ANNUAL PROJECT PROGRESS REPORT

2004

March 2005

International Trypanotolerance Centre (ITC)

Banjul, The Gambia

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Introduction

The Annual Progress Report for 2004 contains summaries of results obtained from the implementation of the ITC Workplan 2004, required for the achievement of outputs for Year 4 of the ITC Medium-Term Plan (MTP 2001-2004). The MTP 2001-2004 was 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. The three Institutional Programmes LISIP, MOSIP and SOLIP comprise the 11 projects that are listed in Table 1. In 2004, Projects 1 and 2 were merged.

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 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 fourth year Workplans was the reaching of the milestones of 2003 and 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 during National and International Conferences, 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.

Institutional highlights

- Successful holding of an International Conference on livestock agriculture in which 120 participants from over 25 countries participated, including four Agricultural Ministers from the Region

- Successful celebration of the 20th Anniversary of ITC

- Institutional, Programme and Project-level research strengthened

- Integrated Research planning and coordination at institutional level instituted in 2001 and modified in the second half of 2003, as the Interim Team for Regional Research Coordination (IT-RRC) performed its tasks at the Centre and in the Region

- PhD Thesis of Staff judged best in an European University

Dissemination/Communication highlights

- 48 publications, comprising 1 book, 17 journal articles (in press, accepted, or submitted), 10 mimeographs and manuals, 1 PhD thesis, 15 Conference presentations and 3 poster presentations were recorded (list in Appendix 1). Two ITC Newsletter covering 2004 produced

- Work and activities of ITC printed and broadcasted in media (radio, television) in 3 countries in the sub-region (The Gambia, Guinea, Nigeria).

- 8 scientific seminars were held

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

- The 2nd ITC Emphasis Week was organised in November 2004 which culminated with an Open Day and 20th Anniversary Celebration, with the Vice President of The Gambia as Guest of Honour

Highlights on acquisition of financial support

- 14 Concept Notes/Research proposals submitted
- 5 proposals funded to date

Research and capacity building highlights

- Eight out of eleven Year 4 (2004) milestones fully realised, 2 partly achieved
- One of the higher degree candidates defended PhD Thesis
- 141 participants in training events from National and Regional institutions

Low-Input Systems Improvement Programme (LISIP)

Background and Justifications

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 input 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 dependant 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 focussed on (1) assessment of disease risk, (2) development of integrated vector and parasite control strategies, (3) genetic improvement of indigenous domestic ruminant resources and (4) integration of farm and on-farm resources to obtain synergies in faring enterprises.

Highlights and Achievements in 2004

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

Disease risk assessment and vector/parasite control

- Although there are 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 more trypanosusceptible crosses. 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". It is essential that distribution of F1 dairy cattle should only be carried out based on an assessment of the local disease risk, 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. Generally, low - zero tsetse / trypanosome challenge is recommended for F1 crossbred rearing.

- There are indications of the existence of a gradient of heartwater-risk for susceptible livestock species with risk increasing from the eastern region of the country towards the western region to the coast. This poses a threat to translocation of small ruminants from the eastern to the western regions and potentially to future livestock upgrading programmes in the country.

- The problem of drug resistance does not seem to exist or is still a very minor one in the Mandiana region of Guinea. However, since drug utilisation in this area is intensifying,

the development of drug resistance cannot be ruled out in the future. The introduction and enforcement of appropriate methods of rational drug use and control are recommended prevention strategies.

Impact of stress factors on maintenance of tolerance to diseases

- Technological packages (breeding stock, feeding strategies and disease control measures) that minimize the effect stress factors that compromise disease resistance and adversely affect productivity of ruminants have been designed and tested at the village level.

Crop-agroforestry-livestock integration and resource management

- The multipurpose use of Moringa for food, feed, fuel, fertilizer, and filter(water) are advantages that could drive its production. Results it has been demonstrated that on-farm production of *Moringa oleifera* can be profitable. However there is a big challenges for Moringa production include its integration into faming system, the problems of soil fertility and of conservation especially in the wet season when the optimum biomass yield could be obtained under rain fed condition.

Genetic improvement of indigenous animal genetic resources

- The GTZ/BMZ-funded long term project on breed improvement has been successfully completed. The established open nucleus breeding programme has been consolidated and the mechanism for the of the superior breeding stock has been strengthened and replicated in Guinea.

Collaborative Activities and Dissemination of Results

Linkages with Advanced Research Institutes, International and Regional Institutes, Regionally based donor-funded projects and NARS are considered essential for the realization of outputs and in their dissemination to grassroots beneficiaries. Several of such linkages were made in the course of planning and implementation of the programme in 2004. Among them the ILRI-led project on chemoresistance to trypanocidal drugs, The GEF project on sustainable management and conservation of endemic livestock.

Potential Impact

Locally the outcomes of this programme are valued to inform policies geared towards the development of the dairy sector in the Greater Banjul Area. In addition, the outcomes of the programme have been invaluable input to programmes of regional (ECOWAS focus on animal genetic resources) and global (GEF project) significances such as the project on *in situ* conservation of endemic ruminant livestock

INSTITUTIONAL PROJECT 1/2

Full project title:	Disease Risk Assessment, development and evaluation of control measures against vector and vector-borne diseases
Short title:	Disease Risk Assessment and control measures
Programme:	Low-Input Systems Improvement Programme
Project number:	LISIP 01
Location(s) of research:	The Gambia (ITC) Kerr Serigne
Start date:	January 2004
Project end date:	December 2004/2005

Background and 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:

- Disease risk assessment in periurban Banjul
- 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

Milestones 2004

- Risk assessment models applicable to sub-region available
- Parasite control measures integrated into micro and macro-policy and strategy for livestock development

Implemented Work Programme

Activity 1: Disease risk assessment and dissemination of integrated management and disease control packages for crossbred dairy cattle herds in The Gambia

Health interventions

Previous epidemiological findings in the Greater Banjul Area were used to design disease control and management packages for crossbred dairy cattle. Twenty (20) F1 farmers operating in 16 villages in the Kombos were classified into 3 groups based on the tsetse density and trypanosomosis prevalence rates established previously in these villages: 1) High risk: 4

farmers in 4 villages with 18 F1 cattle; 2) Medium risk: 5 framers in 4 villages with 9 F1 cattle; 3) Low risk: 11 farmers in 8 villages with 47 F1 cattle.

Disease control interventions were designed according to the level of challenge as follows:

- Farmers in Low risk zone: Therapeutic treatment using *Diminazene aceturate* (Berenil) at dose rate of 0.5 mg/kg body weight.
- Medium risk zone: Prophylactic treatment : All animals in this group received prophylactic treatment using 2% solution *Isometamedium chloride* (samorin) at 0.25 mg/kg body weight in July, October, and December 2004.
- High risk zone: Zero grazing and netting. Any animal detected infected is treated with Berenil.

Animals in the 3 groups received anthelmintic broad treatment in July and October 2004 using *Ivomectin.* Ectodip acaricide liquid was given to farmers in all three groups every month for fortnightly spraying of F1s against ticks.

Nutrition interventions

Low risk and medium risk zones: Farmers maintain their F1s on free range grazing practices throughout the rainy season and the beginning of the dry season. All animals were supplemented with Multinutrient blocks/mixture in June, October, November, and December 2004. Some farmers also gave concentrates (rice bran, millet bran, or groundnut cake).

High risk zone: Farmers were advised to zero-graze their F1 animals. However this was not adhered to due to the lack of ground hay or cut grasses. In January 2005, the Tumani-tenda farmer kept his F1s under zerograzed conditions using 6 kg of groundnut hay as basal diet for each animal plus millet bran and multinutrient mixture. Farmers provided all the feeds whilst the Multinutrient block/mixture was provided by the project in order to test the formula containing *Moringa oleifera* leaves.

Monitoring of health and productivity

Monthly blood samples were collected for laboratory diagnosis of trypanosomosis. Positive animals (infected) were treated with *Diminazene aceturate* (Berenil) at dose rate of 0.5 mg/kg body weight for the low risk group.

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. 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 infections 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

Ticks and fecal samples were collected from each animal during the monthly visits. The ticks were identified and counted, whilst the degree of helminth infestation wase determined using McMaster egg counting method. Animals having EPGs more than 500 were dewormed immediately. Farmers were given a quire book to record milk yield on daily basis at the start of the program and now on weekly basis.

Activity 2. Assessment of the epidemiological importance of Cowdriosis in small ruminants

This study involved a point seroprevalence survey of heartwater (E. ruminantium infection) in small ruminants and was carried out nationwide.

Activity 3: 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

Previous block treatment studies using isometamidium (ISMM) in 3 Mandiana District in the Cotton Zone of Haute Guinea indicated the possibility of drug resistance. Total number of breakthrough infections was small and were insufficient to verify the presence of drug resistant strains of trypanosomes. As a result, rapid resistance testing was carried in the field in 2003. These investigations included a Rapid Appraisal of farmers' views of periods of peak challenge and efficiency of trypanocides, block treatment of positive cases and preparation of reference DNA (positive controls) for trypanosome PCR. Specialised training on PCR techniques was given to Mr A.M. Barry, veterinarian from Guinea (DNE) working under the BMZ-funded ILRI/ITC project for the completion of his PhD, in collaboration with the Institute for Parasitology, Veterinary Faculty, FU Berlin, and the University of Bamako. In 2004, Mr. Barry returned to ITC for about five months (April – September) to carry out the following research work:

- Analysis of about 1000 blood samples by PCR for the presence of trypanosomal DNA
- Characterisation of trypanosomal field isolates from Haute Guinée by standardised tests in N'Dama calves for detection of drug resistance according to the protocol of Eisler et al. (2001)

PCR and strain characterisation:

- Setting up the PCR test system by utilising four different fragments (*Trypanosoma congolense* – savanna type and forest type; *T. brucei*, *T. vivax*)
- DNA extraction from 304 blood samples collected EDTA-tubes during the block treatment study at Mandiana
- Running of 1030 PCR tests on blood samples from Mandiana using four different fragments (*Trypanosoma congolense* – savanna type and forest type; *T. brucei*, *T. vivax*)
- Experiment on drug resistance characteristics of three trypanosome isolates from Haute Guinée in N'Dama calves under fly-proof conditions, according to the protocol of Eisler et al. (2001)
- Species confirmation by PCR of isolates used for the characterisation experiments in calves
- Confirmation by PCR of the efficacy of ISM at 0.5 mg/kg BW i.m., three days after treatment

Results

Activity 1: Disease risk assessment and dissemination of integrated management and disease control packages for crossbred dairy cattle herds in The Gambia

1.1 Tsetse - Kombo Districts, The Gambia:

The Kombo area is still exclusively infested by *Glossina palpalis gambiensis*. It was designated a low tsetse challenge area (<3 tsetse / trap / day) in the 1980s through the 1990s. Tsetse density is still less than 3 tsetse / trap / day when the whole of Kombo is taken into context. However, Abuko (25.67 catch / trap / day), Sala (10.25 t/t/d), and Kitty (5.5 t/t/d) are high tsetse density areas that have greatly influenced on the trypanosome transmission rates in Kombo. This is mainly due to cattle grazing and drinking near these hot spots and also for the extreme sensitivity of F1 cattle. Catches at Mandinaring and Tumanitenda, previous hot spots, have dropped due to inaccessibility to good sites and also effects of season although improved management and intervention measures can be a contributing factor. However, there are many areas of very low tsetse density (<1 catch / trap / day) particularly in and around the big towns. *Trypanosoma congolense* and *T. vivax* were detected and high infection rates (12.59%) of *T.*

vivax and (3.73%) of *T. congolense* were found. However, *T. brucei* was detected in cattle and had been found in tsetse previously using DNA probes**.**

Four species of Tabanidae, *Tabanus taeniola, T. sufis, T. bigutattus* and *Atylotus agrestis,* were captured and identified. The density of Tabanidae was low and poses no significant threat to livestock.

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 more trypanosusceptible crosses.

1.2 F1 dairy cattle – Kombos Districts, The Gambia*:*

Trypanosome infections in F1s were detected in the high risk (HR) and low risk (LR) groups. No infections were detected in the medium risk (MR) prophylactic group, suggesting that the three times prophylactic treatment with Samorin was able to protect the F1s from trypanosome infections.

F1s in the HR group were not stabled in insecticide-impregnated netting for the first 6 months of monitoring. It is only in January 2005 that only one farmer in Tumani tenda starts to zerograzed his F1s on groundnut hay inside an insecticide-impregnated netting. If all F1s in this group are stabled from January it could be possible to illustrate the efficacy of the insecticide-impregnated netting.

Two trypanosome species *Trypanosoma congolense* (66.7%) and *Trypanosoma vivax* (33.3%) are recorded for the 9 trypanosomosis cases of the high risk group. Similarly, two trypanosome species *Trypanosoma vivax* (75%) and *Trypanosoma theiliria* (25%) are recorded for the 4 trypanosomosis cases of the low risk group. There are no mixed infections cases.

High prevalences were recorded especially during the rainy in high-risk areas (16%, 12%, and 20% in July, August, and December, respectively). Low risk areas had 2%, 2%, and 4% in August, November, and December, respectively. Generally, most infections occurred during the rains and early dry seasons.

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. Cattle kept under intensive or semi-intensive conditions, in these built-up areas with little suitable tsetse habitat, are under low trypanosomosis risk. Nonetheless, high numbers of *Stomoxys* spp. were occasionally recorded around such herds and these could pose a risk of mechanically transmitted trypanosomosis. However, the increased use of pour-on insecticides as an intervention measure has reduced their numbers. 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.

Management practices are being introduced to cope with the challenges of rearing F1 crosses for improved dairy production. Tsetse control under the various challenge situations would not be cost effective unless it also provided benefits from tick and nuisance fly control. Pour-on insecticides are being used for such an integrated approach to disease control. The costs and technical feasibility are also assessed. Zero-grazing system in which fodder is brought to crossbred animals were tested for high disease risk situations and integrated with health management using tsetse control. The semi-intensive method integrated with the use of prophylaxis and insecticide pour-on and the extensive system integrated with tick and helminth control is the option for medium and low challenge situations respectively. 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.

It is essential that distribution of F1 dairy cattle should only be carried out based on an assessment of the local disease risk, 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. Generally, low – zero tsetse / trypanosome challenge is recommended for F1 crossbred rearing.

1.3 *Ticks and tick-borne diseases*

In general the over all tick counts are less than 30 per animal. In decreasing order the tick species encountered are Amblyoma, Hyaloma, Boophilus, and Rhipicephalus. Virtually some F1s are tick-free, especially at areas where farmers apply ectodip every fortnight such as in Kerr Seringe. No tick-borne disease parasite was detected from blood samples.

Activity 2: Epidemiology of* E. ruminantium *infection in small ruminants (The Gambia): a point seroprevalence survey

About half (51.6 %, *n*=639) of the sheep samples tested positive for *E. ruminantium* infection with seroprevalence ranging from 6.9 % to 100%. The highest seroprevalence was detected in the two most westerly regions, Western Division (88.1%) and Lower River Division (63.1 %), of the country. Sheep populations in the two easterly regions, Central River and Upper River Divisions showed the lowest levels of *E. ruminantium* serpoprevalence of 29.3 % and 32.4 % respectively and therefore the most at risk of heartwater disease. Sheep sampled in North Bank Division showed an intermediate level of seroprevalence (40.6%). In contrast, of the 679 goat samples collected, less than half (30.3 %) of them were positive for *E. ruminantium* infection. Overall, the highest seroprevalences were detected in goat populations in North Bank Division (59 %) and Western Division (44.1 %) with more than half of the animals sampled in North Bank Division testing positive for heartwater infection. Seroprevalence in goats in Lower River Division (21.9 %) showed an intermediate level, with the two most easterly Regions, Central River Division (4.8 %) and Upper River Division (2.3 %) showing the lowest level of seroprevalence. Furthermore, the results showed that in all Regions, except for North Bank Division, overall seroprevalence was significantly higher ($P < 0.001$) in sheep than in goats. In fact at all sites except for one in North Bank Division, the proportion of seropositive samples was consistently higher in sheep than in goats. In conclusion, these results indicated the existence of a gradient of heartwater-risk for susceptible livestock species with risk increasing from the eastern region of the country towards the western region to the coast. This poses a threat to translocation of small ruminants from the eastern to the western regions and potentially to future livestock upgrading programmes in the country.

Activity 3: Testing for the occurrence of chemoresistant strains of trypanosomes isolated from trypanotolerant cattle in Haute Guinée, in the framework of a coordinated regional study on the management of trypanocide resistance in the cotton zone of West Africa

Two of the field isolates used for experimental infections were identified as *T. b. brucei* (stabilates 4235 Gui 05; 4165 Gui 05), the third as *T. congolense* -savanna type (5769 NJ).

DNA of *T. congolense* -savanna type became undetectable 1-2 days after treatment, while DNA of *T. brucei* remained traceable for at least three days post treatment. No animal relapsed within an observation period of 100 days.

The PCR diagnostic technique was superior to the parasite detection by HCT. The experimental N'Dama breed cattle were clearly showing signs of trypanotolerance as parasites became undetectable about 70 days after infection with the HCT (not PCR negative) and animals still gained some weight at a lower PCV level of around 20 %.

From these results, the summarizing conclusion is drawn that the problem of drug resistance does not seem to exist or is still a very minor one in the Mandiana region. However,

since drug utilisation in this area is intensifying, the development of drug resistance cannot be ruled out in the future. The introduction and enforcement of appropriate methods of rational drug use and control are recommended prevention strategies.

Since December 2004, Mr. Barry is in Bamako for pursuing his academic study requirements at the Medical Faculty of the University (ISFRA) and the writing up of the thesis under supervision of Prof Amadou Diallo. In April 2005, he will return to Guinea. He is planning to submit his thesis later in 2005, for the defence in late 2005 or early 2006.

Potential Impact

Disease risk assessment 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 a result, an integrated Nutrition / Health Management Packages were developed from the F1 monitoring activities and is being currently tested in the field.

The experimental work on trypanocide therapeutic efficiency using PCR has revealed that field isolates from Haute Guinée were sensitive to the tested drug ISM. It also confirmed the superior management of trypanotolerant N'Dama breed of cattle to cope quite well with AAT under normal conditions. The summarizing conclusion is that the problem of drug resistance does not seem to exist or is still a very minor one in the Mandiana region. However, since drug utilisation is intensifying, the development of drug resistance cannot be ruled out in future. The introduction and enforcement of appropriate methods of rational drug use and control are the recommended prevention strategies.

Attainment of Medium-Term Plan Milestones

By the end of 2004 the activities undertaken within the project contributed to the realisation of the MTP milestones for the year.

Application of the Nutrition / Health Management Package to the control of tsetse and trypanosomosis, tick and TBD and helminths for F1 farmers in the Greater Banjul Area. This is described above.

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.

The adoption and application of control intervention measures at farmer level in the F1 diary Industry is a big step in meeting the 2004 milestones.

In 2004, ITC continued to strengthen its collaboration with the extension services of the Department of Livestock Services through various training workshops in order to transfer technical research results to livestock producers. The large number of extension workers and farmers that were trained contributed to the awareness on disease control at village level.

Based on the results of the Disease risk assessment for F1 cattle in the Kombos Districts of The Gambia, an integrated Nutrition / Health Management Package was formulated and is already being applied by farmers.

