight scientific seminars were organised for the presentation and discussion of research outputs from ITC scientists and external guests.

Table 9: Scientific seminars at ITC in 2003

Presenter	Date	Theme of Seminar
N'Guetta Austin Bosso, ITC	25 April 2003	Genetic Parameters for Growth Traits in N'Dama Cattle under Tsetse Challenge in The Gambia
Giorgio Sirugo, MRC Laboratories Fajara	30 May 2003	Human Genetics in The Gambia (DNA-Banking)
Chris Nwafor, ITC	27 June 2003	Farmers' Perceptions on the Concept of Intensive Feed Gardens (IFG)
Famara B. Sanyang, ITC	1 August 2003	On-farm production of F1-crossbred cattle in The Gambia
Prof. Leo Dempfle, Univ. of Munich	22 August 2003	Some Analysis of the F1-Herd at ITC
Momodou Lamin Ceesay, ITC	26 September 2003	Trends in tsetse-challenge in The Gambia: environmental perspectives
Sandra Heuwinkel, ITC	3 October 2003	Preliminary results of a meat hygiene study on the prevalence of Salmonella spp.
Mulumba Kamuanga, ILRI-ITC-CIRDES	19 December 2003	Overview on methodological approaches of socio-economic studies in PROCORDEL and preliminary results

Database on training and training assessments

Information on training events organised at ITC and in partner countries, with essential course details such as course contents, trainees' work affiliations, and resource persons are collected and entered into a training database for reference, production of reports, and the assessment of further training needs.

This database will also be useful for the evaluation of training offered since 2001 by ITC and collaborators and its effects at the individual and institutional level. A systematic assessment of impacts of the training measures has not been undertaken yet, but will be initiated in 2004 on the basis of written questionnaires and semi-structured interviews, as part of the end-of-project activities of PROCORDEL.

Training and information facilities at ITC

In February 2003, a new PC training pool, officially inaugurated during the ITC Council meeting in March, began its operations. In-house training courses for professionals (database management using MS Access and Epi-Info; Power Point) and beginner/refresher courses for general staff (Windows, Word, Excel, Access) were organised in collaboration with resource persons from MRC Laboratories, Peace Corps, and ITC. Two regional training courses took place, on processing and statistical analysis of (1) socio-economic data and (2) of animal health and production data (PROCORDEL-funding).

The excellent relationships with senior staff of the MRC data management and statistics department benefited both institutions with respect to training support of ITC by data management specialists of MRC and occasional usage of the PC-pool for MRC staff training. It is anticipated that this scheme of mutual training support for data management and statistical applications will continue in 2004.

No sufficiently qualified person could be appointed in 2003 to provide administrative-technical supervision of the LAN, therefore the facility could not be kept open outside such group training events. The extremely slow connection to the Internet remained another constraint, virtually excluding the possibility of using the pool for accessing distant education modules or web-based literature searches by individual users or groups.

The GIS-capabilities for exploiting and dealing with spatial information within ITC remained well behind expectations, mainly because of the departure of the specialist consultant at the end of 2002. This was unfortunate, as hardware and software were made available to ITC from Italy (IAO) and FAO. It is hoped that some progress will be made in the near future through networking with institutions and specialists at the national and regional level.

Though ITC's library holding of textbooks, monographs, periodicals, reports, and other documents, was re-organised with the help of a local consultant librarian, it does not fulfil the requirements of the library of a research centre.

However, a number of internet-based library services and databases were identified and made known to ITC scientists (*e.g*. published by INASP - International Network for the Availability .of Scientific Information). The main gateways to a wide range of scientific journals are provided to ITC scientists through free on-line access to the websites of HINARI (WHO) and AGORA (FAO). Again, a constraint is the slow internet connection at ITC.

Following the launching of its Internet website as a platform for general information and news about ITC, the Centre created a quarterly Newsletter in 2003, adding to the visibility of ITC and to the dissemination of information about key activities and developments at ITC and partner institutions.

