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Sustainable Tree Crops Programme

WEST AFRICA REGIONAL CASHEW SURVEY

(covering the countries Guinea, Guinea Bissau, Cote d'Ivoire, Ghana and Nigeria)

Volume 1

May 2001

(Report Number: BHA – 01109)

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Funded by: STCP/USAID

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WEST AFRICA REGIONAL CASHEW SURVEY – Volume 1
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Acronyms

ADRA	Adventist Development and Relief Agency (NGO)
AMAE	Associacao das Mulheres para Actividades Economicas, Guinea Bissau
ANADER	Agence National d'Appui au Developpement Rural, Cote d'Ivoire
BCPEA	Bureau de Coordination des Projects, Guinea
BEI	Bureau d'Etude et d'Ingienerie, Guinea
CD	Cedis, the Ghanian currency
CFA	Currency for a number of West African countries
CNRA	Centre National de Recherche Agronomique, Cote d'Ivoire
CNSL	Cashew nut shell liquid
CRAF	Centre de Recherche Agronomique de Foulaya, Guinea
CRI	Crops Research Institute, Ghana
CRIG	Cocoa Research Institute of Ghana
CRIN	Cocoa Research Institute of Nigeria
CSIR	Council for Scientific and Industrial Research, Ghana
DFID	Department For International Development, UK
DNA	Direction National de l'Agriculture, Guinea
DPDRE	Directeur Prefectorale de Developpement Rural et Environnement, Guinea
GNF	Guinean Franc
GTZ	Deutshe Gesellschaft fur Technische Zusammenarbeit GmbH, Germany
INPA	Instituto Nacional de Pesquisa Agraria, Guinea Bissau
IRAG	Institut de Recherche Agronomique de Guinea
MOFA	Ministry of Food and Agriculture, Ghana
N	Niara, the Nigerian currency
NARP	National Agricultural Research Programme
NARS	National Agricultural Research Systems
NGO	Non-governmental organisation
P	Prefecture
R&D	Research and development
S/P	Sous-prefecture
SARI	Savannah Agricultural Research Institute, Ghana
SNPRV	Service National de Promotion Rurale et Vulgarisation, Guinea
SPCIA	Societe de Production et de Commercialisation d'Intrants Agricoles, Guinea
STCP	Sustainable Tree Crops Programme
T&V	Training and visit system of extension
TOR	Terms of reference
UDA	University of Development Studies, Tamale, Ghana
USAID	United States Agency for International Development

Exchange rates at the time of the survey

1US$ = 1,900 Guinean Francs
1US$ = 600 to 700 CFA
1US$ = 6,770 Cedis
1US$ = 105 Niara

WEST AFRICA REGIONAL CASHEW SURVEY

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Executive Summary

The authors would like begin by thanking all those people who so patiently answered questions and showed the teams around the different cashew sites, without this help the survey would not have been possible. Thanks must also go to all the participating institutes for providing vehicles and drivers for the survey, special thanks should go to IRAG for providing the vehicle that went round 3 countries over sometimes very difficult terrain. Our appreciation goes to STCP/USAID for providing funding for the survey.

The Regional Implementation Workshop of the Sustainable Tree Crops Programme (STCP) was held in Ghana from 22nd to 26th May, 2000. At the workshop it was agreed that a survey of the constraints and opportunities facing the cashew industries in 5 West African countries would be a crucial starting point, to facilitate the establishment of a regional plan of action for cashew research and development in the area. This Report covers the surveys that were carried out to fulfil these objectives

The main body of the report summarises the wealth of detailed observations and comments recorded from the two surveys that were undertaken (detailed in Annexes 1 and 2). Each topic is discussed where necessary for each country separately, followed by general conclusions for West Africa. For example, the topics "germplasm" and "research capacity" are discussed for each country separately and then summarised for West Africa, whereas "pests" and "diseases" are only discussed for West Africa as a whole because of their more general nature.

Pests and diseases

Extensive observations made during the survey suggest that insect pest damage is of much greater significance than disease problems but as the area of cashew expands, the likelihood of major disease problems also increases. It should be remembered that in East Africa up until the early to mid 1970s, when cashewnut production nearly reached 400,000 tons, powdery mildew disease (PMD) was not important. Now it devastates production throughout the region. There is therefore always a need to be vigilant about diseases in order to prevent them becoming established.

The two Hemiptera sucking pests *Helopeltis sp* and *Anoplocnemis curvipes* (both sub-order Heteroptera), and thrips, are probably the most economically damaging pests over the West African region in general. Trunk borers (*Apate terebrans*, Coleoptera, family Bostrychidae) and branch girdlers (*Analeptes trifasciata,* Coleoptera, Cerambycidae) can be serious on a more isolated scale. There are also a number of minor pests in the region as a whole, which could be serious sporadically or from time to time (e.g. Aphids, leaf rollers, etc.).

There is an urgent need for quantitative data on the economic status of pests and diseases, including.

- The distribution of pests and diseases in each country
- The frequency and intensity of damage caused
- The loss of farmer income due to the different pests and diseases

It would be useful if the collection of such data could be harmonised, co-ordinated and jointly analysed across the region. Such region-wide data would be of much greater value than the sum of the parts.

Little previous work has been carried out on cashew pests and diseases and to help ensure that correct quantitative data is collected, a simple handbook should compiled and made available to researchers and field workers. This would collate all available and relevant information from both within the region and other parts of the cashew growing world, where applicable, and be updated as new knowledge became available. Such a handbook should be for the region as a whole and as such should initially be in both English and French but eventually in local languages for extension workers and farmers. Inputs from the different organisations in the cashew network could help keep it up to date as new knowledge arose. A regional handbook used by all organisations would be of great benefit to help maintain harmony and synchronization of pest and disease data collected, and would act as a very much needed educational tool.

At the same time, methods of control need to be researched for the economically damaging pests. Control measures should be practical, safe for use by resource poor farmers, show good economic returns and be environmentally sound.

It is appropriate to mention here the possible potential beneficial role of the predacious ant *Oecophylla*. In East Africa and elsewhere, *Oecophylla* has been shown to significantly reduce *Helopeltis* (sucking pest) damage. As a result of this, research has been conducted on ways of enhancing the territory of *Oecophylla* . Although not very common on cashew in West Africa, *Oecophylla* was seen in sufficient numbers to warrant research on its potential in the region (see Photos. 64 and 65, Vol 2).

Knowledge of cashew pests and diseases was generally very limited among field workers. Also farmers usually could not distinguish different types of damage or say what had caused it.

- In Summary:

A large number of trees were observed at a large number of sites in the main cashew growing regions of 5 West African countries, at about the most critical time in the production cycle, i.e. at the time of flowering /nut set. The incidence of pests and diseases is most critical at this time. The major conclusions are:-

- Insect pests are causing serious economic loss to farmers in some areas, while diseases appear to be of much less importance generally.
- Hemiptera sucking pests and thrips are probably the most economically import pests.
- Only tiny amounts of what might have been anthracnose were seen.
- Other types of damage were incorrectly identified as anthracnose.
- No powdery mildew disease was seen at all.
- More quantitative data on the economic status of pests and diseases is required.
- Pest and disease knowledge transfer to field workers and farmers needs to be radically improved.
- A cashew pest and disease handbook needs to be published for the region as a whole.
- Collection of quantitative pest and disease data and development of control methods should be synchronized over the region.
- Work on enhancement of natural control of sucking pests should commence.
- Quarantine procedures need to be either put in place an/or strictly adhered to.

Other constraints

The problem of flowers drying out with no production is sufficiently serious and widespread to warrant immediate research. Progress on this topic could be made relatively quickly, at least by narrowing down the number of factors that might be responsible.

Obvious cashew growth deficiencies are not a major problem (unless linked to drying of flowers) and although there is work to be done in this area, it is not a high priority

Bush fires and the subsequent damage to cashew is one of the major constraints to cashew production. A comprehensive review of the literature needs to be undertaken to see what approaches have been adopted in other parts of the world, and for other crops, to determine how this can be applied to cashew, a crop that fruits towards the end of the dry season when fires are at their most devastating.

After the literature review various strategies need to be evaluated on farm, for example:-

- where tractors are available, cost sharing strategies might be worked out to make fire breaks
- a hand operated petrol rotavator might be useful for making fire breaks
- growing certain crops around the periphery of cashew plots, that either remain green or ones normally grown and that are kept clean of weeds, need to be explored.

Cashew has a very valuable role to play in bush fire reduction in general because it yields in the dry season. Experience in other countries in the past has shown that as a 'cashew culture' develops with more and more farmers growing cashew, fires are almost automatically brought under control.

A closer look at the economics of high density planting is required and should be undertaken in all the countries, since yield potentials and input costs (such as labour for weeding), will vary considerably. A selection of as similar as possible paired plots could be analysed, one plot low-density and the other high-density cashew.

Finally, more quantitative yield information is required from a representative number of farms (preferably over a number of years) from all the main cashew growing areas, in order to determine the yield potential and profitability of cashew in the different areas. This would be a matter of identifying a number of representative villages and then selecting a number of farmers, perhaps randomly from a register of cashew farmers, and then collecting only reliable past yield information and monitoring future yield data more thoroughly.

Germplasm availability and improvement

There is a tremendous amount of enthusiasm for cashew by farmers (and the authorities) in all countries and the farmers are expanding their cashew often with little or no support. Only Nigeria has seed for sale that has been evaluated to a certain degree. Even in Nigeria, the CRIN seed could be substantially improved.

The universal complaint is lack of good planting material, Annexes 1 and 2 are replete with examples of farmers and associations complaining that one of their main constraints is lack of good planting material. Much needs to be done with regard to selection, introducing new material, establishing germplasm trials for the short term, medium and long term, breeding and finally distribution of planting material to farmers. Because of the long time frame for evaluating cashew material, the need to multiply good material for distribution and the importance of providing farmers with the right material, funding for a future regional breeding programme must have the highest priority.

A related area which needs immediate attention is the introduction of tip or bud grafting techniques to produce clones (genetic replicas of the original mother tree). Without this technique, the breeder's trials are severely constrained, since they are having to use half-sib seeds all the time, which introduces more variability into the trials. With cashew being such a variable crop anyway, this is undesirable. Institutes could develop the technique of vegetative propagation on their own, adapting knowledge from other crops, but to make the process faster it is proposed that a workshop is given by an experienced cashew grafter, in order to transfer the technology that much more quickly and reliably. One or two scientists and/or technicians could attend the workshop from each country.

Finally, it must be emphasised that Brazilian dwarf trees would be entirely unsuitable in areas prone to bush fires.

Research

In all countries (to a lesser extent Nigeria) cashew research is seriously constrained by at least one or more of the following:-

- Limited manpower, especially considering that cashew is grown over a wide area and that there is much research work to do.
- Limited in-depth experience of cashew
- Lack of funds for trials, travel, labour, equipment, etc.

Obviously institutional problems of this nature are not solved easily: some suggestions are given below.

- Cashew needs to have a clear priority within each of the government's National Agricultural Research System (NARS), otherwise it will be difficult to get people and funds.
- Government organizations will need to re-deploy people from other sections or employ new graduates to work on cashew. (Governments are often reticent to employ more personnel due to past over employment).
- For export crops such as cashew a small export levy can be implemented, the money collected should be made available for cashew research and development.
- Submit well thought out projects to funding agencies.
- Regional networking is one of the objectives of the STCP and can be a powerful approach to problem solving – this is discussed in more detail under "Recommendations".

It must be remembered that since cashew is a tree crop, research work on it is a long-term undertaking, with no instant solutions and answers. It therefore requires long-term commitment, in terms of funding and ideally in terms of personnel too.

Potentially Exploitable Cashew Areas

It is only necessary to say that large areas of land suitable for cashew are available in all the countries visited, and so land would not be a limiting factor for a long time. This is purely based upon a visual assessment of the environment during the survey, a rudimentary look at the climatic data, but most of all upon the fact that existing plots of cashew were growing well throughout the survey area. Cashew can have an important role of providing a sustainable increase in smallholder income in an environmentally friendly way.

Total rainfall and the number of months with good rains, decline progressively in a northward direction. The survey was carried out in the main cashew areas of each country and generally speaking this was in areas receiving not less than 1,000mm of rain per year. It would be useful to do another survey further north in areas receiving less than 1,000mm of rain, where environmental problems are greater, crop opportunities for farmers more restricted, with less alternative sources of income and poverty more widespread. In Ghana

the problem of migration of people from the north to the south was being debated in Parliament at the time of the survey. Cashew could provide an important source of income along with environmental benefits in these more challenging regions.

Extension services
The extension service for cashew farmers in most parts of all the countries surveyed is either:-

- Weak - extension personnel are present but are not fully trained with major gaps in their knowledge, for example regarding identification and treatment of pests and diseases.
- Limited in manpower, transport and/or financial resources
- Non-existent.

Extension is a very important and yet a very difficult and complex subject, especially when dealing with resource poor farmers that are often numerous and widely spread. Many millions of dollars have been spent by countries taking loans from the World Bank to develop the Training and Visit system of extension, which is now thought by many to be inappropriate for resource poor farmers, living and working in environments which are characterised by their complexity, diversity and risk proneness.

The T & V system is characterised by the following:-

- It is often expensive and hence unsustainable in developing countries,
- It deals with "contact" farmers and the information is supposed to trickle down to the vast majority of non-contact farmers, which of course it rarely does,
- It uses regimented "do this" and "do that" impact points, which are often not suitable for individual farmer's agro-ecological and socio-economic circumstances.

To try and overcome these overwhelming problems, alternative approaches need to be tried, for example:-

1. A knowledge based approach to extension has many benefits over simple impact points, this builds upon existing farmer knowledge to give him/her a better understanding of the problem, so that existing and future technologies can be adapted to suit his/her own agro-ecological and socio-economic circumstances.
2. Build and strengthen farmer associations to act as focal points for extension activities
3. Train farmers as extensionists as shown above (the Technoserve example, in 11.5). These farmers would still require regular supervision to ensure that they are not making mistakes and passing this on to others.

Training

All of the above activities will rely crucially on having trained personnel at all levels. The type and needs for training are varied and cannot be easily specified in any simple way in this report. Some aspects have been specified, such as skills in vegetative propagation, in extension, etc. and some of these will require more than simple "field skills and training".

Also, there is a need to increase the higher levels of the knowledge base in order to allow the development of suitable background information to ensure "knowledge based" decision, planning and exploitation potentials, in other words to ensure that decisions are based on sound scientific and practical information. Therefore, in addition to the training specifically identified, a well-considered programme of PhD, Masters and Bachelor training needs to be implemented. But before that is implemented an assessment must be made of what is currently available over **all** this region (but necessarily presently identified as for cashew) and a mechanism implemented to allow the efficient sharing of knowledge and resources.

However the primary and urgent need is to make full use of the knowledge already available within the region but which is in "isolated pockets" – the use of "hands-on" training, workshops and strategy meetings will need to be an early feature of the network and one which will bring tangible results in a realistic time scale. See also the section on Farmer Associations given below.

Farmer Associations

Farmer associations, in one form or another were met in all countries visited and most were receiving no support at all. It is important that these associations are successful and provide tangible benefits to their members, especially the poorer ones. Not only do farmer associations potentially benefit the farmer financially, by negotiating higher prices for outputs and lower prices for inputs, they are also very effective vehicles for knowledge and technology transfer and rural development in general. There is an urgent requirement for specialised input regarding farmer associations. It appeared to the survey team that the bigger the association became, the less tangible were the benefits for the smaller farmer.

Training was a constant request from nearly all farmer associations, including the larger ones as for example found in Cote d'Ivoire. It is vital that training is provided as soon as possible, especially for the smaller, new, farmer-generated associations (e.g. those found in Guinea and Ghana), before problems are encountered and enthusiasm wanes. Training needs to be given in accounting, management, transparency, communication, etc. Obviously specialised input could decide the most appropriate course of action, but a strong well-trained cadre of farmer association specialists in each country is a minimum prerequisite. These people in turn could train and support the developing associations.

Diversification

Cashew can have many advantages in semi-arid regions, both financially and environmentally, but it is important to take a holistic view of crop development in these fragile, risk prone environments. Consequently other crops, both food and cash crops, need to be taken into account, as envisaged in the original concept of STCP.

Selling

The majority of farmers did not have a problem actually selling their production. In the more remote or new areas, the situation is improving and will continue to improve as more farmers plant cashew. If the lack of buyers is a problem, them farmers need to co-operate and bulk their nuts and arrange transport themselves, if possible.

Prices

Examples of prices paid for cashew over the past couple of years are given throughout Annexes 1 and 2, and generally speaking, the maximum prices paid to farmers were in-line with what could be expected from international prices. However the following problems were apparent:-

Value added

Processing of kernels

With regard to the processing of nuts, the story is mixed. On the positive side is the initiative in Ghana and the CAJOUCIS factory at Korhogo, Cote d'Ivoire. In the intermediate position is the SODIRO cashew factory at Odienne, Cote d'Ivoire with a good operation but marketing problems. On the negative side were the destroyed Premier Cashew Industry Estate factory (Oghe, Enugu State); the Cashew Processing Industries factory (Ibadan, Oya State) with changes needed in the processing stage and obsolete machinery, followed by marketing and financing difficulties. Both of these examples are in Nigeria. There is also the abandoned factory in Guinea Bissau.

It is very important that a regional review of marketing of processed kernels is undertaken, as obviously a number of factories are experiencing problems in this area.

Use of cashew apples
In all countries visited, the vast majority of cashew apples, which are nutritious and high in vitamin C, are simply wasted. For example see Photos. 52 and 53 (Vol.2). The first shows the family of Mr Fakoly Fofana (Monkono, Cote d'Ivoire) busy separating the nut from the apple of that morning's harvest; unfortunately all the apples were left to rot on the ground. The second shows Mr. Yaya Umoru (Ochaja, Kogi State, Nigeria) and children with the morning's cashew harvest; after bringing the fruits back to the farm house, the nut is detached and the apple is thrown away.

RECOMMENDATIONS

One of the objectives as stated in the Activity Proposal (Annex 7) is to provide an organisational framework of research and development opportunities for the region. It is anticipated that identified institutes will engage in **collaborative** projects to develop the potential of cashew in West Africa.

Summary of research and development (R&D) recommendations
Gu - Guinea, C – Cote d'Ivoire, Gh - Ghana, N – Nigeria

		Objective	**Relative Cost**
1	All	Implement vegetative propagation workshop	Medium
1	All	Implement selection and breeding trials	High
1	Adviser & all	Produce standardised manual of pests, diseases, research methods in English and French	Medium
2	External & all	Review literature of fire prevention and evaluate strategies	Medium
2	All	Collect quantitative data on the economic status of pests and diseases	Medium
2	Gh	Develop appropriate control strategies for pests and diseases.	Medium
1	Gu	Clarify the importance of anthracnose	Low
2	Gh & N	Determine factors responsible for drying of flowers	Low
1	All	Construct database of yield records	Low
2	Gh	Evaluation and enhancement of natural control of insect pests	Medium
3	C	Review economics of high density planting	Low
Admin	All	Establish a network of coordinators	
Admin		Appoint overall adviser and coordinator	
Admin	All	Improve levels of communication	
	C	Review support for extension and implement participatory knowledge based pilot extension project	
	Gu	Implement programme of training and support for farmer associations	
	C & N	Review marketing of kernels	
	N	Develop uses of cashew apples	

NB The country/countries listed to undertake the work are the minimum required, obviously if a particular country has the funds and personnel to do additional work, then that will be encouraged.

The Table provides a summary of research and development activities that need doing and their priority. However such an extensive list of work to be done will be constrained by lack of scientists, funding and facilities. Selecting which recommendations can actually be undertaken will be a matter of funding and agreement of the executing agencies. Funding by host country governments is currently very limited. In order to maximise benefits for all countries it will be very important that a regional integrated programme of research and development is agreed and that this is funded from multiple sources, eg governments, donors, private organisations, STCP.

Implement vegetative propagation workshop
An area which needs immediate attention is the introduction of tip or bud grafting techniques to produce clones (genetic replicas of the original mother tree). Without this technique, the breeder's trials are severely constrained, since they are having to use half-sib seeds all the time, which introduces more variability into the trials. With cashew being such a variable crop anyway, this is undesirable.

It is proposed that a vegetative propagation expert conduct a workshop to transfer this technology to two persons from each of the 4 countries as soon as possible.

The chosen location should be the one most convenient for people to get to, perhaps Ghana or Cote d'Ivoire.

Preparatory work will need to be undertaken by the host organisation by preparing large numbers of seedlings at the right growth stage for practice and a small amount of equipment will need to be purchased.

Implement selection and breeding trials
Quantitative evaluation of existing visually good trees should be carried out over a few years and should include, yield, nut weight, kernel weight and tree characteristics. The best trees can be entered into a simply replicated breeders trial. Care should be taken if selecting any tree, which is growing under particularly ideal conditions (see Section 8.4). There are a number of obvious sites in each of the countries where evaluations should take place, for example some of the estates like the MIM estate in Ghana, the SODIRO and Badikaha estates in Cote d'Ivoire, Kosoni farm, Premier Cashew Industry Farms in Nigeria, and the farm of Mr Sidiki Diakile at Saladou in Guinea.

It is proposed that **at least one**, up to date germplasm trial is established in a main cashew growing area of each of the 4 countries.

Selected material should include:-

1. The best **2 clones** from each of the countries (this will mean careful moving of vegetative material between countries in the region), this material will act as standard material in **all** trials
2. Material from overseas, for example, **seed** from (a) one or two lines of Brazilian dwarfs, (b) Tanzanian polyclonal garden and (c) 2 Indian selections. Again, this will be standard in all trials.
3. **Clones** of the best selected trees from within the individual countries (from on farm or on station)

Mixing clones and seed will present some problems but there is no alternative if material from outside the region is to be evaluated.

There should be a minimum of 2 replicates, plot size for clones should be 4 and for seed, a minimum of 9 (3 by 3)

The universal complaint was lack of good planting material. Because of this and the long time frame for evaluating cashew material, the need to multiply good material for distribution and the importance of providing farmers with the right material, funding for a future regional breeding programme must have the highest priority. However, the workshop on vegetative propagation is a prerequisite for the breeding programme.

Produce standardised manual of pests, diseases and research methods in English and French

As mentioned above all methodology, data recording and data analysis should be standardised to facilitate the pooling and integration of data from all countries. If the research is standardised across the region and well integrated, the value of the whole will be more than the sum of the individual parts. A standard manual in French and English, covering pest and disease identification, quantitative methodology for evaluating pests, disease, agronomic and breeding parameters, will be of tremendous help. This will need to be regularly updated.

Literature review of fire prevention and evaluation of strategies

Bush fires and the subsequent damage to cashew is one of the major constraints to cashew production. A comprehensive review of the literature needs to be undertaken to see what approaches have been adopted in other parts of the world, and for other crops, to determine how this can be applied to cashew, a crop that fruits towards the end of the dry season when fires are at their most devastating. The French and English literature should be thoroughly evaluated and then recommendations from this review should be evaluated on-farm. Obviously ready access to the literature will be an important factor.

After the literature review various strategies need to be evaluated on farm, for example:-

- where tractors are available, cost sharing strategies might be worked out to make fire breaks
- a hand operated petrol rotavator might be useful for making fire breaks
- growing certain crops around the periphery of cashew plots, that either remain green or ones normally grown and that are kept clean of weeds, need to be explored.

Collect quantitative data on the economic status of pests and diseases

Extensive observations made during the survey would suggest that insect pest damage is of much greater significance than disease problems. Diseases were of minor importance, but it should be noted that this might not always be the case. The two Hemiptera sucking pests *Helopeltis sp* and *Anoplocnemis curvipes* (both sub-order Heteroptera), and thrips, are probably the most economically damaging pests over the region in general. Trunk borers (*Apate terebrans*, Coleoptera, family Bostrychidae) and branch girdlers (*Analeptes trifasciata,* Coleoptera, Cerambycidae) can be serious on a more isolated scale. There are also a number of minor pests in the region as a whole, which could be serious sporadically or from time to time (e.g. Aphids, leaf rollers, etc.).

There is an urgent need for quantitative data on the economic status of pests and diseases, including.

- The distribution of pests and diseases in each country
- The frequency and intensity of damage caused
- The loss of farmer income due to the different pests and diseases

Develop appropriate control strategies for pests and diseases
Once a good start on the recommendation "Collect quantitative data on the economic status of pests and diseases" has been made, it will be necessary to research appropriate, environmentally friendly, control strategies, in the first instance natural control if possible and then, if necessary, sensible and rational chemical control methods.

Clarification of the importance of anthracnose
Extensive observations made during the survey would suggest that insect pest damage is of much greater significance than disease problems. As regards the effect of diseases on flowering and nut set, they were generally of minor importance, but it should be noted that this might not always be the case. Although only tiny amounts of what might have been fully developed anthracnose were seen, the confusion regarding the leaf disease as shown in Photos. 16, 17, and 18 (Vol.2) needs to be **urgently** clarified.

Determine factors responsible for drying of flowers
The problem of flowers drying out with no production is sufficiently serious and widespread to warrant immediate research. Progress on this topic could be made relatively quickly, at least by narrowing down the number of factors that might be responsible.

Construct database of yield records
Finally, more quantitative yield information is required from a representative number of farms (preferably over a number of years) from all the main cashew growing areas, in order to determine the yield potential and profitability of cashew in the different areas. This would be a matter of identifying a number of representative villages and then selecting a number of farmers, perhaps randomly from a register of cashew farmers, and then collecting only reliable past yield information and monitoring future yield data more thoroughly.

This exercise would not cost much and yet would provide very useful data for developing cashew.

Evaluation and enhancement of natural control of insect pests
A convenient starting point would be an evaluation of the potential beneficial role of the predacious ant *Oecophylla* (see Photos. 64 and 65, Vol 2). In East Africa and elsewhere, *Oecophylla* has been shown to significantly reduce *Helopeltis* (sucking pest) damage. As a result of this, research has been conducted on ways of enhancing the territory of *Oecophylla* . Although not very common on cashew in West Africa, *Oecophylla* was seen in sufficient numbers to warrant research on its potential to reduce damage by Helopeltis and the much larger *Anoplocnemis curvipes.*

Review economics of high density planting
A closer look at the economics of high density planting is required and should be undertaken in all the countries, since yield potentials and input costs (such as labour for weeding), will vary considerably. A selection of as similar as possible paired plots could be analysed, one plot low-density and the other high-density cashew.

Establish a network of coordinators
In-country coordinators should be formally identified, with clear terms of reference for coordinating the work within their own country and liaising with other countries. The obvious choices for such positions would be those people participating in this survey. Improved levels of communication will be needed.

Appoint overall adviser and coordinator
It will be essential to identify an organisation to provide broad based advice and practical co-ordination at an early stage. This will be needed to allow the network noted above to have a

focus and also to provide the necessary inputs to ensure appropriate levels of help and advice are given. BioHybrids AgriSystems Ltd could provide such a role, with their added advantage of active links with East Africa, but this would need to be viewed by those involved.

Improve levels of communication
Good communication is imperative to the success of the network and at the moment just basic communication need to be improved.

Normally with a crop of national importance there are many players involved, producers, farmer associations, research, extension, buyers, traders, transport companies, processors, exporters, etc and it is important that all these different players "talk" to each other to ensure a reasonable level of co-ordination and vertical integration along what can often be a complex chain. There needs to be appointed by consensus, a manageable group of stakeholders from producers, research, extension, NGOs, traders, processors, government, that can co-ordinate activities within each country. Such a "stakeholder committee" could and should play a pivotal role in organising, co-ordinating and motivating the cashew industry. Some countries have already had stakeholder meetings, but these should be formalised and meet on a regular basis, at least once a year, preferably twice.

The remaining recommendations are outside the remit of the current survey but are very important and are included for future action.

Review support for extension and implement participatory knowledge based pilot extension project
The extension service for cashew farmers in most parts of all the countries surveyed was either weak, limited in manpower, transport and/or financial resources or non-existent.

Extension is a very important and yet a very difficult and complex subject, especially when dealing with resource poor farmers that are often numerous and widely spread. An extension focused review would be desirable.

In the mean time it would be of benefit to start a participatory, knowledge-based, pilot extension project, testing alternative approaches, for example:-

- A knowledge-based approach to extension has many benefits over simple impact points, this builds upon existing farmer knowledge to give him/her a better understanding of the problem, so that existing and future technologies can be adapted to suit his/her own agro-ecological and socio-economic circumstances.
- Work with farmer groups and farmer associations which can act as focal points for extension activities
    - Train farmers to act as extensionists (with regular supervision to ensure that they are not making mistakes and passing this on to others).

Implement programme of training and support for farmer associations
Farmer associations, in one form or another were met in all countries visited and most were receiving no support at all. Not only do farmer associations potentially benefit the farmer financially, by negotiating higher prices for outputs and lower prices for inputs, they are also very effective vehicles for knowledge and technology transfer and rural development in general.

There is an urgent requirement for specialised input regarding farmer associations. Training was a constant request from nearly all farmer associations, including the larger ones as for example found in Cote d'Ivoire. It is vital that training is provided as soon as possible, especially for the smaller, new, farmer-generated associations (e.g. those found in Guinea

and Ghana), before problems are encountered and enthusiasm wanes. Training needs to be given in accounting, management, transparency, communication, etc. Obviously specialised input could decide the most appropriate course of action, but a strong well-trained cadre of farmer association specialists in each country is a minimum prerequisite. These people in turn could train and support the developing associations.

The priority country for farmer associations should be Guinea.

Review of marketing of kernels
It is very important that a regional review of marketing of processed kernels is undertaken, as obviously a number of factories are experiencing problems in this area. Without the ability to market the end product, then obviously the whole processing industry will collapse and the potential for value-added will be lost. Also, if some factories experience such marketing problems, this could also reduce confidence in other factories.

The priority countries should be Cote d'Ivoire and Nigeria

Develop uses of cashew apples
In all countries visited, the vast majority of cashew apples, which are nutritious and high in vitamin C, are simply wasted. More work on this valuable resource should be undertaken. CRIN in Nigeria has undertaken some work in this area and perhaps would be suited to develop suitable apple processing equipment and start distributing to farmer groups. The establishment of small scale juice processing plants can add value to the product and create employment at many levels.

Overview
If such a networking arrangement as envisaged above can become reality, then each country will become more aware of the status of the crop and activities related to it in other countries within the region, thereby allowing research workers to share ideas, new technologies, knowledge and problems. The opportunities for regional cross-cutting, problem solving will be significantly enhanced and any duplication of effort minimised. It will provide the basic underlying data and information on which research, development and extension activities for cashew can be based in the future.

WEST AFRICA REGIONAL CASHEW SURVEY

(covering the countries Guinea, Guinea Bissau, Cote d'Ivoire, Ghana and Nigeria)

Introduction

The Regional Implementation Workshop of the Sustainable Tree Crops Programme (STCP) was held in Ghana from 22nd to 26th May, 2000. At the workshop it was agreed that a survey of the constraints and opportunities facing the cashew industries in 5 West African countries would be a crucial starting point, to facilitate the establishment of a regional plan of action for cashew research and development in the area.

A draft "Activity Document" or project proposal was compiled by BioHybrids Agrisystems Ltd and copies sent by e-mail by the middle of July 2000 to collaborating partners for comments. The final "Activity Document" (equivalent to Terms of Reference or TORs) for the survey can be found in Annex 7 and this focuses mainly on research and development aspects. However during the survey other important areas were evaluated as well and these are covered in the report. The contract was signed on 10th November, about 2 months later than initially scheduled, however, by the end of December 2000, activities were back on schedule.

As mentioned above, some of the material in this report lies outside the original intended scope of the surveys (as outlined in the Activity Document) but is in addition to the original scope, and has been included to give a more compete picture of the factors affecting cashew production and development. Sections 1-10 form the main body of the report, coupled with the Recommendations (Section 16). Sections 11 – 15 cover other areas, outside the original remit and also feature in some of the Recommendations. There are a number of Annexes giving background information, some parts of which have been reiterated in the main report for illustrative purposes.

It is appropriate to briefly consider the qualities of the STCP and the reasons behind its formation and to this end the goal of the STCP is quoted below.

Sustainable Tree Crops Programme Goal
To improve the well-being of smallholder farmers through the development of sustainable tree crop systems that increase productivity, generate income, conserve biodiversity, use natural resources sustainably, and offer stable development prospects and long-term economic incentives.