Contributors

Institutional Project Leader: S. A. Leak (up to May 2004); A. Fall (acting)

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

Senior ITC Technical staff: A. Ceesay, M. Touray, A. Jarju

Collaborating ITC Special Projects: PROCORDEL, Small Ruminant Research Project

Collaborating institutes and scientists:

The Gambia: Department of Livestock Services (NARI), Dr. Arss Secka, Jouf, Darboe; 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

ITC/CIRDES/CTA International Conference on Animal Agriculture in West and Central Africa, 8-12 November 2004, Banjul, The Gambia

INSTITUTIONAL PROJECT 3

Full 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 maintenance of disease resistance /resilience
Programme	Low-Input System Improvement Programme
Project number	LISIP03
Location(s) of research	The Gambia (Kombo, Bansang)
Start date	January 2001
Projected end date	December 2004/2005

Milestones **2004** Technological packages/options made available to farmers in pilot sites

Background and Objectives

The exploitation of resistance/resilience of local stock to parasitic diseases constitutes an economically profitable and an environmentally sound strategy for control of these diseases that are considered serious bottlenecks to the development of animal agriculture in West Africa's subhumid and humid zones. However a number of stress factors including poor nutrition, physiological status and intercurrent diseases may influence the ability of these breeds to express their resistance/resilience to these diseases. In addition, an increasing number of trypanotolerant cattle (especially the NDama) both male and female, is being used for work purposes in sub-Saharan Africa and it has been shown that work can compromise the antibody response to trypanosome infection. Moreover, the rapid expansion of use of exotic germplasm for crossbreeding is likely to dilute the indigenous gene pool and therefore might erode the ability of genetic resources to adapt to diseases.

In connection to these factors, this project has set its objectives as follows: (1) to investigate the interactive relationship between the stability of disease resistance/resilience and known stress factors such as plane of nutrition, physiological status and work and (2) to study the resistance/resilience of crossbred ruminants to vector-borne diseases. Outputs include (1) quantified assessment of impact of stress factors on indigenous and crossbred ruminants and (2) production of packages (technical and environmental) that minimize impact of stress on targeted stock.

Implemented Work Programme

Activity 1: Mechanism to establish farmers' ownership of genetically improved small ruminants in Sierra Leone

Sheep and goats were bought from multiplier facilities in The Gambia to establish multiplier flocks in Sierra Leone as a means to contribute to the restocking of the livestock population in Sierra Leone after more than 90% of the animals in the country having been killed during the 10-year war period.

Activity 2 Up-scaling of technological innovations for improved trypanotolerant ruminant livestock productions in The Gambia

The testing of technological packages with the view to reduce the effects of stress factors hence to improve ruminant productivity was carried out in two districts for cattle (CRD north and CRD south) and two districts for small ruminants (CRD North and URD). The technologies tested for both cattle and small ruminants, were the introduction of improved bulls, rams or bucks and the strategic supplementation of animals. These two treatments were applied alone or in combination in herds and control herds were also included in the study protocol. 571 animals from 23 herds in 11 villages were involved. These animals represent 277 pairs of cow-calf units. The herds were allocated to treatments as followed: (1) Improved bulls alone: 3 herds; (2) Supplementation alone: 3 herds; (3) Improved bulls + Supplementation: 2 herds and (4) Control group no improved stock, no supplementation: 5 herds. All herds including the control group have received health treatments including vaccination against Black Quarter and Haemorrhagic septicaemia and a deworming and external parasite control mainly against ticks.

For small ruminants, a similar design is also used. A total of 174 sheep and 155 goats from six flocks of sheep and six flocks of goats in 5 villages are concerned. These are allocated to the treatments as followed: (1) Improved rams/bucks alone: 1 flock; (2) Supplementation alone: 1 flock; (3) Improved ram/buck + Supplementation: 2 flocks and (4) Control group : 2 flocks. All flocks including the control group have received health treatments including vaccination against PPR and pasteurellosis and a deworming and external parasite control mainly against ticks. Data collected include monthly weightings of animals and milk recordings. For milk yields, only morning milkings have been recorded. Data collection started in September 2004 and continuing.

Activity 3. Training manual: Proposed management interventions for improved small ruminant productivity in The Gambia

The draft training manual was finalized in August. The content of the manual is covering issues such as diseases, improved nutrition (e.g. IFGs) and housing of small ruminants. It is largely based on research results of the Belgian Government (DGDC) funded Small Ruminant Research Project (1995-2003) and of the RFCIP Intensive Feed Garden Programme, but was complemented with results available in literature and existing manuals. Printing was done in October and the output is a 69-page black-and-white training manual (*Proposed management interventions for improved small ruminant productivity in The Gambia*) which is largely pictorial and where use of full text (English) is minimized. Two version have been produced, one for the extension officers (with annex on drug use and treatment) and one for the farmers (without annex). Book was subsequently distributed witin ITC, DLS and NARI, as well as to donors and collaborators outside.

Activity 4. Farmer Field Schools for small ruminant producers in rural areas of The Gambia

Farmer Field Schools are based on an innovative, participatory and interactive learning approach. The FFS approach was developed by FAO in South East Asia for IPM in small-scale rice farming and ILRI developed the FFS methodology in livestock production.

The ITC-FFS programme is conducted in collaboration with DLS and with funding or support from DFID, VVOB and ILRI. Initially, 6 FFS groups with the targeted number of members (25-35) and composed of farmers with a common interest in small ruminant production, were formed in 4 villages in the vicinity of Bansang (Njoren, Korup, Manneh Kunda and Dobong Kunda). Facilitation was done by 4 livestock assistants (3 ITC and 1 DLS) who benefited from the ITC/ ILRI/DFID Training-of-Trainers in FFS approach (July 2003). At a certain stage, the separate FFS groups in both Njoren and Dobong Kunda were merged into one. Every group chose a name ("*chossan"* in Njoren, "*jokore eidam*" in Korup, "*beyang yiriwa kafo*" KAFO in Dobong Kunda and "*beyang nyeriwandee kafo*" in Manneh Kunda) and was consilidated and made operational by the formation of executives, adoption of by-laws and opening of a bank account at the Bansang VISACA. Problems regarding small ruminant production (diseases, nutrition, housing, etc) were identified and ranked by the different groups, using participatory techniques (such as Participatory Epidemiology in case of diseases). Following this exercise, PPR came up as a common threat to SR production and together with DLS a vaccination campaign (also for Pasteurella) was conducted in the villages. In May a consultant from ILRI came on a back-stopping mission for one week and visited the different sites. A *curriculum* was developed by the different groups, outlining their major constraints and the practical experiments to be conducted (PTD's) by them in order to test and compare technologies to solve them. This was followed by disbursment of grants to every group in order to enable them to complete the *curriculum*. A reference training manual with improved guidelines for small ruminant productivity was compiled and made available for facilitators.

Furthermore, the project established links with AAJAC-COLUFIFA in Faoun, Senegal who envisage to use the FFS approach in a small-scale poultry project (supported by a Danish NGO) in Casamance and CRD. A successful 3-day Training-of-Trainers for 15 "*agents polyvalents"* was conducted there in November by the project.

Results

Activity1 . Mechanism to establish farmers' ownership of genetically improved small ruminants in Sierra Leone

About 60 female and male sheep and goats were transferred to the war-torn District of Bombali in Sierra Leone to establish multiplication facilities. More animals are to be sent and monitoring of flocks in their new environment is on-going. Limited mortalities in kids have been reported so far which indicate the adaptability of the animals from the Gambian multipliers in Sierra Leone.

Activity 2. Up-scaling of technological innovations for improved trypanotolerant ruminant livestock productions in The Gambia

The effects for the improved bulls/rams will be measurable on their offspring and the supplementation had actually started after December 2004. Therefore, only baseline data against which the effects of treatments applied will be evaluated were available at the moment of compilation of this report. 278 cows and 269 calves have been weighed between 1 and 3 times and data collection is continuing. A total of 640 records for cows and 625 records for calves have been taken. For the calves there were out of the 269 animals recorded, 217 for which the age was known and age classes have been constructed for the analysis.

For cows, the mean weight was 225.3 ± 32.2 kg. Effect of parity on the average weight for cow was also examined. Even though a statistically significant difference was not detected on the mean weight of cows of different parities, a slight tendency in mean weight increase from parity 1 to 4. This trend is probably related to the late maturing of N'Dama cattle which continues to grow after the first calvings.

The number of cows recorded for milk yield was 257 with a total of 1287 morning milk yield measurements made. The average milk yield was 667.1 ± 332.6 ml. The minimum yield recorded was 100 ml and the maximum 2900 ml. With respect to parity of the cow, the analysis did show any significant difference among cows of different parities even though a slight increase in milk yield from parity 1 to 4.

Activity 3. Training manual: Proposed management interventions for improved small ruminant productivity in The Gambia

Training manual finalized, printed (150 copies) and distributed; Pdf-file in colour available on CD-Rom; Reference material available for FFS facilitators.

Activity 4. Farmer Field Schools for small ruminant producers in rural areas of The Gambia

4 groups established and fully operational; Curriculum *developed* by the groups and implemented; First comparative experiments regarding relationship between (type of) housing and ecto-parasites and footrot conducted; PPR and Pasteurella vaccination; Reference training document available with facilitators; Funding proposal for 2005 accepted by DFID-AHP; VVOB as co-funding agency; Links established with FFS work in Senegal.

Potential Impact

It is expected that the adoption of the health, nutrition and management interventions being tested at a wide scale at the village level with the involvement of farmers and livestock assistants will have a significant impact on the productivity of indigenous ruminant livestock in The Gambia. These results will be documented and widely disseminated in the sub-region.

Attainment of Medium-Term Plan Milestones

The 2004 millstone for this institutional project is: *technological packages/options made available to farmers in pilot sites*. Technological packages that minimize stress factor that compromise disease resistance and adversely affect productivity have been designed and tested at the village level.

Contributors

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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 (Labe)
Start date	January 2001
Projected end date	December, 2004/2005

Background and Objectives

Throughout sub-Saharan Africa increasing human population and livestock 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 in integrated, mixed crop-livestock farming systems. All the aforementioned changes are contributing to an agricultural intensification process in the region, a phenomenon, which many recent assessments identify as a natural consequence of the severe resource competition. Thus, integration of cropping, agroforestry, and livestock will become more imperative in the region.

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

Specific objectives for 2004

- Propose options for efficient use of available and alternative feed resources across systems.
- 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.
- Evaluate the productivity of stabled cows in comparison with those of extensively managed animals
- Evaluate the economic returns of the stabulation technology in financial terms

Milestones

2003: Methodologies and tools for conducting research in integrated crop-agroforestry-livestock farming

2004: Decision-support systems for prediction on integration possibilities made available

Implemented Work Programme

Activity 1: Establishment and Evaluation of Moringa oleifera leaves as supplement in animal nutrition in LRD, The Gambia. (Improving household and livestock nutrition in low-income mixed farming systems in The Gambia)

In collaboration with the National Nutrition Agency (NaNA), *Moringa oleifera* plots were established in communities. Of the eight communities that demonstrated willingness to participate in 2003, seven are still involved in 2004. These are Jenoi, Japineh-Tambeto and Pakaliba in the Jaras as well as Kwinella mansankonno, Kaiaf, Manduar and Burong in the Kiangs.

Moringa establishment and follow up in communities continued during the year. Sensitisation meetings were conducted in existing and new villages. Fencing materials were procured and delivered by the National Nutrition Agency (NaNa). As at August 2004, six communities have either completed or partly completed fencing. All the communities are at various stages of work. Ploughing and planting were done completed in Kaiaf, Burong, Pakaliba, Japinneh Tambeto and Kwinella. In the other two communities, planting is in progress. Weeding is due in nearly all the fields and the farmers are encouraged to do the weeding and fertilizer application on time. In three of the communities, the Moringa planted last year had re-established well. The Moringa plots are being extended in Burong, Manduwar, Kaiaf, Kwinella, Jenoi and Pakaliba communities.

Activity 2: Establishment, expansion and evaluation of Intensive Feed Gardens for small ruminant production (Gambia)

During the reporting year funding from rural finance to support the IFG's came to an end. Activity was focussed on exisiting IFG's and the use to which communities are putting the gardens. During vists in the rainy season, the IFG's in Drammeh and Salen kotoh were in very good condition. The plots were weeded and biomass was high. When questionned as to usage, farmers in Salen kotoh reported cut and carry/zero grazing the feed resource to sick, vulnerable, weak and producitve animals. This was in keeping with the objective of the IFG establishment. In Korup, a community that benefitted from the Saanen x WAD goat production, a livestock pen was constructed within the garden. Here there was maximum utilisation of the IFG. It was observed that the farmers were not able to effectively control the animals and there was danger of overbrowsing. Farmers were senstitized on the for animals to be restrained to allow the tress to recover.

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

Reports from the Central River Division Forestry project (CRDFP) indicate that this activity, previously in partnership with ITC, continued in collaboration between CRDFP and the department of livestock services (DLS), hence no direct activities were carried out by ITC.

Activity 4: Dry season stabling in Guinea Bissau: Evaluation of productivity and economics of the intervention in Guinea Bissau

The 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 and body condition and milk offtake from April to June 2003. Stabled cows were supplemented with cotton seed, groundnut hay and rice straw. They were also dewormed. Non-

stabled animals did not benefit from these package. Quantity and costs of inputs were also measured.

Activity 5: Establishment of *Moringa oleifera* plantations on-station and on-farm (follow-up); yield evaluation; technology for conservation

On-farm Moringa plots were evaluated during the reporting year. Existing plots in Banjulding and lamin horticultural gardens were maintained. A new plot was established in Sukuta garden. Individual farmers; Drs Manneh, Tujerein and Baba Njie, Abuko continue to maintain their Moringa plots. The plot in Tujerin was expanded. In some of the plots yield parameters could not be evaluated on the rain-fed plots, due to uncontrolled browsing by animals, except in Lamin horticultural garden where yield/ha of 3.5t at one cut were obtained. New additional contacts were made with farmers owning F1 crossbred cattle, in peri-urban areas, and some villages. Most had not planted or reported poor germination as at 19th August due to delayed rainfall and workload on personal farms.

The Moringa plot on-station was monitored during the reporting period. Two 1000 ltr capacity water tanks were installed at the cost of D17, 000, to facilitate irrigation in February 2004. A water-pumping machine was also installed. Eight thousand litres of water per day was pumped to about half an hectare of the land from February to June 2004. The other half did not receive irrigation during the dry season. Two staff worked on a makeshift (4 days a week) basis on the plots from January 2004 till date, for irrigation, stumping weeding, fertilizer application and harvesting. In addition, D2, 800 was paid for weeding one hectare of the plot in July 2004. Organic manure was applied at the rate of 10 tons per hectare in February 2004. Subsequently NPK fertilizer was applied, after each 60 days cut on the irrigated plot at the rate of 400kg per ha. Three cuttings have been done on the irrigated plot and one on the non-irrigated plot.

Activity 6: Economics of *Moringa oleifera* production on-farm

A researcher-managed Moringa plot was established on farm to facilitate economic evaluation of Moringa production. Two varieties, India and Senegal, were tested under different fertilizer treatments; Organic, organic plus inorganic, inorganic and zero fertilization types respectively for treatments one to four. The design was split plot with fertilizer types as main plots and variety as sub-plot. Each plot was replicated four times. Agronomic, yield and input output parameters were recorded.

Results

Activity 1: Moringa in Low-income mixed farming systems

Communal Moringa plots were established in nine of the ten sites identified in LRD. Although planting was late in some communities, establishment was good. Of the ten communities that were involved last year, nine retained and maintained their plots, three communities expanded, whilst six replanted. Accompanying technologies for the conservation and utilization of *M. oleifera* leaf powder were further tested on-station and disseminated through community based groups training to a group of 25 women YAMPI farmers and 22 youth members of community youths. On-going collaboration with the National Nutrition Agency NaNA was strengthened.

After resolving the fencing problem, the main constraints identified by communities were scarcity of labour to plant Moringa at the critical period of early rainy season. By the time farmers "finish" working on their food crop fields, the rainy season is half spent. The next technical problem was poor germination due to intermittent rainfall and poor soil fertility.

Activity 2: Establishment, expansion and evaluation of Intensive Feed Gardens (IFG) for small ruminant production (Gambia)

Communities continue to use the IFG's for diverse purposes. Leucaena leaves were used to supplement vulnerable groups of animals. In Korup, the IFG was integrated and expanded with a vegetable garden and small ruminant stable. Horticultural practices continued in most of the IFG's.

It is expected that communities will put to use their knowledge of conservation techniques during the dry season, but this was not the case. Some of them complained of work load during the harvest season and animals had browsed the resource before they could be ready. Five persons planted the browse plants in their backyards. Many more were interested but could not afford the cost of fencing. It is strongly believed that in the long run, individual farmers may be willing to put more efforts into the production when they can expect to reap the direct benefits.

Communities are still at a production level that does not generate surplus biomass; hence multi-nutrient blocks are not being made on community basis. Individual farmers in two communities have picked up the technology and have produced nutrient blocks from Leucaena grown on their own plots. One of the communities is involved in the Farmer field School (FFS) programme.

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

Reports from the Central River Division Forestry project (CRDFP) indicated that the guidelines established by the Senior Extensionist from ITC on integration of forestry with agriculture continue to guide the approach to community involvement in forestry management. All joint agreements were maintained and new ones were signed. Requests were made for additional herbaceous legume seeds to meet increased demands from communities.

Activity 4: 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 and this reflects the higher availability of feed resources in Oio than in Bafata. Stabled cows maintained their live weight (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 (430ml/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)

Activity 5: Establishment of *Moringa oleifera* plantations on-station and on-farm (follow-up); yield evaluation; technology for conservation

The on-station irrigated Moringa plot was monitored for technical and economic parameters on both irrigated and non irrigated plots. In three cuttings at 60 days interval, average biomass yield of 15.05 tons DM/ha of Moringa re-growth in 60 days growing cycles, out of which 10.54 tons DM/ha of leaf or edible materials was obtained. A fourth cutting in November 2004 yielded an additional 4-7 tons DM/ha. At 25% Crude protein, this translates to 2.64 tons of crude protein per ha. An equivalent quantity of groundnut cake would cost 15, 840.00 Dalasis or USD 528.00. Experiments in ITC have shown that Moringa leaf could effectively substitute for groundnut cake in the diet of productive animals.

The results demonstrated that the synergistic effect of combined fertilizer application translated to higher income and increased profit margins. With farmers owing livestock, overnight kraaling on the plots to be used for Moringa will be an attractive option to cut down

on the costs of manure transportation and application. From these results it was demonstrated that on-farm production of *Moringa oleifera* can be profitable.

Activity 6: On-farm economics of *Moringa oleifera* production

The Senegal variety consistently performed better at all tested treatments except in treatment three (inorganic fertilizer plots) in which the India variety was better. Biomass yield were respectively 3.88, 3.49, 5.46, 3.05, 1.52, 2.25, 0.77 and 0.10 tons DM/ha for Senegal and India varieties on treatments 1-4. Production cost per kilogram of moringa averaged 10 Dalasi for treatments 1 and 2, 12 Dalasi for treatment 3 and 100 Dalasi for treatment 4 (zero fertilizer treatment). Weeding at week 4 and fertilizer costs account for greater proportion of input costs.