With financial support by CIM Germany approved in December 2003, ITC will further improve several services linked to training, information exchange and capacity building:

- The Internet access of the training facility and other users at ITC will be enhanced through the installation of a wireless transmission system between the provider (Netpage) and ITC; this will speed up access and downloading time thus allowing literature search via the internet at reasonable speed, access to distant education websites, and faster email connection.
- The introduction of statistical and other software packages for PC training pool (STATA 8, Stat-Transfer, PC-Rdist, Anti-Virus) will improve data management standards and add to better training services.
- Purchase of audio-visual equipment (video; mobile TFT screen) and software for the making and staging of clips/films will support the production of training and extension materials by the Centre.
- The order of a new stock of selected scientific textbooks, monographs, manuals will uplift the access to scientific and technical information at ITC.
- Various equipment, *i.e*. a set of new chairs, white board, and air-conditioner for the PC-pool; a cabinet for new books; a wall-mounted projection screen for conference room, will improve existing facilities.

Other activities:

IP 11 contributed and closely collaborated with DLS and NARI in the preparation and implementation of the PROCORDEL National Conference in The Gambia on "Livestock Research for Development" held in November 2003. Oral presentations on "Training and

Capacity Building" were made at the national conferences in The Gambia, Guinea and Senegal.

It also contributed to the preparation of a Project proposal in English and French on "Technical Training in West Africa to Support Development of Suitable Technologies to Improve Livestock Productivity" forwarded to the Directors of the partner NARS in The Gambia, Senegal, Guinea and Guinea Bissau, for their comments and support prior to submission to potential donor institutions. Building on the extensive inputs under PROCORDEL, this capacity building project shall continue to support participatory research involving researchers, extension workers, and farmers, by strengthening the skills of technical and professional staff and facilitating networking between the collaborating NARS institutions in training and appropriate linkages between all stakeholders in the innovation process, leading to better harmonisation of R&D implementation and uptake of technologies in the Region.

POTENTIAL IMPACT:

Training continued to be implemented in line with the objectives and goals laid down in ITCs Medium Term Plan, the PROCORDEL overall logical framework and the annual work plans. Most training activities were carried out together with collaborating partners, specifically NARS, IARCs, universities, to ensure the relevance of training and share experience and resources.

Besides continuous training for professional and technical staff of ITC and the NARS, the additional components of "Training of trainers" and "Training of farmers" and other beneficiaries are now well established as valuable instruments for the transfer and dissemination of innovative technologies at the grassroots. The intensified production of specific training and extension materials will further stimulate the effectiveness of this approach to the benefit of both the research and development workers and the producers and ultimate users of the outputs of R&D in West Africa.

SCIENTISTS INVOLVED:

Institutional Project Leader: A. Schoenefeld

ITC Scientists: S.Münstermann, K. Agyemang, A. Fall, Y.Akinbamijo, F.Unger, S.Leak, E. Hoeven, F.Sanyang, J.Somda, S.Nouala, N.Adediran, A.Bosso, M.Hempen, B. Faburay, A. Diack, J. Saecker, M. Mbake

ITC Technicians: N. Corr, J. Faye, M. Njie

Collaborating Institutions:

The Gambia	DLS, NARI, NANA, FAO
Senegal	ISRA-LNERV, EISMV, CRZ, CSE
Guinea	DNE-IRAG, CFEL, PAE
Guinea Bissau	DGP, INPA
Sierra Leone	MAFF

IARCs/Regional Projects/Int. Organisations

	ILRI, AU-IBAR/PACE (Nairobi), FAO
ARIs/Universities (Europe)	
	ITM Antwerp, Leuven University (Belgium); FU Berlin, Hohenheim University (Germany); Utrecht University, University of Wageningen (Netherlands)

ATTAINMENT OF MEDIUM TERM PLAN MILESTONES:

The activities undertaken by the Project and collaborating partners in 2003 had contributed to the realisation of ITC's Medium Term Plan Milestones for the year 2003, namely through the implementation and support to training courses at various levels and other training relevant inputs at ITC and NARS, the beginning of the production of training and extension materials, improved networking in training and enhanced information exchange between partner institutions in the Sub-region.