Readers not acquainted with the STCP objectives and organisational components should consult Annex 8 where this original and holistic approach to agricultural development is explained in more detail. Some of the counterparts participating in this survey were not fully informed about the STCP. Presently the STCP focuses on 3 tree crops, cashew, cocoa and coffee.

2. Background

2.1 Country information

For general information regarding population, per capita income, GNP etc. for each of the countries visited, consult the following web sites:-

1. FAO www.fao.org/
2. CIA fact book www.odci.gov/cia/publications/factbook/index.html

2.2 Cashew

Annex 7, page 3, provides some general information about cashew and a graph depicting average cashew prices from 1970 to 1998. In 1999 cashew prices increased significantly only to drop back even more dramatically in 2000. The reason for the drop in price was that cashew imports into the USA and Europe declined in 2000 as a result of historically high prices the previous year. Consumers switched to less expensive products like other nuts, crisps, etc resulting in lower demand and hence a fall in cashew prices.

Cashew production figures for the 5 countries surveyed are given below; the sources of the information are also given in the tables. The data are often sporadic and generally speaking, more credible and convincing data need to be collected. Also inter-country trade in raw cashews complicates the picture. However the information provides an approximate idea of the current production of each country. (For comparison, FAOs' production figures from the FAO STAT database are also provided.)

Estimated production figures for Guinea are given in Table 1. As can be seen, commercial cashew is a new crop for Guinea and overall estimated production is still quite small at around the 6,000 tonne mark.

Table 1. Guinea - annual raw cashewnut production figures from 1994.
Copied from Table A3.3, Annex 3.

Year	Number of tonnes of raw nuts produced	Source of information if estimated put « Est »	Production figures from the FAO STAT database*[1]
1994			No records
1995			No records
1996			No records
1997	2-3000 tonnes	Est	No records
1998	3-4000 tonnes	Est	No records
1999	4-6000 tonnes	Est	No records
2000	Not available	N/a	

Estimated production figures for Guinea Bissau are given in Table 2, production statistics were not readily available but the figures indicate that cashew production has increased quite rapidly from around 11,000 tonnes in 1990 to 70,000 tonnes in 2000. The estimated projection for 2001 is 87,500 tonnes. Guinea Bissau is one of the largest producers in West Africa, but also see comments regarding Cote d'Ivoire below.

Table 2. Guinea Bissau - annual raw cashewnut production figures from 1990.
(Obtained during the survey)

Year	Number of tonnes of raw nuts produced	Source of information If estimated put "Est".	Production figures from the FAO STAT database *[1]
1990	11,695	Verbal/reports	30,000
1991			20,824
1992			30,000
1993			25,000
1994	24,507	Verbal/reports	30,000
1995	29,628	Verbal/reports	37,000
1996	38,000	Verbal/reports	38,000

1997	45,000	Verbal/reports	38,000
1998			38,000
1999	64,000	Verbal/reports	38,000
2000	70,000	Verbal/reports	38,000

Sporadic export figures for Cote d'Ivoire are given in Table 3, production figures are probably slightly higher. If these data are correct, then Cote d'Ivoire, along with Guinea Bissau, are the major cashew producing countries in West Africa.

Table 3. Cote d'Ivoire - annual raw cashewnut EXPORT figures from 1990
(Modified from Tables A4.2 and A4.3, Annex 4)

Year	Number of tonnes of raw nuts EXPORTED	Source of information If estimated put "Est".	Production figures from the FAO STAT database *[1]
1990			7,000
1991			9,000
1992	7,000	CNRA Internal document	10,000
1993	14,000	"	20,000
1994			20,000
1995			20,000
1996	26,000	"	20,000
1997	51,000	"	21,000
1998			28,000
1999	80,000	"	28,000
2000			28,000

Estimated production figures for Ghana are given in Table 4; here commercial cashew has been slowly but steadily increasing since 1990. Overall estimated production is still quite small at around the 5,000 tonne mark.

Table 4. Ghana - annual raw cashewnut production figures from 1990.
(Copied from Table A5.5, Annex 5.)

Year	Number of tonnes of raw nuts produced	Source of information If estimated put "Est".	Production figures from the FAO STAT database *[1]
1990	75	Technoserve	500
1991	90	"	500
1992	100	"	500
1993	140	"	500
1994	200	"	1,000
1995	300	"	1,000
1996	550	"	1,500
1997	700	"	7,500
1998	1,010	"	7,500
1999	2,239	"	7,500
2000	5,000	Est	7,500

Cashew production in Nigeria is given in Table 5. By 1990 production was already over 20,000 tonnes and higher than all the other countries surveyed, but since then production has only increased slowly to a level of 40,000 tonnes in the year 2000. It should be noted however that these figures are based upon calculations of area x average expected production.

Table 5. Nigeria – annual raw cashewnut production figures from 1990.
(Copied from Table A6.2, Annex 6.)

YEAR	Number of tonnes of raw nuts PRODUCED	Source of information If estimated put "Est"	Production figures from the FAO STAT database*1
1990	22,000	Est	30,000
1991	25,000	"	45,000
1992	25,000	"	55,000
1993	25,933	"	75,000
1994	27,480	"	85,000
1995	28,389	"	95,000
1996	30,000	"	110,000
1997	36,000.	"	125,000
1998	36,000.	"	152,000
1999	39,000	"	176,000
2000	40,000	"	176,000

The estimation of tonnage was based on the actual hectarage and on a production of 0.6 metric tonnes/ha.

3. Survey methodology and logistics

Essentially there were 5 major parts to the project (excluding administrative aspects) and these were:-

i. Project proposal

Designing project and writing of "Activity Document".

ii. Pre-field survey questionnaires

Design of questionnaire
Sending to counterparts and completion by counterparts
Checking and correcting with counterparts during the field surveys
Editing for the final report – see Annexes 3, 4, 5 and 6 for completed questionnaires

iii. Literature review

Cited in the report

iv. Field surveys

Preparation by counterparts in West Africa and by BioHybrids in UK.
Survey of Guinea, Guinea Bissau and Cote d'Ivoire - 8th to 29th January.
Survey of Ghana and Nigeria - 4th to 18th February.

v. Report writing

Collation of information
Collation of photographs
Writing report
Submission of report to STCP.

Further details on each of the above stages are given below.

Project proposal
The "Activity Document", on which the "letter of agreement" is based, is given in Annex 7 for completeness and ease of reference in the future.

Pre-field survey questionnaires
Questionnaires were sent out to Guinea, Cote d'Ivoire, Ghana and Nigeria around 15th November (immediately after signing the contract) to all co-ordinators, with a requested deadline for their return by 15th December. Ghana managed to return the completed questionnaire by mid-December; the one from Nigeria arrived in January 2001 and the other questionnaires were received at the start of the field survey. All questionnaires were checked and points clarified with counterparts while travelling together on the field surveys. Tables and other points of interest in these questionnaires are referred to in the main part of the report. Completed questionnaires for Guinea, Cote d'Ivoire, Ghana and Nigeria can be found in Annexes 3, 4, 5 and 6 respectively. No questionnaire was sent to Guinea Bissau as it is not a focal country for the STCP. However, it was included in the survey as it is an important cashew producer in West Africa and it was thought that it may well provide useful information.

Literature review
A literature review covering 1972 to 2000 was undertaken to identify as many references as possible regarding cashew in West African Countries. Those of relevance to the survey were put into a database and hardcopies were obtained for as many as possible.

Field surveys
First field survey.
The first field survey to Guinea, Guinea Bissau and Cote d'Ivoire began on 8th January 2001, amidst various problems facing all the initial survey countries. An attempted coup in Cote d'Ivoire (reported in the international press on 9th January), stability problems in Guinea Bissau after the civil war and growing refugee problems in Guinea. In spite of these potential disruptions, numerous military check-points and sometimes arduous and difficult conditions, the first survey went very well and was completed as planned. Both Dr Camara and Mr Diaora of IRAG (Institut de Recherche Agronomique de Guinea), who were part of the team for the whole of the first survey, were instrumental in its success. A vehicle and driver provided by IRAG proved excellent and these were a critically important element in facilitating travel to all three countries.

The survey started in the Western part of Guinea, then to G. Bissau, back through Guinea to Cote d'Ivoire and down to Abidjan. Figure 1 shows the route taken by the survey team. Details of all activities and observations from the first survey are given in chronological order in Annex 1. The survey finished on 29th January 2001.

Second field survey.
The second survey, involving Ghana and Nigeria, took place from 4th to 18th February 2001.

The survey of Ghana proved very successful, travelling as far north as Tamale, visiting various NGO organisations, farmers' fields, farmer associations and research institutes on the way. On 10th February, Dr Topper flew from Ghana to Nigeria. Here the survey had an ambitious schedule which involved travelling the entire breadth of Nigeria (which is a particularly large country) almost to the border with Cameroon, visiting cashew organisations in both directions; the Nigerian survey also went very well. Details of all activities and observations from the second survey are given in chronological order in Annex 2. Figure 2 shows the route taken by the second survey team.

During the two surveys thousands of panicles and many hundreds of trees were inspected for pest and disease problems and any other factors constraining yield.

The only negative point was that Mr Diaora of Guinea was supposed to participate in the Ghana and Nigeria surveys but unfortunately due to missed connections, he failed to link up with either the Ghana or Nigeria survey teams. This did not in any way affect the success of the surveys but it was disappointing in that Mr Diaora's participation was intended to increase his knowledge of cashew for the benefit of Guinea.

Report

The main body of the report pulls together the wealth of detailed observations and comments recorded from the two surveys and presented in Annexes 1 and 2. Each topic is discussed where necessary for each country separately, followed by general conclusions for West Africa. For example, the topics "germplasm" and "research capacity" are discussed for each country separately and then summarised for West Africa, whereas "pests" and "diseases" are only discussed for West Africa as a whole because of their more general nature.

After the introductory sections (1 Introduction, 2 Background, 3 Survey methodology and logistics and 4 Itinerary), biotic constraints are discussed (5 Insect pests, 6 Disease constraints and 7 Environmental constraints) which sets the scene for problems facing the potential breeding programme (Section 8, Germplasm, breeding and planting material). Then follows an evaluation of the existing capacity and future requirements for research (Section 9). The potential area that could be suitable for cashew planting is briefly described in Section 10.

The next five sections deal with matters that are outside of the original 'terms of reference' for the surveys. Section 11 discusses extension capacity – knowledge and technology transfer and following on from that, Farmer Associations are discussed in Section 12 and the need for diversification at the farm level in Section 13. Some commercial constraints are briefly addressed in Section 14 and 'Valued added products' in Section 15.

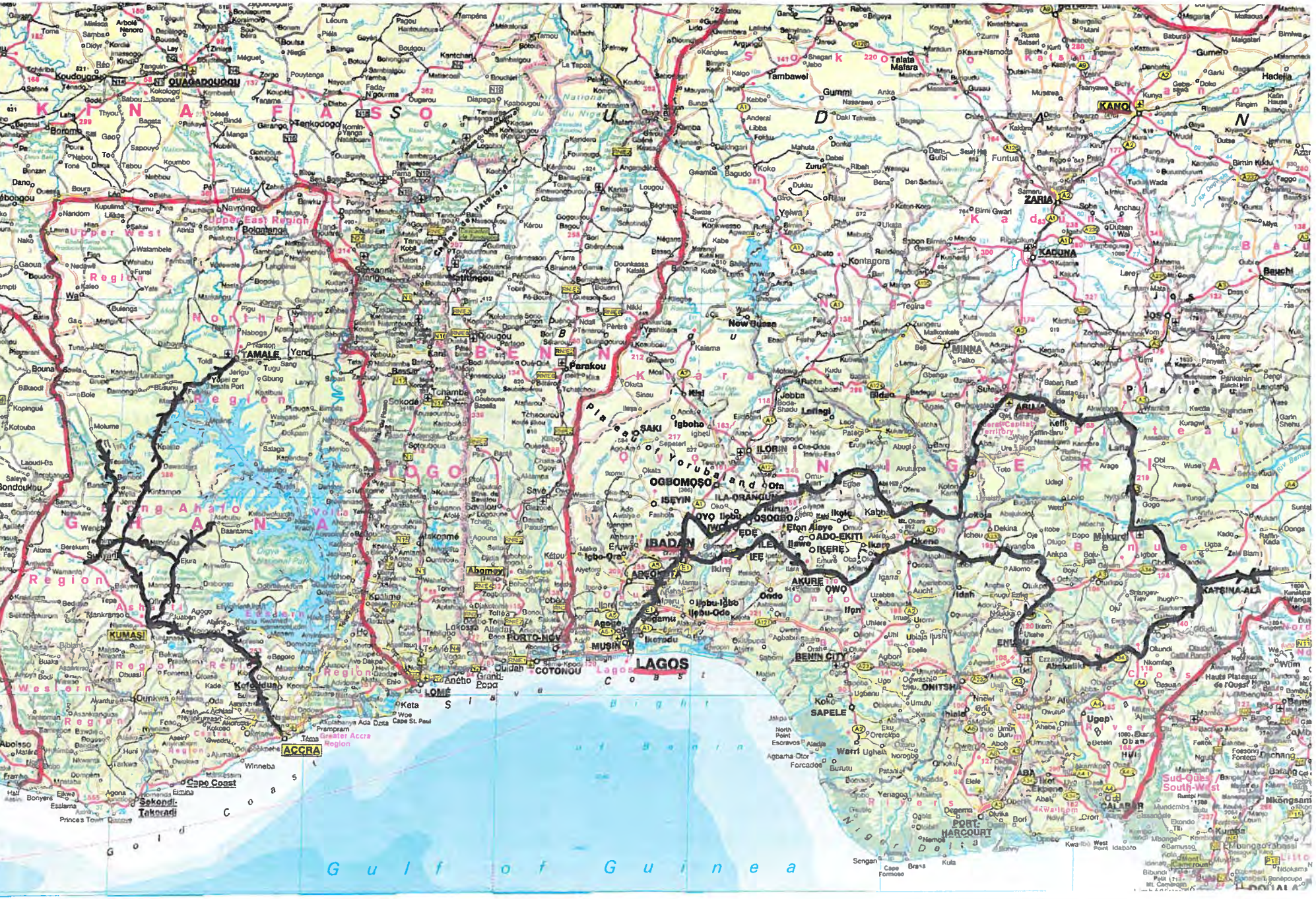
Finally, the Recommendations (Section 16) draw elements from all sections of the report, regardless of their inclusion in the original activity proposal, hence its placement at the end of the report.

Eight annexes provide additional detailed information so that the report is complete in its own right, thereby removing the necessity for some readers of having to refer to other reports, which might be difficult to obtain. A chronological diary of detailed observations regarding all activities, visits and meetings (including pests and diseases seen and all constraints reported by farmers) for each country surveyed is given in Annexes 1 and 2. The main body of the report is based upon these observations and those readers requiring more specific information about individual activities should consult the appropriate Annex. Occasionally, tables from these Annexes are used in the main body of the report. Annexes 3, 4, 5 and 6 provide the completed pre-field survey questionnaires for Guinea, Cote d'Ivoire, Ghana and Nigeria respectively. Annex 7 provides a copy of the final "Activity Document" or project proposal and Annex 8 gives details about STCP.

Volume II of this report, by Topper and Caligari, contains an extensive collection of photographs (67 altogether).

Figure 1 Map of route for survey 1, Guinea, G. Bissau and Cote d'Ivoire (----→---- one way direction; ----→-----←----- two way direction).

Figure 2. Map of route for survey 2, Ghana and Nigeria (---→---- one way direction; ----→----←---- two way direction).



Responsibilities
Names, addresses and the role played by all participants are given in Table 6.

Table 6. Names and addresses of all co-ordinators

Name	Role	Address
Dr. Clive P TOPPER Prof. Peter CALIGARI	Project coordinator Survey - Guinea, Guinea Bissau, Cote d'Ivoire, Ghana, Nigeria Plant breeding expert	BioHybrids Agrisystems Ltd, PO Box 2411, Earley, Reading RG6 5FY, UK. Tel +44 (0)118 969 1757 Fax +44 (0)118 921 9028 e-mail clivetopper@biohybrids.co.uk
Mr. Souret DIAORA Dr. Mahmoud CAMARA	Guinea coordinator Survey - Guinea, Guinea Bissau, Cote d'Ivoire. Survey - Guinea, Guinea Bissau, Cote d'Ivoire.	IRAG, BP 1523 Boulevard de Commerce, Conakry, Guinea. Tel (224) 45-42-62 Fax (224) 45-42-46 e-mail care of spcia@mirinet.net.gn
Mr. Akadie J. B. DJAHA Dr. Felix COULIBALY	Cote d'Ivoire coordinator. Survey - Cote d'Ivoire. Survey - Cote d'Ivoire	CNRA, BP 856, Korhogo, Cote d'Ivoire. Tel (225) 36-86-09-71 Fax (225) 36-86-03-26 e-mail Kgo.cnra@aviso.ci
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4. Itinerary

Detailed itineraries of all meetings, visits and people met are given in Tables 7 and 8 for the first and second field surveys respectively. This is to provide a clear picture of the depth and breadth of the surveys. Figures 1 and 2 show the routes taken by the two surveys.

Table 7. Itinerary for the first survey to Guinea, Guinea Bissau and Cote d'Ivoire.

NB SP = sous prefecture and P = prefecture

Date	Activity	Persons met
08 Jan	Topper departs UK for Paris	
09 Jan	Topper departs Paris at 1100hr, due to delay arrive Conakry, Guinea 2030 hr. To hotel and logistics meeting.	 Dr Camara and Mr Diaora (team members).
10 Jan	**Guinea** To USAID office for briefing and logistical problems. To SPCIA for discussion of survey and cashew work in Guinea. To IRAG for briefing meeting. To SPCIA plantation at Mafrinya (Forecariah) to see seedlings grown from Brazilian clones CCP 09, CCP 1001 and CCP 076. To nearby cashew farm to inspect trees. Arrive Kindia 2030hr	Mr A. Flemming, Mr M. Fofana, Mr. Son Hoang Nguyen. Mr M. A. Kane (Director SPCIA and national co-ordinator of STCP Guinea), Mr K. Yansane (Chambre Agriculture), Mr M. S. Kaltamba (farmer), Mr A. Keita (SNPRV), Mr M Noba (V. President Chambre Agriculture), Mr L. Traore (FICA), Mr S. Kourouma (DNA/MAE), Mr A Bah (Conseiller Presidence Republique), Mr K. Kane (SPCIA) and Mr A. K. Bangoura (BEI – C&C). Dr S. Cisse (Directeur General) and Mr S. Beavogui (Directeur Scientifique). Mr Kourouma. -- --

Table 7 continued ....

Date	Activity	Persons met
11 Jan	To CRAF. Meeting with Director.	Dr Camara (also survey team member).
	Entomology dept. to see pest species & nuts from different accessions.	Mr Rafrou Diallo (technician)
	Food processing dept to see nut & apple processing work.	Dr Bailo Sitibe & Mr Soriba Bangoura.
	Soils dept	Mr Diamoko Diallo.
	Nursery to see grafting.	Mr Saiolou Basoumah & Moussa Conole (technicians).
	Germplasm collection	
	Meeting with Director of Laboratory PV, Foulaya.	Dr Souleymane Bah
	To farm at Woleya (Dubreka) to see farmers' plantation.	Mr Galle Camara (farmer), Mr Amara Keita (extension).
	To the Presidents' plantation in Samaya district (Dubreka)	Mr Sadou Diallo (extension)
	Arrive Boke 2330 hr.	
12 Jan	To Regional Office for discussion re cashew in Boke Region.	Mr S. Souare (DPDDRE), Mr M. Traore (Inspecteur Regional A/E), Mr I. S. Bobo Diallo (SNPRV), Mr I. Diallo (President Chambre Agriculture), Mr K. Camara (DNA), Mr M. T. Ouendeno (SPCIA), Mr G. Tolno (SPCIA), Mr F. Sylla (BCPEA), Mr T. Camara (Coordinateur SNSA), Mr K. Camara (SNPRV).
	To farm of Mr El Hadj Makanera Abdoulaye in Boke Centre district.	Farmer + many of people listed above.
	To SPCIA demonstration plot in Denken district (Boke).	Mr. Michel Ouendeno, SPCIA technician.
	To farm of Mr Djirane N'Diaye (former ambassador).	-
	To farm of Mr Alassan Diallo (former government worker).	Farmer
	To farm of Hadj Banfaseny Fofana.	-
	Meeting with Korera Farmer Association at the farm of Mr El Hadj Dembo	Mr El Hadj Dembo (President of Assoc.) and other farmers.
	Meeting in Boke town with representatives of 3 Farmer Associations	Mr El Hadj Dembo, El Hadj Ausoamane Tounkare, Garankee Camara, other farmers and people from above.

Table 7 continued .....

Date	Activity	Persons met
13 Jan	SPCIA office in Boke Meeting with Dabiss Farmer Association at Dabiss. Meeting with Fif farmer group which is part of Sansale Farmer Association. Meeting with Sansale Farmer Association at Sansale **Cross border into Guinea Bissau at 2100 hr.** Arrive hotel in G. Bissau at 0200 hr.	Mr Gaston Tolno Mr Garankee Camara and other farmers. Mr Arafan Sambo and other farmers. Leaders not elected yet. Mr Abdul Camara (President) and other farmers.
14 Jan	**Guinea Bissau** Making arrangements for meetings. Bringing notes up to date.	--
15 Jan	To meet Director General of the Ministry of Agriculture for briefing and protocol purposes. Presented copy of Cashew and Coconut International Conference Proceedings (1997) Meeting to discuss economic aspects of cashew in G. Bissau. To Plant Protection for discussion on pests and diseases. To National Farmer Association (Associacao Nacional de Jovens Agricultores da Guinea-Bissau.) To INPA (Intituto Nacional de Pesquisa Agraria) for discussion on breeding, To AMAE (Womens Association for Economic Activity) but it was closed. To cashew fields near to Bissau. Further discussion on economic aspects of cashew at hotel.	Mr Louis V. Mendes (Director General), Mr Julio Malam Injai (Plant Protection) and Mamadu Serra Camara (Economics and Statistics). Eng. Carlos de Amarante (Director of GAPLA, Agro-economist) and Mamadu Serra Camara (Economics and Statistics). Mr Julio Malam Injai and Mr Louis Antonio Javares. Mr Mama Samba Embalo (Presidente) Eng. Quintino da Costa (Presidente) & Lourenco Abreu (Coordenador Nacional da Pesquisa). - Mr Julio Malam Injai (Plant Protection) Mr Mamadu Serra Camara

Table 7 continued .....

Date	Activity	Persons met
16 Jan	Visit farm at Lotche, 61 km from Bissau.	Mr Malan Diaye.
	Visit Agri Bissau plantation of 1,200 ha	Mr Jose Pedro Mansal (manager)
	Cross border back into Guinea via Pitche/Foulamory at 1500 hr.	-
	Guinea Visit cashew farm on route to Koumbia.	-
	Arrive Koumbia at 1700 Hr.	-
	Visit new cashew farm of Mamadou Baillo Sylla	Mr Mamadou Baillo Sylla (President of farmer association)
	Visit farm of Mamadou Sarankoule Diallo	Mr Mamadou Sarankoule Diallo
	Meet Koumbia Association of Cashew Growers.	Mr Mamadou Baillo Sylla (President of farmer association), Mr Ahmadou Sow (Secretary and SPCIA agent) and other farmers.
	Arrive Gaoual at 2100hr and stay in guest house.	-
17 Jan	Depart Gaoual at 0700 hr.	-
	Visit cashew farm at Sintouridjaga (Prefecture Gaoual).	Mr Mamadou Diakhabiy
	Arrive Dabola at 1800 hr (main hotels full)	-
	Planning meeting with Director of Agriculture.	Mr Kerfalla Youla (DPDRE, outgoing).

Table 7 continued .....

	Activity	Persons met
18 Jan	Briefing meeting with Director of Agriculture (old and new).	Mr Kerfalla Youla (DPDRE, outgoing), Mr Fakassa Kourouma (DPDRE, incoming), Mr Koulako Demba Camara (Eaux & Forets), Tamba Kamano (SNPRV), Mr Tamba Kelle Traore (SNPRV), Mr Filifing Dansoko (Dabola Assoc. of Cashew Planters).
	Visit cashew farm in SP Konendou.	Mr Mamadou Sherif.
	Visit cashew farm on route to Banko.	Mr Kade Salion Habe (President of farmer assoc.)
	Visit new 40 ha cashew farm belonging to 7 farmers in Hirako district (SP Banko).	-
	Meeting with Banko Farmer association	Mr Kade Salion Habe (President of farmer assoc.) and other farmers
	To government reforestation project at Tankoni, 5 km west of Dabola	Mr Kerfalla Youla (DPDRE, outgoing).
	Briefing meeting with the Prefect of Dabola.	
19 Jan	Depart Dabola at 0800hr.	
	Meeting with Dabola Cashew Association (Group 1) 5 km east of Dabola	Mr Moustapha Keira (President), Mr Filifing Dansoko (Organisation), Mr Kerfalla Kera (Information & Documentation) and other farmers
	Meeting with Group 2 of Dabola Cashew Association, 7 km east of Dabola at the farm of Mr M. Fofana.	Mr M. Fofana and other female & male farmers.
	Arrive Kankan 1400hr.	-
	To Centre de Recherche Agronomique de Bordo (IRAG). Briefing meeting. Visit germplasm collection.	Mr Moustapha Donzo (Directeur), Dr Moridjan Sangare (Coordinateur scientifique) and Mr Sidiki Keita (Chef programme mangue).
	Observe old cashew trees near research station.	-
20 Jan	To Foundation for Investment in Agricultural Commercialisation (FICA), but closed.	-
	Visit farm of Mr Toure, Kankan	Mr El Hadj Bemba Toure (President CRA – Kankan)
	Visit farm of Mr Anabumane, Kankan	Mr El Hadj Anabumane

Table 7 continued .....

Date	Activity	Persons met
21 Jan	Depart Kankan for Mandiana and Cote d'Ivoire.	-
	New cashew farm visited in Moussadu district (SP Kantoumana, P Mandiana).	-
	Visit cashew farm in Moussadu district (SP Kantoumana, P Mandiana).	Mr Abuba Diakite.
	Visit cashew farm in Melila district (SP Kantoumana, P Mandiana.	Mr Sidiki Diallo.
	Discussions with cashew buyer	Mr Harouna Diallo.
	Cross border into Cote d'Ivoire	
22 Jan	**Cote d'Ivoire** Meeting at Agence Nationale d'appui au Developpement Rural (ANADER) - Odienne.	Mr Ghabeu Mamadou (Chef de Zone), Mr Moussa Bamba (Technician specilise cultures vivrieres), Mr Kone Adama (specialise organisation paysane).
	Visit SODIRO cashew and rice milling factory.	Vakaba Doumbia (Manager SODIRO cashew & rice factory).
	Visit cashew farm in district of Odienne Centre.	Mr Mouctar Toure.
23 Jan	Visit cashew farm in Koro Ouleu village.	Mr Kone Koulouba
	Visit SODIRO cashew plantation.	-
	Drive to Seguela	-
24 Jan	Meeting at Agence Nationale d'appui au Developpement Rural (ANADER) - Seguela.	Mr Camara Fassiata (interim Chef du Zone), Madame Kouame Affoue Opportune (SOP – farmer associations).
	Visit farm of Mr Nanga Yeo in Seguela district (S/P Masala).	Mr Nanga Yeo.
	Visit farm of Mr Bakayoko Abou in Seguela district.	Mr Bakayoko Abou
	Visit farm of Mr Coulibaly Yacouba in Seguela district	Mr Coulibaly Yacouba
	Visit farm of Mr Traore Vamogognima in Seguela district.	Mr Traore Vamogognima
	Meeting with representatives of 4 farmer associations	See detailed report

Table 7 continued .....

Date	Activity	Persons met
25 Jan	Drive to Monkono.	-
	Meeting at Agence Nationale d'appui au Developpement Rural (ANADER) - Monkono.	Mr Apia Kakou (Chef du Zone), Mr Kouame Ahoulou (Tree crops specialist), Camara Mamadu (SARS – Site d'adaptation de recherche system), Drissa Diarasousa (Agriculture).
	Visit cashew field in Kogolo village.	-
	Visit cashew field of Mr Lagazin Bamba.	Mr Lagazin Bamba.
	Visit cashew field of Mr Mendoba.	Mr Mendoba.
	Visit cashew field of Mr Fakoly Fofana.	Mr Fakoly Fofana.
	Meeting with LEMISSA farmer co-operative.	Mr Silue Kisselnan Mamadou
	Drive to Korhogo	-
26 Jan	Briefing meeting at CNRA (Centre National de Recherche Agronomique) – Korhogo.	Dr Doumbia Sekou (Directeur Regional) , Dr Bernard Dea Goue (Coordonnateur Scientifique), Dr Angelo N'Guessan (Directeur Lataha Station), Dr Koffi Augustin Yao (Directeur Ferkessedougou station).
	Visit CAJOUCI S. A. - cashew processing factory.	Mr Patrick Adlai'de (Directeur) and Mr Bob Kouadio.
	Visit CNRA research station at Lataha.	-
27 Jan	To Abidjan	
28 Jan	Topper depart for UK and other team members depart for Guinea.	

Table 8. Itinerary for the second survey to Ghana and Nigeria.

Date	Activity	Persons met
04 Feb	Topper departs UK and arrives Accra at 2130 hr. **Ghana** Meeting regarding programme	-- Dr Asante (coordinator)
05 Feb	Meeting with Deputy Director-General of the Council for Scientific and Industrial Research (CSIR). Meeting at Technoserve main office. Meeting at ADRA headquarters. Drive to Tafo. Courtesy call at CRIG, Tafo. Drive to Kumasi.	Prof. E. Owusu-Bennoah. Mr John Addaquay. Mr George Baiden (Country Director) and Mildred Taylor (Programme Manager). -- Reverend Dr. A A Ollenu (Deputy Director of CRIG). --
06 Feb	Visit to MOFA cashew plantation at Atebubu. Drive to Techiman. Meeting at ADRA, Techiman. Drive to Sunyani.	Mr Ako-Nai (District Agricultural Director). -- Mr Richard (Regional Director), Evelyn Cofie (Programme manager) and Mr Okyere Manu. --

Table 8 continued .....

Date	Activity	Persons met
07 Feb	Drive to Mim.	--
	Visit MIM Agro & Industrial Projects Ltd.	Mr Herman Bani (Managing Director – Technical and Production).
	Drive to Techiman.	-
	Meeting at Technoserve.	Mr Thomas Bonney.
	Meeting with Mesidan Cashew Farmers Association.	Mr Nana Akuamoah Boateny (Chairman), Mr Nsowah Takyi (Secretary) and Ms Adwoa Nsiah (Treasurer) and farmers.
	Visit cashew field at Mesidan.	-
	Meeting with Koase Cashew Farmers Association.	Mr W. K. Ankoma (Chairman), Mr Thomas Yeboah (Secretary), Ms Mary Ameyaa (Treasurer) and farmers.
	Visit 1st field of Mr Boachie Ameyaw.	Mr Boachie Ameyaw.
	Visit field of Mr Kwaku Kra.	Mr Kwaku Kra
	Visit 2nd field of Mr Boachie Ameyaw	Mr Boachie Ameyaw
	Stay the night in Techiman	-
08 Feb	Drive to Tamale.	-
	Meeting at Savannah Agricultural Research Institute (SARI).	Dr A B Salifu (Director of SARI & entomologist), Dr S K Nutsugah (Patholgist SARI) and Dr J A Yidana (Lecturer, University for Development Studies (UDS), Tamale)
	Visit germplasm collection (UDS/SARI).	Dr J A Yidana.
	Visit farm of Alhassan Salifu near Cheyohi village.	Mr. Alhassan Salifu
	Meeting with farmers from Cheyohi village.	Mr Alhassan Tia and others.
	Visit farm of Sumani Alhassan, Libga village, Savelugu-Namton district.	Mr Sumani Alhassan.
	Stay the night at Tamale.	--

Table 8 continued .....