On farmers fields, four individual farmers and four communal plots were monitored. Edible biomass ranged from 0.81-9.91 tons DM/ha and 0-7.92 tons DM/ha respectively for both groups. Further classification within groups showed that yields averaged 6.93 tDM/ha for medium scale individual producers as against 4.07 tDM/ha for communal groups.

Potential Impact

The technical versatility of *Moringa oleifera* has been established. Moringa is already being grown in some communities in peri-urban areas through the efforts of AFET, an NGO. The importance of this plant as a feed resource is however only now being realised. Its multipurpose use for food, feed, fuel, fertilizer, and filter(water) are advantages that could drive its production. Greater appreciation of the potentials of Moringa have been achieved with semi-intensive urban and peri-urban livestock producers who have been more responsive to innovation and are trying different techniques of utilisation where the constraints of space could be surmounted. These include, direct feeding, inclusion of Moringa into concentrate rations, silage and multi-nutrient block production. This will increase farmer's feed options, improve livestock access to good and cheap protein source and contribute to improved productivity. In low input systems, the IFG's is evolving as an avenue to promote vegetable production to improve human nutrition in addition to livestock feed.

The results obtained indicate a high potential of good quality fodder that can potentially meet the anticipated increases in nutrient demand especially by high-yielding crossbred animals. The implication for animal production is that there is a possibility to generate high quality fodder that can match the production requirements of lactating crossbred animals at a much lower cost compared than the conventional supplements. In conclusion, the study showed that it is possible to attain a biomass yield of about 15 t DM/ha of good quality fodder that can contribute to the nutrition of urban ruminants.

However there is a big challenge for Moringa production. No studies exist on its integration into faming system and there are few studies on its use as livestock feed. Efforts so far on-farm moringa introduction suggest that medium scale farmers have good potential to adopt Moringa production. On the technical side, there is the problem of conservation especially in the wet season when the optimum biomass yield could be obtained under rain fed condition. Direct feeding, after wilting and silage production are proposed as options. Initial thrusts in silage making have shown very interesting results in ITC.

Attainment of Medium-Term Plan Milestones

During the reporting period, a poster on the potential of Moringa as feed resource was presented at the 11th Conference of the Association of Institute of Tropical veterinary medicine in Malaysia. The results of many years of research activities and technological interventions of the

former Small Ruminant Research Project resulted in a training manual for small ruminant producers, edited by Erik Hoeven. These publications contributed to the MTP milestone for the year.

Contributors

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Meetings

ITC/CIRDES/CTA International Conference on Animal Agriculture in West and Central Africa, 8-12 November 2004, Banjul, The Gambia

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 2004/2005

Milestones 2003 Documentation on breeding, selection, data collection and analysis made available to NARS scientists

2004 Process of estimating genetic progress initiated for small ruminants

Background and 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 2004 included:

- 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

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 nucleus herd maintenance and pasture improvement (Keneba), performance testing, selection and dissemination with emphasis on support to existing and establishment of new multiplication herds and flocks

In 2004, gains made in the establishment and running of the nucleus for cattle, sheep and goats in previous years were further consolidated. At the multiplier tier, support to the Association of the multiplier groups (GILMA) was provided and sensitisation, training of trainers and/of farmers were achieved. Additional multipliers of small ruminants and cattle were established.

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

Through funds made available from the EU-funded regional project, PROCORDEL, the N'Dama nucleus herd at Boké, Guinea, was consolidated in 2004. 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. In addition, the design and establishment o a mechanism for the dissemination of the breeding stock was done in 2004 through the setting up of multiplication facilities for Ndama cattle.

Activity 3: Support, monitoring and impact evaluation of multipliers of the pure breeding programmes in The Gambia and Guinea

In 2004 the preliminary indications of financial benefits and socio-economic impact of the breed improvement programmes was assessed at the level of the nucleus and at the multiplier and producer levels. At the nucleus level analyses were based on genetic progress made when translated into monetary terms. At the multiplier and producer levels comparisons were made among the "before and after" situations of participating farmers and on the "participating" and "non-participating" groups in the breeding programmes. A random sample (n=26) of villages, kafos and individuals that are participating in the project were selected, together with control groups (non-participating; n=24) and surveyed in December 2003 to obtain information on stock productivity, mortality, offtake rates and prices, as well as perceptions about their animals.

Activity 4: Finalising research and submission for PhD Thesis on "Optimum strategies for the implementation of pure breeds improvement programmes"

In 2004, the pure breeding programme for N'Dama cattle was consolidated and strong emphasis was given to the establishment and support of multiplication facilities. In the PhD study on "Optimum strategies for the implementation of pure breeds improvement programmes" progress was made in the description of the N'Dama cattle breeding structure, the steps in the production of the improved germplasm and how that improved germplasm were transferred to the farmers. Another key activity was a review of the ITC breeding scheme with respect to structure and performance and the results compared with those recorded in similar programmes and reported in the scientific literature. The outcome of the exercise was reported in a Paper entitled: *Optimum strategies for the implementation of pure-breed improvement programmes in The Gambia: A Review*.

Results

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

The pure breeding programme, an ongoing program with the nucleus cattle herds and flocks operating from Keneba and weaner and young adults tested in Missira in Niamina East, continued to operate in 2004. The routine management of the herds and flocks which includes monthly weighing, weekly milk measurement, data recording on mating, treatment, breeding value estimation, selection and dissemination of breeding stock to multiplier farmers for both cattle and small ruminants was maintained throughout 2004. Furthermore, pasture improvement and cereal grain production and crop residue generation were carried out in Keneba to improve the feed situation at the Station.

The collaboration with DLS which is considered crucial remained cordial and was effectively used in data collection from the multiplier herds and flocks and in the dissemination and monitoring of improved genetic material. In June 2004 it became necessary to replace rams and bucks in Mbappa Baa, Mbappa Marigeh, Missira and Ballangharr. In April 2004, 13 bulls were distributed to multiplier farmers, during the dissemination process an orientation workshop on the pure breeding program was carried along for new recipients of the multiplier bulls and Livestock Assistants responsible for monitoring these herds. The content of that workshop included the following topics: concept of the pure breeding programme, guidelines for multipliers, roles and expectation of multipliers, and feed conservation and management of multiplier herds. In addition, replacements of the first bulls which were issued in 2001 were carried out in four multiplier herds, 2 in Karantaba Wolof, 1 in Chgargel and 1 in Sare Soffie village, respectively. By the end of 2004, 44 improved breeding bulls including the 4 replacements have been disseminated in 40 herds all over The Gambia. In May 2004 a training workshop on reproductive management and feeding strategies for the members of GILMA, the livestock multiplier association and to Livestock Assistants was held at YBK Station. In July 2004, workshops were held to sensitize participating farmers and Livestock Assistants on the program 'Up- scaling of Technological Innovations for indigenous Trypanotolerant Livestock'.

With respect to small ruminants, as at December 2004 approximately 110 rams and bucks had been disseminated to multipliers in The Gambia. The dissemination activities were extended to the Republic of Sierra Leone where two rams and two bucks from the nucleus together with 60 females purchased from multiplier flocks were delivered to a re-stocking activity in Makeni, Bombali District.

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

Eleven farmers in the region of Boke have received each one bull from the CAE nucleus herd in august 2004. Prior to the placement of the bulls, two sensitising meetings have been organised. With the placement of the bulls farmers were willing to castrate some of the males present in the herd. A workshop on the management of multiplier herds was held in December 2004. Guidelines for the management of multiplier herds and flocks prepared by ITC were presented to farmers and livestock assistants. For the dissemination activity, even though the activity started only in august, farmers have expressed high appreciation and expectations for the bulls received. Institutaional analysis of the the Boke Breeders' Association was also performed.

Activity 3: Support, monitoring and impact evaluation of multipliers of the pure breeding programmes in The Gambia and Guinea

Sheep: When the current sale prices for these various sex-age groups of sheep were compared between participating and non-participating groups, the price of 1-year, 2-year and animals older than 2 years were higher for animals in the households participating in the programme (GD 900, 1532, 1657/ animal) than those from in non-participating households (GD 60, 837, 878 /animal) by 50, 83 and 88%, respectively.

Goats: When the current sale prices for these various sex-age groups of goat were compared between participating and non-participating groups the price of 1-year, 2-year and animals older than 2 years were higher for animals in participating (GD 741, 1000, 1081) than from in non-participating households (GD 449, 588, 725) by 65, 70 and 49%, respectively.

Overall, farmers' sale prices of sheep and goats sired by improved rams and bucks were 80% to 170% higher than sale of sheep and goats of similar age prior to the arrival of the improved sires in the flocks.

Cattle: Offspring from the improved bulls introduced into multipliers have not yet reached an age to meet standards for sale. However, the survey results show that 100% of farmers had observed that calves sired by new bulls from ITC nucleus had bigger size at birth, are more vigorous, have a faster growth rate and survived better than calves from their old bulls. This should translate in the future in higher mature liveweight from the herd and therefore higher sale prices.

Furthermore, analyses of data from the survey showed that producers that were using improved germplasm (bulls, rams, bucks) reported lower mortality rates among the young and adults than those who did not have access to the improved germplasm. The reduced mortality directly contributed to improved profit margins.

Activity 4: Finalising research and submission for PhD Thesis on "Optimum strategies for the implementation of pure breeds improve programmes"

A review of the N'Dama cattle genetic improvement programme implemented, in a low input production system, at the International Trypanotolerance Centre (ITC) in 1994 was done. Based on published and unpublished information, the experience gained from achievements during the development of the improvement programme was presented. The first part of the paper discussed the genetic improvement programme, including the three-tiered pyramidal structure for dissemination of genetic progress. The second part dealt with the establishment of potential outlooks of the improvement programme between now and the future. Some recommendations to strengthen the implementation process, particularly in the field were offered as follows: 1) It is essential to strengthen the collaboration among all the stakeholders involved in the programme, to improve communication and jointly create efforts to promote improved animals that could be distributed to help increase agricultural production, 2) It is also essential to create confidence among the farmers and encourage them to participate in the programme, 3) It is important for farmers to be involved in planning decision making efforts; this will give more value to the programme, 4) More study on the genetic aspects of the N'Dama cattle breed for its improvement through selection, 5) Persistent efforts have to be made in development of training and information packages in order to raise the awareness among government and farmers on the added value of improved N'Dama bulls in increasing production and income, 6) The government must support technical assistance and at least partially finance the costs of training and market development.

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.

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).

Contributors

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Meetings

ITC/CIRDES/CTA International Conference on Animal Agriculture in West and Central Africa, 8-12 November 2004, Banjul, The Gambia

Market-Oriented Systems Improvement Programme (MOSIP)

Background and Justification

The challenges relating to urbanisation are clear and present. Meeting the food challenge in terms of quality and quantity is a priority concern for the production systems. Experiences in the sub-region have confirmed the evolution of market-oriented production systems-in transition.

Several recent assessments have indicated that livestock production systems in several countries in West Africa are becoming increasingly market-oriented. Indicators for this trend include aggregate demand for livestock products, patterns of consumption in relation to human population densities, mobility and settlement patterns of livestock herds/flocks, and the development of input and output markets. Larger numbers of previously extensively managed herds/flocks and their owners are settling around urban areas to take advantage of this market demand. Higher levels of inputs including exotic and crossbred genotypes, drugs, veterinary care and labour inputs are being used more frequently. Changes in management and the higher levels of production imposed are impacting on animal health in ways not easily predictable. As these production systems are expected to contribute increasingly to the aggregate demand in cities and urban towns in the region, appropriate technologies are needed to aid their maturation into fully profitable enterprises for producers and to deliver healthy products at competitive prices to consumers. ITC Research and Development Programme Themes 6, 7 and 8 address issues related to market-oriented production, including the use of biotechnology to increase production. The activities under these themes are complemented by those under public health and socio-economics (Institutional Project 9 & 10). Collaboration with NARS and issues related to training and capacity building in participating institutions is covered under Institutional Project 11.

Highlights and Achievements in 2004

The details of progress made during 2004 are given in the respective reports for IP 6,7 and 8.

- Testing of nutritional and health packages with special emphasis on trypanosomosis control for F1 farmers in the Greater Banjul Area.
- Five milk processing centres established and running in support of development of dairy system in the Gambia
- More than 120 heads of crossbred cattle in different categories are now established in different locations of the Greater Banjul Area

- Fifty-five samples of alternative peri-urban feed resources obtained in a longitudinal survey have been inventoried and analysed
- Survey of current uses and users of Moringa in urban and peri-urban production environment executed
- Nutritional evaluation of *Moringa oleifera* in urban small ruminant nutrition with special emphasis on growth, digestibility and body composition of post-weaning WAD goats and sahelian crosses

- Nutritional evaluation of *Moringa oleifera* in urban small ruminant nutrition with special emphasis on weight gain and digestibility of Matured growing WAD goats and sahelian crosses
- Productivity and impact of nutritional strategy for crossbred small ruminants in Greater Banjul Area with access to horticultural integration determined

- Existence of a gradient of heartwater risk for susceptible animals species with risk increasing from the east to west as indicated by the detection of *Ehrlichia ruminantium* infection in small ruminants using MAP1 B ELISA
- Genetic characterisation of *E. ruminantium* by RFLP and the detection of five different *map 1* profiles in two agro-ecological zones of the Gambia
- Genetic and phenotypic characterization of West African Dwarf goats in ITC mandate countries

Collaborative Activities and Dissemination of Results

Considering the fact that we are at a stage where disseminatino of research result is in progress with regards to peri-urban dairy productiona and processing, improved health, housing, nutrition and management startegies, the MOSIP initiated intervention packages consisting of a cocktail of inovations targetting the urban and peri-urban production system.

Strategic partners are the Institute for Animal Production in the Tropics and SubTropics of the University of Hohenheim, University of Utrecht in The Netherlands, University of Kwazulu Natal, Pitermaritzburg in South Africa where PhD research have either been concluded or on-going.

The collaborations with University of Kwazulu Natal and ANKOM Technology deserves special mentioning especially in the effort that has been put into strenghtening nutrition biochemistry research at ITC.

Most importantly, the programme benefitted from contributions in terms of human resources and technical know-how from our NARS partners – ISRA, DNE, DLS and NARI.

Potential Impact

The small holder peri-urban farmers have been empowered and trained through the joint execution of field activities and also grounding them in a process that ensures sustainability of the emerging production system. In a parallel development, the application of recent advances in molecular diagnostics and recombinant DNA technology in animal health would lead to a better understanding of the epidemiology of endemic diseases. The characterization of genetic purity of indigenous livestock also used as a decision making tool in determining the appropriate intervention in the face of unrelenting incidence of introgression of trypano-susceptible genes. This information of gene flows and purity of breeds can also inform policy strategies for the implementation of appropriate breeding plans.

INSTITUTIONAL PROJECT 6

Full title	Development and evaluation of crossbreds 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
Project number	MOSIP 06
Location{s} of research	The Gambia [Kombo, Foni &Nuimi]
Start Date	January 2001
Project End Date	December 2004/2005

Background and 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 objectives of this research include: the development of crossbred animals that are comparatively more productive; evaluating their performance under various conditions; quantify their roles in household welfare, and to identify and exploit factors that favour profitable enterprises in urban areas.

The major outputs for this research project include:

- 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.

Milestones

- 2003

  Crossbred cows produced and selected smallholder backyard and farm units

- **2004**

  Socio-economically acceptable technological packages for disease control, feeding strategies and housing developed and made available to producers

Implemented Work Programme

Activity 1: Management of on-station cattle herd

Some 120 cattle (including 37 milking cows) were reared on-station under on farm simulated management conditions. The herd serves as a demonstration of a peri-urban milk production scheme based on F1 crossbreds and for research.

The animals were fed on feeds either bought from dealers or collected from nearby open grasslands and horticultural enterprises. Concentrate feed in the form of a ration consisting of groundnut cake, rice bran, spent brewer's grain was given daily. Veterinary healthcare was adequately covered.

Data on productivity and all events in the herd were recorded on a routine basis and stored in computers for future analysis and publication in scientific literature.

Activity 2: On-farm production of F1s for smallholder dairy development through A.I.

Artificial insemination following synchronisation of oestrus (ear implant method) in N'Dama cows continued to be the strategy for producing crossbred cattle on farm. The activity was carried out in late April to May 2004 (time of arrival of funds and semen) in both the Western Division (Kombo) and the Lower Nuimi District of the North Bank Division. Only few farmers had prepared their cows well and were eager to join. Although this period was not an appropriate time for insemination as it was the late dry season when animals were generally in poor body condition because of the scarcity of feed it was felt necessary to maintain their enthusiasm. Some 99 cows belonging to 26 farmers were inseminated.

A training course was organized on 1st to 3rd June 2004 at ITC –headquarters at Kerr Serigne for farmers in order to develop their skill in improved animal husbandry practices which was deemed necessary if conception rates were to be improved. Some 13 farmers from the three project sites (i.e. Kombo, Foni and Nuimi) attended out of the 20 invited. The 3-days course focused on: a) preparation of local N'Dama cows for artificial insemination, b) improved animal husbandry and management practices and housing, c) feeds and feeding.

Another training course based on a manual prepared by ITC and its NARS partners on aspects of the F1 scheme for field officers and farmers was carried out from 23rd February to 4th March 2004. The need to train the extension agents i.e. L/A was deemed necessary as they are the frontline in contact with the farmers for advice and interventions. The purpose of the training was to familiarise the Livestock assistants of the Department of Livestock services {DLS} with the manual and improve their understanding of its contents

Activity 3: Integrated management and disease control measures: Testing of a nutritional and health package with special emphasis on trypanosomosis control for F1 farmers in the Greater Banjul Area

An assessment of tsetse density and infection rate and animal trypanosomosis prevalence carried out during 2003-2003 revealed that there were still hot spots within the coastal areas with high tsetse density and annual trypanosomosis prevalence of 30%. Hence farmers in these areas must now consider tsetse and trypanosomosis among the prevalent disease for control measures. A health and nutritional package was developed at ITC and was introduced to the farmers. This study was designed to assess the efficiency and impact of the package intervention by testing different variables with the general objective of improving the performance of F1 cattle in the different sites. Twenty (20) F1 farmers operating in 16 villages in the Kombo area were divided into 3 groups namely high, medium and low risk based on the tsetse density and trypanosomosis prevalence rates established previously in these villages. 18, 9, and 47 animals were in the high, medium and low risk groups, respectively. The three

interventions were 1) insecticide impregnated netting around stable plus anthelmintic dosing, acaricide treatment and zero grazing with multinutrient block (high risk), 2) same as for high risk group except that animals were on prophylaxis with isometamedium (medium risk) and 3) same as medium risk group but without prophylaxis (low risk).

All animals were monitored for trypanosomosis and helminth infections and tick burdens. On each visit records of milk produced (offtake) and weights of animals are taken.

Activity 4: Milk processing technology in support of development of dairy system in the Gambia

During 2003 five dairy Co-operatives were organised and registered in the Greater Banjul Area. Four of them were based in villages in Kombo Central (Brikama, Kasakunda, Darsilami and Penyem). They pasteurised milk with a gas cooker and processing it into yoghurt. The yoghurt was sold mainly at Brikama market. The fifth group was based in Abuko. They received an in-pouch batch pasteuriser ("Milk-pro"), which they used to produce pasteurised milk and pasteurised flavoured milk. Furthermore they produce pasteurised cream and yoghurt. They sold their products to supermarkets, telecentres, hotels and a school.