The evaluation of the degree of increased capacity of technical and scientific personnel of ITC and NARS will be executed during 2004 together with the assessment of further training needs and of the impact of training on institutional capacity building.

ANNEX 1: LIST OF PROJECT PUBLICATIONS

1. PEER-REVIEWED SCIENTIFIC JOURNALS:

Akinbamijo, O.O., Nouala, S., Sanyang, F.B. & O. B. Smith. 2003. Utilisation of horticultural residues by N'Dama cattle and their crosses in The Gambia. *Livestock Production Science* ***80,*** *221-228.*

Faburay, B., Münstermann, S, Geysen, D., Fall, A. & Jongejaan, F. (2003): Serological transect study of *Ehrlichia ruminantium* infection in small ruminants in The Gambia *(submitted).*

Faye, D., Leak, S.G.A., Nouala, S., Fall, A., Losson, B. & Geerts, S. 2003 Effects of gastrointestinal helminth infections and plane of nutrition on the health and productivity of F1 (West African Dwarf X Sahelian) goat crosses in The Gambia. *Small Ruminant Research,* ***50,*** *153-161.*

Faye, D., Sulon, J., Kane, Y., Beckers, J.-F., Leak, S.G.A., Melo de Sousa, N., Losson, B. & Geerts, S. Effects of an experimental *Trypanosoma congolense* infection on the reproductive performance of West African Dwarf goats. Submitted to *Theriogenology.*

Faye, D., Leak, S.G.A., Kora, S., Losson, B. & Geerts, S. Influence of an experimental *T. congolense* infection and intercurrent stress factors on milk production and some biochemical parameters in West African Dwarf Goats. Submitted to *Acta Tropica.*

Bosso, N. A., Cissé, M.F., van der Waaij, E.H., Fall, A. & van Arendonk, J.A.M. Genetic and phenotypic parameters of body weight in West African Dwarf goats and Djallonké sheep. (Submitted to *Small Ruminant Research*).

Manirakiza, P., Akinbamijo, O.O., Covaci, A., Pitonzo, R. & Schepens, P. 2003. Assessment of organochlorine pesticide residues in West African city farms. *Arch. Environ Contam Toxicol.,* ***44****, 171-179*.

Münstermann, S., Somda, J., Kamuanga, M., Hempen, M., Unger, F. & Carayol, D., Small scale milk transformation to enhance value added milk production from the local dairy sector for the peri-urban markets in The Gambia. *Sahelian Studies and Research*. Accepted December 2003.

Nouala, S., Akinbamijo, Y., Smith, O.B. & Pandey, V. Horticultural Residues as ruminant feed in peri-urban area of The Gambia. *South African Journal of African Science*. In press.

Nouala, S., Akinbamijo, Y., Bosso, N.A. & Agyemang, K. The Comparative Performance of N'Dama crossbred cows under two supplementation levels in The Gambia. *Livestock Research for Development.* In press.

Somda J., Kamuanga, M. & Tollens, E. 2003. Evaluating willingness to adopt integrated packages for trypanosomiasis control in The Gambia: Application of demand revealing mechanisms. *Journal of African Economies.* In press.

Somda, J., Kamuanga, M. & Tollens, E. 2003. Characteristics and Economic Viability of farm Milk Production in the Smallholder Farming Systems in The Gambia. *Agricultural Systems.* In press.

Unger, F., Goumou, A., Diallo, B., Hempen, M., Münstermann, S. & Zessin, K-H. 2003. Prevelance of *Brucella abortus* in herds supplying milk to local markets in Basse, Guinea and associated public health risk. *Submitted to Revue d'Elevage et de Médicine Vétérinaire de Pays Tropicaux.*

2. BOOK CHAPTERS:

Akinbamijo, O.O., R.A. Pearson & A. Fall. 2003. *Management Strategies for Trypanotolerant Draught Animals in West Africa*. In 'Working Animals in Agriculture and Transport. European Association for Animal Production Technical Series No 6. Wageningen Academic Publishers. ISBN 90-76-998256. Pp 113-122.