Date	Activity	Persons met
09 Feb	Drive to Kumasi.	--
	Brief meeting at Crops Research Institute.	Dr E Asafo-Adjei (Deputy Director)
	Meeting at Plant Genetic Resources Centre, Bunso.	Dr S O Bennett Lartey (Director) and Mr Chris Mpere Asare.
	Visit Pokuase germplasm collection.	Dr. E Oppang-Konadu (Research Officer).
	Drive to Accra, arrive 2000 hr.	--
10 Feb	Depart for Nigeria at 0700 hr.	--
	Arrive Lagos 0900 hr, met by team members.	Mr E. A. Ayodele (Cashew coordinator) and Mr P. O. Adebola (Breeder)
	Nigeria Drive to Ibadan.	--
	Planning meeting.	Dr E. A. Ayodele and Mr P. O. Adebola
	Drive to Ochaja, arrive 2200hr.	--
11 Feb	Visit farm of Mr Yaya Umoru, Ochaja, Kogi State.	Mr Yaya Umoru.
	Meeting at CRIN sub-station at Ochaja	Mr Y. Emiola (Officer in charge), Mr A. Ajani (Principal Ag Superintendent) and Mr O. Oladimeji (Finance).
	Meeting with farmer groups at Ochaja.	Mr J. Inyada (Chairman), Mr S. Okpe (Secretary) and about 20 other farmers.
	Visit CRIN germplasm trials.	--
	Visit Innocents farm, owned by Chief Audu Ogbe at Oturkpa, Benue State.	Jacob Anyebe (Farm manager)
	Drive to Enugu.	--
12 Feb	Visit Premier Cashew Industry Farm at Orji River, Enugu State.	Mr Thankgod (Farm manager)
	Visit Premier Cashew Industry Farm and Factory at Oghe, Enugu State.	Hon. Celestine Ikeana (Supervisor) and Mr Ebuo Joseph.
	Drive to Ogoja	

Table 8 continued .....

Date	Activity	Persons met
13 Feb	Visit farm of Mr Olofu Ayakpo, Nyanya, Cross River State.	Mr Olofu Ayakpo.
	Visit Cross River State Cashew Project Farm at Nyanya in Cross River State.	Mr John Emeka Okon (Agric Officer)
	Visit T. Y. Acres Farm near Takum, Taraba State.	Mr Peter Yua, Seriki Garba & Mr John Monday.
	Meeting with T. Y. Acres farm manager.	Mr Hamman (Director), Mr Bala Perewe) Garibum (Farm supervisor).
	Drive to Lafia.	--
14 Feb	Meeting at Agricultural Development Programme office in Lafia, Nassarawa State.	Mr Samuel Meshi (Director of Technical Services & Mr Alhadji Abugakar Lamino (Agro-forestry Officer in charge of tree crops).
	Na Mairo & Sons Ltd Nigeria, Dome Road, Rimi Uka, Lafia	Mr Alhadji Na Mairo Babai.
	Visit farm of Mr Abou Alhadji Uba, Lafia.	Mr Abou Alhadji Uba.
	Drive to Gwagwalada.	--
15 Feb	Visit farm of Gen. Jerry Useni, near Gwagwalada, Federal Capital Territory.	--
	Visit Awoniyi farms, near Kabba, Kogi State.	Mr J. O. Awoniyi.
	Meeting with His Royal Highness Oba P. A. Mesheko, traditional chief of Okebukun Village, Kabba, Kogi State.	His Royal Highness Oba P. A. Mesheko,
	Visit Kosoni-Ola Farm, Oro, Kwara State.	Mr Gabriel Oyelowo (farm manager), Augustine Ologunwa (Farm supervisor)
	Drive to Oshogbo.	--
16 Feb	Visit Cashew Processing Industry Farm, Iwo, Osun State.	Mr. Emmauuel Olugbadehan (Plantation manager).
	Visit Allam Agro-Allied Farm, Oyo, Oyo State.	Mr Moses Irumekhai (Assistant farm manager).
	Drive to Ibadan.	--
	Visit Cashew Processing Industries factory, Ibadan, Oya State.	Mr A. David Olujobi (Accountant).

Table 8 continued .....

Date	Activity	Persons met
17 Feb	Meeting and reception at CRIN. Drive to Lagos. Topper departs Nigeria at 2350 hr.	Dr E. B Esan (Assistant Director), Dr. C.R. Obatolu (Assistant Director), Dr. Mrs. F.A. Okelana, Dr E. A. Ayodele, Mr P. O. Adebola and others. -- --
18 Feb	Topper arrives Gatwick, UK at 0700hr.	--

5. Insect pests

5.1 Introduction

Many trees were observed at the time of panicle production, flowering and nut set in different regions in each country. This time period is the most critical with regard to production of nuts and apples; it is also the time when pests and diseases are at their most damaging. Naturally there may be other pests and diseases that occur at other times of the year, but their effect would be mainly on vegetative production. Fortunately cashew trees can withstand substantial damage to leaves before there is a reduction in yield. It is also highly likely that pest populations will vary in intensity from year to year and place to place.

Damage from the different insect species, albeit at different levels of seriousness, was generally widespread throughout all the survey countries. Therefore insect pests have been discussed on a regional basis rather than country by country. Even though perhaps a particular insect pest species is not a problem in one country at the moment, many insect pests have the ability to move long distances, and could well become a pest in a new place in the future. In addition, as the area of cashew expands and increases, pest dynamics also change, often for the worse.

Where visually obvious symptoms of pest or disease damage were present at a particular site, this has been noted in Annex 1 or 2.

Details of the main insect pests observed during the survey follow and they are grouped according to the type of damage inflicted on cashew.

5.2 Sucking pests

5.2.1 *Helopeltis sp* (Hemiptera: sub-order Heteroptera: family Miridae)

Helopeltis was present at many of the sites visited throughout Guinea, Guinea Bissau and Cote d'Ivoire. *Helopeltis* was also present in Ghana, but there *Anoplocnemis curvipes* damage was another common feature at some sites and it was difficult to distinguish the relative importance of *Helopeltis*. In Nigeria *Helopeltis* was present but damage levels were very low.

Sucking pest leaf damage can take the form of black lesions on petioles or on the leaf midrib, or black angular spots on the leaf surface. Typical feeding damage on stems appears as a discoloured, necrotic area or lesion around the point of entry of the labial stylet into the plant tissue. The tissue around the stylet puncture dies, presumably in response to the enzymatic action of the insect's salivary secretions. Similar lesions also occur on fruits and developing nuts. People encountered during the course of the surveys were often identifying this type of damage as being caused by anthracnose (see Section 6.2 below).

When *Helopeltis* feeding pressure is sufficiently intense the whole shoot dies and this damage is typically called 'Dieback'. Dieback is characterised by the following symptoms - withering of the inflorescence or shoot, followed by progressive dieback, generally starting from the tips and later advancing downwards to the main floral shoots and leaves. The normal green colour of healthy shoots progressively turns brown/black followed by drying up and necrosis, and as a result, fruit or new shoot formation, is arrested (see Photos. 1 and 2, Volume 2). In very serious cases, the entire tree looks burnt.

Helopeltis damage can be difficult to distinguish from early instar *Anoplocnemis curvipes* damage (see Section 5.2.2).

Helopeltis was responsible for significant loss of yield at a number of sites, most notably at the farm of the President of Guinea (see page 4, Annex 1) and at the farm of Mr. Diallo near Koumbia town, Guinea (see page 12, Annex 1).

At the President's farm the level of damage observed was significantly reducing yields and apparently all of the 75 ha of cashew was very badly damaged. The extension officer responsible had little knowledge about pests and diseases.

At the farm of Mr. Diallo (near Koumbia town, Guinea) sucking pest damage was negatively affecting the yield, although some trees seem to have escaped serious damage. Table 9 provides an estimate of the effect this level of insect damage was having on farmer income. The model starts with Mr Diallos' actual yield for the whole farm in 1998 (2000kg) and assumes that in 1998 insect damage was minimal. Next it is assumed that as the trees are around the age of 5 years old and growing well, yields would have increased by 20% a year to 2400kg and 2880kg in 1999 and 2000 respectively. The actual yields were much less than expected and it is estimated that the yield loss was just under 40% in both 1999 and 2000. The results from Table 9 suggest that insect damage was causing substantial economic loss to Mr. Diallo; this loss is likely to be of a similar magnitude in 2001.

Table 9. Predicted loss of revenue due to insect damage, Koumbia, Guinea.
(NB Copied from Annex 1, Table A1.4)

Year	Expected yield, Kg	Actual yield, Kg	Percentage loss of expected yield	Loss in revenue, $
1998	2000	2000	0	0
1999	2400	1500	37.5	450
2000	2880	1800	37.5	540

Assumptions regarding Table 9 above:-
1. In 1998 there was no loss of yield due to insect damage, although it is likely that there would have been some.
2. Yield would increase by 20% per year for 1999 and 2000.
3. Price per kg of raw nuts was $0.50

In East Africa, the sucking pests *Helopeltis anacardii, H. schoutedenii* and *Pseudotheraptus wayi* Brown (Hemiptera: Coreidae) are the main insect pests of cashew and studies there have shown that sucking pest damage can be very variable from year to year and place to place (Boma *et al.* 1997 and Topper *et al*, 1997). In India, *Helopeltis antonii* (the tea mosquito) is the main production constraint. It is therefore likely that *Helopeltis* damage in West Africa could vary in intensity from year to year and place to place, depending upon environmental factors, age and attractiveness of cashew and other host plants in the vicinity.

5.2.2 Anoplocnemis curvipes (Hemiptera; sub-order Heteroptera; family Coreidae)
Damage symptoms:-
A. curvipes is in the same sub-order of insects as *Helopeltis* and it feeds in a similar way by penetrating the living tissues of plants with their piercing mouthparts and imbibing the sap. Photos. 4, 5 and 6 (Vol.2) show examples of *A. curvipes* damage and Photo. 3 (Vol.2) shows an adult of the species in the field.

A. curvipes is distributed throughout Africa where they suck the sap of a variety of plants. Hill and Waller (1988) in their "Field handbook of Pests and Diseases of Tropical Crops, record that both sesame and coffee can be seriously attacked by *A. curvipes*. This pest can also produce an unpleasant odour.

A. curvipes damage was widespread in West Africa and was particularly serious in Cote d'Ivoire and Ghana. Annex 1, pages 21 to 24, gives descriptions of visits to various farms and how *A. curvipes* frequently featured in the list of main constraints for Cote d'Ivoire.

Below are a few extracts from Annex 2, showing the seriousness of *A. curvipes,* for some farmers in Ghana.

Visit to cashew field 1 km from the village of Mesidan

> "This cashew farm was severely damaged by *Anoplocnemis curvipes*, with a high percentage of dead shoots, which were seriously affecting the yield".

Visit to 1st field of Mr Boachie Ameyaw (member of Koase Cashew Farmers Association).

> "Damage due to *Anoplocnemis curvipes* was severe and was significantly affecting yield and tree growth (Photo. 6, Vol.2). According to farmers the insect was most active early in the morning".

Visit to 2nd field of Mr Boachie Ameyaw.

> "The trees here were 4 years old and bee keeping was practised in the field. All trees were damaged by *Anoplocnemis curvipes*, but on some trees, nearly every shoot had been killed and was now shooting again. Three of these damaging insects were seen, 2 were mating (late afternoon)".

In the district of Koase (near Techiman, Ghana) the farmers wanted to spray in order to protect their cashew trees, but ADRA (an NGO working with farmers) was unable to supply the insecticide because of USAID's (ADRA's funding agency) stringent regulations regarding pesticide use.

Because of the seriousness of sucking pest damage, Technoserve (another NGO working in Ghana) started to evaluate 5 insecticides for the control of sucking insect pests at 5 locations in 1995. The work should have continued for 2 more years but funds ran out and government research had no mandate to work on cashew at the time. According to both NGOs, pest attack takes a heavy toll on cashew.

5.2.3 Thrips (Thysanoptera: Thripidae).
Many species of thrips exist and it is likely that more than one species could attack cashew in West Africa. The Plant Protection department in Guinea Bissau had identified *Selenothrips sp.* as one candidate. Adult thrips are very small, (see Photo. 7, Vol.2).

Damage symptoms:-
The vast majority of thrips species derive their nutriment by penetrating the living tissues of plants with their piercing mouthparts and imbibing the sap. Loss of sap can result in yield loss and some species can transmit viral diseases. As a result of such feeding, mainly on more mature cashew leaves, the leaves turn a bronze colour and eventually drop off (Photos, 7 and 8, Vol.2).

Thrips were widespread throughout the 5 countries surveyed, and usually damage was minor and of no economic significance. However in two places in particular, thrips were responsible for serious levels of defoliation and yield loss. The first was the farm of Mr. El

Hadj Makanera Abdoulaye of Boke, Guinea (see page 5, Annex 1) and the second was the MIM Estate in Ghana (see page 4, Annex 2).

At the farm of Mr. El Hadj Makanera Abdoulaye in Boke, the main production constraints were a combination of thrips and *Helopeltis*, with both types of damage widely distributed over the entire farm, and one large area in particular being totally defoliated due to thrips (see Photo. 8, Vol.2). Extension agents incorrectly thought that anthracnose was responsible for this damage.

Table 10 provides an estimate of the effect this level of insect damage was having on farmer income. The model starts with the actual yield for the whole farm in 1998 (5,000kg) and assumes that in that year insect damage was minimal. Next it is assumed that as the trees have ages ranging from 2 to 10 years old and are growing well, yields would have increased by 20% a year to 6,000kg and 7,200kg in 1999 and 2000 respectively. The actual yields were much less than expected and it is estimated that the yield loss was 58% in 1999 and 65% in 2000. As can be seen from Table 10, insect damage was causing substantial economic loss to Mr. Makanera Abdoulaye and this would probably be of a similar magnitude in 2001.

Table 10. Estimated loss of revenue due to insect damage, Boke, Guinea.
(NB. Copied from Annex 1, Table A1.2)

Year	Expected yield, Kg	Actual yield, Kg	Percentage loss of expected yield	Loss in revenue, $
1998	5,000	5,000	0	0
1999	6,000	2,500	58	1,750
2000	7,200	2,500	65	2,350

Assumptions re Table 10 above:-
1. In 1998 there was no loss of yield due to insect damage, although it is likely that there would have been some.
2. Yield would have increased by 20% per year for 1999 and 2000.
3. Price per kg was $0.50

At the MIM Estate in Ghana, thrips and other sucking pests were a major problem. They have to spray 3 or 4 times every year to control the thrips, as without this, the trees would be completely defoliated. Tractor drawn sprayers were used, since back-pack motorised blowers could not do the job. Interestingly, the trees from Indian seed were apparently more susceptible to damage from thrips than the local trees, which was a useful observation.

The severity of attack by thrips usually varies from year to year and place to place and normally they are only dry season pests; as soon as the heavy rains start they disappear.

5.3 Trunk borers and girdlers

Evidence of trunk boring insects was seen at various places throughout the survey, but the number of trees affected was small.

5.3.1 *Apate terebrans* (Coleoptera, family Bostrychidae)

The most spectacular example of borer damage was found on the farm of Mr Nanga Yeo in Seguela district, Cote d'Ivoire). Here in one 6 year old tree, **37** adult borers were found causing extreme damage and the death of the tree (Photos. 10 A and B and 11, Vol.2). The

tree was surrounded by light brown sawdust just like that obtained when sawing wood, which is in contrast to other borers where frass and sawdust are mixed giving a dark brown colour. It is possible that this is simply the difference between adult and larval feeding. Specimens were sent for species confirmation to the British Natural History Museum and were identified as *Apate terebrans* Pallas (Coleoptera, family Bostrychidae). The following information was provided by the Natural History Museum:-

> 'This species is widespread throughout Africa and Madagascar and has been introduced into Central and South America. The larvae develop in a variety of timbers, including living trees and construction wood. The adults also feed in the wood and they can damage young trees, causing death. The life cycle is usually 1 to 3 years depending on the condition of the wood, moisture content, extent of infestation, etc. Adult beetles will disperse naturally by flight but they have also been spread further by trade.'

A. terebrans is polyphagus and Hill and Waller (1988) in their "Field handbook of Pests and Diseases of Tropical Crops", record *A. terebrans* as attacking coffee, citrus, cocoa, guava, cotton and other plants.

Cultural control is usually recommended whereby a flexible wire (eg a bicycle spoke) is pushed into the tunnels to kill the larvae or adults. Insecticide soaked cotton wool can also be pushed into the holes to kill the insect.

Borer damage is usually restricted to a small number of trees, and with vigilance and the appropriate cultural control knowledge, can be kept under control quite easily.

The most bizarre example of "borer damage" was where a member of the team had casually identified borer damage, which in fact turned out to be buck-shot from a shot gun!

5.3.2 Analeptes trifasciata (Coleoptera, Cerambycidae)

Damage by this pest was mainly seen in Nigeria, but it has been reported as being a problem in all the countries surveyed. In Nigeria, *Analeptes*, the cashew girdler, was reported as a serious problem by a group of farmers met at the CRIN Ochata sub-station; it was seen to be a problem at the Premier Cashew Industry Farm at Orji River, Enugu State and at the Cashew Processing Industry Farm at Iwo, Osun State.

Damage symptoms:-
Damage to trees is quite characteristic, branches are completely girdled with a V-section cut by the adult beetles. Only a small segment of branch remains, which is too weak to hold the full weight and hence the branch eventually breaks off. The purpose of the girdling is to provide suitable breeding material for the larvae, in the form of dead wood. Eggs are laid on the cut branch and on hatching the larvae burrow into the wood. The adult is a typical "longicorn" beetle with attractive colouration; it can reach a length of about 55mm and its antennae a further 70mm. The adult is generally black but on the wing cases there are 3 bright orange coloured bands.

5.4 Other insect pests seen or mentioned by farmers that were of minor importance at the time of the survey.

It should be noted that populations of many, even minor pest species, can fluctuate dramatically in response to changing environmental conditions and in some years cause serious economic damage in some areas.

5.4.1 Aphids (Hemiptera; Aphididae).

Aphids were present at a few sites but not economically important. There are many species within the Aphididae family and many are polyphagous, feeding on a range of crops and other non-crop plant species. When attacking cashew they live on young shoots and foliage. Often the severity of aphid attack varies from year to year and place to place; with a heavy attack, shoots and panicles can be killed. Like thrips, aphids are usually a dry season pest and disappear as soon as the heavy rains start.

Aphids can be controlled naturally by a number of other insect predators and parasites.

5.4.2 Lepidoptera

Leaf miner and leaf roller damage was frequently seen but always of minor importance.

5.4.3 Termites

Termites were seen attacking one or two young trees during the course of the survey and the termite *Coptofermes intermedius* (Isoptera, Rhinotermidae) was listed as a pest by the Plant Protection Department in Guinea Bissau.

5.4.4 Mealybugs (Hemiptera, family Pseudococcidae)

Mealybug was seen only on 2 occassions, it was present on many panicles at the farm of Mr Abou Alhadji Uba, Lafia, Nigeria and on an isolated tree at the cashew processing factory at Korhogo, Cote d'Ivoire. It is worth mentioning that *Pseudococcus longispinus* is a serious pest in parts of Tanzania and it is very difficult to control.

5.4.5 From the literature

Pachnoda sp (Coleoptera, Scarabaeidea) was noted in both the Guinea and Nigeria questionnaires as being a significant pest, but it was not seen during the field surveys.

Emoroetis spp (Lepidoptera,Family Lymantriidae, Liparidae) was listed as a pest of cashew by the Plant Protection department in Guinea Bissau.

5.5 Non-insect pests

In Guinea and Guinea Bissau, squirrels were reported to be a pest as they cut the stems of young cashew plants (e.g. pages 7 and 8, Annex 1).

Birds or bats eating the apples (e.g. page 7, Annex 1) and birds taking germinating seeds (e.g. page 14, Annex 1)

Although not normally referred to as a pest, cattle were certainly causing many problems for young cashew plants and this was frequently reported by farmers throughout the survey.

Oligonychus coffeae (Tetranychidae) was listed as a pest of cashew by the Plant Protection department in Guinea Bissau. These mites are very small indeed and leave behind a white powder meshed with fine silken threads. It feeds on many plant species, including *Acacia sp, Anacardium, Citrus sp, Coffea, Gossypium, Mangifera*, etc. Its geographical distribution is widespread. Whether this species causes any economic damage remains to be seen.

5.6 Conclusions

Conclusions for pest problems will be discussed in Section 6.6, together with those for diseases, to give a better perspective on what are the most important biological constraints for cashew production.

6. Disease constraints

6.1 Introduction

As has been noted previously, the surveys were undertaken at the most critical time of year as regards production of cashew, i.e. at the time of flowering and nut set. Obviously diseases could be prevalent at other times of the year, for example during the rainy season, but are less likely to have a major impact on yield.

If visually obvious symptoms of disease damage were present at a particular site, this is noted in Annexes 1 and 2. Diseases observed during the survey were as follows.

Anthracnose

Damage symptoms:-
The fungus *Colletotrichum gleosporioides* is the causal agent of anthracnosis, a disease found on cashew and common on other tropical fruit crops, e.g. mango, citrus, avocado, papaya etc. Black or dark brown necrotic spots or lesions occur on leaves, apples and nuts, Photo. 15 (Vol.2) shows definite anthracnosis on leaves and nuts of cashew in Brazil. It is particularly prevalent during the rainy season and can completely kill the first flush of new shoots and persist to kill varying amounts of later flushes as well. The severity of the disease varies from year to year and place to place depending on environmental conditions. Anthracnose is the major constraint to cashew production in Brazil; in the year 2000 it was estimated that yields had been reduced by 40% by this disease.

In South America anthracnose occurs on both dwarf and tall trees. Copper sprays are used to control anthracnose on dwarves with up to a maximum of 10 applications per season. Sanitation, the collecting up and burning of all old infected leaves, can help in reducing the level of inoculum the following year. Anthracnose can survive on the old leaves and in the soil.

During this one-off survey of West Africa, only **very minor** amounts of what looked like **"fully developed"** anthracnose were found (to be completely sure samples would have to have been sent for confirmation of the causal pathogen). Fully developed anthracnose was possibly present at the following sites:

- on a small number of leaves on a plot just outside the capital Bissau (Photo. 12, Vol.2) (Guinea Bissau).
- on a very small number of apples and nuts from Brazilian material, Foulaya, Guinea (Photo. 13, Vol.2)
- on leaves from Brazilian Common trees, CRNA, Lataha, Cote d'Ivoire (Photo. 14, Vol.2)

The survey was planned to take place during the most critical period affecting yield, namely at flowering and nut set. During this period, only tiny amounts of what might have been fully developed anthracnose were seen, on a very small number of trees from the many hundreds of trees that were inspected. In the 2001 production year and in those areas visited in the 5 countries, anthracnose was of no economic importance. It should be noted however, that this disease would be most prevalent during the rainy season. However, even if it was important during the rainy season, there appeared to be very little carry over into the dry season flowering period to attack panicles and developing fruits. Therefore, we can conclude that anthracnose had no or only a minor affect on yields in 2001 in the main cashew producing areas visited. The drier areas further north, which were not visited, would be even less likely to have anthracnose.

This conclusion that anthracnose was of minor economic importance, (at least in 2001), is in marked contrast with the perceived understanding of the situation by people working in the countries concerned. For example, the following pieces of information provided during the survey would suggest that anthracnose is a reasonably serious disease of cashew:-

- Guinea Bissau Plant Protection department personnel informed the survey team that anthracnose was found 6 years ago and was becoming increasingly important. Cashew material from Mozambique was more susceptible than the local material.
- A project proposal (ref 961862) entitled "Selection and multiplication of superior germplasm **resistant to anthracnose disease** and improvement of apple by-product technology" was submitted to the European Union in 1996 by Instituto de Investigacao Cientifica Tropical, Lisbon and other institutions, to be undertaken in Europe, Guinea Bissau and Guinea. The title and contents would suggest that anthracnose was sufficiently important to warrant a breeding programme to develop germplasm resistant to anthracnose disease. (The project does not appear to have gone ahead however).
- Anthracnose was the leading item on the list of diseases that were considered the most important on cashew, according to the Plant Protection Department in Guinea Bissau and Camara and Vayssie (1996) list it as one of the principle diseases in Guinea Bissau.
- The Cote d'Ivoire questionnaire lists anthracnose as a significant disease. The Guinea questionnaire states that "The disease that is most widespread is anthracnose (*Colletotrichum gloeosporioides*) which attacks the aerial parts (stems, leaves, flowers and fruits). Its action in Guinea is <u>not very important</u>, those few trees identified are cut and burnt."

There are two possibilities to explain this apparent contradiction and these are:-

1. Due to differing environmental conditions in other years, anthracnose has in fact been more of a problem in the past and could be in the future.
2. Field workers have confused other types of damage for anthracnose, leading to mis-identification.

Certainly during the current survey there were a number of occasions where other types of damage were attributed to anthracnose, e.g.

1. Jassid damage at Boke (by extension workers)
2. Sucking pest damage (by a senior research worker in Guinea Bissau)
3. Sucking pest damage (by researchers at Kankan)
4. Fire damage - a number of times

Obviously the situation is not entirely clear and is further confused by the disease shown in Photos. 16, 17, and 18 (Vol.2). This was quite prevalent in the Dabola/Kankan area of Guinea and around Odienne in Cote d'Ivoire. This disease which was found only on leaves, was initially thought to be the rust coloured algae, *Cephaleuros virescens* at various stages of development. Leaf samples with this disease were sent to the International Mycological Institute (IMI) in UK and *Colletotrichum gleosporioides* (*Glomerella cingulata*) and *Phomopsis anacardii* were identified. There are a number of possible explanations:-

1. *Colletotrichum gleosporioides,* which is common in the soil and on other plants was present on the leaf but not active or pathogenic to the cashew leaf (i.e. accidentally present)
2. The genus *Glomerella cingulata* contains saprophytic strains and hence could have been present as a secondary infection i.e. it was feeding off dead tissue caused by a previous pathogen.
3. Pathogenic *Colletotrichum gleosporioides* was present before but due to unfavourable weather conditions it did not develop fully.

If explanation number 3 was correct, then it would have been expected that some fully developed anthracnose (black lesions) would have been seen somewhere in the areas where this disease was found, but none was seen. Whichever explanation is correct, the fact remains that anthracnose was not negatively affecting yields and hence was only of minor importance in 2001. However, it must be emphasised that further work is urgently needed on this issue.

Phomopsis anacardii is not considered to be a significant pathogen of cashew.

In East Africa (where powdery mildew disease is the main constraint), there is a very low incidence of anthracnose; it only affects a very small percentage of panicles on a very small number of trees, hence, very little work has been undertaken on the problem there. Since the introduction of Brazilian dwarfs, anthracnose has become a more noticeable problem, but it is still mainly confined to dwarf trees (e.g. in Mozambique at Monapo, Itoculo and recently at Nassuruma). The situation at Itoculo was so bad that most of the dwarf trees were cut down in an attempt to control the disease; however, more worrying was the fact that the disease had spread to local tall trees.

It can be assumed that since common tall trees in Brazil are very susceptible to anthracnose, tall trees in both West and East Africa will be similarly susceptible, since the African trees originated from Brazil many years ago. The fact that the disease has not become established in East and West. Africa could be due to environmental, cultural or other reasons. However, strict quarantine regulations must be maintained or instigated if they are not already in place, when importing planting material especially from outside the region (see visit to SPCIA plantation, page 2, Annex 1).

6.3 *Cephaleuros virescens* (red or rust coloured algae)

This algae was identified by IMI from cashew leaves collected from the Accra region of Ghana at the time of the regional workshop in May 2000 and seen at various places during the survey, for example on the farm of Mr. Kwaku Kra at Koase, Ghana. It was also listed as one of the most important diseases on cashew according to the Plant Protection department in Guinea Bissau.

This algae is a common parasite of evergreen perennial crops and is not considered to be a constraint to production.

6.4 Powdery Mildew Disease (PMD)

During the dry season (January/February) in West Africa when the surveys took place, climatic conditions and the availability of suitable young host tissue are both ideal for PMD. Therefore if PMD was present, then this is the time when it would be at its most intense. However, of the many hundreds of trees and thousands of panicles inspected, PMD was NOT found on any of them.

Somewhat in contradiction to the above observations, PMD was second on the list of the most important diseases on cashew according to the Plant Protection Department in Guinea Bissau and Camara and Vayssie (1996) list PMD as one of the principle diseases in Guinea Bissau..

For reference PMD is described below.
The most serious biological constraint to cashew production in East and Southern Africa is powdery mildew disease, *Oidium anacardii,* first described by Noack in 1898. It is also found in Brazil but there it appears to attack older, more mature plant tissue while in East Africa it only attacks new, actively growing tissue.

In East Africa, PMD develops on young growing tissue, e.g. new shoots with tender leaves, panicles from the very young to the mature, apples and young nuts. Infected parts look as though they are covered in a white/grey powder. Severely infected young leaves change colour from green to brown, become deformed and eventually drop off prematurely. Mature older leaves with a well developed cuticle are not attacked. Production can be severely reduced when PMD attacks young panicles and flowers. Infection can occur even before buds open on young panicles; often the pedicel (stalk of an individual flower of an inflorescence) is attacked which becomes necrotic and causes the flower to abscise. Badly infected panicles where buds have abscised, appear stunted and grey in colour (compare with "naturally drying flowers, Section 7.1). Infected apples lose their bright colours, becoming cracked and shriveled as they dry up. Young infected nuts may abort; those that manage to mature become tarnished and dull in colour; nut weight and percentage out-turn are both negatively affected.

6.5 Other minor disease problems

6.5.1 Secondary diseases

On the farm of Mr Coulibaly Yacouba in Seguela district, Cote d'Ivoire the main constraint was the puncturing of cashew apples, presumably by a sucking pest, followed by a secondary fungal invasion, which causes the apple to go bad and drop prematurely (Photo. 19, Vol.2).

A number of papers have been published by Olunloyo on secondary diseases of cashew – see Annex 6, Section entitled "Literature on Cashew in Nigeria".

The leaf spot fungus *Pestalotia conglomerata*, was listed as a disease of cashew by the Plant Protection Department in Guinea Bissau. It is unlikely that this leaf spot would be economically damaging.

6.6 Conclusions regarding pests and diseases

6.6.1 General observations

Extensive observations made during the survey would suggest that insect pest damage is of much greater significance than disease problems. Diseases were of minor importance, but it should be noted that this might not always be the case. As the area of cashew expands, the likelihood of major disease problems also increases. It should be remembered that in East Africa up until the early to mid 1970s, when cashewnut production nearly reached 400,000 tons, PMD was not important. Now it devastates production throughout the region. There is therefore always a need to be vigilant about diseases in order to prevent them getting a firm hold.

The two Hemiptera sucking pests *Helopeltis sp* and *Anoplocnemis curvipes* (both sub-order Heteroptera), and thrips, are probably the most economically damaging pests over the region in general. Trunk borers (*Apate terebrans*, Coleoptera, family Bostrychidae) and branch girdlers (*Analeptes trifasciata,* Coleoptera, Cerambycidae) can be serious on a more isolated scale. There are also a number of minor pests in the region as a whole, which could be serious sporadically or from time to time (e.g. Aphids, leaf rollers, etc.).

6.6.2 Basic Requirements for the future

There is an urgent need for quantitative data on the economic status of pests and diseases, including.

- The distribution of pests and diseases in each country
- The frequency and intensity of damage caused
- The loss of farmer income due to the different pests and diseases

It would be useful if the collection of such data could be harmonised, co-ordinated and jointly analysed across the region. Such region-wide data would be of greater value than the sum of the parts.

Not much previous work has been done on cashew pests and diseases and to help ensure that correct quantitative data is collected, a simple handbook should be put together and made available to researchers and field workers. This would collate all available and relevant information from both within the region and other parts of the cashew growing world where applicable and be updated as new knowledge became available. Such a handbook should be for the region as a whole in both English and French and eventually in local languages for extension workers and farmers. Inputs from the different organisations in the cashew network could help keep it up to date as new knowledge arose. A regional handbook used by all organisations would be of great benefit to help maintain harmony and synchronization of pest and disease data collected, and would act as a very much needed educational tool.

At the same time, methods of control would need to be researched for the economically damaging pests. Control measures should be practical, safe for use by resource poor farmers, show good economic returns and be environmentally sound.