Members of the Dairy Co-operatives participated in training courses on hygienic milking practices, milk processing, record keeping, basic business skills and marketing strategies. Their products were monitored on bacteriological quality and much contamination occurring in the beginning of the milk processing activities disappeared after attending more training courses (results of analysis under IP9).

Furthermore, study visits were organised. Members of the Kombo Central Co-operatives travelled to Kolda and Vélingara in Senegal to visit milk processing centres and milk producers. Kombo North Dairy Co-operative went to a dairy farm and milk processing plant near Dakar.

Results

Activity 1: Management of on-station cattle herd

Data collected was analysed and publications in journals was done (see Annex on publications)

Activity 2: On-farm production of F1s for smallholder dairy development through A.I.

Examination to determine conception following the insemination was carried out on only 42 cows in 5 farms which were close to ITC as they were able to confine the cows. 27 were found to be pregnant (64.3%) and all have calved by the time of writing this report. In one of these farms the farmer (a retired civil servant turned entrepreneur) prepared 27 cows and had 14 pregnant (51%) after first insemination. He practiced heat detection for those returning into heat and 6 cows were detected and inseminated which all (100%) conceived. In effect on this single farm 20 cows conceived from the total of 27 cows inseminated (74.1%) after two inseminations. The status of the remaining cows in the distant locations will be known at calving by the appearance of the calf. F1 crossbred calves of Friesian sires are distinguishable from purebred N'Dama calves.

Activity 3: Integrated management and disease control measures: Testing of a nutritional and health package with special emphasis on trypanosomosis control for F1 farmers in the Greater Banjul Area.

Trypanosome infections were detected in both the low and high risk groups but not in the medium risk group. This was because farms in this high risk group failed to confine (zero graze) their animals under insecticide impregnated netting as was required. The animals in both groups were not protected in any way as oppose to those in the medium group which had protection from the injection of isometamedium (Samorin). All infections were detected during

the months July to December which is the rainy and early dry seasons. During these periods vegetation is thick and good habitat for tsetse flies.

Helminth infestation was based on egg counts of individual samples. Most of the F1s were found to be negative or have low counts and only few had medium to high counts in September and October (rainy season effect).

Total tick counts were in the range of 0 – 30 per animal and consisted of *Amblyoma* spp., *Hyaloma* spp., *Boophilus* spp. and *Rhipicephalus* spp. in decreasing order of prevalence. Farmers who sprayed their stock regularly on a fortnightly basis as was advised had almost tick free F1 cattle. Therefore fortnightly spraying was found to be necessary as all the F1s monitored were grazed on free range.

Milk offtake was recorded in 7 farms, 1 and 6 located in high and low risk areas respectively. The highest offtake came from Kerr Serigne farm wher both morning and evening milking was practiced. All others milked only once, that is morning. From the data, an average of 5.5 litres /day/cow was realised when milking was done twice daily as compared to 7 litres obtained on-station. For once daily milking the milk offtake was 3.5 litres/day/cow.

Activity 4: Milk processing technology in support of development of dairy system in the Gambia

All five Dairy Co-operatives are now established and they process milk regularly. Their main constraint identified was milk collection. In order to facilitate milk collection, the co-operatives received twelve bicycles and one moped from FAO. Another constraint was packaging material. It was suggested by the Co-operatives that the packaging of smaller volumes of both milk and yoghurt could increase their sales. Therefore, smaller units of packaging materials were ordered.

The Dairy Co-operatives intend to form a Dairy Board where Dairy Co-operatives find a forum to discuss issues such as milk prices, bulk orders of feed, veterinary drugs and packaging materials. They are also thinking of a “Dairy shop” where they could sell their dairy products.

The GTZ-funded project support for the Co-operatives will end in April 2005. Although the Co-operatives are now established and generate income, it remains important to continue assisting them on matters like group organisation such as the “Dairy Board” and other benefits of co-operatives (milk collection, product diversification, marketing and quality controls).

Achievements

Presently, there are over 120 F1 cattle of all age categories reared on 20 farm units or backyards and under ITC’s monitoring scheme in the Gambia and about 30 in Labe in Guinea Conakry. The first crop produced in Gambia has started producing milk and the potential impact of the scheme is being realised in the communities. Some farmers in both Gambia and Guinea have started to become self reliant by purchasing semen and other inputs on their own as they plan to go bigger. This is seen as indication of adoption of the programme without much donor support in the future.

Five dairy cooperative societies formed last year are operating and providing marketing opportunities for farmers and milk vendors alike. Consumers now have access to fresh and safe hygienic milk produced in the Gambia at competitive prices.

Following the ending of funding from the Government of The Gambia in year 2003, the Canada Fund for Local Initiatives [CFLI] approved a funding proposal for activities under this programme for 2004. This shows that the programme is in line with the development objectives of potential donors within the local environment.

Potential Impact

The direct beneficiaries for this project will be the NARS and the smallholder peri-urban livestock farmers. ITC is empowering them through collaboration in the execution of field activities thereby involving them in all the processes as a way forward to the future sustainability of the emerging farming system. Training courses were carried out and other communication tools e.g. manuals, flyers, audio-visuals were developed all geared towards improving the skills and knowledge of the different stakeholders. With the formation of dairy co-operative societies, farmers who produce excess milk from their crossbred cows can market their produce easily thereby increasing their daily income. Urban consumers also have access to home produced fresh and safe milk.

Contributors

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Meetings

Final FAO/DLS/ITC Stakeholder Workshop on "Improving Milk Safety and Farmers Income Using the Village Milk System", 25-26 November 2004 at Senegambia Hotel

ITC/CIRDES/CTA International Conference on Animal Agriculture in West and Central Africa, 8-12 November 2004, Banjul, The Gambia

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
Start date:	January 2001
Projected end date:	December 2004/2005

Objectives

Appropriate feeding strategies for the livestock raised in the emerging market-oriented production systems is a daunting challenge for producers and researchers alike. The feeds and feeding strategies of the animals will determine the productivity of the animal resource base in the system will meet the inevitable growing demands. 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. In the light of the unique production environment in which these animals are raised, 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.

- 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

Milestones

- 2003
  On-farm testing of feeding strategies undertaken with participating farmer groups extended to other farmer groups
- **2004**
  Economic and socio-cultural assessments of the feeding strategies at on-farm situations

Implemented Work Programme

Activity 1: Longitudinal survey of alternative peri-urban feed resources in The Gambia
During the last two years of the horticulture-livestock integrated project, more unexploited feed resources with strong potential for feeding animals in the peri-urban smallholder dairy industry have been identified. Although many of these feed resources were characterised in a quantitative sense for nutrient contents, there is a paucity of information on the presence of secondary compounds, mineral contents and availability, acceptability by the animals and the mode of integration into the ruminants' diet.

This study was set up to generate results that will be used to produce a feed resource calendar and the mode of integration into the ruminant feeding system. Different feed samples were obtained at different seasons. This information will be helpful in timing farm operations such as artificial insemination and nutritional management of lactating crossbred animals.

Monthly participatory screening activity was conducted in Banjulinding, Lamin, Sukuta, and Bakau, women horticultural gardens. The farmers themselves identified potential feed resources (based on the indigenous knowledge) and requested for biochemical analyses to validate the attributes of the fodders. In addition, candidate materials from other urban locations within The Gambia were also sampled on a quarterly basis. The screening was complemented with by questionnaire on crops grown at the gardens. The questionnaire allowed exhaustive description of the site and samples taken during the visit.

Activity 2: On-farm *Moringa oleifera* production and economic parameters in the Greater Banjul Area of The Gambia 1. Survey of current uses and users
A significant coping strategy for urban dwellers is the production of food in and around urban and peri-urban areas One of the emerging feed resources in the urban areas is the *Moringa spp.* with 15-20 t DM/ha obtained under irrigated conditions. *Moringa oleifera* grows throughout most of the tropics and has several industrial and medicinal uses. The study aimed at investigating current knowledge about uses of *Moringa oleifera* and to identify prospects for on-farm *Moringa oleifera* cultivation.

Two focus group discussions were conducted in *Tumani Tenda* and *Fufoe*, within the GBA, and structured questionnaires were the main instruments of the survey. Three districts (Kombo North and East) were intentionally selected based on intensity of UA practice. Six communities were randomly selected in each district. Structured questionnaires were administered to three randomly selected respondents in each community. Frequencies and summary statistics were used to analyse the data.

Activity 3: Evaluation of *Moringa oleifera* in urban small ruminant nutrition. 1. Effects on the growth, digestibility and body composition of post-weaning WAD goats and sahelian crosses
The objective of this study therefore was to evaluate an urban fattening strategy based on supplementation with *Moringa oleifera* through both *in-vitro* and *in-vivo* approaches and to evaluate the suitability of *Moringa oleifera* as a supplement and replacement for concentrate in the diets of small ruminants.

The feed sources evaluated in this study were groundnut hay (GNH), concentrate made up of 50:50 mixture of rice bran and groundnut cake (CON) and *Moringa* meal (MRG) produced by milling the leaf and soft stem component of dried *Moringa* plant.

Proximate analysis of feed samples was carried out according to standard methods. Growth and digestibility studies were conducted with fourteen post weaning WAD goats and fifteen back crosses of WAD x Sahalian crosses of both sexes. There were five goats per treatment except in one treatment that has four goats. The goats, aged between 3-6 months and

weighing 5.2-12.2kg were balanced for sex and randomly distributed to treatment groups to evaluate the effect of *Moringa* and concentrate supplementation on groundnut hay.

The concentrate was served once at 8.00hours for two hours, while the basal diet was served twice at 10.00 and 16.00 hours. Animals in Treatment 1 (CON) received in addition 100g/h/d of concentrate, while animals in Treatment 2 (MRG) received 100g/h/d of *Moringa* meal. Animals on Treatment 3 (control) received no supplements at all.

Activity 4: Evaluation of *Moringa oleifera* in urban small ruminant nutrition. 2. Effects on weight gain and digestibility of Matured growing WAD goats and sahelian crosses

The objective of this study was to evaluate the nutritional values of *Moringa* through both *in-vitro* and *in-vivo* studies for mature growing goats and to evaluate its suitability as a supplement and replacement for concentrate in the diets of goats. Specifically, the experiment focussed on the evaluation of the nutritional values of groundnut hay, concentrate and *Moringa oleifera* using proximate and in-vitro analytical procedures with a view of assessing the replacement potential of Moringa for Groundnut cake. The biological response of mature goats fed on groundnut-based diets and supplemented with concentrate and *Moringa* was also investigated..

The animals were transferred to individual pens with concrete floors, measuring $2m^2$ and allowed to adjust for a period of ten days. The concentrate for the study was obtained by mixing equal portions of rice bran from the local rice mill and groundnut cake, which has been milled using the hammer mill. The *Moringa* was harvested from 60 days re-growth of 18 months old *Moringa* plants. *Moringa* was cut at 30cm above ground level; leaves and branches were separated from the stem and dried on wooden crates in the sun for about 5-10 days. The dried material was then milled to produce the *Moringa* meal of 0.01-0.05cm particle sizes. Common salt was sprinkled on the *Moringa* powder in order to stimulate acceptance during the adjustment period. The concentrate was served once at 8.00hours for two hours, while the basal diet was served twice at 10.00 and 16.00 hours.

Animals in Treatments 1 and 2 received 200g/h/d of concentrate and *Moringa* meal respectively, while animals on Treatment 3 received no supplements. All animals received ad-lib supply of groundnut hay, which was bought from feed vendors. The hay was thoroughly mixed together to obtain homogenous mixtures and then served. All animals were individually fed. Samples of feed offered were taken daily and bulked per week for analysis, while samples of feed refused were obtained daily for each animal, ten percent of which was sampled daily in order to make weekly composite samples. This was then sub-sampled for chemical analysis. Water and Mineral salt lick were available *ad-libitum*. Routine healthcare and management practices were observed. The trail lasted fifteen weeks.

Activity 5: Productivity and impact of nutritional strategy for crossbred small ruminants in Greater Banjul Area with access to horticultural integration

In pursuance of the livestock horticulture integration, ITC intervened in three horticultural gardens in the greater Banjul area of the Gambia by introducing crossbred small ruminate animals into the system. Through IDRC support, ITC had successfully introduced crossbred cattle into Banjulding Horticultural Garden in Banjul. The success story of this intervention has continued to generate ripples in the horticulture industry. It thus became one of the focal points for intervention in the second phase of the project.

The original intention was to extend the laboratory and field experience into the other women cooperative gardens. However crossbred cattle could not be introduced due the failure of the artificial insemination exercise. Consequently at a participatory meeting with the women prospective beneficiaries, in order to facilitate the nutrient recycling, a new decision was taken to use small ruminants.

Of the three intervention areas, two are women cooperative gardens with combined population of over five hundred women producers. The third beneficiary is a Non-Governmental Organization – Mennonites Educational and Horticultural development Association (MEHDA), a teaching and capacity building organization located on the outskirts of Brikama an important urban town in the Greater Banjul Area.

After the completion of the livestock pens, the animals were taken to the gardens. Animals were allowed to roam in the open enclosures surrounding each house during the day and kept indoors at night. Feed consists essentially of vegetable residues; cut and carry browse plants and groundnut hay. Monthly body weights and body condition of animals were recorded using Salter scale each month. Condition scores were done by two independent persons and the average taken.

Results

Activity 1: Longitudinal survey of alternative peri-urban feed resources in The Gambia

Fifty-five samples were inventoried and analysed at the nutrition biochemistry laboratories of the International Trypanotolerance Centre, Banjul.The materials have been aggregated as much as possible to reduce bulkiness. The samples were analysed for proximate contents. The addition of these 55 samples has broadened the options of the feed resource base and the strengthening of the crop-livestock integration and interaction within the Greater Banjul Area.

In conclusion, the enhanced data base on feed alternatives/and or candidate crops will be discussed with urban producers and the possible role (according to availability) that these resources can play in the urban ruminant nutrition scheme. The identification of new utilisable feed resources in the Greater Banjul Area is a promising development. The updated feed resources database will better help in advising urban farmers on what are the best bet approaches according to availability of feedstuff and their respective nutrient compositions.

Activity 2: Survey of current uses and users of *Moringa*

Seventy-five percent of respondents are males. Most of the respondents (85%) live less than 10 kilometres from the Banjul Central Business District. Ethnic composition of respondents in the target area indicates that the predominant ethnic group is Jola followed by Mandinka. In terms of access to resources, more than 90% of respondents (91.5% male and 93.5% female) indicated that they own their farmlands. All respondents own small ruminant animals, but more male respondents 25.5%, and 14.9% own cattle and oxen, than female respondents 6% and 6% respectively. Personal savings and inheritance are the most important sources of capital for cropping and livestock enterprises. Lack of adequate quantity and quality feed especially in the dry season remained the most important constraints to livestock production according to the producers' ranking. Other constraints of importance are labour, lack of space and diseases. Next to rangelands where they exist, crop residues and agro-industrial by-products are the most important sources of feeds for urban ruminant livestock. Hence cut and carry and supplementary feeding are prevalent practice, although the use of browses is not so common. Hence some sensitisation would be necessary before farmers can be expected to adopt the use of *Moringa* as alternative supplementary feed. The sensitisation process has been launched but it requires a lot of time and resources to get the practice well grounded.

It can be concluded from the survey that insufficient livestock feed and other benefits could become a driving force in the introduction of *Moringa*. Land will not be a constraint to planting *Moringa* but labour and capital need further attention. Sensitisation and on-farm adaptive research will be necessary to enhance integration of *Moringa* into the farming systems.

Activity 3: Evaluation of *Moringa oleifera* in urban small ruminant nutrition. 1. Effects on the growth, digestibility and body composition of post-weaning WAD goats and sahelian crosses

Intake of concentrate or *Moringa* as supplements by goats was significantly different ($p<0.0001$), with animals on MRG consuming more of the supplementary feed. Mean intake of supplements was 6.74 g/kgBWd^{-1} and 8.69 g/kgBWd^{-1} for *Moringa* and concentrate respectively (SE=2.506). Animal sex did not significantly ($p>0.05$) affect supplement intake although supplement intake was significantly different ($p<0.05$) between breeds of goats. Animal weight (lwt) had high significant effect ($p<0.01$) on feed intake.

Total dry matter intake (DMI) per kg body weight was not significantly different ($p>0.05$) among treatments, neither did breed nor sex. Mean total DMI were 36.35, 36.66 and 35.22g/kgBWd^{-1} respectively for Treatments 1, 2 and 3 (SE=0.512).

Live weight gain was statistically significantly different ($P<0.05$) among treatments with goats in Treatments 1 and 2 gaining more weights than animals in Treatment 3 initial live weight had very high statistical significance ($p<0.001$) on body weight. Breed and sex had no significant ($p>0.05$) effect on live weight. Weight gain per day was also significantly different ($P<0.01$) among treatments.

Mean weight gain was higher although not significant in the concentrate supplemented group over the *Moringa* group, but both were significantly higher ($p<0.01$) than in the control group. Breed, sex and iwt had no significant ($p>00.05$) effect on weight gain. Feed efficiencies were highly significantly ($p<0.01$) different among treatments. WAD Goats were less efficient in feed conversion than the crossbreds although the difference was not statistically significant ($p>0.05$). Initial body weight was very significant ($p<0.01$) for feed efficiency, but sex was not.

In conclusion, *Moringa* can be fed in an urban small ruminants fattening scheme up to 20% inclusion of the total dry matter intake. The goats that received Moringa performed equally well or better than the goats offered concentrates.

Activity 4: Evaluation of *Moringa oleifera* in urban small ruminant nutrition. 2. Effects on weight gain and digestibility of Matured growing WAD goats and sahelian crosses

There were no statistical difference ($p>0.05$) in the intake of dry matter per kilogram body weight and kilogram metabolic weight for Treatments 1 & 2. Animals on Treatments 1 and 2 consumed more ($p<0.001$) dry matter than goats on treatment three. This may be attributed to the effect of highly digestible feed on roughage intake. It has been reported in literature that overall intake is increased when more digestible supplements are feed together with poor quality roughages. Dry matter digestibility (DMD) and organic matter digestibility did not differ between mature goats consuming either groundnut hay singly or in combination with concentrate, although goats taking *Moringa oleifera* supplements exhibited better ($p<0.01$) digestibility coefficients. This may be due to the better digestibility *Moringa* supplementation although the NDF values were higher than the feed for the concentrate group. Dry matter intake was not significantly affected by the breed effect.

Weight gains were 27.4, 34.9, and 20.7g per day respectively for goats on Treatments 1-3. Mature goats on the *Moringa* replacement diet performed significantly better ($p<0.01$) than the goats on the concentrate ration. Body weight evolution was statistically significant ($p<0.01$) among treatments and breeds ($p<0.05$) .

The results of this studies confirmed similar findings on the nutritive quality of *Moringa oleifera* when used as supplement to poor quality roughage. It can thus be concluded that *Moringa* can be fed up to 20% of the ration of mature goats and it can completely replace concentrate and protein source in the diet of goats.

Activity 5: Productivity and impact of nutritional strategy for crossbred small ruminants in Greater Banjul Area with access to horticultural integration

Of the three locations, Lamin horticultural garden had the best management practice and survival after six months. Mean body weight of goats increased in Lamin and Sukuta gardens up till November and dropped but continued to rise again from December due to commencement of kidding in both farms. Pirang is described as medium tsetse challenge area and morbidity was high in the first few weeks of the introduction of crossbred animals. One goat also aborted.