Fall, A. Fall, A. Diack & F. Dia 2003. *The role of work animals in semi-arid West Africa: current issues and their potentials for future contribution*. In: 'Working Animals in Agriculture and Transport. European Association for Animal Production. Technical Series No. 6. Wageningen Academic Publishers. ISBN 90-76-998256. Pp 27-38.

Leak, S.G.A. 2003. *Tsetse fly.* In: Encyclopaedia of Insects. Eds. Carde, R.T. & Resh, V. Academic Press.

3. CONFERENCE AND WORKSHOP PROCEEDINGS:

Oral Presentations:
Agyemang, K. Agriculture and Livestock integration in the context of the developing world, with emphasis on SSA. 2nd Triennial Conference, GFAR, Dakar, 22-24 May 2003.

Akinbamijo, O. O. 2003. Efficiency of Tsetse and trypanosomiasis intervention and the research agenda of ITC. Joint PAG/ICPTV Meeting, Pretoria, South Africa, Sept 23-26 2003.

Akinbamijo, O.O., J.J. Bennison & L. Dempfle 2003. Evaluation of diet and infection effects on blood metabolites of lactating trypanotolerant cows under artificial trypanosomal challenge. ISCTRC 27th Meeting, Pretoria, South Africa, Sept 29- Oct 4 2003.

Akinbamijo, O.O. Introduction to Peri-Urban/Market Oriented Systems. PROCORDEL National Conference, The Gambia, November 2003.

Akinbamijo, O.O. Feeding for milk: an evaluation of peri-urban feeding strategies based on locally available materials. PROCORDEL National Conference, The Gambia, Nov. 2003.
Bosso, N.A., van der Waaij, E.H., Agyemang, K. & van Arendonk, J.A.M. *Genetic parameters for growth traits under tsetse challenge in a pure N'Dama breed in The Gambia*. Proceedings of the 54th Annual Meeting of European Association for Animal Production. Rome, Italy, 31 August -3 September 2003.

Diall, O., Clausen, P-H, Diallo, B., Münstermann, S., Bocoum, Z., Diarra, B., Barry, A.M., Bengaly, Z., Affognon, H., Randolph, T.F., McDermott, J.J. *Field characterization of*

trypanocide resistance in the cotton zone of West Africa. Proceedings of the 10th Symposium of the International Society for Veterinary Epidemiology and Economics, November 17-21, 2003 Vina del Mar, Chile.

Diall, O., Clausen, P-H, Diallo, B., Münstermann, S., Bocoum, Z., Djiteye, A., Diarra, B., Barry, A.M., Bengaly, Z., Affognon, H., Randolph, T.F., McDermott, J.J. *Evaluation de la chimiorésistance des trypanosomes dans la zone sub-humide cotonnière de l'Afrique de l'Ouest*. ISCTRC, 27th Meeting, October 2003, Pretoria, South Africa.

Bosso, A.N., Corr, N. & Fall, A. Genetic Improvement of Trypanotolerant Cattle, Sheep and Goat in The Gambia (Purebreeding Programme). PROCORDEL National Conference, Banjul, The Gambia, November 2003.
Faburay, B., Münstermann, S., Fall, A., Jongejaan, F., Geysen, D. *Cowdriosis: Some epidemiological aspects.* PROCORDEL National Conference, The Gambia, November 2003.

Fall, A. An introduction to Low-input Livestock Production Systems. PROCORDEL National Conference, The Gambia, November 2003.

Hempen, M. *Quelques caractéristiques de la filière laitière informelle et l'hygiène du lait produit dans ce système en Gambie et au Sénégal* at a Conference on "Supply, Hygiene and Quality of milk and milk products in the Sahel", Bamako, Mali, 24 February to 2 March 2003.

Hempen, M. *Quelques caractéristiques de la filière laitière informelle et l'hygiène du lait produit dans ce système en Gambie et au Sénégal* at a Seminar on "Results from studies on the dairy sector in Tambacounda and Kolda", Kolda, Senegal, 4 to 6 June 2003.

Hempen, M. The hygienic status of raw and sour milk from smallholder dairy farms and local markets and potential risk for public health. PROCORDEL National Conference, Banjul, The Gambia, November 2003.