It is appropriate to mention here the possible potential beneficial role of the predacious ant *Oecophylla*. In East Africa and elsewhere, *Oecophylla* has been shown to significantly reduce *Helopeltis* (sucking pest) damage. As a result of this, research has been conducted on ways of enhancing the territory of *Oecophylla* . Although not very common on cashew in West Africa, *Oecophylla* was seen in sufficient numbers to warrant research on its potential in the region (see Photos. 64 and 65, Vol 2).

Knowledge of cashew pests and diseases was generally very limited among field workers. Also farmers usually could not distinguish different types of damage or say what had caused it.

6.6.3 Summary of pests and diseases

A large number of trees were observed at a large number of sites in the main cashew growing regions of 5 West African countries, at about the most critical time in the production cycle, i.e. at the time of flowering /nut set. The incidence of pests and diseases is most critical at this time. The major conclusions are:-

- Insect pests are causing serious economic loss to farmers in some areas, while diseases appear to be of much less importance generally.
- Hemiptera sucking pests and thrips are probably the most economically import pests.
- Only tiny amounts of what might have been anthracnose were seen.
- Other types of damage were incorrectly identified as anthracnose.
- No powdery mildew disease was seen at all.
- More quantitative data on the economic status of pests and diseases is required.
- Pest and disease knowledge transfer to field workers and farmers needs to be radically improved.
- A cashew pest and disease handbook needs to be published for the region as a whole.

- Collection of quantitative pest and disease data and development of control methods should be synchronized over the region.
- Work on enhancement of natural control of sucking pests should commence.
- Quarantine procedures need to be either put in place an/or strictly adhered to.

7. Environmental constraints

7.1 'Natural' drying of flowers

Panicles can dry out naturally to give a perfectly formed flowering panicle, which is brown in colour and devoid of potentially useful nuts. Photos. 20 and 21 (Vol.2) show examples of such mature, dried, flowering panicles; often entire trees are affected like this. This problem is **not** caused by any disease.

Natural drying of panicles can be a serious problem in East Africa in some areas or years. Little research has been done on this problem but the possible causes could be genetical, environmental, lack of pollination, rainfall during flowering or nutrient deficiency.

The presence of dried flowers was seen quite frequently and reported as a problem by a number of farmers. Some examples, drawn from Annexes 1 and 2 are given below:-

1. On the farm of Mr. El Hadj Anabumane near Kankan, Guinea, many new plants were suffering from a high proportion of dried panicles (Photo. 20, Vol.2), pale leaves and leaf disease.
2. At Atebubu, Ghana, Annex 2 states – "Other problems experienced included thrips, sucking pest damage (both minor) and the drying of a high percentage of panicles. The latter could be due to a number of factors e.g. nutrient deficiency, genetics, lack of pollinators, weather conditions".
3. Drying of flowers was significant on the farm of Mr. Alhassan Salifu near Cheyohi village, Ghana.
4. At the meeting with a farmer group from Cheyohi village, Ghana, the drying of flowers caused by insects/midges was reported as one of their major problems.
5. At the meeting with farmer groups at Ochaja sub-station, Nigeria, one of their main problems was the drying of flowers as a result, they thought, of the harmattan winds. The harmattan (cool, dry winds from the north east) were blamed for the drying of flowers. One farmer gave the following example - he normally harvested up to 50 bags (90 to 100kg each) but for the last 2 years when the harmattan has been bad, production had dropped to only 12 bags or a quarter of the expected yield.
6. On the farm of Mr Abou Alhadji Uba, Lafia, Nigeria, panicles on some trees had dried out and were unproductive, whilst other trees were bearing well.

During the survey in Nigeria, the harmattan was blamed for a number of problems, but the drying of flowers was the most frequently mentioned by farmers. However, as example 6, above shows, in one location it was apparent that the seriousness of dried flowers can vary dramatically from tree to tree. Sardinha *et al* (1993) reported in Guinea Bissau that "Since it is well known the negative impact in cashew yield (by affecting its fertilisation) of the dry wind spells from the Sahara, that normally occurs from 10-30 April, one selection criteria must be set to choose those clones or lines that show early blossom period." According to Mr. Adebola, the harmattan actually benefits some tree crops like mango and oil palm, but for cashew the situation is still unclear.

This problem of flowers drying out giving no production is sufficiently serious and widespread to warrant further research.

7.2 Deficiencies

Symptoms of nutrient deficiency were only seen occasionally and the symptoms displayed were similar at all sites – mottled (like marble) yellow and green leaves (Photos. 22 and 23, Vol.2). This was thought possibly to be a Nitrogen and/or Zinc deficiency but a precise diagnosis would require leaf and soil analyses.

The sites where these symptoms were seen were Atebubu, Ghana where the trees were exhibiting widespread yellow spots on the leaves (see Photo. 22, Vol.2); the farm of Mr. Alhassan Salifu near Cheyohi village, Ghana, where many of the trees had an unhealthy appearance due to yellow mottled leaves; and at the "Cashew Processing Industry Farm, Iwo, Nigeria (Photo. 23, Vol.2).

7.3 Fire

7.3.1 Fire damage to cashew

Fire was probably the major cause of lost cashew production in West Africa and was frequently reported by farmers as one of their major problems, see Annex 1 and 2 for details. Below are <u>some</u> of the examples of fire damage actually seen by the survey team.

1. On the farm of Mr. El Hadj Anabumane near Kankan, Guinea, fire destroyed 800 recently planted seedling cashew plants in early January 2001, just before the survey visit.
2. Mr. Sumani Alhassan (Libga village, Savelugu/Namton district. Ghana) was so worried about fire that he stayed on the farm, day and night, in order to try and prevent outbreaks. He had made fire breaks but he did not have the resources to weed the whole area. According to him, fires were started for a number of reasons, (1) to enable the hunting of small mammals, (2) accidentally, (3) because of grudges, (4) to increase new grass for cattle and (5) to remove weeds ready for land preparation.
3. At "Cross River State Cashew Project Farm" (Nyanya, Cross River State, Nigeria) an estimated 50% of the new plantation had been lost to fire and will require replanting. To try and reduce the risk of fire, farmers are allowed to intercrop.
4. A devastating fire in late December had totally destroyed about 80% of the 250 ha of cashew (Photo. 28, Vol.2) at "T. Y. Acres Farm" (Takum, Taraba State, Nigeria). Most of the cashew will probably survive but there will be no yield from the burnt trees this year and possibly next year and many branches will have been killed. The outbreak was impossible to control even with 25 men and two tractors with water tanks, as strong harmattan winds assisted the fire. Fire was an annual problem on at least part of the farm. Photo. 27 (Vol.2) shows trees which have been repeatedly damaged by fire and exhibiting many dead branches.
5. The farm of General Jerry Useni (near Gwagwalada, Federal Capital Territory, Nigeria) was a large farm, part of which was planted with cashew, but due to the annual round of bush fires much of the cashew had been permanently lost. On this visit, the remaining cashew had again been burnt (Photo. 29, Vol.2). As a consequence of annual fires the farm has reverted back to growing annual crops and diversified into cattle, fish ponds and ostrich production. The owner was rarely on site.
6. Last year fire damaged 50% of Allam Agro-Allied Farm, (Oyo, Oyo State, Nigeria). So far this year there has not been a problem, but according to the manager, if cattle herders go through the farm then they would set fire to it. Fire breaks had been made around the outside, tractors had slashed between the trees and hired labourers slashed under the canopies. The cut grass and weeds were just left lying on the ground, so if a fire did start, the damage could still be substantial.

One of the factors contributing to the fire hazard at the above plots/estates, is that often there is no other cashew in the area, and so the plots are isolated. Consequently, annual crop farmers and herders have no interest in the problem. However, it has been demonstrated that as a 'cashew culture' develops with more and more farmers growing cashew, fires are almost automatically brought under control. An example of this is the Korera Farmer Association (Boke, Guinea) which has a constitution and 198 members who contribute GNF 1,000 per year. The association has already introduced measures to control bush fires, which in the past have caused much damage to cashew fields. Now, fire is not one of their major problems.

7.3.2 Fire and the environment

The preceding section has described the effects of bush fires on cashew plots and the loss of income to the numerous farmers affected was substantial. In addition to the impact of fires on farms and estates, with or without cashew, there is an enormous environmental cost to the bush fires that rage across large areas whether it is farm land or not. Not only are crops, trees and grasses destroyed, but the valuable top-soil can also be eroded, leaving less and less fertile land.

On the drive from Gaoual to Dabola (Guinea) we passed through large areas of land which had been burnt by bush fires, some of it to improve grazing for cattle, some of it for gaining access for clearing trees, either, for charcoal or perhaps future farm land (see Photos. 24, 25 and 26, Vol.2). Similar scenes of vast areas of total devastation due to bush fires were encountered when driving to Seguela in Cote d'Ivoire. Ghana and Nigeria had similar problems.

Annual bush fires contribute to a decline in biodiversity and biomass, release a considerable amount of CO_2 to the atmosphere and so contribute to global warming. Various human activities, for example, the burning of fossil fuels, deforestation, grassland conversion and other land use changes, have contributed to large increases in the level of carbon dioxide and other greenhouse gases in the atmosphere, which are thought to be responsible for global warming. Most experts now agree that if this trend of global warming continues, the global consequences could well be substantial and worst affected could be Africa.

Much of this non-farm land where bush fires were rampant, would be suitable for growing cashew. Not only would cashew provide cash income but it could play a crucial role in preserving the environment by removing the need for annual bush fires and the devastation that follows. Also the growing of tree crops and improved cultivation of the soil can actually sequester carbon, which is basically the redistribution of carbon **from** the atmosphere to other reservoirs of carbon.

Young (1997) suggested that the wider adoption of agroforestry could help to reduce the build-up of atmospheric carbon dioxide and other greenhouse gases which contribute to global warming (Dixon *et al.*, 1994; Schroeder, 1994; Dixon, 1995, 1996). Possible means by which such a reduction could come about are:

- taking up carbon into trees on farms;
- increasing soil carbon (carbon enters the soil as roots, litter, residues and animal manure);
- indirectly, by reducing pressure for forest clearance.

7.4 Overcrowding of trees

On many farms visited the cashew trees were overcrowded; Annexes 1 and 2 give numerous instances of overcrowded cashew plots. Spacing was sometimes down to 3m, even the large, original, Brazilian common trees at the CRNA research station at Lataha, were planted at an interval of 4m. The reason for such close spacing of trees was connected with the planting of cashew as a forestry crop for environmental purposes. Even when farmers planted cashew for commercial reasons they still planted at high density because they didn't know more about optimum planting distances for nut production.

An interesting example was the farm of Mr Traore Vamogognima (Seguela district, Cote d'Ivoire). His farm was 3.75 ha in size and was planted closely spaced over the years 1987, 88 and 89. The plot started to yield after 3 years and in 2000 it produced 3 tons from 3.75ha, in spite of the fact that the trees are overcrowded. Because the canopy was contiguous there were no weeds. He only had to control the weeds around the periphery of the plot where fire from outside of the plot was still a problem. With fire being such a problem in cashew orchards (due to the presence of weeds) and labour to control the weeds being either in short supply or expensive, it <u>might</u> be more economic to plant cashew at high density. This keeps the weeds down, reduces the risk of fire damage and minimises labour costs, although on the negative side, yields are lower. This might be acceptable if the following criteria are valid:-

1. land is plentiful,
2. labour is limited and/or expensive
3. **diseases are of little importance** (high density planting <u>often</u> exacerbates disease problems)
4. insect pest problems are not made worse by high density cashew trees.

A number of farmers commented that they preferred a dense cashew stand so that they don't have to weed. When more quantitative data is available, a rigorous economic analysis should be done on high versus normal density planting.

7.5 The need for quantitative yield data

There is an important need for a database of farmers' yields to help:-

1. To determine what the potential yield of cashew is in different areas and hence estimate its profitability and likely attractiveness to farmers.
2. Clarify cashew production constraints.

The reasoning behind **why** this information should be collected originated from the following observations, (NB such 'snap-shot' observations using farmer recall are likely to have some error associated with the data, nevertheless, approximate estimates are still useful at this stage) :-

1. In the village of Cheyohi (Ghana), last year Mr. Alhassan Salifu harvested only 40 kg from 10 acres of 6 year-old trees (<10kg/ha) and Mr. Alhassan Tia planted 4 acres in 1995 and harvested 15kg (approx. 9kg/ha), both yields were very low yield indeed.
2. The cashew of Mr Sumani Alhassan (Libga village, Savelugu/Namton district, Ghana) yielded 320kg from 3 acres of 12 year-old trees (256kg/ha) and 160kg from 8 acres of 7 year old trees (48kg/ha). Again yields were low, but according to Dr Yidana (UDS), this was one of the better farms in the area.
3. Mr Yaya Umoru, Ochaja, Kogi State had a 5 acre block of 12 year-old cashew and another 55 acre plot of 11 year-old trees. From the 55 acres he harvested approx. 30 bags of between 90 and 100 kg. This converts to roughly 3000kg from 23 ha or 130kg/ha, which is low.
4. Last year the yield from " T. Y. Acres Farm" (Takum, Taraba State, Nigeria) was approx. 275 bags (90kg per bag) from about 220 ha of unburnt cashew, equivalent to 112.5kg/ha, which is low for 9 and 10 year old trees. The plantation was not making

a profit, which is not surprising considering the low yields/ha, frequent fires and a range of highly paid staff (accountants, auditors etc.). As a result, they have stopped planting cashew even though there is much land still available.

5. Last year Allam Agro-Allied Farm (Oyo, Oyo State, Nigeria) only produced 26 tons from approx. half of the plantation (fire damaged the rest), which equates to about 118kg/ha, which is low.

In all of the above cases, there was no immediately obvious reason for the low yields; since the yields were for the previous year, the survey team obviously did not see the condition of the trees and thus were unable to put forward a possible reason for these low yields.

The question of why the above plots and no doubt others, produced such low yields, urgently needs further work. More quantitative yield information is required from a representative number of farms over a number of years from all of the main cashew growing areas, along with information on possible pests and diseases and any treatments given.

7.6 Conclusions

The problem of flowers drying out with no production is sufficiently serious and widespread to warrant immediate research. Progress on this topic could be made relatively quickly, at least by narrowing down the number of factors that might be responsible.

Obvious cashew growth deficiencies are not a major problem (unless linked to drying of flowers) and although there is work to be done in this area, it is not a high priority

Bush fires and the subsequent damage to cashew is one of the major constraints to cashew production. A comprehensive review of the literature needs to be undertaken to see what approaches have been adopted in other parts of the world, and for other crops, to determine how this can be applied to cashew, a crop that fruits towards the end of the dry season when fires are at their most devastating.

After the literature review various strategies need to be evaluated on farm, for example:-

- where tractors are available, cost sharing strategies might be worked out to make fire breaks
- a hand operated petrol rotavator might be useful for making fire breaks
- growing certain crops around the periphery of cashew plots, that either remain green or ones normally grown and that are kept clean of weeds, need to be explored.

Cashew has a very valuable role to play in bush fire reduction in general because it yields in the dry season. Experience in other countries in the past has shown that as a 'cashew culture' develops with more and more farmers growing cashew, fires are almost automatically brought under control.

A closer look at the economics of high density planting is required and should be undertaken in all the countries, since yield potentials and input costs (such as labour for weeding), will vary considerably. A selection of as similar as possible paired plots could be analysed, one plot low-density and the other high-density cashew.

Finally, more quantitative yield information is required from a representative number of farms (preferably over a number of years) from all the main cashew growing areas, in order to determine the yield potential and profitability of cashew in the different areas. This would be a matter of identifying a number of representative villages and then selecting a number of farmers, perhaps randomly from a register of cashew farmers, and then collecting only reliable past yield information and monitoring future yield data more thoroughly.

8 Germplasm, breeding and planting material for farmers

8.1 Introduction

We now have a reasonable idea of the major biotic and environmental constraints to cashew production in the region, on which breeders can start selecting resistant or tolerant types, in addition to the normal characteristics of good yield and quality as produced in the local environment. (It is unfortunate that we can not reasonably expect the breeders to produce fire-resistant cashew plants!)

There follows a review of existing germplasm, and what breeding work has been carried out - both on-station and off-station - and vegetative propagation trials, according to country. The sub-heading "Breeding Research" is used in its broadest sense, to include selection of useful looking trees.

8.2 Guinea

8.2.1 Research station sites.

The "original" germplasm collection at CRAF (Foulaya) was a group of 61 old trees, planted as seed in the 1950s during colonial times; the trees, although planted at a good spacing, are now somewhat overcrowded (Photo. 30, Vol.2). The source of these trees is unknown, although Tanzania and Mozambique have been suggested as possibilities. The reason for their selection is also unknown; at the time of planting their purpose might have been for forestry or just to have cashew on the research station for student studies. Many of the trees were flowering well, there was no apparent disease and insect damage was minimal. Characterisation of nuts from these trees has started, see Table A3.6 in Annex 3; average nut weight for individual trees in this collection ranges from 2.5g to 14.1g and the best 14 trees have been identified using various selection criteria. These selected trees have nut weights ranging from 6.1g to 14.1g, with an average for the 14 trees of 9.1g (see Table A3.7, Annex 1).

A new germplasm trial had started (Photo. 31, Vol.2). All material had been planted from seed and therefore all the new plants were half-sibs and not clones of the original mother trees. New material included seed from:-

- the best trees in the "original" collection (see Table A3.7),
- selected mother trees from Boke region (Photo. 32, Vol.2),
- Brazilian seed originating from a forestry project (nothing more is known about this source).

Kankan - The germplasm collection consisted of seed from some of the original Foulaya collection and seed from a few selected trees in the region and was planted very recently in both 1998 and 1999. There were no replicates and the researchers did not know how many trees were surviving (although this appeared to be low).

8.2.2 Recently introduced material.

The only new plant material of known provenance recently introduced into Guinea was seed imported from Brazil by SPCIA. The seed, from Brazilian clones CCP 09, CCP 1001 and CCP 076 was planted at Mafrinya (Forecariah). The seeds were planted in polythene pots on 22/11/00 and germination started after 11 days which is about normal. Unfortunately only a small percentage have germinated after about 7 weeks, see Table A1.1 in Annex 1. The pots were kept in a locally made shade house and watered in the morning and evening, which was excessive and probably contributed to the very low rates of germination. It was

apparent that only plants at one end of the shade house had germinated (Photo. 33, Vol.2), which was somewhat strange but there was no immediately obvious reason for this that the survey team could elicit. Those seedlings which had germinated, looked healthy.

It should be noted that these seeds were imported without any quarantine procedures. This is potentially **very dangerous** as Brazil has cashew pests and diseases, which are not found in West Africa. Before importing more cashew seeds from other countries, especially outside of West Africa, suitable quarantine procedures must be in place.

8.2.3 Germplasm demonstration plots.

SPCIA demonstration plot (Denken district, Boke). The objective of this plot was to demonstrate to farmers a range of germplasm and how best to grow cashew. However, the plot was in very poor condition, many of the trees had died and many were engulfed in weeds so tall that finding the plants was difficult – hardly the type of demonstration plot to show farmers. In fact on a neighbouring farm, cashew was growing much better.

Unfortunately much of the potential opportunity regarding evaluation of different germplasm has been lost:-

- Seed from selected mother trees in the Boke region had been mixed up, so it was impossible to associate any superior performing trees with the original mother tree.
- Seed from Brazil had no information at all about where it came from, or about the trees involved.
- Many of the lines of seed from individual trees in the Foulaya germplasm collection have been lost.
- There is no replication, even at a simple level.
- Most of the lines have no labels informing of their identity or provenance.

Another example was at the farm of Mr Moustapha Keria at Dabola. Seed for this particular plot was provided by the Extension Service for evaluation purposes, however, nobody, at least in Dabola, knows where the seed came from! Without this information, any evaluation can only be of limited value. Seeds were germinated in plastic bags prior to transplanting into the field at a spacing of 10m x 10m, in 1999. The plants are growing well.

8.2.4 Farmers and germplasm

One of the main constraints reported by most farmers in Guinea was lack of good planting material, see Annex 1 for numerous examples.

The situation with regard to cashew planting material for farmers was that everything was planted as seed from either:-

- An unknown origin.
- Purchased locally from another farmer.
- Obtained from another part of Guinea, e.g. Boke or Mandiana due to greater production in these areas (perhaps selected on nut size).
- Obtained from Guinea Bissau or Cote d'Ivoire for no particular reason other than that production in these two countries is more substantial than Guinea.
- Obtained from selected "mother trees".

At present there is no strategy for planting material as none of the above options are guaranteed to provide improved trees. There is no evidence that Boke, Mandiana, Guinea Bissau and Cote d'Ivoire have any better planting material than the farmers have already. The issue of selected "mother trees" is discussed below.

8.2.5 Vegetative propagation

At Foulaya, research technicians have started practicing grafting cashew plants. However, so far all germplasm material planted has been derived from seed; no vegetatively produced seedlings have been used.

There was confusion amongst some people as to why trees grown from seed were called half-siblings and **not** clones and also about what constituted a clone.

8.2.6 Breeding Research

A start has been made with:-

1. characterising nuts from the "original" germplasm collection
2. selecting possibly superior trees from the "original" germplasm collection and "mother trees" from farmers fields and planting in a new trial. See below for comments regarding "mother trees".

(NB A few trees on the farm of Mr Sidiki Diakite (Maletoumanina district, Sous Prefecture Saladou) were producing large nuts and yielding well and would be worth cloning for evaluation.)

8.3 Guinea Bissau

8.3.1 Research station sites.

None were visited during the survey.

8.3.2 Recently introduced material.

Local researchers were not aware of any imported planting material (it was suggested that the company Agri-Bissau had imported seed from Brazil but this was not the case – see Annex 1). USAID wanted to import cashew from Brazil but this was refused on quarantine grounds.

8.3.3 Germplasm demonstration plots.

Not aware of any.

8.3.4 Farmers and germplasm

Farmers were planting local seed and some were selecting on the basis of nut size. ADDP (an NGO from Denmark) was selecting local seed for planting, based on nut size.

Initially, in 1994 and 1995, the Agri-Bissau estate selected seed for planting from an old plantation at Quihamel. Since then they have selected seed from their own plantation. The criteria for selection of seed were nut weight, tree structure and intensive branching.

8.3.5 Vegetative propagation

Agri-Bissau was experimenting with side grafting of precocious trees. Apart from this very minor experimental testing, there appeared to be no practical use made of vegetative propagation techniques in Guinea Bissau. This is rather ironic considering that in 1990 there was a 3 year European Union funded project to develop sophisticated *in vitro* techniques for cashew tissue culture and propagation. All of the *in vitro* work was carried out in European Universities and much still needs to be researched to make cashew tissue culture a viable proposition. Needless to say this project has had virtually no beneficial impact in Guinea Bissau, the researchers spoken to had no idea about the project. See Section 8.3.6 "Research", for more details.

8.3.6 Research

According to Eng. Quintino da Costa (Presidente) and Lourenco Abreu (Coordenador Nacional da Pesquisa) at INPA (Intituto Nacional de Pesquisa Agraria), Guinea Bissau does not have a cashew breeding programme and does not have a trained cashew breeder. Given the importance of the crop for the country's economy and as West Africa's main producer of cashew, this is surprising. The project below does not appear to have helped in this matter of institution building.

The European Union funded a 3-year research project entitled "Selection of superior genotypes of cashew (*Anacardium occidentale* L.) in Guinea Bissau and the development of *in vitro* techniques for their propagation" (Contract no. TS2-A-0167 P). The propagation part of this project has already been mentioned in Section 8.3.5. 42 trees were selected from the regions of Biombo, Oio, Bafata and Bolama. Selection was based upon the colour, shape and size of the apple or pseudo-fruit. Secondary characteristics were also measured, e.g. apple size, weight and astringency, nut size, branching habit, flower ratios and precocity. Yield was not taken into account and nut weight was only a secondary characteristic, although these are the 2 most important parameters as far as farmers are concerned. The fruits from these 42 trees were then grouped into one of 7 classifications based primarily on the colour, shape and size of the apple. For example Group F had the following characteristics:-

1. Apple – periform, yellow, big size, very astringent and consistent
2. Nut size – big
3. Branching type – extensive.

The classification based upon apple characteristics (periform/cordiform, red/yellow, big/small, astringent/not astringent) seems very rudimentary. It is perhaps not surprising that when selections are based primarily on **apple** characteristics, nut weights are generally very small; 5 out of 7 of the groups had mean weights ranging from 4.8 to 5.8g. The establishment of a clonal garden through well established grafting techniques proved a failure. Ironically, this project concluded that "Cashew nuts' commercial grade in Guinea Bissau is poor due to its small size, this warrants a clear action directed to provide improved material with higher commercial potential". Unfortunately this project did very little to assist in this important matter.

According to Camara and Vayssie (1996) the only distinction with regard to cashew types or "varieties" was between the local variety (caju de terra) with red apples and caju de Mozambique with yellow apples. The former has sweet apples and small nuts, while the latter has astringent apples and larger nuts.

The reports by Camara and Vayssie (1996 and 1997) provide considerable nut-weight data, some of which is summarised in Table 11.

Table 11. Percentage distribution of raw nut weights from Guinea Bissau
Data from Camara and Vayssie (1997)

Category >	cajui	tres petite	petites	moyennes	grandes	Tres grande
Weight range	<3,35 g	3.36-4.50g	4.51-7.00g	7.01-10.00g	10.01-15.00g	>15.00g
1995/96	10	32	51	7		0
1996/97	6	28	54	12		0
Average	**8**	**30**	**52.5**	**9.5**		**0**

Table 11 shows that from the average of the two seasons' samples, 38% of nuts weighed less than 4.5g, the grade termed 'tres petite' or very small. It is estimated that around 60% of raw nuts weigh less than 5.00g (Camara and Vayssie, 1996). The fact that nuts from Guinea Bissau are generally small was reported at the 2001 World Cashew Congress in India and yet, in spite of their small size, they command a small premium on the international market. The reason for this, is the high percentage kernel out-turn of nuts from Guinea Bissau. This is probably nothing specifically to do with Guinea Bissau, but that generally the smaller the nut the higher the percentage out-turn.

8.4 Cote d'Ivoire

8.4.1 Research station sites.

The CRNA germplasm collection at Lataha consisted of 36 trees, planted in one row in 1984, with a spacing of 4m between trees. The history is that the seed for these trees originated from one tree in Brazil (Photo. 34, Vol.2) and certainly the visual characteristics (size of nut and tree) would suggest that the trees did originate from either one or more "Brazilian common" trees. Mr Jean Baptiste Djaha has just started to evaluate this collection and has found that only 4 trees out of the 36 produced a yield of > 8kg/tree <u>and</u> a percentage kernel out-turn of >20%.

It should be noted that "Brazilian common" trees are very large and with only 4m spacing between the CRNA trees, yield data cannot be very accurate, particularly as a potential indicator for further planting. Obviously with wider spacing and a full canopy, many of the trees would yield much more.

Seed from some of the original germplasm collection was planted in a new block of 45 trees in 1997 at a spacing of 8m x 6m (a spacing more commonly used for dwarf material).

8.4.2 Recently introduced material.

No new cashew material has been introduced into Cote d'Ivoire recently.

However, some time ago, seed from Brazil, presumably from large common trees, was imported and planted on an estate at Badikaha (near Korghogo). The SODIRO cashew plantation (100 ha) which was planted in 1993, used seed from this farm in Badikaha. Both sites would be good areas to evaluate the yield of a few visually good trees for possible selection and trials.

8.4.3 Germplasm demonstration plots.

None were seen.

8.4.4 Farmers and germplasm

Since 1995 ANADER has been selecting seed from good trees on the basis of colour of apple, yield, tree structure and size of nut. People have complained that nobody could tell the different varieties apart - this is not surprising however, since there aren't any different varieties. The issue of planting material was very confused in people's minds, and nothing is being evaluated on farm and very little on station (see above).

A very valuable and informative visit was made to the farm of Mr Kone Koulouba in (Koro Ouleu village, Cote d'Ivoire). In 1992, the farmer started to plant an additional 4 ha of cashew with assistance from ANADER. The seed for this block was <u>**all**</u> taken from one supposedly superior "selected mother tree" (Photo. 35, Vol.2) and as is often the case, this selected tree was growing under ideal environmental conditions, i.e.:–

- isolated from other trees hence canopy well developed to give good yield
- open aspect
- good access to sunlight
- good access to soil nutrients and water
- little competition.

Whether this tree is in fact superior due to its ideal environmental position or, whether there is any genetic basis for its above-average yield, can only be determined in a properly designed trial comparing it with other good material. This is a typical example of "mother tree" selection found in many countries. (NB "Selected mother tree" often means a local tree with supposedly superior qualities like yield or nut weight.)

8.4.5 Vegetative propagation

All germplasm material planted so far has been from see; no vegetatively produced seedlings have been used. Developing the technique of vegetative propagation was given priority at a recent stakeholder meeting.

8.4.6 Breeding research

Very little research work has been undertaken on cashew breeding in Cote d'Ivoire as evidenced by the very short literature list at the end of Annex 4. This is not surprising considering that Mr Jean Baptiste Djaha is the only full time senior cashew researcher and that he was transferred from working on papaya only a year ago.

8.5 Ghana

8.5.1 Research station sites.

The UDS/SARI germplasm collection at Tamale consisted of trees grown from seed taken from 60 local "selected mother trees" (Photo. 36, Vol.2). Eight seeds from each of the 60 mother trees were planted in one replicate in 1997. Table A5.12 in Annex 5 provides some information on the first 30 accessions. Note that the nut weights given are from the original mother trees and not from the progenies planted in this trial; it is apparent that some of the mother trees are producing nuts of very low weight.

The block was reasonably well maintained but it was unfortunate that only 1 replicate was planted. Also more information needs to be obtained from the original mother trees.

The material used for planting the Pokuase germplasm collection (near Accra) was seed from local trees. The performance of the mother trees was not evaluated, seeds were simply collected from trees around the vicinity. About 50% of the seedlings were dead. Such a trial has very little value.

8.5.2 Recently introduced material.

Technoserve Ghana has imported seed from the CP range of Brazilian clones and "jumbo" nuts from Nigeria. Over 20 tons of "jumbo" nuts have been imported since 1995 and more is being imported in 2001; this material is being sold to the farmer. "Jumbo" nuts come from one farm in Eastern Nigeria (Kosoni Farm, Oro, Kwara State - visited later in the survey, see Section 8.6.2). There appears to be no evaluation of these introductions by research or NGOs.

At the MIM estate in Ghana, some of the trees were grown from seed from India and the rest of the seed were obtained from an old plantation at Sampa in Ghana. Now they are selecting mother trees from their own plantation based on yield and nut size. One mother tree was seen, and this was isolated on the edge of a block, which can give elevated yields

due to reduced competition. When discussing the problems associated with mother tree selection (see 8.4.4, 'Farmers and germplasm'), it was pointed out by the manager that a few of the selections were within blocks growing under normal conditions of competition with other cashew trees. It would be useful if research could obtain clones from these selected trees for evaluation. It was also useful to note that trees originating from seed from India were more susceptible to damage by thrips.

8.5.3 Germplasm demonstration plots.

None were seen.

8.5.4 Farmers and germplasm

Technoserve Ghana initiated the selection of mother trees in 1994, but found that trees produced from the seed were very variable. Seed provided to farmers working with ADRA was obtained from selected mother trees in Wenchi district and subsequently from MOFA, again from selected local mother trees. All of this new planting will be very variable and much of it without any particularly desirable qualities.

Mr Kwaku Kra (member of Koase Cashew Farmers Association) had 2 acres of trees that originated from Brazilian dwarf seed material obtained from ADRA, the trees are now nearly 3 years old. A few trees had been killed by fire. It is worrying that seed from outside the country is being sold to the farmer prior to any evaluation under Ghanaian conditions. For example, Brazilian dwarf material, although having some useful characteristics, is particularly susceptible to anthracnose, *Helopeltis* and fire. There is also the possibility that under Ghanaian environmental conditions it performs worse than in Brazil. Obviously cashew development workers are enthusiastic to get things moving, often when there is inactivity in other organisations, but **evaluation must take place** to ensure the farmer will not eventually be negatively affected.

8.5.5 Vegetative propagation

No vegetative propagation of cashew is being undertaken.

8.5.6 Breeding Research

As already mentioned there is some evaluation of local "mother tree" selections, but little else. It is only recently that the issue of cashew research has been given any priority by the government.