Sheep exhibited better adaptation in Pirang and consistently gained weight. Feed was most limiting in Sukuta garden. All animals are group fed. In a situation of limited feed, the more aggressive animals had the first access. Hence goat performance in Sukuta was better than sheep. Body condition fluctuated according to the physiological status of the animals, feed availability and season. Most of the animals lost condition after kidding due to lactation stress, but regained condition one to months later. However the women were encouraged to buy some groundnut hay to augment feed supply from the gardens. Lamin garden showed the best results in the performance of both sheep and goats.

All farms started with twelve crossbred small ruminants in June 2004. However by December 2004, Lamin and Sukuta gardens had twenty-three small ruminants each, while Pirang had eighteen. Most of the increase are due to kidding except for Pirang and Lamin which bought one buck each for mating purposes.

The additional benefits to integration include waste management through the utilization of residue for livestock feeding and the availability of manure for soil amelioration. It also include making cash savings from on-farm generated manure. Most importantly, the animals have facilitated the nutrient recycling process *in-situ*.

Potential Impact

Fresh results on animal response to *Moringa* supplementation strategy has confirmed the benefit that can still be derived from appropriate use of the plant in peri-urban systems. Results obtained for the reporting period has confirmed previous findings and also opens a window of opportunity to broaden supplementation options available to urban and peri-urban livestock owners. In four different training sessions in Gambia, Senegal and Guinea, trainers and farmers were empowered with new knowledge on feeding systems during technology transfer processes. In The Gambia, all twenty farmers that own F1 cattle and in Guinea have been trained (in-situ) on how to feed their animals properly using locally available feedstuffs. The knowledge acquired is expected to snowball in the different communities.

Contributors

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Collaborating ITC Special Projects: IDRC, PROCORDEL

Meetings

PROCORDEL/ITRA - INRAB course and workshop on cultivated fodders 19-23 January 2004, Cotonou, Benin

11th International Conference of the Association of Institutes of Tropical Veterinary Medicine, 24-27 August, 2004, Kuala Lumpur, Malaysia

ITC/CIRDES/CTA International Conference on Animal Agriculture in West and Central Africa, 8-12 November 2004, Banjul, The Gambia

IDRC-initiated Regional consultative meeting on biotechnologies in West Africa, 22-24 November, 2004, Novotel, Dakar, Senegal

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(s) of research	The Gambia (Kombo, Keneba, Bansang, Niamina), Senegal (Kaolack, St. Louis, Kolda-Sedhiou, Fatick), Guinea (Boke, Labe), Guinea Bissau (Bafata, Gabu)
Start Date	January 2001
Projected end date	December 2004/2005

Background and Objectives

Biotechnology has emerged as one of the most powerful tools that can be used to address development challenges. Among agricultural and allied fields, the application of the tool in animal health and production offers great prospects for improved livestock productivity in meeting the growing demand for products of animal origin in sub-Saharan Africa. Advances in molecular biology have made possible the wide use of monoclonal antibodies and polymerase chain reaction (PCR)-based techniques for efficient diagnostics and genetic characterisation of pathogenic microorganisms, that allow more accurate epidemiological investigations leading to the development of effective disease control and eradication measures. Genetic engineering and molecular cloning of genes offer great opportunity for the development of more effective and safer vaccines for the prevention of viral, bacterial and parasitic animal diseases. Genetic characterisation of indigenous livestock using recombinant DNA technology provides information on the extent of genetic purity of the local breeds, which is essential for the design of genetic improvement and breeding programmes. The application of related integrated technologies like GIS in animal health and production research gives a better characterisation of the production system thus enabling the development of policies and strategies for improved livestock productivity.

The overall objectives of IP 8 are:

- To develop, test and/or use diagnostic tools (e.g. improved ELISA, PCR)
- To characterize genetic diversity of pathogenic microorganisms
- To genetically characterize domestic indigenous small ruminants in West African regional countries
- To introduce and integrate GIS into livestock R&D activities

Specific objectives in 2004 were:

- To use MAP1-B ELISA to study the seroprevalence of *E. ruminantium* in small ruminants in The Gambia
- To characterize genetic diversity of *E. ruminantium* in hosts and vectors in different agroecological zones of The Gambia
- To genetically and phenotypically characterize West Dwarf goats in ITC-mandate countries
- To generate soil quality maps at selected sites in Greater Banjul Area of The Gambia

Milestones

– 2003
Marker-assisted breeding programmes initiated with partners reported

– **2004**
Evaluation of novel techniques deployed in the region made

Implemented Work Programme

Activity 1: Detection of *Ehrlichia ruminantium* infection in small ruminants using MAP1 B ELISA

One thousand three hundred and eighteen serum samples from 679 local dawraf sheep and 639 local dwarf goats from 5 Divisions of The Gambia (Western Division, Lower River Division, North Bank Division, Central River Division and Upper River Division) were tested using the indirect MAP1 B ELISA. For testing sera from each of the species (sheep and goats), specific antispecies, i.e., anti-sheep/goat IgG (H + L)/PO conjugate was used. Optical densities (OD) of the ELISA tests were measured using Titertek Multiskan® ELISA reader using a 405 nm wavelength. Each serum sample was tested in duplicate. Each test included a duplicate negative and positive control. The cut-off value (COV) was determined by addition of 2 standard deviations to the mean optical density value of a reference negative local sheep and goat population. OD values of samples that were equal to or greater than the COV were considered positive for *Ehrlichia ruminantium* infection.

Activity 2: Genetic characterisation of *E. ruminantium* by RFLP

Primer sequences were deduced from conserved regions of the *map*1 gene of the 9 *E. ruminantium* isolates from different geographic regions. The first PCR amplification of genomic DNA samples from ticks and small ruminants in different agro-ecological zones of The Gambia was carried out using the forward primer ERF1 and the reverse primer ERR1. The semi nested second amplification was done using the forward primer ERF1 and the reverse primer ERR3. The PCR amplified a 720-738 bp fragment of the *map*1 gene of *E. ruminantium*. The amplification products were analysed further by RFLP using restriction endonuclease, *Alu*1. DNA fragments were submitted to horizontal electrophoresis in 0.5x TBE buffer at 100 V for 2h: 30min. The gel was subjected to silver staining according to prescribed protocol.

Activity 3: Genetic and phenotypic characterization of West African Dwarf goats in ITC mandate countries

A total of 615 individuals from 17 West African goat populations from five countries (Gambia, Mali, Senegal, Guinea Bissau and Guinea), as well as one out-group population, were genotyped for 16 microsatellites. For this, two missions were undertaken to ILRI, Nairobi in

order to complete the genotyping, which started in 2003. The study objectives were to examine genetic diversity and relationship between West African populations and to assess the degree of genetic admixture between the two goat types present. Preliminary results were presented in seminars and in poster-format at the ISAG 29th Conference in Japan (September).

Results

Activity 1: Detection of *Ehrlichia ruminantium* infection in small ruminants using MAP 1 B ELISA

About half (51.6 %, *n*=639) of the sheep samples tested positive for *E. ruminantium* infection with seroprevalence ranging from 6.9 % to 100%. The highest seroprevalence was detected in the two most westerly regions, Western Division (88.1%) and Lower River Division (63.1 %), of the country. Sheep populations in the two easterly regions, Central River and Upper River Divisions showed the lowest levels of *E. ruminantium* seroprevalence of 29.3 % and 32.4 % respectively and therefore the most at risk of heartwater disease. Sheep sampled in North Bank Division showed an intermediate level of seroprevalence (40.6%). In contrast, of the 679 goat samples collected, less than half (30.3 %) of them were positive for *E. ruminantium* infection. Overall, the highest seroprevalences were detected in goat populations in North Bank Division (59 %) and Western Division (44.1 %) with more than half of the animals sampled in North Bank Division testing positive for heartwater infection. Seroprevalence in goats in Lower River Division (21.9 %) showed an intermediate level, with the two most easterly Regions, Central River Division (4.8 %) and Upper River Division (2.3 %) showing the lowest level of seroprevalence. Furthermore, the results showed that in all Regions, except for North Bank Division, overall seroprevalence was significantly higher ($P < 0.001$) in sheep than in goats. In fact at all sites except for one in North Bank Division, the proportion of seropositive samples was consistently higher in sheep than in goats.

In conclusion, these results indicated the existence of a gradient of heartwater-risk for susceptible livestock species with risk increasing from the eastern region of the country towards the western region to the coast. This poses a threat to translocation of small ruminants from the eastern to the western regions and potentially to future livestock upgrading programmes in the country.

Activity 2: Genetic characterisation of *E. ruminantium* by RFLP

Analysis of the restriction profiles of the *map*1 gene of samples indicated the potential presence of at least 8 different genotypes of *E. ruminantium*. We detected 5 different *map*1 profiles in both the SG and WSS zones. Some of the *map*1 profiles originating from sites in different agro-ecological zones identical. Specifically, the profile of KS (Kerr Serigne) isolate, which originated from the SG zone, was identical to the profile of sample #61 (tick sample, not shown) from the WS zone and to several other profiles of samples from animals originating from the ESS zone. Three profiles, originating from the SG zone, were entirely distinct and showed no identity with any of the profiles in either of the agro-ecological zones. Of the 5 different profiles characterised in the WSS zone, 3 showed identity with profiles in SG and ESS zones. The latter zone had overall, 3 different profiles, which showed no uniqueness and were identical to 3 profiles in the WSS zone.

The frequency distribution showed that the Kerr Seringe (Gambia) isolate, showed the highest frequency accounting for about 33 % of the overall profiles. Profile #3 and #6 (not shown) showed equal frequency of about 26 %, the second highest frequency. The rest of the profiles showed significantly ($P < 0.05$) lower frequency of about 3 % each. Furthermore, the results showed that the profile of Kerr Seringe isolate is present at all the sites in the three

different agro-ecological zones of the country and therefore makes it a suitable candidate for further genetic and immunological characterisation.

Activity 3: Genetic and phenotypic characterization of West African Dwarf goats in ITC mandate countries

The results indicated that the Senegalese Sahelian populations differ from Malian (98%), whereas Guinean Dwarf populations are distinguishable from the others (78%). Principal component and admixture analysis indicate two introgression gradients of Sahelian genes: a north-south gradient starting in Senegal and an east-west gradient starting in Mali; six populations were considered crossbred. At the end of both routes populations of the WAD genotype were found.

Further analysis and and interpretation of data make it possible to assign every sampled population to 3 classes (WAD, Sahelian or Crossbred), which will form the basis for phenotypical characterisation of populations. Furthermore, trends and threats of introgression of Sahelians into trypanotolerant dwarf populations were visualised and sub-populations were identified within each of the two goat types.

Potential Impact

In West Africa, improvement of the livestock industry, which is dominated by ruminant livestock species, to meet the growing demand for protein of animal origin (meat and milk) is severely constrained by the incidence of disease, principally heartwater. Additionally, it is accepted that the low level of productivity of indigenous genotypes of livestock would not offset the shortfall in this demand and would have to resort to the exploitation of more productive but highly disease-susceptible exotic genotypes livestock and their crosses. The application of recent advances in molecular diagnostics and recombinant DNA technology in animal health would lead to a better understanding of the epidemiology of numerous endemic diseases that impact negatively on livestock production and also serve as an obstacle to the region's participation in international trade in livestock and livestock products. This, importantly, could lead to remarkable improvements in the livelihood and welfare of resource-poor smallholder farmers. On the other hand, 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 and tick-borne diseases. This unique trait is threatened by the introgression of non-trypanotolerant genes through the introduction of Zebu and Sahelian sheep and goats from tsetse and relatively tick-free areas in the north of Africa.

Genetic characterization of indigenous livestock with the aim of determining the level of genetic purity of these breeds especially with respect to trypanotolerance, tick-borne infections and to a large extent to other endemic diseases, will facilitate the development of policy strategies for the implementation of appropriate breeding programmes. Consequently, this will contribute to a better utilisation and conservation of indigenous livestock genetic resources.

Attainment of Medium-Term Plan Milestones

The important milestones set for the year 2004 have been basically achieved. The epidemiology of heartwater in The Gambia is now better understood, especially with respect to the distribution of disease risk, the genotypes of the causal agent and their frequency distribution. Information on the degree of Sahelian gene introgression into the trypanotolerant gene pool of

indigenous West African Dwarf goats in the region is available first time and constitutes an important basis for the formulation of policies on breeding programmes.

Contributors

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Collaborating ITC special projects: PROCORDEL, Small Ruminants Project

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Meetings

ITC/CIRDES/CTA International Conference on Animal Agriculture in West and Central Africa, 8-12 November 2004, Banjul, The Gambia

Systems' Overlap and Linkages Improvement Programme (SOLIP)

Background and justification

The Systems' Overlaps and Linkages Improvement Programme (SOLIP) targets crosscutting issues of relevance to both the low-input and market-oriented systems. The contributions of the Programme are geared towards improved livelihoods of producers through increased incomes from improved marketing of quality livestock products that assure public safety, understanding and possibly removal of socio-economic constraints that act on the development of livestock-based farming systems, and towards human resource development and capacity building through training and information exchange at different levels.

In order to achieve these objectives, SOLIP's three 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 the 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 2004

Under the Consumer Safety and Public Health Project, IP 9, pilot surveys were initiated for two abortion-causing zoonoses in small ruminants, i.e. brucellosis and Rift Valley Fever, in Gambia and Guinea, Results may help to sensitise rural populations at risk and to develop feasible and effective control strategies in the future.

The operation of the milk pasteurisation cum training unit at ITC, the organisation and support of local cooperatives for generating income from locally produced and marketed milk and yoghurt, and further dissemination of more productive crossbred F1 cows were positive examples of the complementary and collaborative work of ITC donor-supported activities (e.g. FAO-TCP; GTZ; EU/PROCORDEL), national partners (DLS) and producers and processors. The good hygienic standards of local dairy products (fresh, flavoured milk, yoghurt) has further increased the confidence into the products by consumers and by the producer groups, mostly women, into the viability of the local dairy cooperatives.

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, namely through (1) identification of socio-economic factors characterising low-input and market-oriented systems in Guinea and Guinea-Bissau, (2) identification of factors determining adoption of technologies (improved milk production), and (3) evaluation of the impact of policy reforms on livestock production (Gambia, Senegal and Guinea).

IP 11 contributed to the operational objectives and achievements of the other institutional projects through assistance to training, information exchange and capacity building. It continued to (co)organise and support training activities targeting different groups. Once more, the *Train the Trainer (ToT)*- and *Training of Farmers (ToF)*-approach received much support in 2004. As an alternative pathway, Farmers Field Schools (FFS) for livestock farmers were also supported in The Gambia. Various training and extension materials were further developed, field-tested and produced (or are in the pipeline) for wider distribution.
Individual training received support in the form of short/medium-term, supervised on-the-job/on-site instructions, study attachments and visits, and assistance to postgraduate PhD studies.

The results of a training impact assessment survey (2001-2004) showed that the training inputs have contributed in no small way to the increase in critical mass at the professional and technical level and to the extension and transfer of research results to the ultimate beneficiaries.

ITC's infrastructure for training and information exchange was strengthened, e.g. through the inauguration of a "new library" stock of about 100 new titles of scientific and technical textbooks, and the installation of a computer local area network, with (potentially) faster internet access.

Collaborative Activities and Dissemination of Results

The collaborative links with the various partners at the national, regional and international level were maintained and/or expanded in 2004.

As in the previous years, SOLIP contributed to a better understanding of "people and their circumstances" as livestock producers and processors, and to transfer and dissemination process of R&D results obtained under LISIP and MOSIP. This is documented by the fact that the number of persons trained under the *ToT*- and *ToF*-approach (730 in 2004) had been increased again as compared to the previous year (557 in 2003).

Besides other important meetings, SOLIP staff contributed to the preparation and implementation of the International Conference on "*Livestock Agriculture in West & Central Africa: Achievements in the past 25 years, challenges ahead and the way forward*", held from 8-12 November in The Gambia, that was jointly organised by ITC, CTA and CIRDES, and included a review and assessment of achievements of PROCORDEL in the ITC and CIRDES zones, as a 'Model for Regional ARD partnerships', as well as to the 20th Anniversary Celebrations of ITC.

Potential Impact

Potential impact of the activities carried out in 2004 under SOLIP:

- Better understanding of the epidemiological situations regarding two important zoonoses (brucellosis, Rift Valley Fever), and their potential impact on public health
- Improved handling and hygienic standards for increased local production of milk and milk products
- More socio-economic information available on livestock policies and their impact, development of appropriate technologies, and on the transfer of knowledge and technologies to ultimate beneficiaries
- 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 and processor level
- Training inputs and improved networking and information exchange that impact on capacity building and human resources 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:	Systems' Overlaps and Linkages Improvement Programme
Project number:	SOLIP 9
Location(s) of research:	The Gambia (Greater Banjul Area, Kiang West, Dankunku and Niamina) Guinea (Dubreka, Kindia and Pita)
Start date:	July 2001
Project end date:	December 2004/2005

Background and Objectives

In all West African countries zoonoses, transmitted from live animals to man, 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 (e.g. brucellosis and tuberculosis) are important examples of emerging or re-emerging zoonoses and 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. In addition some zoonoses like brucellosis and Rift Valley Fever (RVF) can have an impact of elevated rates of abortions on herd productivity beside their public health importance. However, only little and sketchy information on the distribution, epidemiology and public health impacts of zoonoses in livestock and man exists in West Africa. Identification of livestock herds serving as sources of infections, of magnitudes of infections in livestock herds and livestock products and understanding the entry and spread of agents in food chains thus are the first essential steps in order to eventually formulate programs aimed at reduction of exposure of humans to hazardous diseases and agents. For the process of risk evaluation of such diseases and the disease-agent-husbandry interactions, results of 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 hazards (zoonotic diseases) and their impact on consumer safety.

The specific objectives of the project for 2004 were:

- To assess the current status of the brucellosis due to *Brucella melitensis* in small ruminants in selected regions of The Gambia and Guinea, by screening a representative number of animals and determining their serological status
- To assess the serological prevalence of RVF in small ruminants by means of antibody ELISA for IgG and IgM simultaneously, in selected regions of the Gambia and Guinea

- To investigate the infections in humans at risk of contact with positive animals
- To inform and educate livestock farmers on the zoonotic character and risks of abortion-causing infections in livestock such as brucellosis and RVF
- Improvement of consumer safety due to better understanding of the epidemiology of food borne infection
- Improvement of milk quality of locally produced milk in The Gambia and Guinea

Milestones

2003	Risk assessments carried out for the design of new disease control programmes
2004	WTO-SPS measures for individual food commodities and food chains propagated

Implemented Work Programme

Activity 1: Selected diseases (*B. melitensis* and RVF) of small ruminants in traditional farming systems with potential public health impact in The Gambia and Guinea

In order to generate necessary baseline data for the development of strategies to minimise risks of transmission of the zoonoses brucellosis due to *B. melitensis* and RVF to humans, a pilot study aimed at providing estimates of the prevalence of these infections were designed and implemented in 3 Districts of The Gambia (LRD, CRD and URD) and 2 Districts of Guinea (Dubreka and Kindia) by on-farm screening surveys. The study started in July 2005 and will last for 12 consecutive months.