Leak, S.G.A., Ceesay, M.L., Fofana, D. & Münstermann, S. *Prevailing diseases and control options for F1 cattle in the Kombos Districts of The Gambia*. PROCORDEL National Conference, Banjul, The Gambia, November 2003.

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

Münstermann, S. Overview of the PROCORDEL programme 2001-2004. PROCORDEL National Conference, Banjul, The Gambia, November 2003.

Sanyang, F.B. Development of a milk production scheme in peri-urban areas based on an F1-breeding scheme PROCORDEL National Conference, Banjul, The Gambia, November 2003.

Schoenefeld, A. Training and Capacity Building. PROCORDEL National Conference, Banjul, The Gambia, November 2003.

Somda, J., Kamuanga, M. and Tollens, E. 2003. *Evaluating willingness to adopt integrated packages for trypanosomiasis control in The Gambia: Application of demand revealing mechanisms*. ISCTRC, 27th meeting, 29 September - 3 October 2003, Pretoria, South Africa.

Unger, F. (2003). Regional studies on bovine brucellosis and the related public health risk carried out at ITC in 2000-2003. Commonwealth Veterinary Association Regional Conference, 13-15 October 2003, Gambia.

Unger, F. Selected results of studies on zoonoses and the related public health risk carried out in The Gambia in 2000-2003: Bovine tuberculosis and brucellosis in cattle; Salmonellosis in cattle and chickens. PROCORDEL National Conference, 13-14 November 2003, The Gambia.

Unger, F. Résultats d'une étude sur les zoonoses et les risques associés pour la santé publique réalisée en Guinée entre 2000 et 2003. Proceedings of the PROCORDEL National Conference, 3-4 December 2003, Conakry, Guinea.

Unger, F. Résultats d'une étude sur les zoonoses (*B. abortus*) et les risques associés pour la santé publique réalisée en Guinée entre 2000 et 2003. Proceedings of the PROCORDEL National Conference, 3-4 December 2003, Conakry, Guinea.
Unger, F., Konte, M. Résultats d'une étude sur les zoonoses et risques associés pour la santé publique réalisée au Sénégal entre 2000 et 2003. Proceedings of the PROCORDEL National Conference, 22 December 2003, Dakar, Senegal.

Poster presentations:
Adediran S.A., Cham, A.O. F., Hess, P., Schade, C., Sillah, J., Njie, O., Münstermann, S. & Agyemang, K. 2003. Linking Agroforestry with smallholder Livestock production – *A strategy for Participatory Forest Management with communities in the Central River Division of The Gambia.* International Research on Food Security, Natural resource Management and Rural Development: Deutscher Tropentag 2003, Georg-August Universität, Göttingen, 8-10 October 2003.

Adediran S.A., O.B. Akinbamijo, O.O. Akinbamijo (2003). *Environmental Implication of Fuelwood Extraction and Gender Roles – Farmers' Perception of Sustainable Forest Management in West Africa.* International Research on Food Security, Natural resource Management and Rural Development: Deutscher Tropentag 2003, Georg-August Universität, Göttingen, 8-10 October 2003.

Akinbamijo, Y., Nouala, S., Saecker, J., Adesina, M.A., Hoffman, E., Muetzel, S., Fugile, L. & Becker, K. (2003). *Prospect of Moringa oleifera as a Feed Resource in the West Africa Mixed Farming System.* International Research on Food Security, Natural Resource Management and Rural Development: Deutscher Tropentag 2003, Georg-August Universität, Göttingen, 8-10 October 2003.

Akinbamijo, O. O., R. A. Pearson & A. Fall 2003. Quantitative approaches to the maintenance of Trypanotolerance of working N'Dama (*Bos taurus*) bulls in The Gambia. ISCTRC, 27th meeting, Pretoria, South Africa, Sept 29-Oct 4 2003.

Akinbamijo, O. O.; S. T. Fall, S. A. Adediran, P. Manirakiza F. B. Sanyang and O. B. Smith. 2003. The evolution of integrated Urban Farms in The Gambia and Senegal - a demonstration of sustainable partnerships in agricultural development. Second triennial conference of the Global Forum for Agricultural Research, Dakar, Senegal. 22-24 May, 2003.