8.6 Nigeria

8.6.1 Research station sites.

The CRIN sub-station at Ochaja was home to a number of breeding trials:-

1. 'Block NW-7' was the original germplasm collection planted in 1977, with half-sib accessions from Brazil, India, Tanzania, other countries and locally selected material. There were 32 plots of 4 trees (i.e. 4 seeds from one tree) replicated twice, Photo. 37, (Vol.2) shows a map of part of the trial and Photo. 38, (Vol.2) shows one of the trees in this trial. 18 types have been selected for farmer planting.
2. Brazilian "jumbo nut" trial – these nuts were obtained from Kosoni Farm (Oro, Kwara State - see Section 8.6.2). They were graded according to weight and then the whole 7ha block was planted according to nut weight, that is the smallest nuts at one end rising to the biggest nuts at the other (Photo. 39, Vol.2). Spacing was 9 x 9m. The nuts were <u>not</u> from selected trees.
3. Millennium block – Brazilian jumbo type nuts were being evaluated at different spacings, 9 x 9m, 8 x 8m and 6 x 6m. Again each plot was planted according to nut

weight, with the lower weight nuts at one end moving to the highest weights at the other end.

4. Other trials were present and some of the older ones had been earmarked for upgrading trials.

At another site, half-sibs of 25 locally selected "mother trees" were being evaluated, again 4 seeds from one tree were planted per plot and replicated twice.

8.6.2 Recently introduced material.

There does not appear to have been much new planting material introduced in very recent years, but in the past, there has been quite a lot, e.g. 'Block NW-7' and others at Ochaja sub-station and Brazilian "common" or "jumbo" seed imported and planted at Kosoni-Ola Farm (Oro, Kwara State), see below.

On Kosoni-Ola Farm, an area of 350 ha was planted entirely with Brazilian "common" seed imported from Brazil, Photo. 42 (Vol.2) shows an example of one of the trees. Planting started in 1986 and was finished by 1988 and then gapping (filing in of spaces) continued. The total farm area was 500ha. Nut size was variable but a high percentage of trees were giving a very good nut size (Photo. 43, Vol.2). It is from this farm that Ghana imports the Nigerian "jumbo" nuts. Yields were low, last year 250 ha produced only 50 tons, equal to 200kg/ha. More could be done to improve productivity, e.g. top-work unproductive trees, improved maintenance and more efficient harvesting. However this type of tree **needs to be evaluated fully**, before recommending it to the farmer, e.g. for yield potential per ha, kernel weight, percentage kernel out-turn, etc. The main observation was that there appeared to be no anthracnose symptoms on the trees, although there were black oily lesions on the nuts (Photo. 66, Vol.2), which needs further investigation. In Brazil this type of tree would be exhibiting severe anthracnose (Photo. 15, Vol.2), but here, there was none.

8.6.3 Germplasm demonstration plots.

None were seen.

8.6.4 Farmers and germplasm

It was reported that CRIN has distributed 1.5 million seeds from selected trees, for planting by farmers. The present cost to the farmer of this seed is N50/kg. They also distribute seedlings (CRIN seed raised in poly-bags) for N 5 per seedling but the actual cost is N 16, so these are heavily subsidised. They were only selling a small number of seedlings due to high transport costs; as a result more than 70,000 seedlings were unsold last year.

At Awoniyi farms (near Kabba, Kogi State) the planting material was seed purchased from CRIN and the resulting trees appeared to be producing larger nuts than those produced by nearby indigenous cashew trees, but the latter were very small indeed (see Photo. 44, Vol.2). However at Lafia (Nassarawa State) the seed from CRIN were about 5 to 6g in weight (and some were even smaller) and this was <u>smaller</u> than the local nuts seen at the office of extension. Planting in Nassarawa State was either using seed from local trees or from CRIN and unfortunately last year a proportion of the CRIN seed material was discarded due to lack of drying.

The CRIN seed comes from selected individual trees and because of out-crossing, it is likely to be very variable. A poly-clonal seed garden would improve seed production. Here <u>clones</u> of a number of the best trees (perhaps 20) are grown together in a certain arrangement and allowed to cross pollinate. The resulting seed would be a mixture of the characters of the selected clones and resulting trees should be better than the existing farmers' trees

At one of the very first cashew plantations planted in the early 1950's, (Premier Cashew Industry Farm at Oghe, Enugu State), some of the trees still looked very good, giving high yields of possibly up to 50kg/tree and medium sized nuts (Photo. 40, Vol.2). Seeds from selected trees from here were used in CRIN's 1977 germplasm collection. Both this plantation and the Premier Cashew Industry farm at Orji River, acted as sources of seed for farmers when cashew was commercialised.

8.6.5 Vegetative propagation

Only air-layering (marcotts) had been practised on a limited scale, this technique is rarely used these days because it is time consuming with a low success rate; tip or bud grafting are normally used in East Africa, India and Brazil.

8.6.6 Breeding Research

Nigeria has a long history of cashew breeding research, as demonstrated by replicated germplasm trials planted in 1977 and a small number of papers published in regional journals – see the literature section in Annex 6.

8.7 Conclusions

There is a tremendous amount of enthusiasm for cashew by farmers (and the authorities) in all countries and the farmers are expanding their cashew often with little or no support. Only Nigeria has seed for sale which has been evaluated to a certain degree. Even in Nigeria, the CRIN seed could be substantially improved.

The universal complaint is lack of good planting material, Annexes 1 and 2 are replete with examples of farmers and associations complaining that one of their main constraints is lack of good planting material. Much needs to be done with regard to selection, introducing new material, establishing germplasm trials for the short term, medium and long term, breeding and finally distribution of planting material to farmers. **Because of the long time frame for evaluating cashew material, the need to multiply good material for distribution and the importance of providing farmers with the right material, funding for a future regional breeding programme must have the highest priority.**

A related area which needs immediate attention is the introduction of tip or bud grafting techniques to produce clones (genetic replicas of the original mother tree). Without this technique, the breeder's trials are severely constrained, since they are having to use half-sib seeds all the time, which introduces more variability into the trials. With cashew being such a variable crop anyway, this is undesirable. Institutes could develop the technique of vegetative propagation on their own, adapting knowledge from other crops, but to make the process faster it is proposed that a workshop is given by an experienced cashew grafter, in order to transfer the technology that much more quickly and reliably. One or two scientists and/or technicians could attend the workshop from each country.

Finally, it must be emphasised that **Brazilian dwarf trees would be entirely unsuitable** in areas prone to bush fires.

9 Research capacity

9.1 Introduction

With the exception of Nigeria, generally speaking very little cashew research on all topics has been undertaken in the countries visited. Breeding research has been discussed above. This lack of research is not really surprising, as it reflects the 'newness' of cashew in the

region and that in some countries, government research organizations have only recently either been mandated or funded to work on cashew. Funding is a critical factor in all countries, with budgets extremely tight or non-existent.

Research capacity for each country is reviewed separately, but conclusions are given for all countries together at the end of the section.

9.2 Guinea

There is only one full-time senior research person working on cashew, Eng. Souret Diaora (member of the survey team) and he is a general agriculturalist. He is supported by 3 full-time technicians. Over the past 3 years they have been gaining some experience of cashew. This small team is based at Foulaya, which is a 5 hour drive away from Boke, one of the main cashew growing areas, the journey to which involves an unpredictable ferry crossing. In view of this, it will be necessary to have at least one member of research staff based in Boke. At present, trained manpower is limited

Funding is extremely limited and has been in the range GFr 3 to 4 million per annum ($1,500 to $2,100 at the current exchange rate of GFr1,900 /$) since 1998; before that there was no budget specifically for cashew.

See Section "Research Capacity", Annex 3 for further details.

9.3 Guinea Bissau

It was not intended to review the capacity for research in Guinea Bissau, but a few comments are given below.

At a meeting at Direccao de Estudos, Planificacao e Seguimento Politicas e Programas Agrarias the survey team were informed that Guinea Bissau has very limited research facilities and since 1993, has been severely financially constrained. Since the civil war ended in 1998, stability in the country has been a major problem, but nowadays things have improved somewhat.

According to Eng. Quintino da Costa (Presidente) and Lourenco Abreu (Coordenador Nacional da Pesquisa) at INPA (Intituto Nacional de Pesquisa Agraria), Guinea Bissau does not have a cashew breeding programme and does not have a trained cashew breeder.

Considering that cashew is the country's main export crop, (70,000 tons of raw cashew nuts in 2000), the capacity for research appears undesirably limited.

9.4 Cote d'Ivoire

The CNRA (Centre National de Recherche Agronomique) station at Korhogo is responsible for cashew research. Presently there is only one full-time senior cashew research worker, Mr Akadie Jean Baptiste DJAHA (member of the survey team) and he transferred from papaya to cashew only one year ago. There is one full time cashew technician. Other scientists can be called upon to work on cashew from other programmes, for example, Dr Felix COULIBALY (member of the survey team), who is a pathologist for all crops. In-depth experience of cashew is very limited at the moment.

The country has been divided up into various ecological zones and the Korhogo centre is responsible for the savannah region, which normally receives between 1,100 and 1,300 mm of rain a year. There were 4 research programmes operating at Korhogo :-

1. Tree crops (mango, citrus, cashew and papaya)
2. Agro-systems
3. Sugar cane
4. Maize.

At present there is no specific budget for cashew and funds from the mango budget assist cashew research. See Section "Research Capacity", Annex 4 for further details.

9.5 Ghana

The Crops Research Institute (CRI) at Kumasi was recently given the mandate for cashew research. There are 7 well qualified senior scientists working part time on cashew, unfortunately only between 5 and 10% of their time is devoted to cashew. These scientists came from a range of organisations, see Table A5.8, Annex 5. Presently there is very little in-depth experience of cashew research.

The main constraint for cashew research is funding, in 1998, Cedis 23 million ($3,400 at the current exchange rate of Cedis 6,700 to the US$) was allocated to cashew research, but this has been the only funding.

At the Savannah Agricultural Research Institute (SARI) at Tamale, funding for research essentially stopped about 3 years ago. Salaries were paid but delays were experienced with even that. Funding from GTZ, a long term supporter of SARI, stopped in 1998 and now there are a few small DFID and American University collaborative projects. NARP funding finished in 1999.

There are 5 Zonal Research Committees, one for each agro-ecological zone in the country. Below the Zonal committees are district level committees, made up of farmers, extension workers, NGOs and 1 research person. These groups are supposed to define farmer's problems and pass them on to researchers, to ensure that research activities are demand driven. Obviously these district level committees in cashew growing areas should be of value in defining problems and constraints for cashew production.

9.5 Nigeria

Table A6.5, Annex 6 provides a list of senior research personnel of the Cocoa Research Institute of Nigeria (CRIN). The list is quite impressive with a good number of well trained scientists, however these scientists are responsible for research on 5 major tree crops, cocoa, coffee, tea, cashew and kola.

Funding for cashew research was in the region of between $2,000 to $4,000 per annum for 1995 and 1996, it then jumped to $20,000 and $28,000 for 1997 and 1998 respectively and then went down to $10,000 - $12,000 for 1999 and 2000.

See Annex 6, Section "Research Capacity" for more details.

9.7 Conclusions

In all countries (to a lesser extent Nigeria) cashew research is seriously constrained by at least one or more of the following:-

- Limited manpower, especially considering that cashew is grown over a wide area and that there is much research work to do.
- Limited in-depth experience of cashew
- Lack of funds for trials, travel, labour, equipment, etc.

Obviously institutional problems of this nature are not solved easily: some suggestions are given below.

- Cashew needs to have a clear priority within each of the government's National Agricultural Research System (NARS), otherwise it will be difficult to get people and funds.
- Government organizations will need to re-deploy people from other sections or employ new graduates to work on cashew. (Governments are often reticent to employ more personnel due to past over employment).
- For export crops such as cashew a small export levy can be implemented, the money collected should be made available for cashew research and development.
- Submit well thought out projects to funding agencies.
- Regional networking is one of the objectives of the STCP and can be a powerful approach to problem solving – this is discussed in more detail under "Recommendations".

It must be remembered that since cashew is a tree crop, research work on it is a long-term undertaking, with no instant solutions and answers. It therefore requires long-term commitment, in terms of funding and ideally in terms of personnel too.

10. Potential Cashew Areas

It is only necessary to say that large areas of land suitable for cashew are available in all the countries visited, and so land would not be a limiting factor for a long time. This is purely based upon a visual assessment of the environment during the survey, a rudimentary look at the climatic data, but most of all upon the fact that existing plots of cashew were growing well throughout the survey area. Cashew can have an important role of providing a sustainable increase in smallholder income in an environmentally friendly way.

Total rainfall and the number of months with good rains, decline progressively in a northward direction. The survey was carried out in the main cashew areas of each country and generally speaking this was in areas receiving not less than 1,000mm of rain per year. It would be useful to do another survey further north in areas receiving less than 1,000mm of rain, where environmental problems are greater, crop opportunities for farmers more restricted, with less alternative sources of income and poverty more widespread. In Ghana the problem of migration of people from the north to the south was being debated in Parliament at the time of the survey. Cashew could provide an important source of income along with environmental benefits in these more challenging regions.

11. Extension capacity - knowledge and technology transfer.

11.1 Introduction

A review of extension capacity is beyond the remit and TORs of this survey. However, observations from the survey and comments on this topic for each country should be of use for focusing on factors constraining production and future development.

Once knowledge or a particular technology has been developed either by research and/or farmer groups, and tested in on-farm trials and/or farmer trials and has proved successful, it is important to transfer this to the widest possible clientele. Without a good level of farmer adoption, the knowledge or technology is wasted.

11.2 Guinea

There are a total of 3,000 extension agents in the whole of Guinea for all crops and in 2000, a total of 15 extension agents were trained as tree crop specialists. SPCIA also have a small number of cashew extension agents.

In some areas farmers complained that they received no support from extension – see Annex 1.

11.3 Guinea Bissau

No observations were made on this topic.

11.4 Cote d'Ivoire

ANADER is the principle organisation responsible for extension activities. The personnel composition of the ANADER office in Monkono is given below:-

Chef du zone	1
Survey/statistics specialist	1
Association specialist	1
Specialist on professional organisation	2
Agricultural specialist (incl. tree crops)	2
Supervisors	2
Field extension agents	22

The Monkono office serves approximately 200,000 farmer households and this seems to be a typical arrangement for an ANADER office and a typical ratio of extension staff to farmers. So very approximately, each field extension agent has about 10,000 farmers to work with and obviously this is an impossible number with which to transfer new knowledge and new technologies.

11.5 Ghana

Both MOFA and NGOs carry out extension work, the NGOs ADRA, Technoserve and Cashpro are particularly active with cashew in some areas and in those areas the quality of service is quite good. Technoserve organised a trip to Nigeria for representatives of 5 cashew societies to see cashew activities there; these people then became extension agents to help other farmers.

11.6 Nigeria

Nigeria follows the T&V system of extension. It has had one multi-million dollar T&V programme financed by the World Bank (Phase 1) but Phase 2 has not materialised to date and now it would appear that already the extension service is lacking funds and is poorly resourced.

The lack of an effective extension service was frequently quoted by farmers as a major constraint and many new cashew farmers have had no support whatsoever - see Annex 2.

In Lafia (Nassarawa State) the extension service had156 Village Extension Workers (VEW's) servicing 220,000 farmer households, a ratio of VEW's to farmers of 1 to 1,403. A few VEWs had bicycles but the majority had no means of transport with which to get to their

clients. Without transport it is impossible to reach widely dispersed farmers. There were a total of 24 Subject Matter Specialists (SMSs), of which 4 were tree specialists. Extension services were paid for by the individual States. At least in this state, there did appear to be some collaboration between extension and research regarding cashew, but for other states there appeared to be little or no research and extension interaction.

11.7 Conclusions

The extension service for cashew farmers in most parts of all the countries surveyed is either:-

- Weak - extension personnel are present but are not fully trained with major gaps in their knowledge, for example regarding identification and treatment of pests and diseases.
- Limited in manpower, transport and/or financial resources
- Non-existent.

Extension is a very important and yet a very difficult and complex subject, especially when dealing with resource poor farmers that are often numerous and widely spread. Many millions of dollars have been spent by countries taking loans from the World Bank to develop the Training and Visit system of extension, which is now thought by many to be inappropriate for resource poor farmers, living and working in environments which are characterised by their complexity, diversity and risk proneness.

The T & V system is characterised by the following:-

- It is often expensive and hence unsustainable in developing countries,
- It deals with "contact" farmers and the information is supposed to trickle down to the vast majority of non-contact farmers, which of course it rarely does,
- It uses regimented "do this" and "do that" impact points, which are often not suitable for individual farmer's agro-ecological and socio-economic circumstances.

To try and overcome these overwhelming problems, alternative approaches need to be tried, for example:-

1. A knowledge based approach to extension has many benefits over simple impact points, this builds upon existing farmer knowledge to give him/her a better understanding of the problem, so that existing and future technologies can be adapted to suit his/her own agro-ecological and socio-economic circumstances.
2. Build and strengthen farmer associations to act as focal points for extension activities
3. Train farmers as extensionists as shown above (the Technoserve example, in 11.5). These farmers would still require regular supervision to ensure that they are not making mistakes and passing this on to others.

12. Farmer associations

12.1 Introduction

Farmer Associations were met in all of the countries and ranged from the small and informal to the large, National associations. Annexes 1 and 2 report on the outcome of a large number of meetings with farmer associations in all the survey countries; below are some of our experiences and comments that exemplify the general observations made.

12.2 Guinea

Annex 1 details a number of meetings with farmer associations. A good example was the Korera Farmer Association (Boke) which had a constitution and 198 members who

contributed GNF 1,000 per year. The association had already been instrumental in improving the situation with regard to cashew by introducing measures to control bush fires, which in the past had caused much damage to cashew fields. The elected officers had never been trained in skills useful for running the association and there was no external support. Such an absence of skills training may create problems in the future.

The meeting with the Dabola Cashew Planters Association was quite exceptional because it was the first time that we had met any women at any meeting or farm visit (Photo. 46, Vol.2). Therefore, some time was spent discussing problems specific to women farmers. Their main concern was to provide a future for their children and their main constraint was time due to all their other responsibilities of housework, food preparation and childcare. There were 138 members of which 58 were women. The Association's objective was to have 100 ha of cashew planted by the end of 2001 (they had 12 ha already planted). Cashew is a new crop in this area.

All of the Guinea farmer associations appeared to be very enthusiastic about cashew and were farmer generated (rather than imposed from the top), which is very good. None of the representatives have received training in the skills necessary for running successful farmer associations, although SPCIA has been trying to help. The elected representatives were generally the older, wealthier members of the community.

12.3 Guinea Bissau

A meeting was held with the President of the National Farmer Association (Associacao Nacional de Jovens Agricultores da Guinea Bissau) but the meeting did not promote a great deal of confidence in the organisation.

12.4 Cote d'Ivoire

Representatives from a number of large associations were met, for example the Bengueman co-operative, CEACI co-operative and CAWORO co-operative. These associations had up to 1,000 members or more, or covered a range of villages (e.g. the CEACI co-operative covered 60 villages), and included a range of crops (e.g. members of the CAWORO co-operative had 275 ha of coffee, >1000 ha of cocoa, 420 ha of cashew, 100 ha of cotton plus rice and maize).

The LEMISSA farmer co-operative was even larger than the examples above, with over 6,000 members covering 320 villages in the Department. Each village contributed CFA 10,000 and had a sub-committee (President, Secretary, treasurer, etc). One representative from each village sat on the sous-prefecture committee and each sous-prefecture had a representative on the LEMISSA board. This was a very different structure to all previous farmer associations encountered. The crops included cashew, mango, citrus, and cereals but NOT cotton. It was difficult to get a clear picture of what the association actually did for the farmer, but the following seemed to be part of the package:-

- It helps farmers with pest problems by negotiating with companies like Novartis for products.
- It works with ANADER regarding extension (although LEMISSA itself does not have any extension agents).

The village of Kogolo, which was visited by the survey team, was part of the LEMISSA co-operative but the farmers were **not** even aware of its existence! The President said that this was one of the difficulties that they need to overcome.

At the other end of the spectrum was the Masala farmers association, which was a very informal association, with no joining fee and no annual fee. The association received commission from the sale of cashew and last year this money was used to buy a balance, a very practical and useful action.

Also not all experiences with farmer associations were good. Mr. Fakoly Fofana (Monkono) was a member of a cotton association but had stopped growing cotton – the cotton and cashew harvests occur at the same time and since he was getting a better return on cashew, he had relinquished cotton. He also had problems with the cotton association manager, which, according to researchers and farmers, seems to be a frequently encountered problem for farmers. He wanted help to start a cashew association.

12.5 Ghana

Some of the farmer groups working with ADRA had obviously realised the benefits of group "power" and were trying to register as co-operatives, but the farmers did not like the word "co-operative" as it has bad connotations from the past with inefficient government co-ops; they prefer the word "association". There were difficulties regarding registration, i.e. various rules and regulations had to be satisfied, but ADRA had been helping with the problem. ADRA had run a workshop giving advice on how to run farmer associations.

12.6 Nigeria

Mr Umoru (Ochaja) belonged to the Nigeria Farmers Association but according to him, he derived no benefits from being a member. The joining fee was N 5,000.

At the meeting with about 20 representatives from different farmer groups at Ochaja sub-station, all the groups belonged to the Nigerian Farmers Association and the perceived benefits of membership were mixed. About 10% had received loans of about $50 and about 50% had bulked their nuts to negotiate a higher price. (It is likely that the representatives attending this meeting were the larger farmers and/or officials of the various groups and would therefore give a more positive response regarding the benefits of the Nigerian Farmers Association).

Many of the sites visited in Nigeria were large estates, but of the few smallholder farmers met, all of them belonged to the Nigeria Farmers Association, which seems to be a large and unwieldy organisation, unresponsive to the needs of small cashew farmers.

12.7 Conclusions

Farmer associations, in one form or another were met in all countries visited and most were receiving no support at all. It is important that these associations are successful and provide tangible benefits to their members, especially the poorer ones. Not only do farmer associations potentially benefit the farmer financially, by negotiating higher prices for outputs and lower prices for inputs, they are also very effective vehicles for knowledge and technology transfer and rural development in general. There is an urgent requirement for specialised input regarding farmer associations. It appeared to the survey team that the bigger the association became, the less tangible were the benefits for the smaller farmer.

Training was a constant request from nearly all farmer associations, including the larger ones as for example found in Cote d'Ivoire. It is vital that training is provided as soon as possible, especially for the smaller, new, farmer-generated associations (e.g. those found in Guinea and Ghana), before problems are encountered and enthusiasm wanes. Training needs to be given in accounting, management, transparency, communication, etc. Obviously specialised input could decide the most appropriate course of action, but a strong well-trained cadre of farmer association specialists in each country is a minimum prerequisite. These people in turn could train and support the developing associations.

13. Diversification at the farmer level (and risk reduction)

Achieving an appropriate level of diversification of risk for farmers is important for long-term stability. In Guinea Bissau rice production was declining, due partly at least to increased cashew planting, and as a result rice imports had increased. In semi-arid areas cashew can have a competitive advantage over some other food crops. Thus, putting a higher proportion of farmer resources into increasing cashew production at the expense of food security is acceptable, providing cashew prices remain attractive and the income generated is more than enough to buy food for the family. Serious problems can arise if cashew prices become unattractive, or yields decline drastically. It is therefore important to get the right balance between food security and diversity of cash crops. This is especially so for tree crops, which have a much longer time frame to maturity than annual crops.

An example of over-reliance on one cash crop was that of mangoes in the Kankan region of Guinea. Mangoes were the most important cash crop until the mango processing factory in Kankan closed in the 1980's, reducing demand. However due to the long term nature of tree crops, production kept increasing and to make matters worse, all of the trees produced at the same time (there were no later varieties). Hence it was very difficult to sell mangoes, or to get a good price at the time of plenty. This is one of the reasons why many farmers are starting to plant cashew in this region, where previously there was none.

The Monkono region (Cote d'Ivoire) was a big cotton growing area, but because of decreasing cotton prices and increasing cost of inputs, farmers were starting to diversify into cashew. Other crops of importance in the area included mango, citrus and a little coffee. Associations for cotton are starting to incorporate cashew.

Mr Lagazin Bamba (Kogolo village, Cote d'Ivoire) was intercropping citrus with cashew which in principle was a good idea. Unfortunately, in this instance, the 5 ha field of cashew and citrus was too overcrowded and the yield from cashew was being negatively affected. Photo 62 (Vol.2) shows another less crowded field of cashew and citrus. *Oecophylla*, a beneficial predacious ant, (Photos. 64 and 65, Vol.2) was present on both types of tree.

Cashew can have many advantages in semi-arid regions, both financially and environmentally, but it is important to take a holistic view of crop development in these fragile, risk prone environments. Consequently other crops, both food and cash crops, need to be taken into account.

14. Commercial constraints at the farm-gate

14.1 Selling

Only in the remoter parts of Guinea and in those areas where cashew was very new, have there been problems of actually selling the crop in the last year or so. For example:-

- Mr Mamadou Diakhabiy (Sintouridjaga, Gaoual Prefecture, Guinea) sold his yield in Guinea Bissau by taking it there himself on passing trucks! His was one of the very few cashew farms seen between Gaoual and Dabola and there was no association in this area due to the very limited number of cashew farmers.
- At the meeting with the Koumbia Association of Cashew Growers (Guinea), lack of buyers was given as one of the constraints and one member took his yield to Senegal but could not find a buyer (this was in marked contrast to another farmer who said he sold his cashew crop in Senegal for the very high price of CFA 1250/kg).
- In 1999 Mr. Sumani Alhassan, (Libga village, Savelugu/Namton district, Ghana) could not find a buyer in his area and hence his yield was wasted; by contrast in 2000, there were 3 buyers each offering successively higher prices. Obviously the situation is improving there.

In Sansale region (Guinea) farmers often exchanged cashew for rice; in 1999 1 bag of rice was equivalent to1.5 bags of cashew, in 2000 it had increased to 2 bags of rice = 1 bag of cashew. In Guinea Bissau bartering for rice was a very common practice.

The majority of farmers did not have a problem actually selling their yield. In the more remote or new areas, the situation is improving and will continue to improve as more farmers plant cashew. If the lack of buyers is a problem, them farmers need to co-operate and bulk their nuts and arrange transport themselves, if possible.

15.2 Prices

Examples of prices paid for cashew over the past couple of years are given throughout Annexes 1 and 2, and generally speaking, the maximum prices paid to farmers were in-line with what could be expected from international prices. However the following problems were apparent:-

1. Price variability during the season with very low prices at the beginning of the season. Those farmers which were short of cash early in the season were forced to sell, often at very low prices.
2. Variation in price between neighbouring villages at the same time of year
3. Farmers lack information on prices and what to expect.
4. There was no price premium for nuts of better quality or size. This does not encourage farmers to improve the quality of their cashew, which will become an increasingly important factor in the future.

In Kankan region (Guinea) the prevailing price for cashew in 2000 was between GNF 500 and 600, which was much lower than in Boke (Guinea). The reasons were high transport costs either to Conakry (700km) or to Abidjan in Cote d'Ivoire and the GNF / CFA exchange rate. Both Guinean and Ivoirian buyers operated in this area.

According to Mr Traore Vamogognima (Seguela district, Sous-prefecture Masala, Cote d'Ivoire) he was paid between CFA 300 and 330/kg and there was no shortage of buyers. As regards selling, the main problem was the variability in price, in 1997, one buyer offered CFA 40/kg! Buyers also offer different prices at different villages. The farmer did not get any information regarding international cashew prices from the radio or ANADER. For harvesting he pays girls and women CFA 250 to harvest 20 to 25kg of nuts.

The company Olam (based in Singapore), pre-finances Na Mairo & Sons Ltd (a buyer of agricultural commodities based in Lafia, Nigeria), who in turn pre-finance agents to go to villages, buy nuts and bring them back to the warehouse. Last year they used about 100 agents and about 20% absconded with the money. Last year they paid between N22,000 and N50,000 for one ton and bought a total of 1,500 tons. The local buyer gets between 10 and 15% commission. The top price paid by Olam last year was N58,000/ton. Olam collects the nuts and ships them direct to India for processing.

15. Value added products

15.1 Introduction

For all African cashew producing countries, the majority of raw nuts are shipped all the way to India for processing and then re-exportation to USA, Europe, Japan, etc. Although this route is perfectly acceptable, as farmers can still derive a good income from growing cashew, any potential value-added from processing is lost to the country. Obviously there are major benefits to be gained if processing of the nut and the apple can be undertaken in-country, rather than exporting the raw commodity. However, care must be taken to ensure

that the farmers **do not** end up subsidising inefficient and unprofitable processing industries. This can happen if huge taxes are imposed on the export of raw nuts in order to allow local processing industries to compete with India.

Described below are examples of various processing industries in the countries visited.

15.2 Processing of kernels

15.2.1 Guinea.

No processing takes place.

15.2.2 Guinea Bissau

There was one large cashew processing factory of Italian origin (probably manufactured by Oltremare) which has never functioned. The reasons for the demise and what must have been a substantial loss of investment, were not determined. There was a small amount of hand processing for the local market and Portugal, and the objective is to process more. There have been a number of projects to develop hand processing but it was difficult to get information on exactly how much was being processed by hand.

15.2.3 Cote d'Ivoire

The SODIRO cashew (and rice milling) factory at Odienne started processing in May 1998. All the machinery was bought from India and one Indian technician spent one year at SODIRO training people. The finished kernels were vacuum packed in nitrogen for export and they also produced a smaller packet of ready to eat cashew for the local market (demand apparently was not high). The factory was well organised and maintained and the environment for workers was very good. The finished kernels looked of a high quality and the taste was good.

In early 2000, SODIRO bought 1,400 tons of raw cashewnuts and by January 2001, they had only processed 700 tons, in spite of the fact that the new buying season was about to start. The factory had a capacity of 2,500 to 3,000 tons per year. At the moment it is running at less than one third of capacity and most of the machines (probably 80%) are idle (Photo. 49, Vol.2). The reason for this is that they have not managed to sell the processed kernels since starting in 1998 and have about 4,000 cartons (each 22.68kg) in Abidjan. The factory employs 800 people of which 700 are women. Supply of labour is not a problem. It was not possible to meet the company's managers in Abidjan to obtain more information on this potentially very serious problem, but it urgently needs to be examined in more detail.

The CAJOUCIS cashew processing factory at Korhogo was using both mechanical and hand processing equipment to produce kernels. The mechanical equipment was purchase from Oltremare in Italy and was installed in 1979 with a capacity of approximately 2000 tons of raw nuts per year. The nuts were washed and graded according to thickness. CNSL was used for roasting the raw nuts and as a source of fuel. The nuts were placed manually into holders (clips) prior to mechanical cutting (Photo. 50, Vol.2). A metal blade was used for peeling, which can result in scarification of the kernel. The kernels were simply vacuum packed in 25 lb packs. Some of the kernels were organic, apparently some fields have been certified as organic and the produce from these fields was kept separate from the rest.

In addition to the mechanised factory, they started with manual processing using Indian machines in 2000. Presently they are processing 1.5 tonnes per day with this method and hope to reach 2 tonnes per day in the near future. Two shifts operated. Kernel out-turn was given at between 21 to 22%. The amounts processed since 1998/99 are given in Table 12, as can be seen, production is increasing. They hope to process 2,500 tonnes in 2001/2002.

Unfortunately more detailed production statistics, e.g. percentages of each grade, were not available from the factory and had to be obtained from the Head office in Abidjan.