In The Gambia, sampling was carried out during September and November 2004 in 3 Districts (Niamina, CRD north; Dankunku, CRD south and Kiang West, LRD) based on previous reports on abortions in small ruminants (SR) and confirmed/suspected cases of RVF in man and SR respectively. For each of the selected districts, up to 14 villages were be randomly selected; at village level (herd level), up to 60 animals stratified by age were randomly sampled. In addition a representative number of ITC station animals (SR) in Keneba, which is located in the Kiang West District, were sampled.

In Guinea sampling was carried between October and November in Dubreka District and is still on-going in the District of Kindia. The districts were selected based on previous reports on abortions or assumed preferable conditions for the vector of RVF. Sampling follows the same procedures as in The Gambia.

All samples were subjected to an ELISA for the presence of RVF antibodies (IgG and IgM) and Rose Bengal Plate Test (RBT) followed by Complement Fixation Test (CF) of positive tested samples for brucellosis in RBT. The analysis started in November 2004 and is still on-going. To establish the ELISA test kit for RVF at DLS/ITC in The Gambia and at DNE in Guinea, one laboratory technician from each country were send for a two-week training in October to ISRA-LNERV in Dakar, Senegal. For each location GPS records were taken.

Activity 2: Control of bacteriological quality of pasteurised milk and milk products produced by a women's group in Pita, Guinea

A women's group in Pita, consisting of milk producers, received a small-scale milk processing plant in 2003 sponsored by FAO. In order to ensure good quality of their products, samples of different milk products were collected and sent to the food safety laboratory at DNE in Conakry. 25 samples (8 raw milk, 6 pasteurised milk, 7 yoghurt, 3 soft cheese and 1 butter)

have been collected and analysed for total mesophilic bacterial count (TBC; only in raw and pasteurised milk) and coliform bacteria count (CC).

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

In the Greater Banjul Area of The Gambia exist five Dairy Co-operatives, which were registered in November 2003. One Dairy Co-operative, Kombo North Dairy Co-operative Society (KONODCS), based in Abuko, is pasteurising milk with an in-pouch batch pasteuriser ("Milk-Pro"). They also processed milk into flavoured pasteurised milk, yoghurt and cream. KONODCS supplied supermarkets, telecentres, hotels and a school. The other four Dairy Co-operatives, which are based in Brikama, Penyem, Kasakunda and Darsilami, pasteurise milk with a gas cooker and process it into yoghurt. They sold their products mainly at Brikama market.

The quality of the milk products produced by these Dairy Co-operatives was regularly monitored by ITC through bacteriological test on Total Bacterial Counts (TBC) and Coliform Bacteria Counts (CC). Furthermore, swab samples were collected to assess contamination through hands and equipment.

The same procedures and standards were applying to the milk processing plant at ITC that continued to supply different supermarkets and individuals with pasteurised milk and yoghurt, thus contributing to Centre-generated income.

Results

Activity 1: Selected diseases (*B. melitensis* and RVF) of small ruminants in traditional farming systems with potential public health impact in The Gambia and Guinea

Gambia: Based on the analysis for RVF (IgG) carried out until December 2004 an individual animal prevalence of 13% (49/480samples) was calculated for villages at Dankunku District and of 25% for ITC station animals at Keneba (38/150). For *B. melitensis,* no positive reactor was found. Serological analysis and confirmatory testing are still on-going.

Guinea: First results from the District of Dubreka obtained until December 2004 indicate an individual animal prevalence for RVF (IgG) of 20% (16/20) and for *B. melitensis* of 7% (18/271) respectively. Sampling in the District of Kindia, analysis and confirmatory tests are still on-going.

Activity 2: Control of bacteriological quality of pasteurised milk and milk products produced by a women's group in Pita, Guinea

Total Bacterial Count (TBC):

The raw milk samples had very high bacterial counts with an average of 8.78×10^7 colony forming units per millilitre (cfu/ml). Pasteurisation did not reduce contamination effectively since only half of the samples contained acceptable numbers of mesophilic bacteria (3×10^4 cfu/ml).

Coliform bacteria count (CC):

The average coliform bacteria count of raw milk was 3×10^6 cfu/ml. Pasteurisation did reduce the number of coliform bacteria. However, two contaminated samples were identified with 110 and 770 coliform bacteria per millilitre. The same number of yoghurt samples (2) were found being contaminated with coliform bacteria (340 and 3,000 cfu/ml). Higher contaminations with coliform bacteria were found in two of the three cheese samples with CC of 7×10^3 cfu/ml and 2.7×10^5 cfu/ml. No coliform bacteria could be isolated from the butter sample.

These results indicate that there are many sources of contamination. Firstly, the raw milk already contained very high numbers of mesophilic and coliform bacteria at the farmer level.. Secondly, the pasteurisation does not reduce the bacterial load efficiently and thirdly, post-pasteurisation contamination was taking place. Although the quality of the pasteurised milk and milk products is already far better than the raw milk, there is still an urgent need for more training on hygienic practices from farm to the dairy and on milk processing procedures.

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

21 pasteurised milk samples and 30 yoghurts samples were collected between February and September 2004. Furthermore, 23 swab samples from processors hands and processing equipment were analysed.

Only three (14.3%) pasteurised milk samples showed Total Bacteria Counts above 100 cfu/ml but below 4,000 cfu/ml. None of the pasteurised milk samples exceeded 100 cfu/ml. Eight yoghurt samples (26.7%) contained coliform bacteria above 400 cfu/ml. These samples originated from the dairy Co-operatives using a gas cooker for pasteurisation. Five of them exceeded 1 x 10^4 cfu/ml.

Coliform counts from swab samples were generally acceptable. Only results from Darsilami Co-operative showed counts above 100 cfu/ml on hands and milk processing equipment like strainer, milk containers and empty yoghurt cups. Yoghurt samples from the same day and group were also contaminated with coliform bacteria.

Members of the Dairy Co-operatives participated in various training courses on milk processing and the quality of their products improved after attending those courses. Actually, most of the contaminated yoghurts have been produced in February 2004. Samples collected some months later were of a better quality.

In addition, several training materials were developed by ITC and collaborating projects (FAO/TCP), e.g. a manual on good dairy practices and an operating manual for the “Milk Pro”-dairy (pasteurisation) plant.

Potential Impact

The results obtained from the studies on zoonosis (Prevalence studies on brucellosis and RVF) and milk hygiene in The Gambia, Guinea may have implications for within country and regional trade.

The results can contribute to the identification of effective control measures and the establishing of control programmes in the future. This is in particular the case for the control of RVF. The results obtained for The Gambia and Guinea (first record for the existence of RVF in Guinea in livestock) will contribute to the global network for this infection established by FAO. Based on the results of the epidemiological studies policy makers can make decisions on the appropriate control strategy (i.e. vaccinations).

Moreover, the results are being used as a basis for setting national standards (e.g. microbiological contamination) or identification of high-risk areas (e.g. brucellosis or RVF) through the National Codex Committees (NCC, The Gambia). As a partner institution of the NCC and the National Nutritional Agency (NaNA) of The Gambia, ITC contributed to the setting up these standards, which is presently on-going, by providing base line data on major zoonoses and food hygiene and through the formulation of recommendation of control option. This includes the reinforcement of the application of existing veterinary regulations.

These development are likely to restore or boost consumer confidence in livestock products, which in turn will pull for higher production, processing and marketing activities, as producers and marketers re-orient themselves to take advantage of the elevated market demand.

Furthermore, under the conditions of higher hygienic standard of milk produced locally, different processed dairy products can be introduced, thereby stimulating the expansion of the dairy sub sector.

Attainment of Medium-Term Plan Milestones

Risk assessments for the design of new disease control programmes were partly achieved: Based on results of pilot, follow-up and related new activities recommendations for the control of bovine brucellosis, salmonellosis and tuberculosis were formulated in collaboration with national partners and broadcasted in several meetings with stakeholders (e.g. NaNA and National Codex Committees).

WTO-SPS measures for individual food commodities and food chains propagated: The establishment of WTO-SPS measures is an on-going process in partner countries. As an advisory partner of the NCC (The Gambia), ITC has contributed to the setting up of national standards (e.g. microbiological standards) by providing base line data on selected zoonoses and food hygiene and recommendations for control options of the zoonoses investigated.

Contributors

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

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Meetings:

National Conference on the Food Control System in The Gambia, held from 1-3 September 2004 at the Kairaba Hotel

Final FAO/DLS/ITC Stakeholder Workshop on “Improving Milk Safety and Farmers Income Using the Village Milk System”, 25-26 November 2004 at Senegambia Hotel

ITC/CIRDES/CTA International Conference on Animal Agriculture in West and Central Africa, 8-12 November 2004, Banjul, The Gambia

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 2004/2005

Background and Objectives

Agriculture represents the major employment sector in The Gambia, Senegal, Guinea and Guinea–Bissau, accounting for more than 20% of the Gross Domestic Product (GDP) of these countries. Although the share of livestock in the four economies varies widely, the countries face the same constraints of meeting the current and future demand for animal products. Among those constraints are also related to urban agriculture (UA), an economic activity that plays a major role in improving food security and alleviating poverty among city dwellers. Lack of government recognition of the importance of UA implies lack of policy and regulatory framework for improvement. The gap between domestic production and demand for animal products has for long been filled by imports. But, due to recent economic crisis this approach is not sustainable. Policy reforms initiated in the early 1980s were implemented with only a mere knowledge of the production conditions within which farmers operate and their ability to adjust to external shocks.

The overall objective of this Institutional Project (IP10) 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 forwards is a combination of macro and micro economic studies in order to (1) capitalise on information about farm households resources and their behaviour, and (2) identify potentials and constraints to the livestock sub-sector development. Expected outputs of the project include:

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

Milestones

2003	Socio-economic factors determining adoption of technologies are identified
2004	Impact of policy reforms on livestock production is evaluated and policies for sustainable animal agriculture are elaborated

Implemented Work Programme

In 2004, six research activities were undertaken in four countries, namely The Gambia, Senegal, Guinea and Guinea Bissau and one socio-economic research activities was contributed to IP 10 by the Market-Oriented Systems (MOSIP) programme of ITC.

Activity 1: Study of livestock production systems in Guinea and Guinea-Bissau
Livestock production systems in Guinea and Guinea Bissau are known as predominantly extensive with low productivity. Information at the farm household level has remained scanty, making development efforts difficult to effectively impact on the livelihoods of the livestock owners. This activity was carried out with the view to assist policy makers and development actors to better target the research-development efforts undertaken in both countries. The specific objectives were to (1) characterize the major production systems in the intervention zones and (2) analyse constraints, potentials and assess available opportunities for improved productivity. In Guinea, three ecological regions were selected to conduct this activity: Moyenne, Basse and Haute Guinée. In Guinea Bissau, a survey was conducted in the northern region. In each country, about 200 livestock owners were enumerated on socio-economic attributes of the farm household and aspects of the livestock production (livestock species and rearing)..

Activity 2: Characterisation of milk production systems in Senegal and Guinea Bissau
This activity was designed to provide background information on the characteristics of milk producers and the strengths, weaknesses, opportunities and threats (SWOT) of milk production activities at farm household level. Specifically, the activity aimed at (1) typifying the producers and (2) evaluating the economic performance of milk production as an enterprise. The surveys covered 89 livestock owners in Senegal and 200 in Guinea Bissau..

Activity 3: Appraisal of success rate of dairy cooperatives in The Gambia
This activity was undertaken as a consultancy to FAO/TCP, on the basis of the results of an ITC study to assess the quantitative importance of locally produced milk as an edge over imports. The objectives of the consultant's study were to: (1) assess the market shares of the various products developed by the five dairy cooperatives in the Greater Banjul Area (GBA); (2) provide detailed recommendations on improved market access and competitiveness; (3) provide a detailed marketing strategy for improving and sustaining market share of the dairy cooperatives in the GBA; (4) conduct cost-benefit analysis of production of each dairy cooperative.

Activity 4: Appraisal of productivity and output increase of the pure breeding programme in The Gambia
A questionnaire survey has been designed and is being administered in Keneba area and in the CRD to collect and assess farmers' perceptions (feedback) on the utilisation of improved stock (N'Dama cattle and small ruminants) from the ITC multiplier scheme. Specific objectives include (1) an evaluation of the income earned by farmers from participating in the scheme and (2) the conditions for sustainability of the benefits from the operation. Preliminary results will be made available in March 2005.

Activity 5: Analysis of livestock feeds and veterinary inputs marketing systems in The Gambia

In the dry season, feeds and veterinary inputs account for more than 35% of the farm production costs in The Gambia. Most livestock farmers buy these inputs on the market places. Markets therefore play an important role in factors allocation in the economy. However, to contribute to optimal allocation of production factors markets need to be cleared at prices that reflect the social costs of these factors. Effectiveness of the marketing systems is an important factor that in the process of achieving the intensification of livestock production. Yet, the information available on the operation and functioning of marketing systems for inputs is scanty in The Gambia. The specific objectives of this activity bwere 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 the different crop residues available at each of the 233 farm household sampled were estimated and their different usages evaluated. Next, market surveys were conducted to evaluate the veterinary and feed inputs marketing systems. Two companies were enumerated for veterinary inputs and 37 sellers for feeds in the Kombo. Data were analysed using descriptive statistics. A preliminary report is available.

Activity 6: Socio-economic factors of urban agriculture and livestock integration in the Gambia

The specific objectives of this activity, funded by IDRC were to (1) characterise urban agriculture practitioners within the GBA, The Gambia, (2) identify the determinants of peri-urban horticulture-livestock integration and (3) analyse issues of gender and generation, land use and land tenure and marketing as related to urban agriculture.

Primary data were collected from urban farmers in the GBA and complimented by data from four horticultural gardens of Banjulding, Bakau, Sukuta and Lamin. The data for the census of producers and women producers within horticultural gardens were collected with the aid of snowball sampling techniques. A survey was used to collect data from other urban households engaged in agriculture. The census and sampling approaches produced a database with 6,565 urban agriculture practitioners in geo-referenced locations. The instrument used provided information on tribe, sex, location, education, household type, origin, number of plots, occupation, assets, use of earnings from urban agriculture and importance of urban agriculture to household.

Activity 7: Policy reforms and the performance of livestock production systems: a farm household modelling in The Gambia

This activity is part of a broader study on the macro and micro level performance of livestock systems as a result of policy reforms. Collection of secondary data was completed in early 2004 including monthly monitoring of livestock production at farm level and market analysis. The secondary data already collected were used to advance the macroeconomic analysis of policy effects in The Gambia in comparison with Senegal and Guinea. The farm level data will be used to develop a farm household model for The Gambia as a case study. The objectives are to evaluate the effects of policy reforms at the macroeconomic level and to assess their implications for the 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.

Results

Activity 1: Study of livestock production systems in Guinea and Guinea-Bissau
At a first glance, livestock production systems in Guinea and Guinea Bissau have characteristics that are similar to those practised in other West African countries. The majority of farmers operate still at low levels of inputs, although transition to more intensive, market-oriented systems is perceptible. A variety of species are reared in extensive systems, with small variations between ruminants and monogastrics. Because the fieldwork has been delayed due to various constraints, data processing and analysis could not yet be completed. Advanced drafts of working papers on the subject will be completed by March 2005.

Activity 2: Characterisation of milk production systems in Senegal and Guinea Bissau
Discriminant and gross margin analyses were used to compare economic performance among milk producers. In Senegal two resource-based groups of milk producers were identified. Structural variables of dissimilarity between the two groups were land and cattle ownership, as well as the size of the farm household (in man-equivalents). There was no significant difference in management practices between the resourced-based groups, and the major constraints to improving milk productivity was 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). Where F1 cows have been introduced at farm level (Kaolack and Fatick areas), it has been shown that factor productivity is higher on farms using F1 in milk production than on other farms using local breeds. Gross margins of CFA 238/cow/day and CFA 793/cow/day were generated by milk enterprises using local breeds and crossbred cattle, respectively.

In Guinea Bissau, four resourced-based groups of milk producers were identified. Five structural variables significantly determined the differences among farmers: size of household (man-equivalents), land and cattle ownership, value of investments in intermediate (equipment) and permanent assets (buildings such as kraals). With respect to the sample average, these groups can be called: resource-poor (below the average), medium (at the average) and resource-rich (above the average) farms. Like in Senegal, the major constraint to improving milk productivity in Guinea Bissau was the availability and quality of feeds. The gross margin analysis indicates that milk production under current market conditions was profitable for the medium and resource-rich farmers, and not so for the resource-poor. In terms of cash generation, milk production is profitable for all groups of resource-based farmers in Guinea Bissau.

In sum, milk production in both countries is a profitable enterprise at farm level, although this is being accomplished at low levels of productivity, particularly for smallholders operating with low levels of resource endowment. Two working papers are available.

Activity 3: Appraisal of success rate of dairy cooperatives in The Gambia
The results of the study are summarised in the consultant's report (M.A. Jagne, November 2004). In summary the study found that a significant market potential exists for locally produced dairy products in the GBA. The study also established the potential for increased profitability, through improved efficiency, adequate reflection of production costs in sale prices, and in particular by significantly increasing production levels. At present, the cooperatives have the distinct advantage of not paying for some of the implicit costs, giving them a unique opportunity to make more profit. However, to exploit this potential, a well-planned and coordinated approach has to be adopted to tackle the challenges and constraints faced by the dairy cooperatives. Recommendations include (1) increasing the level of production to reflect the full costs and introduction of new products; (2) increasing facilities to collect more raw

milk; (3) reducing transaction costs; (4) encouraging the participation of cooperative members, and (5) dealing with competition.

Activity 4: Appraisal of productivity and output increase of the pure breeding programme in The Gambia

Data collection is underway at the time of compilation of this report.

Activity 5: Analysis of livestock feeds and veterinary inputs marketing systems in The Gambia

Preliminary results on feeds inputs in The Gambia indicate there is 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 frequently purchased feeds on farms were groundnut hay (168 kg/household) and rice bran (8 kg/household). At the market level, the results indicate two categories of sellers. One-time, spontaneous sellers and farmers and livestock sellers 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. A seller purchases 56 tonnes of groundnut hay for 77,235 Dalasi per year. This underscores the importance of feed transactions to the farm business. The benefit from selling groundnut hay and the constraints associated with this activity still need to be assessed.

Unlike the feeds, veterinary inputs' marketing is better organised. Two private companies lead 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. A draft working paper is available.

Activity 6: Socio-economic factors of urban agriculture and livestock integration in the Gambia

This study characterises urban agriculture (UA) at household level as well as in a gender specific way in the GBA. The datasets generated by the census were modified for accessibility through the web. Test runs of its versatility indicate that opportunities exist to improve information systems on UA, enhance the formation of marketing associations, and increase incomes of UA practitioners (in The Gambia and regionally) through using and updating the producers' census database.

UA is practised predominantly in open spaces and insecure plots. This affects potential output because farmers are reluctant to use 'expensive' though attractive technologies on such plots. The alternatives are for scientists to concentrate on cheapening technologies and/or for advocates to negotiate new tenure rights e.g. right to harvest current crop in the event of imminent development of plot. The marketed proportion of products is shown to have doubled in the last 15 years and the tendency is towards increased commercialisation of urban agriculture. In the GBA, commercialisation is constrained more by the affordability rather than availability of inputs as farmers knew about and had access to fertilisers, improved seed, insecticides, pesticides, etc. Seasonality and losses during glut were major factors affecting farmers income stream.