Bosso, N. A., van der Waaij, E.H., Agyemang, K. and van Arendonk, J.A.M. Environmental and genetic effects on growth of N'Dama cattle raised under tsetse challenge. ISCTRC, 27th Meeting, Pretoria, South Africa. September 29 - 3 October 2003.

Hempen, M., Unger, F., Münstermann, S., Seck, M.T., Zessin, K.-H. *Small Scale Milk Processing: a Business Benefiting both Dairy Farmers and Consumers* at the Conference "Deutscher Tropentag" 2003, Georg-August Universität, Göttingen, Germany, 8 to 10 October 2003.

Leak, S.G.A., Hoeven, E., Kora, S., Faye, D. & Hanotte, O. 2003 Trypanotolerance and Genetic characterisation of small ruminants in West Africa. ISCTRC, 27th meeting, Pretoria, South Africa, 2003.

Münstermann, S., A. Fall, Y. Akinbamijo, A. Schönefeld, S. Leak, K. Agyemang. PROCORDEL: A regional research network for livestock development in West Africa. Conference on International Agricultural Research for Development, Deutscher Tropentag, October 2003, Göttingen, Germany.

Münstermann, S., D. Richard, M. Kamunaga, K. Agyemang, A. Gouro. PROCORDEL: A Model for Regional ARD partnership. Second triennial Conference, Global Forum for Agricultural Research (GFAR), Dakar, Senegal, May 2003.

Münstermann, S., Mbake, M., Mboge, K. Trypanocidal drug efficiency in trypanotolerant cattle in a high challenge area of The Gambia. ISCTRC, 27th Meeting, Pretoria, South Africa, 2003.

Steglich, M., K.-H. Peters. A methodology to identify the role of local institutions in livestock breed development: Results of a case study in West Africa. "Deutscher Tropentag" in Göttingen, Germany, 8 to 10 October 2003.

Unger, F., Münstermann, S., Goumou, A., Diallo, B., Konte, M., Zessin, K-H (2003). Seroprevalence of bovine brucellosis in herds supplying milk to local markets in Guinea, The Gambia and Senegal and potential public health risk. Brucellosis 2003 International Research Conference, September 15-17, 2003, University of Navarra, Pamplona, Spain.

4. ITC WORKING PAPERS:

Somda J., Kamuanga M., Münstermann S. Bittaye, A. 2003. *Socio-economic characterization of smallholder dairy systems in The Gambia: Milk production, marketing and consumption.* Socio-economy Working Paper No 1. International Trypanotolerance Centre. Pp 61.

Unger, F., Münstermann, S., Goumou, A., Apia, C.N. & Konte, M. 2003. *Risk associated with Mycobacterium bovis infections detected in selected study herds and slaughter cattle in 4 countries of West Africa.* Animal Health Working Paper No 1. International Trypanotolerance Centre. Pp 25.

Unger, F., Münstermann, S., Goumou, A., Apia, C.N., Konte, M. & Hempen, M. 2003. *Risk associated with bovine brucellosis in selected study herds and market places in four countries of West Africa*. Animal Health Working Paper No 2. International Trypanotolerance Centre. Pp 37.

5. THESES:

PhD Thesis:
Faye, D. (2003) Interaction et impact de la trypanosomose, des helminthoses gastro-intestinales, du type génétique et du niveau de nutrition sur la santé et la productivité des chèvres naines en Gambie. University of Liège, Institute of Tropical Medicine, Antwerp, Belgium.

MSc Thesis:
Dhollander, S. (2003) Health and productivity of West African Dwarf goats and their Saanen crosses in a tsetse infested area of The Gambia. Master of Science in Animal Health, Prince Leopold Institute of Tropical Medicine (ITM), Antwerp, Belgium

Thèse de doctorat de médecine vétérinaire:
Diouf, A. (2003) Prevalence and incidence of trypanosomosis in equines in The Gambia. EISMV, Dakar.