Table 12. Amount of kernels processed at CAJOUCIS cashew processing factory, Korhogo, Cote d'Ivoire. (Copied from Table A1.7, Annex 1)

Year	Total production	Source of kernels
1998/99	1,000 tonnes	Mechanised
1999/00	1,500 tonnes	Mechanised
2000/01	2,000 tonnes	Mechanised + hand
2001/02	(2,500 tonnes)	Mechanised + hand

15.2.4 Ghana

Technoserve has been instrumental in setting up a fledgling cashew processing industry. In 1996 Techoserve organised a processing workshop for farmer groups with a consultant from Nigeria and a resource person from the Natural Resources Institute (UK). In 1997, a business plan was drawn up for a processing plant with a capacity of 30 tonnes of raw nuts/annum and the equipment was installed the same year. The association which owned the small factory paid 20% of the cost up front and Technoserve loaned the rest of the costs for that year. Loans for subsequent years were organised through the normal banking system but guaranteed by Technoserve. In the first year of operation 2 tonnes of raw nuts were processed. Members of the association bought shares in the company. Processing was by hand using both the Indian and Brazilian hand shellers, although the Brazilian one is preferred. All of the machines were made in Ghana. This processing system has been replicated twice more, so there are now 3 processing factories in all, based at:-

1. Msawkaw,
2. Kabile,
3. Sampa

The target for 2001 for the 3 units is to process 12 tonnes of kernels (approx. 48 tonnes of raw nuts). These kernels go to the "Golden Harvest" company for final roasting, salting and packaging for the local market. The kernels are packaged in 100g bags or 250g jars (see Photo. 48, Vol.2). The Golden Harvest company is owned by the 3 processing associations (45%) and Ms. Esi, who owns Mase Foods. Again Technoserve was instrumental in setting up this arrangement.

Ghana is a new and small producer of cashew (5,000 tons per year and increasing) but already they have been thinking about the benefits of the value-added from processing. This was an important move to initiate a processing industry very early in the cashew development phase.

15.2.5 Nigeria

At the Premier Cashew Industry Estate (Oghe, Enugu State) was an old cashew processing factory which stopped operating in 1979. In 1989 a new Japanese factory was commissioned, with an operating capacity probably of more than 2,000 tonnes per annum. This modern looking factory was totally vandalised in 1998 and is now beyond repair, although the buildings could still be put to good use after restoring the roof (Photo. 51, Vol.2). It was said that the employees had not been paid for some time and in their frustration, destroyed the factory. The factory must have cost a few million US$ and was destroyed after only 9 years of operation.

The Cashew Processing Industries factory (Ibadan, Oya State) was commissioned in 1990 and was purchased from Oltremare of Italy. The oil bath mechanism had to be by-passed due to scorching or browning of kernels. Why this should happen was unclear, since the Oltremare technology for roasting nuts works well in other factories around the world. Steam roasting was introduced and the machinery for that was fabricated in Nigeria.
Now nearly all of the original Oltremare machinery is obsolete, with only the ovens and packing machine operational (packed into tins with CO_2). The company had introduced Indian type hand shelling machines in 1999 (made in Nigeria), and either one or two people operate one machine. Apparently 2 people can shell up to 60kg of raw nuts in one 8 hour shift.

After shelling the kernel out-turn ratio was said to be 28% and by the end of processing it was 22%. There were some ongoing marketing problems. The company needs credit to process, to purchase raw nuts, pay for labour, buy consumables (e.g. gloves), but the bank will not loan any money until a letter of credit has been issued by the prospective purchaser of kernels - and they are finding it difficult to find buyers, especially overseas. Why this should be so was not made clear. They now hope to sell raw nuts from the Cashew Processing Industry Farm at Iwo, Osun State (see above) to finance processing of other people's nuts under contract. It remains to be seen whether this will work or not.

15.2.6 Conclusions

With regard to the processing of nuts, the story is mixed. On the positive side is the initiative in Ghana and the CAJOUCIS factory at Korhogo, Cote d'Ivoire. In the intermediate position is the SODIRO cashew factory at Odienne, Cote d'Ivoire with a good operation but marketing problems. On the negative side were the destroyed Premier Cashew Industry Estate factory (Oghe, Enugu State); the Cashew Processing Industries factory (Ibadan, Oya State) with changes needed in the processing stage and obsolete machinery, followed by marketing and financing difficulties. Both of these examples are in Nigeria. There is also the abandoned factory in Guinea Bissau.

It is very important that a regional review of marketing of processed kernels is undertaken, as obviously a number of factories are experiencing problems in this area.

15.3 Use of cashew apples.

In all countries visited, the vast majority of cashew apples, which are nutritious and high in vitamin C, are simply wasted. For example see Photos. 52 and 53 (Vol.2). The first shows the family of Mr Fakoly Fofana (Monkono, Cote d'Ivoire) busy separating the nut from the apple of that morning's harvest; unfortunately all the apples were left to rot on the ground. The second shows Mr. Yaya Umoru (Ochaja, Kogi State, Nigeria) and children with the morning's cashew harvest; after bringing the fruits back to the farm house, the nut is detached and the apple is thrown away.

In Lafia state (Nigeria), there was more interest in using the apples: here, apples were sold in the market and by the roadside (see Photos. 54 and 55, Vol.2); there was also interest expressed in processing the apples into juice.

The most remarkable use of apples seen during the survey (and anywhere else in Africa) was the production of very good cashew-apple brandy at the MIM Agro and Industrial Projects Estate in Ghana. The unique aspect of this plantation was that they make a very professional cashew-apple brandy (see Photos. 56, 57, 58 and 59, Vol.2). The brandy was an after-thought to the plantation, but to date they have produced 42,000 litres (60,000 bottles of 0.7 litres) mainly for the local market; they are now trying to access the European market. The brandy was in the duty free shop at Accra airport and looked as professionally

finished as the more well known brandy and whiskey brands. The plantation sells one bottle for CD 15,000 but this is a promotional price, it will increase to CD 25,000 some time in the future.

From the daily field collection of nuts/apples, only about 35% of the apples are selected for brandy processing. If a delay of only 12 hours occurs, then the percentage of apples wasted goes up significantly. The apples are not picked, they are allowed to completely ripen on the tree and drop, in order to maximise the sugar content. Some of the brandy making equipment was purchased in South Africa and the remainder manufactured locally.

16. Recommendations

Introduction

One of the objectives as stated in the Activity Proposal (Annex 7) is to provide an organisational framework of research and development opportunities for the region. It is anticipated that identified institutes will engage in **collaborative** projects to develop the potential of cashew in West Africa. This will involve relevant research ranging from breeding, crossing and selection to crop protection and on-farm husbandry. In the longer term, this will be integrated with extension activities and social dimensions. In other words, through a participatory process, transfer new technologies and knowledge to smallholder farmers. This in turn should promote sustainable tree crop systems that increase productivity, generate greater income, and protect the environment.

Table 13 provides a summary of research and development (R&D) recommendations: the reasons behind all of these recommendations are discussed in the appropriate sections of the report. Priority is on a scale of 1 to 3 and cost on a scale of low – medium – high.

Table 13. Summary of research and development (R&D) recommendations
Gu - Guinea, C – Cote d'Ivoire, Gh - Ghana, N - Nigeria

Priority	Countries	Objective	Relative cost
1	All	Implement vegetative propagation workshop	Medium
1	All	Implement selection and breeding trials	High
1	Adviser & all	Produce standardised manual of pests, diseases, research methods in English and French	Medium
2	External & all	Review literature of fire prevention and evaluate strategies	Medium
2	All	Collect quantitative data on the economic status of pests and diseases	Medium
2	Gh	Develop appropriate control strategies for pests and diseases.	Medium
1	Gu	Clarify the importance of anthracnose	Low
2	Gh & N	Determine factors responsible for drying of flowers	Low
1	All	Construct database of yield records	Low
2	Gh	Evaluation and enhancement of natural control of insect pests	Medium
3	C	Review economics of high density planting	Low
Admin	All	Establish a network of coordinators	
Admin		Appoint overall adviser and coordinator	
Admin	All	Improve levels of communication	

	C	Review support for extension and implement participatory knowledge based pilot extension project	
	Gu	Implement programme of training and support for farmer associations	
	C & N	Review marketing of kernels	
	N	Develop uses of cashew apples	

NB The country/countries listed to undertake the work are the minimum required, obviously if a particular country has the funds and personnel to do additional work, then that will be encouraged.

Table 13 provides a summary of research and development activities that need doing and their priority. However such an extensive list of work to be done will be constrained by lack of scientists, funding and facilities. Section 9.7 provides some suggestions on how to improve the overall facilities for cashew R&D. Selecting which recommendations can actually be undertaken will be a matter of funding and agreement of the executing agencies. Funding by host country governments is currently very limited. In order to maximise benefits for all countries it will be very important that a regional integrated programme of research and development is agreed and that this is funded from multiple sources, eg governments, donors, private organisations, STCP.

Further details on each of the topics listed in Table 13

At this stage, it is not the intention (or even possible) to provide detailed and budgeted proposals for each of the activities.

The 4 countries refer to Guinea, Cote d'Ivoire, Ghana and Nigeria, but if funding for Guinea Bissau can be found, then there is no reason why it can not participate as well.

All methodology, data recording and data analysis should be standardised to facilitate the pooling and integration of data from all countries.

Implement vegetative propagation workshop

An area which needs immediate attention is the introduction of tip or bud grafting techniques to produce clones (genetic replicas of the original mother tree). Without this technique, the breeder's trials are severely constrained, since they are having to use half-sib seeds all the time, which introduces more variability into the trials. With cashew being such a variable crop anyway, this is undesirable.

It is proposed that a vegetative propagation expert conduct a workshop to transfer this technology to two persons from each of the 4 countries as soon as possible.

The chosen location should be the one most convenient for people to get to, perhaps Ghana or Cote d'Ivoire.

Preparatory work will need to be undertaken by the host organisation by preparing large numbers of seedlings at the right growth stage for practice and a small amount of equipment will need to be purchased.

Implement selection and breeding trials
Quantitative evaluation of existing visually good trees should be carried out over a few years and should include, yield, nut weight, kernel weight and tree characteristics. The best trees can be entered into a simply replicated breeders trial. Care should be taken if selecting any tree, which is growing under particularly ideal conditions (see Section 8.4). There are a number of obvious sites in each of the countries where evaluations should take place, for example some of the estates like the MIM estate in Ghana, the SODIRO and Badikaha estates in Cote d'Ivoire, Kosoni farm, Premier Cashew Industry Farms in Nigeria, and the farm of Mr Sidiki Diakile at Saladou in Guinea.

It is proposed that **at least one**, up to date germplasm trial is established in a main cashew growing area of each of the 4 countries.

Selected material should include:-

1. The best **2 clones** from each of the countries (this will mean careful moving of vegetative material between countries in the region), this material will act as standard material in **all** trials
2. Material from overseas, for example, **seed** from (a) one or two lines of Brazilian dwarfs, (b) Tanzanian polyclonal garden and (c) 2 Indian selections. Again, this will be standard in all trials.
3. **Clones** of the best selected trees from within the individual countries (from on farm or on station)

Mixing clones and seed will present some problems but there is no alternative if material from outside the region is to be evaluated.

There should be a **minimum** of 2 replicates, plot size for clones should be at least 4 and for seed, a minimum of 9 (3 by 3) – but note these really far less than optimal and should be increased if resources permit.

The universal complaint was lack of good planting material. Because of this and the long time frame for evaluating cashew material, the need to multiply good material for distribution and the importance of providing farmers with the right material, funding for a future regional breeding programme must have the highest priority. However, the workshop on vegetative propagation is a prerequisite for the breeding programme.

Produce standardised manual of pests, diseases and research methods in English and French

As mentioned above all methodology, data recording and data analysis should be standardised to facilitate the pooling and integration of data from all countries. If the research is standardised across the region and well integrated, the value of the whole will be more than the sum of the individual parts. A standard manual in French and English, covering pest and disease identification, quantitative methodology for evaluating pests, disease, agronomic and breeding parameters, will be of tremendous help. This will need to be regularly updated.

Literature review of fire prevention and evaluation of strategies
Bush fires and the subsequent damage to cashew is one of the major constraints to cashew production. A comprehensive review of the literature needs to be undertaken to see what approaches have been adopted in other parts of the world, and for other crops, to determine

how this can be applied to cashew, a crop that fruits towards the end of the dry season when fires are at their most devastating. The French and English literature should be thoroughly evaluated and then recommendations from this review should be evaluated on-farm. Obviously ready access to the literature will be an important factor.

After the literature review various strategies need to be evaluated on farm, for example:-

- where tractors are available, cost sharing strategies might be worked out to make fire breaks
- a hand operated petrol rotavator might be useful for making fire breaks
- growing certain crops around the periphery of cashew plots, that either remain green or ones normally grown and that are kept clean of weeds, need to be explored.

Collect quantitative data on the economic status of pests and diseases

Extensive observations made during the survey would suggest that insect pest damage is of much greater significance than disease problems. Diseases were of minor importance, but it should be noted that this might not always be the case. The two Hemiptera sucking pests *Helopeltis sp* and *Anoplocnemis curvipes* (both sub-order Heteroptera), and thrips, are probably the most economically damaging pests over the region in general. Trunk borers (*Apate terebrans*, Coleoptera, family Bostrychidae) and branch girdlers (*Analeptes trifasciata,* Coleoptera, Cerambycidae) can be serious on a more isolated scale. There are also a number of minor pests in the region as a whole, which could be serious sporadically or from time to time (e.g. Aphids, leaf rollers, etc.).

There is an urgent need for quantitative data on the economic status of pests and diseases, including.

- The distribution of pests and diseases in each country
- The frequency and intensity of damage caused
- The loss of farmer income due to the different pests and diseases

Develop appropriate control strategies for pests and diseases

Once a good start on the recommendation "Collect quantitative data on the economic status of pests and diseases" has been made, it will be necessary to research appropriate, environmentally friendly, control strategies, in the first instance natural control if possible and then, if necessary, sensible and rational chemical control methods.

Clarification of the importance of anthracnose

Extensive observations made during the survey would suggest that insect pest damage is of much greater significance than disease problems. As regards the effect of diseases on flowering and nut set, they were generally of minor importance, but it should be noted that this might not always be the case. Although only tiny amounts of what might have been fully developed anthracnose were seen, the confusion regarding the leaf disease as shown in Photos. 16, 17, and 18 (Vol.2) needs to be **urgently** clarified.

Determine factors responsible for drying of flowers

The problem of flowers drying out with no production is sufficiently serious and widespread to warrant immediate research. Progress on this topic could be made relatively quickly, at least by narrowing down the number of factors that might be responsible.

Construct database of yield records

Finally, more quantitative yield information is required from a representative number of farms (preferably over a number of years) from all the main cashew growing areas, in order to

determine the yield potential and profitability of cashew in the different areas. This would be a matter of identifying a number of representative villages and then selecting a number of farmers, perhaps randomly from a register of cashew farmers, and then collecting only reliable past yield information and monitoring future yield data more thoroughly.

This exercise would not cost much and yet would provide very useful data for developing cashew.

Evaluation and enhancement of natural control of insect pests
A convenient starting point would be an evaluation of the potential beneficial role of the predacious ant *Oecophylla* (see Photos. 64 and 65, Vol 2). In East Africa and elsewhere, *Oecophylla* has been shown to significantly reduce *Helopeltis* (sucking pest) damage. As a result of this, research has been conducted on ways of enhancing the territory of *Oecophylla* . Although not very common on cashew in West Africa, *Oecophylla* was seen in sufficient numbers to warrant research on its potential to reduce damage by Helopeltis and the much larger *Anoplocnemis curvipes.*

Review economics of high density planting
A closer look at the economics of high density planting is required and should be undertaken in all the countries, since yield potentials and input costs (such as labour for weeding), will vary considerably. A selection of as similar as possible paired plots could be analysed, one plot low-density and the other high-density cashew.

The following 3 recommendations are administrative.

Establish a network of coordinators

In-country coordinators should be formally identified, with clear terms of reference for coordinating the work within their own country and liaising with other countries. The obvious choices for such positions would be those people participating in this survey. Improved levels of communication will be needed.

Appoint overall adviser and coordinator

It will be essential to identify an organisation to provide broad-based advice and practical co-ordination at an early stage. This will be needed to allow the network noted above to have a focus and also to provide the necessary inputs to ensure appropriate levels of help and advice are given. BioHybrids AgriSystems Ltd could provide such a role, with their added advantage of active links with East Africa, but this would need to be viewed by those involved.

Improve levels of communication
Good communication is imperative to the success of the network and at the moment just basic communication need to be improved.

Normally with a crop of national importance there are many players involved, producers, farmer associations, research, extension, buyers, traders, transport companies, processors, exporters, etc and it is important that all these different players "talk" to each other to ensure a reasonable level of co-ordination and vertical integration along what can often be a complex chain. There needs to be appointed by consensus, a manageable group of stakeholders from producers, research, extension, NGOs, traders, processors, government, that can co-ordinate activities within each country. Such a "stakeholder committee" could and should play a pivotal role in organising, co-ordinating and motivating the cashew

industry. Some countries have already had stakeholder meetings, but these should be formalised and meet on a regular basis, at least once a year, preferably twice.

The remaining recommendations are outside the remit of the current survey but are very important and are included for future action.

Review support for extension and implement participatory knowledge based pilot extension project

The extension service for cashew farmers in most parts of all the countries surveyed was either weak, limited in manpower, transport and/or financial resources or non-existent.

Extension is a very important and yet a very difficult and complex subject, especially when dealing with resource poor farmers that are often numerous and widely spread. An extension focused review would be desirable.

In the mean time it would be of benefit to start a participatory, knowledge-based, pilot extension project, testing alternative approaches, for example:-

4. A knowledge-based approach to extension has many benefits over simple impact points, this builds upon existing farmer knowledge to give him/her a better understanding of the problem, so that existing and future technologies can be adapted to suit his/her own agro-ecological and socio-economic circumstances.
5. Work with farmer groups and farmer associations which can act as focal points for extension activities
6. Train farmers to act as extensionists (with regular supervision to ensure that they are not making mistakes and passing this on to others).

Implement programme of training and support for farmer associations

Farmer associations, in one form or another were met in all countries visited and most were receiving no support at all. Not only do farmer associations potentially benefit the farmer financially, by negotiating higher prices for outputs and lower prices for inputs, they are also very effective vehicles for knowledge and technology transfer and rural development in general.

There is an urgent requirement for specialised input regarding farmer associations. Training was a constant request from nearly all farmer associations, including the larger ones as for example found in Cote d'Ivoire. It is vital that training is provided as soon as possible, especially for the smaller, new, farmer-generated associations (e.g. those found in Guinea and Ghana), before problems are encountered and enthusiasm wanes. Training needs to be given in accounting, management, transparency, communication, etc. Obviously specialised input could decide the most appropriate course of action, but a strong well-trained cadre of farmer association specialists in each country is a minimum prerequisite. These people in turn could train and support the developing associations.

The priority country for farmer associations should be Guinea.

Review of marketing of kernels

It is very important that a regional review of marketing of processed kernels is undertaken, as obviously a number of factories are experiencing problems in this area. Without the ability to market the end product, then obviously the whole processing industry will collapse

and the potential for value-added will be lost. Also, if some factories experience such marketing problems, this could also reduce confidence in other factories.

The priority countries should be Cote d'Ivoire and Nigeria

Develop uses of cashew apples

In all countries visited, the vast majority of cashew apples, which are nutritious and high in vitamin C, are simply wasted. More work on this valuable resource should be undertaken. CRIN in Nigeria has undertaken some work in this area and perhaps would be suited to develop suitable apple processing equipment and start distributing to farmer groups. The establishment of small-scale juice processing plants can add value to the product and create employment at many levels.

Training

All of the above activities will rely crucially on having trained personnel at all levels. The type and needs for training are varied and cannot be easily specified in any simple way in this report. Some aspects have been specified, such as skills in vegetative propagation, in extension, etc. and some of these will require more than simple "field skills and training".

Also, there is a need to increase the higher levels of the knowledge base in order to allow the development of suitable background information to ensure "knowledge based" decision, planning and exploitation potentials, in other words to ensure that decisions are based on sound scientific and practical information. Therefore, in addition to the training specifically identified, a well-considered programme of PhD, Masters and Bachelor training needs to be implemented. But before that is implemented an assessment must be made of what is currently available over **all** this region (but necessarily presently identified as for cashew) and a mechanism implemented to allow the efficient sharing of knowledge and resources.

However the primary and urgent need is to make full use of the knowledge already available within the region but which is in "isolated pockets" – the use of "hands-on" training, workshops and strategy meetings will need to be an early feature of the network and one which will bring tangible results in a realistic time scale. See also the other sections particularly on Farmer Associations.

17. Summary – See Executive Summary

If such a networking arrangement as envisaged above can become reality, then each country will become more aware of the status of the crop and activities related to it in other countries within the region, thereby allowing research workers to share ideas, new technologies, knowledge and problems. The opportunities for regional cross-cutting, problem solving will be significantly enhanced and any duplication of effort minimised. It will provide the basic underlying data and information on which research, development and extension activities for cashew can be based in the future.

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Acknowledgements

The authors would like to thank all those people who so patiently answered questions and showed the teams around the different cashew sites, without this help the survey would not have been possible. Thanks must also go to all the participating institutes for providing vehicles and drivers for the survey, special thanks should go to IRAG for providing the vehicle that went round 3 countries over sometimes very difficult terrain. Our appreciation goes to STCP/USAID for providing funding for the survey.

ANNEX 1.

OBSERVATIONS AND ACTIVITIES SPECIFIC TO GUINEA, GUINEA BISSAU AND COTE D'IVOIRE.

9th to 27th January 2001

Survey team members:-

Guinea, Guinea Bissau and Cote d'Ivoire.

Dr. Clive P. Topper
Dr. Mahmoud Camara
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Cote d'Ivoire
Mr. Akadie Djaha
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The survey members would like to thank all the very helpful people who assisted the survey, a special thank you should go to Mr Mamadu Serra Camara and Mr. Julio Malam Injai from Guinea Bissau

Annex 1.

Observations and activities specific to Guinea, Guinea Bissau and Cote d'Ivoire.

Introduction

Activities, observations and information obtained from each country are presented in chronological order. The detailed itinerary given in Section 4 in the main report provides complete information on the names of all people met and gives an easier overview of the chronology of activities. This Annex concentrates on the observations made and information obtained.

Field-survey questionnaires completed *prior* to the survey taking place, can be found as follows:-

Guinea – Annex 3
Cote d'Ivoire – Annex 4
Guinea Bissau – no questionnaire was sent out.

Specific observations and activities

Guinea, Tuesday, 9 January.
Arrive Conakry at 2030 hr. Meeting with Dr Camara and Mr Diaora, the other members of the survey team.

Guinea, Wednesday, 10 January.
Meeting at USAID office with Mr A. Flemming, Mr M. Fofana and Mr. Son Hoang Nguyen for briefing and logistical information.

Meeting at SPCIA with Mr M. A. Kane (Director SPCIA and national co-ordinator of STCP Guinea), Mr K. Yansane (Chambre Agriculture), Mr M. S. Kaltamba (farmer), Mr A. Keita (SNPRV), Mr M Noba (V. President Chambre Agriculture), Mr L. Traore (FICA), Mr S. Kourouma (DNA/MAE), Mr A Bah (Conseiller Presidence Republique), Mr K. Kane (SPCIA) and Mr A. K. Bangoura (BEI – C&C).

The consultant briefed other participants on the objectives of the survey and in turn, saw a presentation on cashew work in Guinea and was made aware of the importance given to cashew at the highest level in the country.

SPCIA was originally a Government financed project and it is now a private company with a Head Office in Gueckedou. Its main focus is supply of seeds and fertiliser. They have divided the country into zones and have a number of development agents (70 people in total) in each of these. They give advice on inputs but also act as commercial agents. They have imported cashew seed from Côte D'Ivoire and Guinea-Bissau (GB) and they visited GB in 1998.

Meeting at IRAG headquarters with Dr S. Cisse (Directeur General) and Mr S. Beavogui (Directeur Scientifique) for briefing.

Visit SPCIA plantation at Mafrinya (Forecariah) to see seedlings grown from Brazilian clones CCP 09, CCP 1001 and CCP 076. These seeds were imported without any quarantine procedures - this is potentially **dangerous** as Brazil has cashew pests and diseases, which are not found in West Africa. Before importing more cashew seeds from other countries, especially outside of West Africa, suitable quarantine procedures should be in place. The seeds were planted in polythene pots on 22/11/00 and germination started after 11 days which is about normal. Unfortunately only a small percentage have germinated after about 7 weeks, see Table A1.1.

Table A1.1. Germination data for seeds imported from Brazil.

Mother clone	No. seeds planted	No seeds germinated	% germination
CCP 009	67	30	45
CCP1001	44	1	2
CCP 076	33	24	73

The pots were kept in a locally made shade house and watered in the morning and evening, which was excessive and probably contributed to the very low rates of germination. It was strange that only plants at one end of the shade house had germinated (Photo. 33, Vol.2). Those seedlings which had germinated looked healthy.

A lengthy explanation was given by the consultant as to why these seedlings were **not** clones of the trees in Brazil but were half-siblings - there was general confusion about what constituted a clone.

A visit to a nearby, but poorly maintained cashew farm showed that growth was good, panicle development was progressing well and that damage levels were not significant (leaf miner and leaf roller).

Guinea, Thursday, 11 January.
Visit CRAF Centre de Recherche Agronomique de Foulaya, (IRAG).
Meeting with Director, Dr Camara for overview of CRAF.

The station was created in 1946 to focus on fruit and vegetables and was once the main research station during French colonial times. After independence, it became more centred on agricultural crops. They currently have 10 programmes ranging over fruit (cashew, avocado, lemon, pineapple and banana) but also cassava, vegetables and aspects of agro-technology.
The Centre has germplasm collections consisting of:

- Cashew - (see later)
- Mango – 104 varieties
- Citrus – 64 varieties
- Bananas – 4 varieties (imported *in vitro* from INIBAP in Montpellier)
- Pineapple – 3 varieties (imported *in vitro* from Montpellier)

Visited the Entomology department to see collection of insect pest species and nuts from various CRAF accessions. The variation in nut weight from the different trees was large and ranged from 14.1g to 2.5g – see Table A3.6 in Annex 3. Yields were generally quite low, but the trees did have overlapping canopies.

In the Food Processing Department, a locally made "Brazilian type" nut decortication machine (hand operated) was demonstrated along with cashew kernel oil (clear and pale yellow in colour), cashew apple jam and apple preserved in syrup.

At the cashew field nursery, cashew seedlings were growing in polythene bags and many had been used by technicians for practising side and bud grafting. The plants were quite substantial in size when grafting had been carried out which meant that the roots had probably started to curl around in the bottom of the bag. This could well compromise the growth potential of the plant if it was to be transplanted, but obviously for practice purposes, this is not an important issue. Seedlings in the nursery had been treated with insecticide (anthracnose was prevalent on nearby mango trees).

The "original" germplasm collection at CRAF was a group of 61 old trees, planted as seed in the 1950s, during colonial times; the trees are somewhat overcrowded now (Photo. 30, Vol.2). The source of these trees is unknown, although previously Tanzania and Mozambique were mentioned as possible sources. The reason for their selection is also unknown; at the time of planting their purpose might have been for forestry or just to have cashew on the research station for student studies. Many of the trees were

flowering well, there was no apparent disease and insect damage was minimal. Characterisation of nuts from these trees has started, see Table A3.6 in Annex 3; average nut weight for individual trees in this collection ranges from 2.5g to 14.1g and the best 14 trees have been identified using various selection criteria. These selected trees have nut weights ranging from 6.1g to 14.1g, with an average for the 14 trees of 9.1g (see Table A3.7).

A new planting in the germplasm collection had started (Photo. 31, Vol.2). Again all material so far had been planted from seed and therefore was not a clone of the original mother trees. New material included seed from:-

- the best trees in the "original" collection (see Table A3.7),
- selected mother trees from Boke region (Photo. 32, Vol.2),
- Brazilian seed originating from a forestry project (nothing more is known about this source).

The main damage constraints in the new block were *Helopeltis* (Photo. 2, Vol.2) and thrips, both were significant. A trunk boring insect, *Apate terebrans* (Bostrychidae, Coleoptera) had killed or was in the process of killing, 3 trees in the new collection (Photo. 9 A and B, Vol.2). Possible Anthracnose was seen on one of the Brazilian trees acquired from the forestry project (Photo 13, Vol.2).

In the afternoon the team departed Foulaya for Boke, one of the main cashew areas, visiting farms on the way.

Visited cashew farm at Woleya (Prefecture - Dubreka) between Conakry and Boke. Seed was initially purchased in Guinea Bissau in 1999 and planted directly into the ground, but either did not germinate or died after germination. Subsequently, unselected seed from Kankan was purchased and planted in polythene bags (24/6/2000) and then transplanted, with much better results. So far 7.5 ha had been planted with a target of 100 ha. The trees were sprayed with Diazinon (organophosphorus insecticide) on 24th November 2000 for leaf rollers. Low levels of *Helopeltis* damage were present. The extension agent had been experimenting with a copper based fungicide, although the reasons for this were not apparent.

Visited the President's plantation in Samaya district (Prefecture - Dubreka); this consisted of 75 ha of cashew planted in 1996 and many hectares of oil palm. The seed used for planting came from Cote D' Ivoire. This was obviously an important plot in terms of the profile of cashew in Guinea. Unfortunately the cashew was very badly damaged by *Helopeltis*, a sucking insect pest that causes black lesions on shoots and panicles and when the damage is sufficiently intense, the shoot dies. The level of damage observed was significantly reducing yields and apparently all of the 75 ha of cashew was badly damaged. Recommendations regarding chemical control were given to the responsible technician, although it was stressed that it was already very late and over due. The recommendation was for immediate application by motorised blower, of 1 ml of pyrethroid insecticide (eg Fastac or Karate) in approximately 300ml of water, per tree. Flow rate and throttle settings should be appropriate for the size of tree (probably minimum flow rate and throttle set at half). Repeat application after 3 weeks and again after 4 weeks.

Ways of enhancing the natural or biological control of *Helopeltis* need to be developed by research.

NB. The drive to Boke from Foulaya (without diversions) takes about 5 hours and includes an unpredictable ferry crossing and is therefore a substantial journey for researchers wishing to visit Boke. In view of this, it is necessary to have at least one member of research staff based in Boke.

Guinea, Friday, 12 January.
A meeting was held at Boke Regional Office to discuss cashew with many high level people responsible for agriculture and development in the Boke Region. It was apparent that there was much enthusiasm for cashew, not only from farmers but also the authorities.

Visit to farm of Mr El Hadj Makanera Abdoulaye ('Boke Centre' district), an example of "small farmer" now grown to "large farmer" status thanks to profits from cashew. He first started in the 1960's with mangoes but this proved risky because marketing was unpredictable and mangoes can soon deteriorate when ripe. At that time cashew was only planted for fences/boundaries. Now he has a total of 20 ha, some 10 years old, another block of 4 years old and the most recent, 2 years old. The most recent cashew was planted using the biggest seed from his older blocks and this block was yielding already and the few nuts observed were of a good size.

Farm-gate price in 1999 was GNF 800/kg and in 2000, GNF 1,000/kg.
The main production constraints were a combination of thrips and *Helopeltis*, with both types of damage widely distributed over the entire farm, and one large area in particular being totally defoliated due to thrips (see Photos. 7 and 8, Vol.2). Extension agents incorrectly thought that anthracnose was responsible for this damage.

Table A1.2 estimates the loss of farmer revenue due to insect damage, based on actual yield information given to the survey team by the farmer.

Table A1.2. Estimated loss of revenue due to insect damage.

Year	Expected yield, Kg	Actual yield, Kg	Percentage loss of expected yield	Loss in revenue, $
1998	5,000	5,000	0	0
1999	6,000	2,500	58	1,750
2000	7,200	2,500	65	2,350

Assumptions re Table A1.2 above:-
1. In 1998 there was no loss of yield due to insect damage, although it is likely that there would have been some.
2. Yield would have increased by 20% per year for 1999 and 2000.
3. Price per kg was $0.50

As can be seen from Table A1.2, insect damage was probably causing substantial economic loss, and judging from the amount of insect damage seen, this is likely to be of a similar magnitude in 2001.

Another factor was that the oldest block was now becoming overcrowded and needed thinning.

Oecophylla nests (Photos. 65 and 64, Vol.2), both new and old were seen on 1 cashew tree, they were not common but at least they can survive on cashew.

To SPCIA demonstration plot in Denken district (Boke). The objective of this plot was to demonstrate to farmers a range of germplasm and how best to grow cashew. Unfortunately, the plot was in very poor condition, many of the trees have died and many were engulfed in weeds so tall that finding the plants was difficult – hardly the type of demonstration plot to show farmers. In fact cashew on a neighbouring farm was growing much better.