Crop-livestock integration in the GBA is found more on the fringes of the city centre at an average distance of 18 km compared to 5 km for crop producers. This increases transaction costs for access to market for inputs and products. The need to import feed to city centre to feed animal makes it labour intensive. At the moment, this is not yet attractive for urban dairy production given low milk yield of the N'Dama. Commercial poultry and pig production, which

require smaller space and are, therefore, better suited to urban agriculture than cattle, is constrained by lack of commercial compound feed manufacturers. In the circumstances, sheep and goats appear to be better-bets for integration into crop farming even though the demand for them is seasonal i.e. during festivals.

Urban agriculture contributes up to 67 percent of total income of urban households in The Gambia, more so for women who concentrate on the production of horticultural crops over which they have control on decision to sale and the use of proceeds. When these decisions are made by women, 50 percent of the income from urban agriculture is ploughed back to feeding the family and 37 percent for payment of school fees of children in the household.

Activity 7: 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 farm household model of consumption and production to determine farmer behaviour toward policy reforms is in a final stage of development. The different models are being tested and are part of the PhD thesis under preparation by Jacques Somda (KLU Belgium).

Preliminary results of the impacts of policy reforms point to the fact that non-price factors (size of national stocks of cattle and small ruminants) have been significant in determining the evolution of meat and milk production compared with trade liberalisation and other supply - enhancing policy instruments.

Potential Impact

The potential impact of these results can be assessed in different ways. The macroeconomic results of the determinants of domestic livestock production 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. Opportunities do exist for urban agriculture development if major constraints are removed.

Attainment of Medium-Term Plan Milestones

The activities undertaken by the Project and collaborating partners have contributed to the realisation of ITC's Medium Term Plan Milestones for the year 2004, namely through (1) identification of socio-economic factors characterising low-input and market-oriented systems in Guinea and Guinea-Bissau, (2) identification of factors determining adoption of technologies (improved milk production), and (3) evaluation of the impact of policy reforms on livestock production (Gambia, Senegal and Guinea).

Contributors

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Meetings

Final FAO/DLS/ITC Stakeholder Workshop on "Improving Milk Safety and Farmers Income Using the Village Milk System", 25-26 November 2004 at Senegambia Hotel

ITC/CIRDES/CTA International Conference on Animal Agriculture in West and Central Africa, 8-12 November 2004, Banjul, The Gambia

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 2004/2005

Background and Objectives

As vital part of the joint R&D activities, ITC and cooperating partners continued in 2004 their efforts to create "critical mass" (HRD) and contribute to capacity building at the different levels.

Institutional Project 11 assisted ITC's mission, objectives and strategy through a range of activities and inputs, with the specific objectives of strengthening the research capacity of technical and scientific personnel of the NARS partners and ITC, to support networking and information exchange between stakeholders, and to promote the dissemination of research results and technology transfer through targeted training, workshops, seminars and the production of training material.

The main activities that were listed in ITC's Annual Work Plan 2004 under IP 11 included to: (1) (co-)organise training courses for professionals/technicians pertaining to prioritised training needs; (2) train extension personnel, livestock-producing farmers, and milk handling persons in improved breeding, nutrition and feeding strategies, management, disease control, and sanitary measures towards consumer safety; (3) support and operationalise Farmer Field Schools in CRD; (4) support higher degree studies' research in collaboration with reputed universities, as well as individual study attachments at ITC; (4) to maintain database for monitoring of immediate and longer-term impact of training; (5) maintain a PC-training pool and support to develop GIS/mapping facilities at ITC; (6) support library & literature search facilities at ITC; (7) produce training materials such as videos, leaflets, posters, manuals; (8) maintain ITC Newsletter and website.

Milestones

2004 - Training implementation continued
- Training needs (re)assessed
- Training impact evaluated

Implemented Work and Results

ITCs' approach to capacity building that targets the whole continuum of stakeholders and actors, from producers, processors, marketers to planners across member countries, using resources and expertise in the region, has contributed during the reporting period towards developing a regional-based "critical mass" of expertise for livestock research and development.

In view of the ending main phase of Procordel in March 2004 (CE5) and the one-year extension phase (CE6), the dissemination of research results and technology transfer through targeted training, workshops, seminars and the production of training material were given high priority. A complicating factor for the organisation and implementation of training activities was the time-consuming administrative (and financial) transition from the main phase of Procordel that ended March 2004 to the 11-month extension phase that faced extended delays due to late release of operational funds.

In pursuance of the mission and objectives of IP 11 and supported by many collaborators and contributing partners, the following activities were implemented in 2004:

Training courses

Group training and related extension activities operated at national/regional level in close collaboration between ITC and NARS resource persons and support staff remained the most important tools for the transfer and dissemination of the output deriving from (joint) R&D activities.

Particular attention was paid again to the transfer of improved technologies to ultimate beneficiaries through *Train the Trainer* & *Train the farmer*-courses, addressing specific constraints of the producers via resident extension agents. By improving the capacity and role of local trainers, the transfer process is considered to be more sustained, with involvement of farmers/producers groups and "early adopters" leading to desirable "multiplier effects".

To ensure relevance and feasibility, namely in budgetary terms, the training agenda was guided by the programme as laid down in the ITC Annual Workplan 2004, and in the workplans of special projects, particularly Procordel's Cost Estimate No. 6.

In 2004, two *ToT*-courses with 27 participants (trained trainers) and altogether 17 ToF-courses / *combined ToT/ToF*-courses with 81 trainer-participants and 654 producer-participants were conducted.

In support of the emerging dairy sector in GBA, a range of *ToT/ToF* events took place under the FAO TCP/GAM/2802 *Improving Milk Safety and Farmers Income Using the Village Milk System*, jointly implemented by DLS, FAO and ITC, providing guidance for dairy cooperative members and DLS/ITC core group members on operations and management of the units, with significant inputs by two FAO-consultants (separate detailed reports). In a complementary manner, this programme was receiving support from ITC's special-funded (GTZ) milk technology project on improving milk hygiene in Gambia and neighbouring countries (that gained even more importance after the ending of FAO's TCP in November 2004).

The process of initiation of "Farmers Field Schools" (FFS) for livestock farmers in The Gambia continued and throughout the year four village groups of farmers in CRD were routinely visited by 4 ITC/DLS-facilitators based in Bansang. In this context, Gertrud Buyu, ILRI consultant, came for a short backstopping mission to Gambia (25/4-2/5/04). In November, ITC also provided some assistance to the initial training of future FFS-facilitators in Senegal (Casamance).

t is noteworthy to mention that the *ToT/ToF*-approach also included some cross-border training and familiarisation visits of selected groups of farmers/producers together with extension agents - i.e. training under GAM0410, SEN0403, and GBI0401 (see tables below).

This was another form of regional mobility that included the ultimate (producers) rather than the intermediate beneficiaries (professionals) as in the previous year. As a matter of fact, no professional or technician could benefit from this scheme under Procordel in 2004, as the funds foreseen for this purpose in CE6 were not made available on time (though two positions at ITC were advertised, in support of (1) farmers adoption of improved production and feeding strategies for cattle in Sierra Leone and (2) of milking hygiene and milk processing in Guinea Bissau.

Only one regional training course, on ruminant nutrition and feeding strategies, was implemented in 2004. However, a second regional course, on ArcView GIS and selected epidemiological applications, was initiated & prepared for in 2004, for implementation in January 2005 in collaboration with CIRAD.

The total number of participants in 2004 group & individual training events was 804 (2001-2003: 1135), of which 663 participants belonged to the group of ultimate beneficiaries (2001-2003: 623).

Details of the group-training activities at regional and national levels are given in the following tables (1-5):

Table 1: Regional training course in 2004

Course title	Description/objective	Start date & duration	Participants	Collaborators / Instructors
REG0401: Regional training course on ruminant nutrition and feeding strategies	Review and recommend feeding strategies for increased productivity of cattle, focussing on locally available resources in ITC zone countries (incl. *Moringa*)	29/11/2004 – 8 days	8 professionals / technicians from Gambia (2), Senegal (2), Guinea (2), Guinea Bissau (1), Sierra Leone (1)	ITC, ISRA, ENSA, PRODEV, CWS

Table 2: Training courses - The Gambia/ITC in 2004

Course title	Description/objective	Start date & duration	Participants	Collaborators / Instructors
GAM0401, GAM0402: Multi-Nutrient Block Production (2 runs)	Improve feeding & nutrition of ruminant livestock	09/02/2004 – 5 days; 22/02/2004 – 5 days	*ToF*: 47 Livestock farmers and youths (YAMPI Farmers' Association)	ITC, FAO, IDRC
GAM0403: F1 crossbred cattle production & husbandry (incl. training manual testing)	Improve F1 crossbred production and management practices	23/02/2004 – 8 days	*ToT/ToF* combined: 10 LAs; 15 livestock farmers from GBA & North Bank	ITC, DLS
GAM0404: F1 crossbred cattle production &	Improve F1 crossbred production and management practices	01/06/2004 – 3 days	*ToF*: 13 livestock farmers - GBA & North Bank	ITC, CFLI

husbandry (incl. training manual testing)				
GAM0405: Orientation of DLOs & pure breeding multipliers farmers (GILMA), for dissemination of breeding bulls	Orientation of multiplier farmers and distribution (auction) of ITC-tested improved breeding N'Dama bulls	01/04/2004 – 2 days	*ToT/ToF* combined: 6 DLOs & 10 multiplier farmers	ITC, DLS
GAM0406: Reproduction & feeding strategies for indigenous ruminant livestock	Improve production & feeding practices of ruminant livestock	06/05/2004 – 5 days	*ToT/ToF* combined: 7 LOs/LAs; 37 farmers	ITC, DLS
GAM0407: W/shop on up- scaling & testing technologies for pure breeding programmes	Improve efficiency of pure breeding programmes at field level	19/06/2004 – 1 day	*ToT*: 12 LOs/LAs	ITC, DLS
GAM0408: Sensitisation & training on improved pure breeding of ruminant livestock (2 runs)	Improve efficiency of pure breeding programmes at farmers' level	16-17/7/2004 – 1 day in 2 locations	*ToT/ToF* combined: 3 LAs; 12 livestock farmers	ITC, DLS
GAM0409: Training on management of pure breeding programmes	Improve efficiency of pure breeding programmes at farmers' level	27-28/08/2004 – 1 day in 2 locations	*ToF*: 37 livestock farmers	ITC, DLS
GAM0410: Training Programme for dairy cooperative members and DLS/ITC core group	Upgrade knowledge and skills of local trainers and members of local dairy cooperatives on operating the 'Village Milk System'	June-July 2004 - 7 days (5 courses)	*ToT/ToF* combined (5 different courses): 11 DLS & ITC staff; 280 members of dairy cooperatives in GBA	FAO, DLS, ITC
GAM0411: F1 crossbred cattle production & management for dairy cooperatives members	Orientation of dairy cooperative members on F1 crossbred cattle production & management practices	21/10/2004 – 2 days	*ToT/ToF* combined: 5 DLS staff; 25 milk cooperative members	ITC, DLS
GAM0412: Farmers Field School (FFS) - 4 village groups in CRD	*ToF* by regular (~weekly) meetings at village level, for participatory problem identification and solving	5 half days; 14 Feb. 2003	*ToF*: ~ 35 farmers	ITC, DLS
ITC0401: Introduction to statistical package STATA 8	Introduce & distribute new statistical package to ITC users	13/05/2004 – 1 day	8 professionals of ITC, 3 MRC	MRC Laboratories (D. Jeffries)
ITC0402: EXCEL advanced - formatting, formulae, charting, Pivot, data transfer	Improve skills and optimise usage of Excel	18/11/2004 – 3 half days	9 prof., techn., general staff from ITC, 2 DLS	MRC Laboratories (P. Snell)

Table 3: Training courses - Senegal in 2004

Course title	Description	Duration & start date	Participants	Collaborators / Instructors
SEN0401: Hygienic milking and milk handling (2 runs)	Improve standards on hygienic milking and milk processing practices	23/08/2004 – 1 day each in Kolda and Vellingara	*ToF*: 44 dairying farmers, milk collectors	ITC, CRZ
SEN0402: On-site training in quality control & bacteriol. analysis of milk	Improve standards in quality control and bacteriological examination of milk	23/08/2004 – 3 days	Training of 3 lab technicians (Kolda)	ITC, CRZ
SEN0403, SEN0404: Study visit to Gambia of Senegal F1-producers of ASEM & APREMKA and extension workers on milk transformation (1); ASEM & APREMKA Producer Associations restitution meetings (2)	Improve knowledge base of F1 crossbred cattle farmers from 'Bassin Arachidier' on milk transformation and marketing, through guided familiarisation tour to ITC/GBAGambia (1) and subsequent discussion among association members.	08/12/2004 – 3 days (1); 18/12/2004 – 1 day (2)	*ToT/ToF* combined: 4 P/T, 5 F (1); 9 P/T, 30 F (2)	ITC, DLS; ISRA, DIREL, PAPEL, ANCAR
SEN0405: Farmer Field School methodology	Orientation on FFS concept and methodology (from experience with livestock farmers in Gambia), for local adoption in Casamance by 'Agents polyvalents'	23/11/2004 – 3 days	*ToT*: 15 facilitator - technicians	ITC, AAJAC / COLUFIFA (Farmers' Assoc. / NGO)

Table 4: Training courses - Guinea in 2004

Course title	Description	Duration & start date	Participants	Collaborators / Instructors
GUC0401: F1 crossbred cattle pro-duction & husbandry (incl. manual testing)	Improve F1 crossbred cattle production and management practices	15/03/2004 – 4 days	*ToT/ToF*: 5 DNE staff, 35 livestock farmers	DNE/IRAG
GUC0402: Orientation on improved dairy and pasteurisation practices	Orientation & discussions with women group members on improved dairy and pasteurisation practices (prep. initiative on hygienic milking & processing)	18/08/2004 – 1 day	*ToT/ToF*: 1 DNE staff, 12 members of dairy women group "Nafaya", Pita	ITC, DNE
GUC0403: Feeding crossbred cattle under intensified systems	Improve feeding & nutrition of crossbred cattle for higher productivity using locally available resources	21/12/2004 – 3 days	*ToT/ToF*: 8 technicians, 9 farmers	ITC, DNE, Fandie farm management
GUC0404: Guidelines on pure breeding for profess./ technicians & members of Boke breeders' association	Upscaling dissemination of genetic progress from nucleus to production herds in Boke	22/12/2004 – 1 day	*ToT/ToF*: 8 DNE/IRAG, CAE staff; 6 farmers	ITC, DNE/IRAG, CAE

Table 5: Training course - Guinea Bissau in 2004

Course title	Description	Duration & start date	Participants	Collaborators / Instructors
GBI0401: Training & familiarisation tour of delegation from Bissau to Gambia on adapted milk technologies	Orientation and training on hygienic milking and quality processing through operating the 'Village Milk System" – (in prep. of Procordel initiative on hygienic milking and quality processing)	21/10/2004 – 9 days	*ToT/ToF:* 4 technicians, 2 dairy cooperative members	ITC, DLS; DGP Bissau

Individual training and promotion

Support to individual training was provided towards supervised study attachments and assistance to postgraduate studies for PhD.

As in previous years, ITC continued to support the PhD studies of research staff in collaboration with Universities and IARCs, particularly in the framework of Procordel. Some details on the status of these studies are summarised in Table 6. Dr. Simplice Nouala Fonkou graduated at Hohenheim University in June 2004 and thereafter left ITC. Mr. Bonto Faburay and Mr. Austin Bosso are continuing their studies at ITC and in close contact with their respective overseas research institutions. Mr. Jacques Somda left ITC by end of March 2004 on his own wish, and is still pursuing the completion of his thesis. It is also noted that the status/progress of the thesis preparation, based on research work done at ITC, by three former staff members (M. Steglich, S. Heuwinkel, J. Saecker) was not exactly known at the time of compilation of this report.

During March and April 2004, Mr. Erik Hoeven of ITC visited ILRI Nairobi for a second time, in pursuance of joint research work on genetic diversity and admixture in West African goats.

In September, Mr. Nerry Corr of ITC commenced part-time studies on 'Gender and Development' (diploma) at MDI in Kanifing/Banjul, with assistance of ITC as part of its staff development plan. Another staff member, Mr. Lamin K. Darbo, Livestock Assistant at ITC Bansang, was accepted in December for a higher Diploma Course in Agriculture at Gambia College, but, unfortunately, missed this year's entry date.

Table 6: ITC Staff engaged in higher degree studies in 2004

Name & Home Country	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 (for PhD)	4th 3-month study period at Univ. Wageningen. nalysis of results in progress	University of Wageninge n
Bonto Faburay, Gambia	ITC Vet./ Research Associate (PROCORDEL)	Epidemiology of *Cowdria ruminantium* infection in small ruminants in The	2nd 3-month study period at Antwerp and Utrecht.	Utrecht Univ. & ITM

		Gambia (for PhD)	Practical work and analysis of results in progress	Antwerp
Simplice Nouala Fonkou, Cameroon	ITC Nutritionist / Research Associate (PROCORDEL)	Feeding strategies for cattle in Gambia and Senegal: Optimum level of supplementation. PhD-Thesis: 'Comparison of plant cell wall degrading community in the rumen of N'Dama and N'Dama x Jersey crossbred cattle in relation to *in vivo* and *in vitro* cell wall degradation'	5-month study period at Hohenheim, Germany, for completion and defence of thesis (9/6/2004)	University of Hohen-heim
Jacques Somda, Burkina Faso	ITC Agric. Economist / Research Associate (PROCORDEL)	Effects of policy reforms on the performance of livestock systems in The Gambia with comparative analysis of Senegal and Guinea (PhD study)	Left ITC by 31.03.04. Writing up in progress	Leuven University
Michaela Hempen, Germany	ITC Veterinarian	The hygienic status of milk sold in local markets of The Gambia (PhD study)	1 month study period in Berlin. Writing up of thesis in progress	FU Berlin

In the course of the year, ITC hosted a number of persons from the sub-region and Europe, for short-term study attachments of different nature:

From April to early September 2004, Mr. Alpha Madiou Barry of DNE Conakry, research fellow under the ILRI/BMZ regional Project "Improving the management of trypanocide resistance in the cotton zone of West Africa", carried out his practical research work at ITC on serological and PCR-based testing of trypanosome isolates from Guinea for drug resistance. In December 2004, he proceeded to the University Bamako, for academic studies and the writing up of his PhD thesis (to be completed until end of 2005).

Mr. Douadeu Bleu of RCI and Mr. Bassirou Sall of Senegal both undertook, independent from each other, to characterise, analyse and evaluate the emerging F1-crossbred cattle producing small-scale farms in GBA, profiling the production system and economic viability. Based on the submitted study, Mr. Sall successfully graduated and obtained an MSc with IAM, France.

Ms. Christa Bodaan, a final-year student of the Vet. Faculty of Utrecht, Netherlands, and Ms. Flora Logan, in preparation of her PhD-studies at London University, participated in on-going research or routine field work undertaken by ITC, for three respectively one month.

For the first time, four final-year agricultural students of the young University of The Gambia (UTG), Faculty of Science & Agriculture, were accepted to undertake supervised practical studies at ITC for thesis production, in fulfilment of the requirements for a BSc-honours degree. For slightly varying periods of about 4 months, the students were attached to ongoing practical studies/research work at ITC (i.e. on ruminant feeding, milk hygiene, AAT, training & extension), under the supervision of the respective subject matter specialists. At the end of 2004, none had yet completed the compilation and writing of the thesis.

In addition to these opportunities for individual students of UTG, several groups of students were given practical instructions and demonstrations on selected research and routine activities at farm and laboratory level, on the occasion of pre-arranged visits together with their lecturers to ITC.

Table 7: External study attachments at ITC in 2004

Name, Country	Period	Assignment
Alpha Madiou Barry, Guinea (DNE/IRAG, Guinea)	April – early Sept. 2004	IND0401: Evaluation de la chimiorésistance des trypanosomes et proposition des stratégies de contrôle chez le bétail trypanotolérant en Haute Guinée (Serological and PCR-based characterisation of trypanosome isolates from Guinea & testing for drug resistance)
Ms. Christa Bodaan, NL (Univ. of Utrecht)	March – June 2004	IND0402: Final year vet. studies research traineeship: Participation in epidemiological studies on Cowdriosis in small ruminants in The Gambia
Mr. Douadeu Bleu, RCI/France (CIRAD attachment))	Mai – August 2004	IND0403: Research study attachment: Catégorisation du niveau de production des exploitations bovines laitières à métis F1 dans le 'Greater Banjul Area' (GBA), Gambie. Survey and desk study.
Mr. Bassirou Sall, Kaolack, Senegal (IAM, Montpelier)	July – October 2004	INDO404: Research study attachment: Evaluation de la petite production laitière basée sur le croisement en zone periurbaine de Banjul. Field & desk study for MSc
Ms. Flora J. Logan, Glasgow/London, UK	August 2004	IND0405: Study visit on practical aspects of tsetse and trypanosome surveys and the monitoring of livestock
Mr. Demba Jallow, Univ. of The Gambia (UTG)	May – September 2004	IND0406: Study attachment for BSc (Hons) Agric.: Small ruminant feeding: Effects of *Moringa oleifera* on growth and body condition of WAD goats
Mr. Alagie Bah, UTG	May – September 2004	IND0407: Study attachment for BSc (Hons) Agric.: Quality control of milk and milk products produced by dairy cooperatives in The Gambia
Mr. Poulo Joof, UTG	May – September 2004	IND0408: Study attachment for BSc (Hons) Agric.: Trypanosomiasis in cattle, general description and selected aspects of testing for drug resistance
Mr. Kebba N.S. Jammeh, UTG	December 2004 onwards	IND0409: Study attachment for BSc (Hons) Agric.: Observations on the training process & development of extension materials in support of improved milk production in The Gambia

Seminars at ITC

In 2004, eight seminars by ITC staff and guest presenters on scientific and technical themes were held at ITC (for topics see Table 8).

Table 8: Seminars at ITC in 2004

Presenter	Date	Theme of Seminar
Kwaku Agyemang, A. Fall, N.A. Bosso	13 February 2004	Towards estimation of the economic benefits from genetic improvements in the ruminant nucleus breeding at ITC
Abdou Fall, ITC	30 April 2004	Screening of village livestock for milk and growth rates in The Gambia and Guinea – achievements and outlook
Susanne Münstermann, ITC	11 June 2004	Procordel Extension – What is it about ?
Erik Hoeven, ITC	11 June 2004	Genetic characterisation of West African goat populations [on invitation also presented at MRC]
Cristopher L. Kelley,	18 June 2004	Rapid methods for fibre and fat analyses

Ankom Inc., N.Y., USA		
Christa Bodaan, & Bonto Faburay, ITC	24 June 2004	End-of attachment presentation on a survey undertaken for a serological transect study on Cowdriosis in small ruminants in The Gambia
Simplice Nouala Fonkou, ITC	25 June 2004	Comparison of plant cell wall degrading community in the rumen of N'Dama and N'Dama x Jersey crossbred cattle in relation to in vivo and in vitro cell wall degradation
Mopoi Nuwanyakpa, Consultant	22 December 2004	African agricultural consultants working in Africa: Challenges, rewards and outlook

Training impact assessment survey 2004: Assessment of the training programme impact on institutional, personnel and beneficiary capacity / knowledge increase

Based on available database information on the former trainees, an effort was made to assess and evaluate the effects and impact of all group training (60; Procordel: 34) and individual (29; Procordel: 26) training events that were implemented by ITC and its partner institutions and collaborators from 2001 to March 2004 (marking the end of Procordel's main phase). Assessments were to be done at individual and at institutional level.

As component of the end-of-project activities of PROCORDEL, a comprehensive questionnaire was developed in English (for Gambia, ITC) and French (Senegal, Guinea, Guinea Bissau), composed of three parts, separately and anonymously addressing ex-trainees, ultimate beneficiaries (indirectly), and institutional/unit heads and supervisors:

Follow-up Survey on Training Activities (co)-organised by ITC and Partner Institutions in The Gambia:

Part 1: Participants' Survey (Questions 1.1 – 1.7)
Part 2: Beneficiaries' Survey (Questions 2.1 – 2.5)
Part 3: Institution/Employer Survey (Questions 3.1 – 3.6)

Suivi des Sessions de Formations (co)-organisées par ITC et ses Institutions Partenaires au Sénégal / Guinée / Guinée Bissau:

1ère Partie: Enquête Participants (Questions 1.1 – 1.7)
2ème Partie: Enquête Bénéficiaires (Questions 2.1 – 2.4)
3ème Partie: Enquête Institution/Employeur (Questions 3.1 – 3.6)

The questionnaire survey was designed to:

(1) allow to better assess the perception, appraisal and impact of training on professional & technical staff, and to learn from these accounts;
(2) allow to better assess the effects of the *ToT/ToF*-approach on ultimate beneficiaries (livestock farmers or milk processors/vendors) indirectly, i.e. through the judgements of field (extension) staff, who have been involved in *ToF* as trainers-facilitators-extensionists;
(3) obtain from institutional/unit heads & supervisors of participants/beneficiaries a judgement from the institutions' point of view.

The personalised questionnaires (referring to the specific training events of individual respondents) were distributed with the assistance of the Procordel National Coordinators in Senegal in September, in Gambia/ITC in October, and Guinea and Guinea Bissau in December 2004, and re-collected as soon as possible and to the extent possible. By the end of 2004, the questionnaires of 115 respondents had been returned to ITC (= 58 %).

The main findings from the preliminary assessment of the questionnaires indicate that:

- Former participants rate the overall quality and effects of training positive (medium-high);
- Targeted training contributed to work performance, staff competence, motivation;
- Training under this programme was often the only training opportunity for NARES staff during the last four years;
- More training with a practical orientation is in high demand;
- The *ToT/ToF*-approach appears successful as ultimate beneficiaries and groups have started to adopt recommendations and new technologies.
- However, the collaborative training programme could not fully substitute any deficient HRD & training agenda of partner NARS

It can be confidently concluded that the multi-facetted targeted training programme implemented over the last four years had increased (1) the implementation capacities for the collaborative annual work plans with the NARS, (2) the application and harmonisation of recommended methods, (3) the personal performance (knowledge, skills, attitudes), and (4) supported, in a smaller number of cases, individual career development.

Training and information facilities at ITC

ITC's PC training pool that became operational in 2003, was no more than modestly made use of in 2004: one introductory training for familiarisation with the new Stata 8 software package (ITC0401) and a training on more advanced useful Excel functions were carried out in collaboration with resource persons from the MRC Laboratories, who in turn organised some separate training for their own data managers using the facility. However, the existing good infrastructure of the pool enabled ITC to plan for and offer in late 2004 a two-week regional training course on *ArcView GIS and selected epidemiological applications* that was then carried out very efficiently in collaboration with experts from CIRAD and ILRI in January 2005 (13 participants from 7 countries and ITC).

With the support and funding by **CIM**, Germany, ITC was able to realise in 2004 the improvement of several services/infrastructure with relevance to training, information exchange and capacity building:

- The enhanced internet link of the training facility through installation of a wireless transmission system between the internet provider (Netpage) and ITC.
- The acquisition of a new statistical software package STATA 8 (& Stat-Transfer) for the pool and ITC professional staff, and related introductory training in the pool are adding to the standardisation and individual performance in data handling & analysis at ITC.
- The acquisition of new audio-visual equipment (video camera; video cutting software; mobile LCD-screen) is used for small video projects for training and extension purposes.
- The acquisition of about 95 new titles of scientific textbooks, monographs, and manuals as stock for starting ITC's "New Library" is substantially improving access to scientific and technical information in a range of fields (e.g. in: agricultural development policy; animal science, husbandry, breeding, production, feeding/nutrition; dairying; small-scale farming and extension; (peri-)urban livestock agriculture; animal health (cattle, sheep, goats, poultry, zoo & wild animals), clinical examination, vet. drugs/pharmacology; human and public health, zoonoses; epidemiology, disease control; (molecular) biology, genetics; food and veterinary microbiology; parasitology; biochemistry; biotechnology; bioinformatics; statistics, sampling, modelling, Stata 8 applications)
- The acquisition of some new equipment has improved existing facilities, *i.e.* (1) for the training pool: a set of 12 new chairs, one white board, one split-type air-conditioner; (2) for

the reading room: a wooden cabinet for holding the "new library"; (3) for the conference room: a wall-mounted projection screen.

Despite ITC has been equipped with a LAN and connected to the local internet provider via a telephone-independent wireless system, frequent technical shortfalls and severe slowness due to bandwidth restrictions (a country problem) constrained the services over much of the year (recent improvements). It still precluded from any opportunity of preparing the PC-pool for distant education modules or literature search exercises in a group training context. ITC staff continued, however, to have access to a wide range of scientific journals through on-line access to the websites of HINARI (WHO) and AGORA (FAO).

The updating of ITC's homepage (www.itc.gm) was problematic for most of 2004 due to lack of in-house expertise on accessing the website for maintenance & uploading of documents. The situation had finally improved with the part-time employment of the data manager and in cooperation with the hosting internet-provider.

Staff development

In October 2004, ITC was able to appoint a Data Manager, Mrs. Bridget Chukualim, on a part-time basis (6 months consultancy). Within the framework of IP 11, Mrs. Chukualim assisted in the maintenance of the ITC website, made herself acquainted with ArcView GIS for assistance during the GIS training course, and is providing support to senior ITC staff in database management (Access).

Other activities

In April 2004, a project proposal on *"Technical Training to Support Development of Suitable Technologies to Improve Livestock Productivity in West Africa" (Formation Technique pour Soutenir le Développement des Technologies Adaptées pour Améliorer la Productivité de l'Elevage en Afrique de l'Ouest)* that had previously been forwarded to NARS Directors was sent to the African Development Bank, for examination and possible donor-funding. Though direct contacts to senior persons in the Bank's West Africa Department (Agriculture) were established and maintained throughout the year, no binding statements could be obtained so far.

The Training Coordinator participated in the '*African Regional Workshop on the Implementation of Article 6 (Education, Training and Public Awareness) of the United Nations Framework Convention on Climate Change'*, Banjul, 28-30 January 2004, and presented a paper on ITC's mission in the context of livestock-agricultural research and training & capacity building in the sub-region.

On 22 June, ITC organised a Workshop/Seminar for Decision-makers in The Gambia (various levels, public & private), to present major R&D results and achievements of Procordel; the Training Coordinator gave an overview on training, information exchange and capacity building activities.

From 13-17 September, the Training Coordinator visited ISRA and other partners in Senegal to initiate the training evaluation survey in close collaboration with the National Procordel Coordinator, and to plan for further training (F1-farmers exchange visit/training module on 'transformation du lait'; regional GIS course).

From 5-7 October, the Training Coordinator attended the Conference "Deutscher Tropentag" at Humboldt University in Berlin, Germany, where he presented a poster on "Regional Approach to Technical Training and Capacity Building for Improving Livestock Productivity in West Africa" (see Conference Abstracts: A. Schoenefeld, K. Agyemang, S. Münstermann).

On 19 October, the Training Coordinator briefed Mrs. E. Visser of the *EU Monitoring Team* on ITC/Procordel's training and capacity building activities. He also attended her debriefing meeting at ITC on 21 October.

IP 11 also contributed to increase the visibility of the Centre by designing and producing flyers on the mission and work of ITC (English & French version): *"Regional Cooperation on Livestock-based Agricultural Research for Development in West Africa" / "Coopération Régionale en Recherche-Développement sur l'Elevage en Afrique de l'Ouest"*.

The Training Coordinator closely collaborated with the DG of ITC, PMC members and others in the preparation and implementation of the International Conference, held from 8-12 November in The Gambia, on "*Livestock Agriculture in West & Central Africa: Achievements in the past 25 years, challenges ahead and the way forward*" that was jointly organised by ITC, CTA and CIRDES, and included a review and assessment of achievements of PROCORDEL in the ITC and CIRDES zones, as a 'Model for Regional ARD partnerships'. A presentation on communication and training was given in the Session 'Communication, Training and Regional Dialogue'.

On 25-26 November, ITC staff involved in the local milk system improvement work and related training participated and contributed to a end-of-project workshop on FAOTCP/GAM/2802 'Improving milk safety and farmers income using the village milk system'.

In 2004, the coverage of events in the ITC Newsletter has been limited to two issues (mainly because of smallness of the production team). The collation and dissemination of information through the newsletter on key activities, events and developments at ITC have clearly increased the visibility of the Centre.

The production and field-testing of training manuals for farmers, producers, and Livestock Assistants (in their role trainers-extensionists) had made good progress. Three illustrated manuals became available as final products (Guidelines for good dairy practices, Vol. 1: Hygienic milking and milk handling; Improved small ruminant production) or working versions (F1-crossbred cattle production). A manual on indigenous ruminant pure breeding and a manual on applied socio-economic survey methods (CIRDES, ITC/ILRI are under preparation.

The parallel production of two multimedia training packages for farmers, producers, and Livestock Assistants (in their role trainers-extensionists) was started at ITC, one on hygienic milking and processing of locally produced milk (~ 16 minutes), the other on F1 crossbred cattle production (~ 40 minutes), with modules 1-6: reproduction by A.I., husbandry, housing, health feeding, milk hygiene. Five versions to be produced for PC-based video projection via CD (VHS cassette) and wide distribution in the sub-region, i.e. a Series A: English subtitles with comments in Mandinka (A1), Wollof (A2) and Fulla (A3), and a Series B: French subtitles with comments in Wollof (B1) and Fulla (B2).

The publication of selected R&D results in the three ITC Research Working Paper Series was continued in 2004, with Animal Health Research Working Paper No. 3 & 4, Animal Production Research Working Paper No. 1-4 (1-3 in collaboration with ISRA), and Socio-Economic Research Working Paper No. 2, 3 (with IRAG), and 4 (with INPA). Two Proceedings of the 2003 Procordel National Conferences in The Gambia and in Guinea were also published in 2004. All these documents can be downloaded from ITC's website.

Potential Impact

IP 11 continued to support and implement various activities on training, information exchange and capacity building, in line with the objectives and goals of ITC's Medium Term Plan, PROCORDEL's CE5 and CE6, and the Annual work plan 2004. Despite some administrative-

technical factors, many of the planned training activities could be carried out in collaboration with the respective partners. However, the delays in the release of operational funds under Procordel CE6 had not allowed to implement all plans for strengthening the local knowledge base through regional mobility, i.e. short-term attachments at ITC in support of improved ruminant feeding strategies in Sierra Leone and on improved milk hygiene and processing in Guinea Bissau had to be postponed.

Networking between key institutions and many other partners that assumed important roles in the R&D activities was extended or maintained, for the enhanced transfer of technologies to the livestock owners and other stakeholders.

The "Training of trainers"- and "Training of farmers"-approach had gained even more importance and is now well established as instruments for the transfer and dissemination of innovative technologies at the grassroots. The increased availability of specific training and extension materials contributed to the effectiveness of this approach.

The evaluation of the assessment of the ITC training programme in general, and of Procordel's important training component in particular, has given positive results, indicating that the training inputs have contributed in no small way to the increase in critical mass at the professional and technical level and to the extension and transfer of research results to the ultimate beneficiaries.

Realising that the achievements in HRD and capacity building so far can rapidly be lost again, ITC's efforts to seek international donor-support for a continuation of HRD and training under a new regional project approach to technical training and capacity building for improving livestock productivity in West Africa.

Attainment of Medium-Term Plan Milestones

The activities undertaken by the Project and collaborating partners have contributed to the realisation of ITC's Medium Term Plan Milestones for the year 2004, namely through the implementation and support to training courses at various levels and other training relevant inputs at ITC and NARS, the production of training and extension materials, improved networking in training and enhanced information exchange between partner institutions in the Sub-region.

Contributors

Institutional Project Leader: A. Schoenefeld

ITC Scientists: K. Agyemang, A. Fall, S.Münstermann (left in August), Y.Akinbamijo, F.Unger, S.Leak (left in August), E. Hoeven, F.Sanyang, J.Somda, S.Nouala, N.Adediran, A.Bosso, M.Hempen, B. Faburay, M. Mbake, B. Chukualim

ITC Technicians: N. Corr, M. Njie

Collaborating Institutions:

The Gambia: DLS, NARI; Senegal: ISRA-LNERV, EISMV, CRZ, PAPEL, ANCAR; Guinea:DNE-IRAG, CFEL, PAE; Guinea Bissau: DGP, INPA; Sierra Leone: MAFFS

IARCs/Regional Projects/Int. Organisations: FAO, ILRI

ARIs/Universities (Europe): ITM Antwerp, Leuven University (Belgium); FU Berlin, Hohenheim University (Germany); Utrecht University, University of Wageningen (Netherlands)

Annex 1: List of Publications 2004

Book:

Agyemang, K.: 2005. Trypanotolerant Livestock in the context of trypanosomiasis intervention. PAAT Technical and Scientific Series **7**, FAO, Rome

Journals:

Akinbamijo, O. O. 2004. Urban fodder forests in The Gambia. *Urban Agriculture Magazine*, 13:20

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Muenstermann, S., Somda, J., Kamuanga, M., Hempen, M., Unger, F., Carayol, D. (2004). 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*, 8-9, 125-131

Nouala, S., Akinbamijo, O.O., Smith, O.B., Pandey, V.S. (2004). Horticultural Residues as ruminant feed in peri-urban areas of The Gambia. *Livestock Research for Rural Development*, 16 (6), Art. 37

Somda, J., Kamuanga, M., Tollens, E. (2004). Characteristics and economic viability of farm milk production in the smallholder farming systems in The Gambia. *Agricultural systems*. (In press)

Somda, J., Kamuanga, M., Tollens, E. (2004). Evaluating farmers' willingness to adopt integrated packages for trypanosomosis control in The Gambia: Application of demand revealing mechanisms. *Pakistan Journal of Social Sciences*, 2 (3), 211-220.

Somda, J., Tollens,E., Kamuanga, M (2004). Structural Adjustment Programmes and Domestic Supply of Food: A Case Study of Ruminants' Meat and Milk in West Africa. *Food Policy* (Accepted in April 2004)

Somda J., Tollens, E. Kamuanga, M. Policy Reforms and Performance of the livestock sub-sector in West Africa: Case Studies of The Gambia, Guinea and Senegal. *Food Policy,* (Accepted - forthcoming)

Unger, F., Münstermann, S. (2004): *Assessment of the impact of zoonotic infections (bovine tuberculosis and brucellosis) in selected regions of The Gambia, Senegal, Guinea and Guinea Bissau*. DFID Animal Health Programme. Project Report, April 2004. 102pp.

Conference/Workshop and Poster Presentations:

Oral Presentations:

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