Unfortunately much of the potential opportunity as regards evaluation of different germplasm has been lost:-
- Seed from selected mother trees in the Boke region have been mixed up, so it is impossible to associate any superior performing trees with the original mother tree.
- Seed from Brazil has no information what so ever about where it comes from or from what trees.
- Many of the lines of seed from individual trees in the Foulaya germplasm collection have been lost.
- There is no replication, even at a simple level
- Most of the lines have no labels informing people what they are.

In addition, the SPCIA technicians have virtually no knowledge of pests and diseases.

The 25 ha farm of Mr Djirane N'Diaye (a former ambassador) was visited. This was planted in 1997 using seed from Guinea Bissau and from Boke.

Mr Alassan Diallo (a former government worker) started planting cashew in 1996 using local seed. Only family labour is used for harvesting. The main problem at the time of the survey was a significant level of *Helopeltis* damage, which according to the farmer was also bad in the year before. The farmer did not know that it was an insect causing the black lesions and killing some shoots. In 2000 he sold his cashew yield for GNF 1000/kg and in 1999 for GNF 300/kg. The increase the farmer attributed to the presence of buyers from Guinea Bissau in 2000. He did not experience any problems selling his crop. Sometimes a bag of cashew was bartered for 2 bags of rice.

Mr Hadj Banfaseny Fofana planted 28 ha of cashew in 2000 using seed obtained from Mr El Hadj Makanera Abdoulaye (the first farmer seen today). The seeds selected were >11g in weight, in the past farmers specifically used small seed. Extension helped to coordinate the planting and provided information on how to plant (e.g. spacing of 10m x 10m; holes 40cm x 40 cm; 100g of TSP). Seedlings were reared in plastic pots for 1.5 months before transplanting.

A meeting was held with Korera Farmer Association at the farm of Mr El Hadj Dembo. The main problems experienced by the farmers in the association were:-

- The lack of credit availability (for labour and construction of fences)
- Damage to plants (all types of pest and disease damage are considered as one by farmers)
- Lack of planting material

The association has a constitution and 198 members who contribute GNF 1,000 per year. The association has already introduced measures to control bush fires, which in the past have caused much damage to cashew fields. The elected officers have never been trained in skills useful for running the association and there is no external support, which may create potential problems in the future.

In the coming harvesting season the farmers think that prices will improve because of increased competition from more local Guinean buyers (exporting through Conakry) as well as those from Guinea Bissau. [Information from other sources suggests that a number of Guinean buyers are already operating.]

Mr El Hadj Dembo has 600 ha of cashew planted with seed from Guinea Bissau.

A meeting held in Boke town with representatives of 3 Farmer Associations, suggested that the following were major problem areas:-

- Lack of inputs
- Lack of planting material
- No use for the apple
- Lack of fences to reduce stealing
- Price information
- Lack of credit facilities

It was very obvious that all farmers, officials and farmer associations met so far, were extremely enthusiastic about the potential of cashew. It is important that these farmer associations are successful

in the long term. Not only do they potentially benefit the farmer but they are also very effective vehicles for cashew development. They seemed to be appreciative of SPCIA's role in cashew development.

According to one farmer, seed from Foulaya was planted in Boke in 1964, but no follow up has been made.

It appears that government officials have little appreciation of farmer knowledge. Although the farmers we saw seemed to have only a limited knowledge of pests and diseases, they would certainly have valuable knowledge with regard to the ecology of their farms.

Guinea, Saturday, 13 January.
SPCIA office in Boke – this coming harvesting season, SPCIA will purchase nuts if a third party contracts them to buy a certain quantity of nuts, otherwise it will not be involved in buying nuts. In previous years it has not bought nuts. SPCIA has printed a simple free cashew handbook for farmers.

Meeting with Dabiss Farmer Association at Dabiss (Sous Prefecture – Dabiss). This association had 58 members, a formal constitution and members pay a fee of GNF 1,000 per year. It had only just started and officials were still to be decided. Problems put forward by the members included:-

- No support or training for association activities
- Lack of proper planting material (at present they just use local seed from Boke)
- Birds/bats eat apples
- Lack of credit for labour
- Lack of storage facilities to bulk nuts prior to selling
- Animal cuts the stems of young cashew plants and rice (probably squirrels).
- Migration of young people to towns

Farmers received GNF 700 /kg of nuts at the beginning of the last harvesting season rising to GNF 1,000/kg at the end. Two buyers came last year, the agent of one stayed in the village and paid cash for nuts. Guinea Bissau farmers sometimes brought nuts to Guinea to sell, presumably for a better price. There was no distinction in price for nuts of different size or quality. Other sources of income were citrus, mangoes and rice, but the most important was cashew.

Mr El Hadj Alpha Barry and Mr Sauoussy Boueah Camara were two of the major buyers from Guinea.

Meeting with Fif farmer group which is part of Sansale Farmer Association; they have still to elect a representative. Problems for cashew producers were:-

- Insect damage
- Rodent pest which cuts the plants (probably squirrels)
- Weeds
- Lack of inputs
- Lack of storage to bulk nuts
- Lack of credit.
- Transport, bad condition of roads

Farmers planted the biggest locally available seeds. There was great enthusiasm for cashew amongst the farmers in this inaccessible area of Guinea with appalling roads, unpredictable rivers to cross and one antiquated ferry crossing.

Farmers here often exchanged rice for cashew; in 1999 1 bag of rice = 1.5 bags of cashew, in 2000, 2 bags of rice = 1 bag of cashew, or GNF 35,000 /50kg bag. Farmers did not pay tax on cashew sales and buyers took cashew through the bush to avoid paying taxes at the border! Alcohol was made from the apples and sold at GNF 1,500 per litre, but most apples were wasted. It was observed that there was a

lot of overcrowded cashew of 10 years old or more, in this area. Abandoned cashew areas were cut and the wood used for cooking.

Meeting with Sansale Farmer Association (Association des Producteurs d'Anacardia de Sansale) at the village of Sansale. The overall President is Mr Abdul Camara and the association is made up of a number of sub-groups from sous-prefectures. The number of members in each sub-group is given in Table A1.3.

Table A1.3. Number of members in the various sub-groups of the Sansale cashew association.

Sous prefecture	No. of members
Sansale centre	98
Mera	33
Fif	74
Santia	16
Fetelenon	6
Singbany	19
Kofkoi	22
Gbaklonto	36
Yanany	12
Darousalem	10
Hamolalaye	38
Djarga	36
TOTAL	**400**

The association had been formalised and the annual contribution was GNF 1,000, which seemed to be fairly standard. The problems facing cashew farmers were given as follows:-

- Lack of inputs (insecticide, fertiliser)
- Animals and insect pests
- Lack of credit to hire labour to clear bush and weed
- Roads
- Lack of storage facilities to accumulate nuts.

Price of cashew in 2000 was GFN 700/kg from buyer from Boke and CFA 350 from a Guinea Bissau buyer. Transactions were for cash. Here traders pay tax at the border to Bissau. The association was pleased with SPCIA's efforts in the area.

Cross border into Guinea Bissau at 2100 hr. Roads in Bissau were much better than in the Sansale prefecture of Guinea.

Guinea Bissau,

Guinea Bissau, Monday, 15 January
Meeting at the Ministry of Agriculture with Luis Mendes (Director General), Mr Julio Malam Injai (Plant Protection) and Mamadu Serra Camara (Economics and Statistics). An outline of the STCP and objectives of the survey were given. Dr Topper presented a copy of the Proceedings of the International Cashew and Coconut Conference (1997) to the Director General. A brief discussion on cashew in G. Bissau followed.

Meeting at **Direccao** de Estudos, Planificacao e Seguimento Politicas e Programas Agrarias to discuss economic aspects of cashew in G. Bissau. Cashew originally was planted for forestry purposes but now it is a thriving commercial industry. In 2000, an estimated 70,000 tons were produced and over the last

few years annual increases of 20 to 25 % have been achieved. Other less important exports are fish, cotton and wood.

Guinea Bissau has limited research facilities and since 1993, has been severely financially constrained. Some people have been trained at Foulaya, Guinea. Since the civil war ended in 1998, stability in the country has been a major problem, but nowadays things have improved somewhat. Certainly the ravages of the war were apparent in the capital, Bissau.

There was one large cashew processing factory of Italian origin (probably manufactured by Ultramare) which has never functioned. There was a small amount of hand processing for the local market and Portugal, but the objective is to process more. There have been a number of projects to develop hand processing but it was difficult to get information on exactly how much was being processed by hand. FOB export price had ranged from $700 to $1,200/ton and all nuts were exported to India. At the 2001 World Cashew Congress (Kochin, India, 23rd to 25th February), it was learned that raw nuts from G. Bissau command a slightly higher price on the world market because of their high percentage kernel ratio and this is in spite of their generally small nut size. (NB Generally, the smaller the nut, the higher the percentage kernel ratio).

Farmer knowledge on planting technique, spacing, etc was very limited. USAID wanted to import cashew from Brazil but this was refused on quarantine grounds. Ministry officials thought that the company Agri-Bissau might have imported seed from Brazil illegally, but on visiting their plantation, this proved not to be the case.

An export tax of 13% had been imposed by the Government and it was proposed that 5% of the export tax should be allocated to agricultural research and extension, but this had not been agreed by the Ministry of Finance.

Rice production is declining, due partly at least to increased cashew planting, and as a result rice imports have increased. Implementing an appropriate level of diversification of risk is important for long-term stability. Putting a high proportion of farmer resources into increasing cashew production at the expense of food security is acceptable, providing cashew prices remain attractive and the income generated is more than enough to buy food for the family. Serious problems can arise if cashew prices become unattractive, or yields decline drastically. It is therefore important to get the right balance between food security and cash crops.

Even when cashew trees were overcrowded and as a consequence yields were declining, farmers were reluctant to cut down trees to open up the tree-stand, which should improve yield. However if they were given credit, they would thin their trees on the assumption that the credit would help pay for the extra labour required for weed control, which is necessary to prevent destruction by fire.

To Plant Protection Department for discussion on pests and diseases.

The following list of pests were, according to the Plant Protection department, the most important ones damaging cashew in Guinea Bissau.

Analeptus trifasciata (Coleoptera, Cerambecidae)
Selenothrips spps.(Thysanoptera, Thripidae)
Oligonyohus coffea (Acarina, Tetraniphidae)
Coptofermes intermedius (Isoptera, Phinotermidae)
Emoroetis spp (Lepidoptera,Liparidae)

The following diseases were the most important on cashew according to the Plant Protection department:-

Anthracnose (*Colletotrichum gloeosporoides*)
Powdery mildew (*Oidium anacardii*)

Pestalotiose (*Pestalotia conglomerata*)
Rust coloured algae (*Cephaleuros virescens*)

Apparently anthracnose was found 6 years ago and is becoming increasingly important. There was much anthracnose on mango; cashew material from Mozambique was more susceptible than local material according to Plant Protection department personnel.

The Plant Protection department had not published any papers or reports regarding pests and diseases.

In Guinea Bissau, a good number of trees were observed (although limited to a small number of different fields - see below), at about the most critical time in the production cycle, i.e. at the time of flowering /nut set. The incidence of pests and diseases is most critical at this time. The points of interest are that:-

- no powdery mildew was seen at all and in January it should be at its most intense due to prevailing climatic conditions and the availability of suitable host tissue being at maximum levels.
- only tiny amounts of what **might** have been anthracnose were seen, but it should be noted that this would be most prevalent during the rainy season. However, if it was important during the rainy season, there would be at least some carry over into the dry season to attack panicles.
- the most serious insect damage seen, caused by a sucking pest, most probably *Helopeltis* was not even on the official list of pest species and in the field, this damage was attributed to anthracnose by a senior plant protection person *[1].
- Obviously more work needs to be done in this very important area

*[1] – *Helopeltis* is mentioned in an annex (p193) of Camara and Vayssie (1996) although it is not clear whether this is just general information from other parts of the world.

A project proposal (ref 961862) entitled "Selection and multiplication of superior germplasm resistant to anthracnose disease and improvement of apple by-product technology" was submitted to the European Union in 1996 by Instituto de Investigacao Cientifica Tropical, Lisbon and other institutions to be undertaken in Europe, Guinea Bissau and Guinea. It does not appear to have gone ahead.

Meeting at the National Farmer Association (Associacao Nacional de Jovens Agricultores da Guinea Bissau).

This national association worked with all farmers and had 2,113 members in the whole country, about 90% of whom were cashew farmers. Lack of funding was a major constraint for the operation of the association. It was impossible to obtain from the president, even an approximate estimate of what proportion of the total number of farmers in the country were members of the association. Such a statistic must be of paramount importance when determining the success or impact of the association and when seeking funding. Funding currrently or in the past has come from NGOs, USAID and obviously farmers. USAID funding has finished. A representative from each district sits on a regional level committee and one regional representative sits on the national committee. It costs CFA 1,000 to join and CFA 350 per year.

Problems

- Funding for the association
- Lack of credit for purchasing inputs
- Lack of processing
- Lack of good planting material for all crops
- Shortage of labour for weeding and harvesting
- Lack of training for skills required to run the association at all levels

A workshop produced a calendar of very general cashew activities to be undertaken at different times of the year.

Meeting at INPA (Instituto Nacional de Pesquisa Agraria) for discussion on breeding,

Cashew was introduced by the Portuguese a few hundred years ago. It was initially grown by the Portuguese on plantations and when they left in 1974 the plantations were taken over by the government. The plantations then declined in productivity due to poor maintenance. About 10 years ago, Indian traders began exchanging rice for cashew and eventually for cash. Farmers soon realised the value of cashew and started planting using seed from local sources.

Researchers were not aware of any imported planting material (it was suggested that Agri-Bissau has imported seed from Brazil but this is not the case – see below). An NGO by the name of ADPP from Denmark was selecting local seed for planting, based on nut size.

Guinea Bissau does not have a cashew breeding programme and does not have a trained cashew breeder. Farmers were planting local seed and some were selecting on the basis of nut size. The only distinction with regard to cashew types was between trees producing yellow and red apples (Camara and Vayssie,1996)

To AMAE (Womens association for economic activity) but closed.

Visit cashew fields near to Bissau.

The trees were very overcrowded and *Oecophylla* ants were quite common, more so than in Guinea (Photo. 64, Vol.2). Helopeltis damage was quite apparent, but was incorrectly identified as anthracnose disease by the senior crop protection person present. A small amount of what was possibly anthracnose was seen (Photo. 12, Vol.2). The issue of anthracnose urgently needs to be clarified, different types of insect damage, other diseases and even fire damage were all incorrectly attributed to anthracnose during the survey. Large EU funded and proposed research projects have been preoccupied with breeding for anthracnose resistance and yet during the course of this small survey, anthracnose was found to be of negligible importance. (NB Anthracnose would be more obvious during the wet season).

Guinea Bissau, Tuesday, 16 January

Visit cashew farm at Lotche, 61 km from Bissau.
Many cashew fields were overcrowded; cashew was used as a fence / boundary, in which case it had more room to grow. *Helopeltis* damage was seen frequently and although not of economic importance at the time of this survey, it could be in another year. Anthracnose was seen on mango. This farmer obtained 80 bags of cashew nuts of 50 kg each from a stand of 10 ha. The spacing used was 8m x 8m and the trees were around 5 metres high or medium in size.

Visit Agri Bissau plantation.
The plantation size was 1,200 ha and planting started 6 years ago. Spacing was 10m on a triangular pattern giving 118 trees per ha (some areas had a closer spacing). Average yield from the oldest trees was 7kg which gave 826kg/ha. Agri-Bissau has predicted that the yield will reach 3 tons per ha when mature but this might be optimistic as canopies will start to overlap soon and the yield will stabilise. Last year production was 80 tons and this was sold to a buyer for $650/ton. If Agri-Bissau could export direct, then the price would be around $750/ton but to do this a minimum of 300 tons would be required.

The planting seed was selected from Quihamel, an old plantation, in the years 1994 and 1995, since then they have selected seed from their own plantation. The criteria for selection of seed were nut weight, tree structure and intensive branching. Seeds were germinated in plastic bags and remained in the bag for 4 months, which is probably too long. They were also experimenting with side grafting of precocious trees. At the time of the survey, the trees here were all flowering and some had well developed nuts.

Helopeltis damage was most obvious and was probably depressing yields slightly (Photo. 1, Vol.2). Termites were reported to cause problems at the time of planting. One tree looked as though it had been gnawed by a squirrel or similar; trunk borer was also seen.

Apparently the nuts from this estate have a high percentage oil content (7%) which was considered of value. This was determined in India but if was difficult to understand how this came to light. The salary of the senior technician was CFA 75,000/month.

Cross border from Guinea Bissau back into Guinea via Pitche/Foulamory at 1500 hr.

It is remarkable that at the Guinea Bissau / Guinea border, cashew virtually stops. Before the border in Guinea Bissau, cashew was everywhere, while after the border in Guinea, it was very sparse. This area of Guinea had a big cotton development project and it was this project that maintained the roads.

Visit cashew farm on route to Koumbia in Prefecture Goual.
This cashew farm was badly attacked by *Helopeltis* and the fact that the cashew was intercropped with cotton probably contributed to the intensity of damage on cashew as both of these crops are hosts of this sucking pest.

Visit new cashew farm of Mamadou Baillo Sylla near Koumbia town.
The first batch of seed planted here all died due to planting too deep. On the second attempt, most seedlings were doing OK. However the weeds were rather prolific and in the event of a fire most of the seedling plants would perish. Seed had been obtained locally from the neighbouring farmer.

Visit farm of Mamadou Sarankoule Diallo near Koumbia town.
A small number of trees (<5) originated from seed from Foulaya and now 2 of these trees are providing seed for other farmers. Other trees had been grown from seed material from Boke and some from Guinea Bissau. The trees were planted 5 years ago. Sucking pest damage was generally bad, but there did appear to be differences in susceptibility between some trees. The resultant effect of this damage, on income, is estimated in Table A1.4, using actual yield data as supplied by the farmer.

Table A1.4. Predicted loss of revenue due to insect damage.

Year	Expected yield, Kg	Actual yield, Kg	Percentage loss of expected yield	Loss in revenue, $
1998	2000	2000	0	0
1999	2400	1500	37.5	450
2000	2880	1800	37.5	540

Assumptions re Table A1.4 above:-
1. In 1998 there was no loss of yield due to insect damage, although it is likely that there would have been some.
2. Yield would increase by 20% per year for 1999 and 2000.
3. Price per kg was $0.50

As can be seen from Table A1.4, insect damage was causing substantial economic lost and is likely to be of the same magnitude in 2001.

The owner says he sold 1 ton of cashew in Senegal for CFA 1250/kg (=$1.5) which seems impossibly high.

Meeting with Koumbia Association of Cashew Growers.

President - Mamadou Baillo Sylla
Secretary - Ahmadou Sow (also SPCIA agent)
There were 69 members altogether and between them they presently have a total cashew area of 41 ha. The association was established with a constitution in 2000. To join the association there was a fee of GNF 5000 and the annual fee was still to be decided. The objective of the association was to improve income through increased cashew production.

The problems experienced by the members included:-

- Lack of buyers
- Damage to trees (mainly insect pests)
- Lack of good planting material
- Lack of inputs
- Lack of credit
- Fire
- Lack of training for farmers (eg on how to plant)
- Lack of training on how to run an association

One member took his yield to Senegal and could not find a buyer which is in marked contrast to the previous farmer who said he sold his cashew crop in Senegal for CFA 1250/kg.

Other cash crops grown by the farmers included mango, cotton, groundnuts, rice and vegetables.

Some farmers have the misconception that they will be given money when they join and are therefore waiting for this to happen prior to joining!

Guinea, Wednesday, 17 January.
On the drive from Gaoual to Dabola very little cashew was seen. We passed through large areas of land which had been burnt by bush fires, some of it to improve grazing for cattle and in some areas the trees were being cleared either for charcoal or farm land (see Photos. 24, 25 and 26, Vol.2). Much of this land would be suitable for cashew and not only would it provide cash income but could play a crucial role in preserving the environment by removing the need for annual bush fires and the devastation that follows.

Visit cashew farm of Mr Mamadou Diakhabiy at Sintouridjaga (Gaoual Prefecture).
This was one of the very few cashew farms seen between Gaoual and Dabola. The cashew, some already 7 years old, was growing very well with many trees already producing nuts. The main production contraints at the time were sucking pest damage, thrips and leaf roller, although none were particularly significant.

The farmer sold the yield in Guinea Bissau by taking it there himself on passing trucks! There was no association in this area due to the very limited number of cashew farmers.

Guinea, Thursday, 18 January.

Briefing meeting with the Director of Agriculture (both outgoing and incoming), Dabola.

Visit cashew farm of Mr Mamadou Sherif in Sous-prefecture Konendou.
Cashew was planted using local seed 4 years ago, at a spacing of 10m x 10m. The trees were growing and flowering well. The main biological constraints were sucking pest damage and a leaf disease similar to that shown in Photos. 16, 17 and 18 (Vol.2), the identity of the causal agent is not clear at the moment, see Section 6.2 of the main report. Termites had killed one tree. Labour was another constraint as there were only 2 family members for working the cashew farm. Fire was also a big problem; bush

fires were everywhere so if the cashew area is not kept clear of weeds, then it is almost certain that fire damage will ensue and weeding is very labour intensive. Cattle also damaged young trees.

The lack of availability of inputs was a problem for this farmer as he had money to buy them if necessary.

Other cash crops included mango and cotton.

Visited the farm of Mr Kade Salion Habe (President of Banko Cashew Association), he had 30 ha of cashew, 15 ha of mango, 10 ha of rice, 40 ha he could not work and 20 cattle. Land was not a constraint but labour or the cost of hiring, was.

The main cashew problems were:-

- Fire (to renew the grass for cattle and remove weeds for cultivation)
- Cattle damage to young trees
- Insect problems
- Lack of credit (credit facilities exist only for cereals)
- No government or SPCIA extension people for tree crops
- Lack of seed for planting.

The National Chambre de Agriculture organised and paid for 5 farmers to go to Mandiana (see later) in 1999 to learn about cashew from other farmers. There are a total of 3,000 extension agents in the whole of Guinea for all crops.

Mangoes were the most important cash crop but the mango processing factory in Kankan closed in the 1980's reducing demand, however, production kept increasing and all trees produce at the same time (no later varieties) hence it is very difficult to sell mangoes now. This is one of the reasons why many farmers are planting cashew. Cashew was not grown in this region previously, so there are no production figures.

The Banko Cashew Association started in 1997 for tree crops, but in 2000 changed to just cashew. Originally there were 35 members, but this has increased to 210. Fees were GNF 5,000 to join and GNF 1,000 per year.

Visit new 40 ha cashew farm of 7 farmers in Hirako district (Banko sous-prefecture).
Seven farmers had co-operated to plant a 40 ha continuous block of cashew in August 2000. The seeds were obtained from Cote d'Ivoire, but of no special provenance. They used their own money and labour to do the work. Approximately 60 g of urea and/or NPK was incorporated in the hole and 2 seeds were planted directly. The main problems so far were squirrels and birds taking the germinating seeds.

A government environmental reforestation project at Tankoni, 5 km west of Dabola was visited. The objective was to reduce fire damage and soil erosion. Both teak and cashew have been planted over 10 ha. The local Department of Agriculture wants to do more, but funds were limited.

Cashew has a very valuable role to play in fire reduction because it yields in the dry season and therefore it is important to prevent fires at this time.

Briefing meeting with the Prefect of Dabola.

Guinea, Friday, 19 January
Meeting with Dabola Cashew Planters Association

The President was Mr. Filifing Dansoko and Mr Kerfalla Mara was responsible for Information and Documentation. There were 138 members of which 58 were women. The Association's objective was to have 100 ha of cashew planted by 2001 (they had 12 ha already planted). Cashew is a new crop in this area.

Problems:-

- Cattle damage to young plants
- Lack of inputs
- Lack of good germplasm for planting
- Lack of credit
- Training for farmers
- Training for association

Meeting with Group 1 of Dabola Cashew Planters Association at the farm of Mr Moustapha Keria (President of Group 1) which was 5 km east of Dabola.

Seed for this plot was provided by the Extension Service for evaluation purposes, however, nobody, at least in Dabola, knows where the seed came from! Without this information, any evaluation can only be of limited value. Seeds were germinated in plastic bags prior to transplanting into the field at a spacing of 10m x 10m, in 1999. The plants are growing well. The farmer will intercrop with groundnuts in the coming rainy season.

The situation here was typical of the germplasm problems in general – as far as farmers (and research and extension) were concerned, planted seeds were either:-

- Of unknown origin
- Purchased locally from another farmer
- Obtained from another part of Guinea, eg Boke or Mandiana (perhaps selected on nut size)
- Obtained from Guinea Bissau or Cote d'Ivoire for no particular reason other than production in these two countries is more substantial than Guinea.

Meeting with Group 2, 7 km east of Dabola at the farm of Mr Fofana, who was intercropping cassava with his newly planted cashew. The whole cashew plot was bounded by a substantial wooden fence to keep cattle out. This was an exceptional meeting because it was the first time that we had met any women at any meeting or farm visit (Photo. 46, Vol.2). Consequently some time was spent discussing problems specific to women farmers. Their main concern was to provide a future for their children and their main constraint was time due to all their other responsibilities of housework, food preparation and childcare.

Visit Centre de Recherche Agronomique de Bordo (IRAG), Kankan.
Briefing meeting with Mr Moustapha Donzo (Directeur), Dr Moridjan Sangare (Coordinateur scientifique) and Mr Sidiki Keita (Chef programme mangue).

Farmers were coming to the research station requesting information on cashew and the station has provided seed to some farmers. There was a germplasm screening trial with many "varieties", see below. One of the main problems for the station was protecting trials from cattle.

The prevailing price for cashew in 2000 was between GNF 500 and 600, which was much lower than in Boke. The reasons were high transport costs either to Conakry (700km) or to Abidjan in Cote d'Ivoire and the GNF / CFA exhange rate. Both Guinean and Ivoirian buyers operated in this area. There were no price differentials for quality or size of nut. There were no production statistics for the region. At the station there were two scientists and 1 technician working on tree crops, including cashew.

Funding for research in general, came from FAC, IDA and the government.

Commercialisation of mango suffered a big blow when the processing factory closed in the 1980's. It is interesting how important this closure still is in the minds of farmers, after all these years.

The germplasm collection consisted of seed from some of the original Foulaya collection and seed from a few selected trees in the region and was planted in both 1998 and 1999. There were no replicates and the researchers did not know how many trees were surviving (although this appeared to be low). Researchers mistakenly confused insect sucking pest damage with anthracnose disease.

Observations on old cashew trees (approx. 7m high) near the research station revealed only minor sucking pest damage, otherwise the trees were healthy and flowering well.

Guinea, Saturday, 20 January
Visited the Foundation for Investment in Agricultural Commercialisation (FICA), but closed.

Visited farm of Mr. El Hadj Bemba Toure (also President of the Chambre de Agriculture), near Kankan. He farms a large area, a total of 76 ha and he owns a tractor.

He had a total of 9 ha of cashew, 6 ha of which were old and 3 ha planted 4 years ago. The 4 year old block of cashew yielded 245 kg last year - the seed was provided by research and originated from Foulaya although there was no indication of which particular trees they came from in the collection at Foulaya. Mango trees were mixed in with the cashew and groundnuts or fonio were intercropped between the trees. Research provided instructions for planting. The cashew looked healthy, flowering was profuse and some trees were setting nuts with either red or yellow apples. There was quite widespread disease on leaves (Photos. 16, 17, 18, Vol.2) although this was probably not affecting yields (the identity of the causal agent is not clear at the moment, see Section 6.2 of the main report). Also, there was minor sucking pest damage and minor leaf roller damage. *Oecophylla* nests were present on one small tree, which is unusual.

Seed for the older cashew block came from Guinea Bissau and Cote d'Ivoire and here there was more *Helopeltis* damage and drying of flowers without setting nuts.

The farmer was trying to change the variety of mango by top-working trees, unfortunately virtually all the grafts were unsuccessful. Altogether he had 37 ha of mango.

Visited farm of Mr. El Hadj Anabumane near Kankan. The total area was 30 ha, 15 of which was cashew and 15 for mango. Cashew was planted on this farm 30 years ago for fence / boundary purposes, the seed for this came from Cote d'Ivoire. Seed from this old cashew was used for planting 15 ha in 1998 and 1999. These new plants were suffering from a high proportion of dried panicles (Photo. 20, Vol.2), pale leaves and leaf disease (as Photos. 16, 17, 18, Vol.2). Sucking pest damage was minor. Larger trees on the border were developing better (one tree had exceptionally large nuts) and a few of the recently planted trees were performing better in this area. Part of the problem could be due to the high winds experienced here.

Fire destroyed 800 seedling cashew plants (5m x 5m) in the ground in early January 2001.

Last year the farmer received GNF 600/kg for his cashew and also received a total of GNF 113,000 for citrus from 155 trees in the local market.

General information obtained from Mr. El Hadj Anabumane and others:-
There are 3 cashew associations in Kankan prefecture, (1) Banko (Kankan), (2) Missamana and (3) Kankan. The later has 28 big cashew growers and approx. 400 members just starting with cashew. The joining fee is GNF 2,000 and the annual fee, GNF 500.

The main problems are:-

- Fire
- Insect damage
- Lack of good planting material
- Cost of labour (see below)
- No support or training for association

Problems specific to smaller farmers:-

- Lack of credit
- Only family labour with which to expand cashew area.
- Supply of inputs

A representative of the farmer association is a member of the Research Committee at Bordo.

Labour costs appeared quite high compared with other parts of the country

Table A1.5. General labour costs for different parts of the country.

Region	Cost per day in GNF
Kankan	GNF 3,000 + food
Kankan	GNF 4,000, no food
Kindia	GNF 2,000, no food
Dabola	GNF 1,500, no food

The main buyers in Kankan are :-

El Hadj Kabou Sangari (he has a large store to consolidate nuts)
Koya Karamoko Toure
Moumini Kaba from Karifamoriya (just outside Kankan.

All buyers sell in Cote d'Ivoire

In 2000, in the whole of Guinea, a total of 15 extension agents were trained as tree crop specialists.

Guinea, Sunday, 21 January
Depart Kankan for Mandiana and Cote d'Ivoire.

After leaving Kankan there was very little cashew but the incidence started to increase towards Mandiana and on to the border with Cote d'Ivoire.

New cashew farm visited in Moussadu district (Prefecture Mandiana). This was planted last year at a spacing of only 3m x 3m and was intercropped with cotton, which is a host of the potentially damaging *Helopeltis*.

Visit cashew farm of Mr Abuba Diakite in Moussadu district. This farm was planted 4 years ago with seed from Cote d'Ivoire and is now intercropped with maize. The trees were closely spaced but not affecting the yield at the moment. He planted at a high density to keep weeds down and because he doesn't know any different. Sucking pest damage was low to moderate.

Mr Abuba Diakite was a member of the Moussadu Cashew Farmer Association (President – Mr Mousa Sidibe) with 40 to 50 members. The bigger members generally had around 6 ha of cashew, the moderate ones about 3 ha and the smaller farmers about 1 ha.

Problems cited included:-

- Trunk borer
- Fire
- Lack of germplasm
- Lack of credit
- No extension – first time he has seen anybody about cashew.

Visited cashew farm of Mr Sidiki Diallo in Melila district (Prefecture Mandiana).
This cashew was intercropped with cotton; nut size was variable but on the small to medium size. Fire had damaged some of his trees, due to being unable to weed properly (limited family labour), leaf disease (similar to Photos. 16, 17, 18, Vol.2) was present, as were a high percentage of aborted black nuts.

Visited farm of Mr Sidiki Diakite in Maletoumanina district (Sous Prefecture Saladou).
Here the trees were quite dense and in places definitely overcrowded which was negatively affecting the yield. There was a big variation in nut size, but one tree had very good sized nuts and was giving a high yield and it would be worth evaluating clones from this tree. Apple colour varied from tree to tree – red, yellow and intermediate.

Discussions with Mr Harouna Diallo, a cashew buyer
He was financed by an Indian buyer in Cote d'Ivoire. Last year he bought 270 tons and took it to Cote d'Ivoire. He started this business 14 years ago. He only buys medium to large nuts, but does not know what the farmers do with the small nuts. He paid GNF 825 to farmers which was better than in Kankan. He received CFA 550 /kg and paid for transport – he also provided seed from Cote d'Ivoire free to farmers. Last season he distributed 100kg of seed for planting, however he does not perform any extension activities. He has 30 ha of cashew.

There was no farmer association here.

Cross border from Guinea to Cote d'Ivoire

On to Odienne in Cote d'Ivoire. Trees in this area were medium in size, like a substantial dwarf – a good size.

Cote d'Ivoire, Monday, 22 January
Meeting at Agence Nationale d'appui au Developpement Rural (ANADER) - Odienne. ANADER is the organisation responsible for development of all crops and livestock.

Originally cashew was used for reforestation purposes and planted at densities of 2 to 3 metres. Between 1960 and 1969 more than 8,000ha were planted by villages and >2,000 ha by SODEFOR (a forestry society). In 1969 BORIE started to purchase nuts but soon stopped due to commercial problems. In 1972, SOVANORD society started commercialisation of cashew and in 1974 AICI (a large manufacturer) started processing nuts (2,500 tons) although it is not clear by what method. In addition, in 1974, a big cashew campaign began.

Since 1995 ANADER has been selecting seed from good trees on the basis of colour of apple, yield, tree structure and size of nut. People complained that nobody could tell the different varieties a part (this is not surprising since there aren't any different varieties). The issue of planting material was very confused in people's minds, and nothing is being evaluated on farm and very little on station – see later.

There was much enthusiasm for cashew and it was thought to be the "cocoa/coffee" of the north by ANADER and farmers themselves. There were cotton and rice farmer associations in Odienne and these are just starting to incorporate cashew.

Visited SODIRO cashew and rice milling factory, Odienne.
Processing started in May 1998. All the machinery was bought from India and one Indian technician spent one year at SODIRO training people. The nuts were steam cooked and the CNSL was extracted by crushing and then stored in barrels. The shells were used to fire the steam boiler. They had to modify the drying ovens from India as the kernels were scorching at the top while not drying at the bottom. This was remedied by adding a fan to circulate the air. There were 150 hand-shelling machines and normally 2 women operated one machine (Photo. 49, Vol.2). The women were paid CFA 250 /kg of kernel. A metal knife was used for peeling and the finished kernels were vacuum packed in nitrogen for export. They also produced a smaller packet of ready to eat cashew for the local market (demand apparently was not high). The factory was well organised and maintained and the environment for workers was very good.

After shelling they obtained 27 to 29% of kernel. TableA1.6 gives the production statistics for the last 700 tons of processed raw nuts.

Table A1.6. Processing statistics, SODIRO cashew factory, Odienne.

KERNEL CATEGORY	% ACHIEVED
W180	0.03
W120	0.06
W240	1.83
W320	4.87
W450	0.50
ST1	**7.29**
SW	2.49
SSW	
DW	0.15
ST2	**2.64**
BUTT	1.56
SPLIT	1.72
LWP	2.99
SWP	0.76
ST3	**7.03**
SB	0.38
SP	1.52
DP	
BB	0.30
ST4	**2.20**
T EXP	**19.15**

The smaller grades of W320 and W450 contributed 74% of the total whole kernels, which suggests that kernel size is generally quite small in Cote d'Ivoire.

The price paid for nuts last year averaged between CFA 390 and 400/kg. According to the manager, there was a high proportion of rejects as the farmers do not know how to dry and store the nuts after harvesting.

In 2000 SODIRO bought 1,400 tons of cashewnuts and by the time of the present survey, they had only processed 700 tons, in spite of the fact that the new buying season starts soon. The factory had a capacity of 2,500 to 3,000 tons per year. At the moment it is running at less than one third of capacity and most of the machines (probably 80%) are idle (Photo. 49, Vol.2). The reason for this is that they have not managed to sell the processed kernels since starting in 1998 and have about 4,000 cartons (each 22.68kg) in Abidjan. The factory employs 800 people of which 700 are women. Supply of labour is not a problem.

It was not possible to meet the company's managers in Abidjan to obtain more information on this potentially very serious problem, but it should be looked at in more detail.

In addition, SODIRO owned a 120 ha cashew plantation.

At the site there was also a 3,000 ton rice milling factory, which due to a drop in production stopped working in 1999. Rice production increased from 4,000 tons in 1989 to 6,000 tons in 1996 as a result of a rice and soybean development project. As production costs increased, farmers wanted a higher price but SODIRO could not process the rice at that price and remain competitive with imported rice. As a result the farmers stopped producing rice, and the factory closed.

Visited cashew farm of Mr Mouctar Toure in the district of "Odienne Centre".
This farmer had cashew that was more than 25 years old. It had been planted at a very high density for forestry purposes and some further trees planted 4 years ago. His main problem was fire as quite a few trees were badly damaged. Sucking pest damage and the unconfirmed leaf disease (Section 6.2 of the main report) were only minor. Like most farms, nut size was variable.

Cote d'Ivoire, Tuesday, 23 January
Visited cashew farm of Mr Kone Koulouba in Koro Ouleu village.
He has 4 ha that was planted 30 years ago (1970) using seed from Korghogo for production purposes (not forestry) and in 1983 he began to sell the nuts at a price of CFA 100/kg. This block was originally planted at a close spacing and is now very overcrowded. In 1990, production from this block was 3 tons and the price of nuts, CFA 250/kg, now the yield is 3.5 tons. He sells to buyers from Korghogo.

In 1992, the farmer started to plant another 4 ha with assistance from ANADER regarding planting technique, etc. The seed for this block was <u>all</u> taken from one supposedly superior mother tree (Photo. 35, Vol.2) and as is often the case, this selected tree was growing under ideal environmental conditions, ie:–

- isolated from other trees hence canopy well developed to give good yield,
- open aspect
- good access to sunlight
- good access to soil nutrients and water
- little competition

Whether this tree is in fact superior due to its ideal environmental position or whether there is any genetic basis for its above average yield, can only be determined in a properly designed trial comparing it with other good material. This is a typical example of mother tree selection found in many countries.

The main production constraints were insect borers, sucking pest damage mainly in the new cashew block (*Anoplocnemis curvipes* seen), minor fire damage (confused with anthracnose by researchers) and limited labour (he employed migrant Mali workers).

Otherwise the trees were flowering well with plenty of pollinating insects like bees, nuts were setting and there were no disease problems. *Oecophylla* was widespread in the older trees.

Visited SODIRO cashew plantation of 100 ha.
The plantation was planted in 1993 with seed from a farm in Badikaha (near Korghogo). Apparently the owner of the Badikaha farm brought seed back from Brazil. The trees were uniformly planted but the canopies were starting to overlap. This would be a good area to evaluate the yield of a few visually obvious good trees for possible selection and trials.

The individual trees at SODIRO were variable, producing both big and small nuts and red and yellow apples. The plantation was well maintained and a tractor was used to plough between the trees to keep the weeds down. Flowering was good and *Oecophylla* was widespread.

Minor constraints, in addition to overlapping, were thrips, leaf miner and sucking pest damage.

Harvesting was undertaken by nearby farmers and girls from Odienne

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Drive to Seguela through scenes of total devastation due to bush fires.

Cote d'Ivoire, Wednesday, 24 January
Meeting at Agence Nationale d'appui au Developpement Rural (ANADER) - Seguela.

In this area there were specific associations for cashew - see later. Associations have to abide by government rules set out specifically for them.

Seguela was a big cotton growing area and the price for cotton has gone down whilst the cost of inputs had gone up. In 1999, the price of 1st grade cotton was CFA 210/kg and in 2000 it had dropped to CFA 175, for second grade the price was CFA 180 and CFA145/kg respectively for 1999 and 2000.

ANADER was supporting a women's initiative for the commercialisation of maize, groundnuts, cassava and vegetables.

Visited farm of Mr Nanga Yeo in Seguela district (Sous Prefecture Masala).
This farmer had 1 ha of cashew approximately 6 years old planted from seed from unknown sources and another block of 1.5 ha which was 2 years old – these trees were transplanted from the older block.
Constraints encountered included:-

- Boring insects probably of two different species. In one tree 37 adult borers (identified by the British Natural History Museum as *Apate terebrans* Pallas; Coleoptera, family Bostrychidae) were found causing extreme damage and the death of the tree (Photos. 10 A and B and 11, Vol.2). The tree was surrounded by light brown sawdust just like when sawing wood, which is in contrast to other borers where frass and sawdust are mixed giving a dark brown colour (perhaps this is just the difference between adult and larval feeding).
- Fire.
- Sucking pest damage
- Cattle damage to young trees
- Variegated grasshopper found on young trees but damage was not obvious.

The only labour used on the cashew farm were the farmer and two sons. He was not a member of an association.

Visited farm of Mr Bakayoko Abou in Seguela district.
Mr Bakayoko was a small cashew farmer with 0.5ha planted in 1997 from local unselected seed; the trees started producing after 2 years. His main problem was quite severe sucking pest damage, see Photo. 3, Vol.2 for a photograph of an adult *Anoplocnemis curvipes* and Photo 5, Vol.2 for an example of the damage.

Visited farm of Mr Coulibaly Yacouba in Seguela district.
He has 1.25 ha of cashew (planted in 1994 with local seed), 2.5 ha of mango and 2.25 ha of cotton. Price paid for cashew last year was CFA 250/kg but he did not know the yield. For his cotton he obtained CFA 175/kg with a yield of 1 ton/ha and used 6 insecticide applications.

The main constraint was the puncturing of cashew apples, presumably by a sucking pest, followed by a secondary fungal invasion, which causes the apple to go bad and drop prematurely (Photo. 19, Vol.2). There was some leaf miner damage. *Oecophylla* was found on the mango trees.

Visited farm of Mr Traore Vamogognima in Seguela district, Sous-prefecture Masala.
This farm was 3.75 ha in size and was planted over the years 1987, 88 and 89 using seed from Makono – at that time this was the only place with seed. The plot started to yield after 3 years and in 2000 it produced 3 tons from 3.75ha, in spite of the fact that the trees are overcrowded. Because the canopy was contiguous there were no weeds, so he only had to control the weeds around the periphery of the plot. Fire was still a problem (at least around the edges), as were borers; both thrips and sucking pest damage were of minor importance. A further 2 ha were planted in 2000.

With fire being such a problem in cashew orchards (due the presence of weeds) and labour to control the weeds being either in short supply or expensive, it <u>might</u> be more economic to plant cashew at high density. This keeps the weeds down, reduces the risk of fire damage and minimises labour costs, although on the negative side, yields are lower. This might be acceptable if land is plentiful, labour limited **and diseases of little importance** (high density planting often exacerbates disease problems).

It was notable that the trees on <u>**all**</u> farms seen were clear of lower branches and the plots were generally tidy. *Oecopyhlla* was present on cashew trees.

The price paid last year was between CFA 300 and 330/kg and there was no shortage of buyers. As regards selling, the main problem is the variability in price, in 1997, one buyer offered CFA40/kg! Buyers also offer different prices at different villages. The farmer did not get any information regarding international cashew prices from the radio or ANADER. For harvesting he pays girls and women CFA250 to harvest 20 to 25kg of nuts.

Mr Traore Vamogognima was the President of Masala farmers association, which was a very informal association, with no joining fee and no annual fee. The association received commission from the sale of cashew and last year this money was used to buy a balance.

A meeting was held with the representatives of 4 farmer associations / co-operatives, ANADER offices, Seguela.

<u>Bengueman co-operative.</u>

This was a formal association, with a list of 820 members covering 19 villages in the sous-prefecture Sequela; it costs CFA 15,710 to join. It was established on 10th June 2000. The President was Mr Kande Metiaba and the officials will be elected every 3 years.

The crops covered included cotton (500 ha), cashew (175 ha), maize (100 ha), cassava (50 ha) and coffee (75 ha). In 2000, 50 tons of cashew were sold through the association; this was not the total yield from 175 ha.

New cashew was being planted using seed from any source. Last rainy season they obtained some seed from ANADER (who got it from SODIRO or Badikaha – see above).

CEACI co-operative
This was another formal association started on 12th December 1999 with 42 villages, which has now increased to 60. The joining fee was CFA 12,000 and the President was Mr Cisse Soukpaha.

The crops covered included cotton (3,678 tons in 1999/00), cashew (4 tons), maize and groundnuts.

The cashew was sold for CFA 300/kg to a buyer from Abidjan. The prices varied greatly, from CFA150 to 400 per kg (as was the case for all associations). Usually it was lower at the start of the season and gradually increased. Farmers need money at the start of the cashew buying season and often have to accept a low price.

CAWORO co-operative.
This was established on 1st January 2000 with 15 villages, it had 700 members and the joining fee was CFA 20,000. The President was Mr. Diara Souba Souleymane.

The members had 275 ha of coffee, >1000 ha of cocoa, 420 ha of cashew, 100 ha of cotton and rice and maize. The association was desperate for training on how best to run an association.

General problems facing all the associations.

- Insect pests
- Lack of credit for commercialisation
- Availability of inputs
- Farmer training
- Training on how best to run an association
- Training for ANADER (which in turn would benefit the farmers)

Labour was not a problem in this case.

All of the associations were very enthusiastic about cashew and they felt it was the crop which could enrich the north of Cote d'Ivoire.

Cote d'Ivoire, Thursday, 25 January
Meeting at Agence Nationale d'appui au Developpement Rural (ANADER) - Monkono.
This region was a big cotton growing area and was just starting to diversify into cashew. Other crops of importance included mango, citrus and a little coffee. Associations for cotton are starting to incorporate cashew.

We visited what was purported to be the first cashew field in Kogolo village.

This was planted >20 years ago for production purposes, not for forestry. The trees were closely spaced and overcrowded.

Visit to the cashew field of Mr Lagazin Bamba, Kogolo village.

He had 5 ha of cashew intercropped with citrus (>10 years old) and a further 2 ha of pure citrus. Last year he planted another 1 ha of cashew using selected seed from his old trees. Total cashew yield last year was 3 tons, which he sold for CFA 430/kg. He kept these nuts until the end of the season to get the best price.

The citrus / cashew field was too overcrowded and the yield from cashew was being negatively affected. In principle this intercropping arrangement is a good idea and Photo 62 (Vol.2) shows another less crowded field of cashew and citrus. *Oecophylla* was present on both types of tree.

Mr Lagazin Bamba was formerly the main producer of citrus in the area, but now everybody was growing citrus so there was an over supply, and it was difficult to get a good price. The situation was worse now due to Cote d'Ivoire's instability – few buyers were coming from other neighbouring countries to buy.

Visited cashew field of Mr Mendoba.
This field was 4 years old, well spaced and producing nicely. Problems were thrips, sucking pest damage which was quite bad on some trees (Photo. 4, Vol.2) and a few trees not yielding due to drying of flowers.

Visited cashew field of Mr Fakoly Fofana.
He had a 2 ha block of >20 year old cashew and a 3 ha field of 7 years old, both of which were planted with local seed. The total cashew area of 5 ha yielded 3 tons last year, which he sold for between CFA 100 to 430/kg. He sold small amounts of cashew at the beginning of the season at very low prices because he needed the money, but kept the bulk for later in the season when the price was higher. There were no problems selling other than the price fluctuation.

The family were busy separating the nut from the apple of that mornings harvest, unfortunately all the apples were left to rot on the ground (Photo. 52, Vol.2).

He was a member of a cotton association but had stopped growing cotton – the cotton and cashew harvests occur at the same time and since he was getting a better return on cashew, he stopped growing cotton. He also had problems with the cotton association manager, which seems to be a frequently encountered problem for farmers in general. He wanted help to start a cashew association.

Oecophylla was present on old trees.

The main problems were:
- Insects, sucking pests; leaf miner damage.
- Lack of information on cashew techniques, eg planting.
- Lack of germplasm

Fire was reported not to be a problem (although significant fire damage was seen) due to agreements between the farmers in this area.

In this area, there were many big trees, which were yielding profusely, but the nut size was very small and also there were many small black aborted nuts. The cause could be natural abortion due to the yield capacity of the tree being reached or insect damage at a very early stage of the nut's development.

General comments.

Personnel composition of the ANADER office in Monkono

Chef du zone		1
Survey/statistics specialist		1
Association specialist		1
Specialist on professional organisation	2	
Agricultural specialist (incl. tree crops)	2	
Supervisors		2
Field extension agents	22	

The Monkono office serves approximately 200,000 farmer households and this seems to be a typical arrangement for an ANADER office and a typical ratio of extension staff to farmers.

Meeting with LEMISSA farmer co-operative.
President - Mr Silue Kisselnan Mamadou, General Secretary – Mr Bamba Laddi, Treasurer – Mr Toudyou Bomisso.

This co-operative was established on 30th March 2000 according to new laws regulating farmer associations. It had 6,000 members covering 320 villages in the Department. Each village contributed CFA 10,000 and had a sub-committee (President, Secretary, treasurer, etc). One representative from each village sat on the sous-prefecture committee and each sous-prefecture had a representative on the LEMISSA board. This was a very different structure to all previous farmer associations encountered.

The crops included cashew, mango, citrus, and cereals but NOT cotton.

The total cashew area was 9,578 ha, of which 5,768 ha was actually in production.

The village of Kogolo was part of this association but the farmers were NOT aware of its existence! The President said that this was one of their problems.

It was difficult to get a clear picture of what the association actually did for the farmer, but the following seemed to be part of the package:-

- It helps farmers with pest problems by negotiating with companies like Novartis for products.
- It works with ANADER regarding extension (although it does not have any extension agents).

The association does not buy or sell cashew nuts.

Problems were :-

- Lack of training for farmers
- Lack of training for the association
- Lack of vehicle
- Lack of credit for the association to be used for the farmers.

Cote d'Ivoire, Friday, 26 January
Briefing meeting at CNRA (Centre National de Recherche Agronomique) – Korhogo.
The country has been divided up into various ecological zones and the Korhogo centre is responsible for the savannah region, which normally receives between 1,100 and 1,300 mm of rain a year, although it includes the Odienne area, where rainfall can reach 1,500 mm per annum.

There were 4 research programmes:-

1. Tree crops (mango, citrus, cashew and papaya)
2. Agro-systems
3. Sugar cane
4. Maize.

The main agricultural exports of Cote d'Ivoire were Cocoa (1 million tons in 2000), coffee, palm oil, rubber, cotton and sugar cane. For the Korhogo region, the most important agricultural products were cotton, sugar, mango and cashew.

Mango has been the priority with varieties like Kent, Smith, Brooks, Amelie and Valencia.

Cashew was present prior to 1959, but after this date, it was expanded for forestry purposes; the source of seed was unknown. Since 1972 cashew was commercialised and processing started in 1975, when apparently, 2,200 tons were processed. Since 1972, seeds from the cashew forestry areas have been used for planting. Cashew is now a priority for farmers.

In August 2000, a local workshop was held to develop a plan of action for cashew, focusing on pests and diseases, germplasm and processing. Evaluation of the existing germplasm collection (see below) and

the development of grafting were prioritised along with determination of the number of cashew trees within the country.

Presently there is only one full-time cashew research worker, Mr Akadie Jean Baptiste DJAHA and he transferred from papaya to cashew about one year ago. There are other scientists that can be called upon to work on cashew from other programmes, for example, Dr Felix COULIBALY, who is a pathologist for all crops. However, at present there is no specific budget for cashew and funds from the mango budget assist cashew research.

Visited cashew processing factory of CAJOUCIS, Mr Patrick Adlai'de (Directeur) and Mr Bob Kouadio (Production manager).

The Oltremare factory (Italian) was built in 1979 with a capacity of approximately 2000 tons of raw nuts per year. The nuts were washed and graded according to thickness. CNSL was used for roasting the raw nuts and as a source of fuel. The nuts were placed manually into holders (clips) prior to mechanical cutting (Photo. 50, Vol.2). A metal blade was used for peeling, which can result in scarification of the kernel. The kernels were simply vacuum packed in 25 lb packs. Some of the kernels were organic. Apparently some fields have been certified as organic and the produce from these fields was kept separate from the rest.

Unfortunately production statistics as presented in Table A1.6 above, were not available from the factory and had to be obtained from the Head office in Abidjan.

In addition to the mechanised factory, they started with manual processing using Indian machines in 2000. Presently they are processing 1.5 tons per day with this method and hope to reach 2 tons per day in the near future. Two shifts operated. Kernel out-turn was given at between 21 to 22%.

Table A1.7. Amount of kernels processed at CAJOUCIS cashew processing factory.

Year	Total production	Source of kernels
1998/99	1,000 tons	Mechanised
1999/00	1,500 tons	Mechanised
2000/01	2,000 tons	Mechanised + hand
2001/02	2,500 tons	Mechanised + hand

Mealybug was seen on an isolated cashew tree at the factory.

Visit CRNA research station at Lataha.
The CRNA germplasm collection consisted of 36 trees planted in 1984, in one row with a spacing of 4m between trees. The history has it that the seed for these trees originated from one tree in Brazil (Photo. 34, Vol.2). Mr Jean Baptiste Djaha thought that due to the different characteristics of the trees (different apple colour, nut size, yield, etc) that the seeds must have originated from different trees in Brazil (although these differences could have arisen due to out-crossing). However, the visual characteristics (size of nut and tree) would suggest that the trees did originate from either one or more "Brazilian common" trees.

It should be noted that "Brazilian common" trees are very large and with only 4m spacing between the CRNA trees, yield data can not be very accurate, particularly as a potential indicator for further planting.

Only 4 trees produced a yield of > 8kg/tree with a percentage kernel out-turn of >20%. Obviously with wider spacing and a full canopy, many of the trees could yield more.

Seed from some of the original germplasm collection was planted in a new block of 45 trees in 1997 at a spacing of 8m x 6m.

Anthracnose was noted on one tree (Photo. 14, Vol.2), red algae was common especially on the younger trees and variegated grasshoppers were observed nibbling buds.

The station was well maintained with important collections of mango, citrus and papaya. A man-made lake had been constructed for irrigation on-station and for farmer rice production. The laboratories and offices were closed at the time of our visit.

Cote d'Ivoire, Saturday, 27 January

Drive to Abidjan.

ANNEX 2.

OBSERVATIONS AND ACTIVITIES SPECIFIC TO GHANA AND NIGERIA.

4th to 17th February 2001

Survey team members:-

Ghana.

Dr. Clive P. Topper
Dr. A. K. Asante
Dr. Adomako Boamah

Nigeria

Dr. Clive P. Topper
Mr. E. Akin Ayodele
Mr. Patrick O. Adebola

The survey members would like to thank all the very helpful people who assisted the survey in both Ghana and Nigeria.

ANNEX 2

Observations and activities specific to each country visited

Introduction

Activities, observations and information obtained from each country are presented in chronological order. The detailed itinerary given in Section 2 of the main report provides more information on the people met and gives an easier overview of the chronology of activities; this section concentrates more on the observations made and information obtained.

Questionnaires completed prior to the survey taking place, can be found as follows:-

Ghana – Annex 5
Nigeria – Annex 6.

Ghana specific observations and activities

Ghana, Monday, 5 February

Meeting with Professor E. Owusu-Bennoah, Deputy Director-General of the Council for Scientific and Industrial Research (CSIR, Accra).

Prof. E. Owusu-Bennoah outlined the arrangement for existing research committees at the Zonal level, there being 5 for the country. Below the Zonal committees are district level committees, made up of farmers, extension workers, NGOs and 1 research person. These groups are supposed to define farmer's problems and pass them on to researchers, to ensure that research activities are demand driven. The importance of working within the priorities of the NARS was also discussed.

Meeting at Technoserve main office (Accra) with Mr John Addaquay.
The estimated raw nut production was about 5,000 tons for the whole country, but the demand was much higher, with Indian buyers submitting orders for much larger quantities. In 2000, the price of raw cashew nut ranged from CD 1,000 to 4,000 with an average of around CD 2,000 (the exchange rate at the time was in the region of CD 4,000/$).

The main constraints were:
Land ownership problems.
Insect pests.

Technoserve has been involved with cashew since 1993 under the USAID funded promotion of non-traditional export crops.

Technoserve has been instrumental in setting up a fledgling cashew processing industry. In 1996 Techoserve organised a processing workshop for farmer groups with a consultant from Nigeria and a resource person from the Natural Resources Institute (UK). In 1997, a business plan was drawn up for a processing plant with a capacity of 30 tons of raw nuts/annum and the equipment was installed the same year. The owning association paid 20% of the cost up front and Technoserve loaned the rest of the costs for that year. Loans for subsequent years were organised through the normal banking system but guaranteed by Technoserve. In the first year of operation 2 tons of raw nuts were processed. Members bought shares in the company. Processing was by hand using both the Indian and Brazilian hand shellers, although the Brazilian one is preferred. All machines were made in Ghana.

This processing system has been replicated twice more, so there are 3 processing factories based at:-

1. Msawkaw,
2. Kabile,
3. Sampa

The target for 2001 for the 3 units is to process 12 tons of kernels (approx. 48 tons of raw nuts). These kernels go to the "Golden Harvest" company for final roasting, salting and packaging for the local market. The kernels are packaged in 100g bags or 250g jars (see Photo. 48, Vol.2). This

company is owned by the 3 processing associations (45%) and Ms. Esi, who owns Mase Foods. Again Technoserve was instrumental in setting up this arrangement. Further details of Technoserve's activities are given later.

Meeting at ADRA headquarters (Accra) with Mr George Baiden (Country Director) and Mildred Taylor (Programme Manager).
ADRA kindly funded the pre-survey workshop that helped to complete the questionnaire given in Annex 5. ADRA has been involved with cashew for some years now, again funded by USAID. Their role has been mainly to support farmer groups with inputs and information. They have concentrated on the whole agro-forestry system and therefore have introduced intercrops as well. ADRA has 31 nurseries providing cashew seed, grafted mango seedlings and other tree crops as required.

Further details of ADRA's extension work with farmers in the area of Techiman, are given later in the report.

A courtesy call was made at CRIG (Tafo) to brief Reverend Dr. A. A. Ollenu (Deputy Director of CRIG). Dr. Adomako Boamah (breeder) joined the survey team at Tafo.

Ghana, Tuesday, 6 February
Visit to MOFA cashew plantation at Atebubu.
This plantation of more than 40 ha of cashew was started by a German project in 1994 and at the end of the project the government took it over. Local seed was used as planting material and the nuts being produced are generally small, probably in the region of 5 grams. Until last year there were a lack of buyers, so obviously little was spent maintaining the plantation. Last year, (2000), was the first time that they were able to sell the nuts. The yield was not known, but they sold the total for CD 1.8 million, which equals about 900 kg of raw nuts, assuming CD 2000 per kg. Unfortunately fire damaged part of the plantation last year. The trees were exhibiting widespread yellow spots on the leaves (see Photo. 22, Vol.2) thought to be a fungal disease, but to the consultant, this looked more like a nutrient deficiency, possibly nitrogen and/or Zinc – this would need confirmation.

Other problems experienced included thrips, sucking pest damage (both minor) and the drying of a high percentage of panicles. The latter could be due to a number of factors e.g. nutrient deficiency, genetics, lack of pollinators, weather conditions.

Oecophylla was present on a few trees.

Meeting at ADRA offices in Techiman to discuss their cashew programme.
ADRA became involved with cashew in 1996, working with farmer groups in 3 districts. Details of these groups and the areas planted, are given in Table A2.1. The groups were formed as follows:-

- The purpose of the project was explained to the different communities (i.e. improved cashew production).
- They were then asked to form groups of 20 farmers with the criteria that each farmer was (1) resident in the village, (2) owned land, (3) prepared to work in a group, (4) not on any payroll, (5) willing to pay back any loans, (6) willing to work with ADRA and (7) that approx. one third were women. The village chief was specifically not included.

Table A2.1. Group and planting statistics for the ADRA cashew programme in Techiman.

District >>	Techiman	Kintampo	Nkoranza	Total
No. of groups	25	25	25	75
No. of participants	500	500	500	1,500
No. of male participants	290	299	281	870
No. of female participants	210	201	219	630
No. of acres cultivated	1,513	1,566	1,506	4,585
No of cashew seeds planted	90,780	93,360	90,360	264,510
No. of seedlings surviving	87,149	88,692	85,842	261,683
Percentage germination	96%	95%	95%	95%

A total of 20 villages were selected, so some villages might have 4 or 5 groups. These groups were supported with various inputs:-

- In the first year farmers were given cash to assist with land preparation.
- Seed, both cashew and food crops
- Fertiliser
- Knapsack sprayer and insecticide
- Food

In spite of the prevalence of serious insect pest problems, the issuing of sprayers and insecticide has stopped, due to USAID's stringent rules on pesticide use. The food was given free and the remaining inputs were taken as a loan to be paid back from the proceeds from the sale of food crops. In the first year, loan recovery was 100%; this has since dropped to 80%, but this is still quite an impressive recovery rate, given the circumstances. One of the factors behind the lower recovery rate is that some farmers think that the project is going to finish.

Originally the cashew seed was obtained from selected mother trees in Wenchi district and subsequently from MOFA, again from selected local mother trees.

The farmers appeared very enthusiastic about the potential of cashew and the project. Last year the raw nuts were sold for between CD 500 and 3,000 (exchange rate at the time was around CD 4,500 to the $). There were no problems selling.

Some groups were trying to register as co-operatives, but the farmers do not like the word "co-operative" as it has bad connotations from the past with inefficient government co-ops; they prefer the word "association". There are difficulties regarding registration, i.e. various rules and regulations have to be satisfied, but ADRA has been helping with the problem. They have run a workshop giving advice on how to run farmer associations.

ADRA only have 3 field staff. They do not have any nurseries here, but plan to move into grafting in the future. Field visits to ADRA farmer groups are covered later in this Annex.

Ghana, Wednesday, 7 February.
Visit MIM Agro & Industrial Projects Ltd (Mr Herman Bani, Managing Director – Technical and Production).
This plantation was located in the "semi forest savannah" agro-ecological zone where there are only 3 to 4 months dry season, so they were concerned that it may not be the most appropriate zone for cashew. The company also had an extensive oil palm plantation, but yields were not economic, due to insufficient rain for oil palm.

The cashew plantation covered 500 acres, planted over the last 6 years. Seed originated from India and an old plantation at Sampa in Ghana. Tree spacing was 7m x 7m triangle. Now they are selecting mother trees from their own plantation based on yield and nut size. One mother tree was seen, and this was isolated on the edge of a block, which can give elevated yields due to reduced competition. When discussing the problems associated with mother tree selection, it was pointed out by the manager that a few of the selections were within blocks. The best tree was yielding 17 kg.

Thrips and other sucking pests were a major problem, they have to spray 3 or 4 times every year to control the thrips, as without this, the trees would be completely defoliated. One of the insecticides used was Dursban and insecticide application stopped before flowering. Tractor drawn sprayers were used, since back-pack motorised blowers could not do the job. The trees from Indian seed were apparently more susceptible to damage from thrips than the local trees, which was a useful observation.

The plantation was very well maintained, the trees were regularly pruned to prevent canopy overlap, to allow the passage of the tractor and spray machine. The grass was slashed by tractor drawn slashing machines. They make their own trailers for transporting people around the plantation.

The plantation produced 45 tons in both 1999 and 2000, but this year they are expecting 120 to 150 tons of raw nuts. In 2001, harvesting started in January, but in 2000, harvesting did not commence until March, the reason for this was not known. In the past they sold nuts through Cashpro but in future they want to sell direct or export to maximise the price.

The unique aspect of this plantation was that they make a very professional cashew brandy (see Photos. 56, 57, 58 and 59, Vol.2). The brandy was an after-thought, but to date they have produced 42,000 litres (60,000 bottles of 0.7 litres) mainly for the local market; they are now trying the European market. The brandy was in the duty free shop at Accra airport and looked as professionally finished as the more well known brandy and whiskey brands. The plantation sells one bottle for CD 15,000 but this is a promotional price, it will increase to CD 25,000 some time in the future.

From the daily field collection of nuts/apples, only about 35% of the apples are selected for brandy processing. If a delay of only 12 hours occurs, then the percentage of apples wasted goes up significantly. The apples are not picked, they are allowed to completely ripen on the tree, in order to maximise the sugar content. Some of the brand making equipment was purchased in South Africa and the remainder manufactured locally.

Meeting with Mr Thomas Bonney of Techoserve at Techiman.
Technoserve has been working on the promotion of non-traditional export crops and initially focused on cola nuts, shea nuts, cashew and pineapple. Cola and shea nuts were phased out, due to unattractive world market prices.

85% of Ghana's cashew is produced here in Brong-Ahafo region, hence much of Technoserve's work is done here. They started with cashew in 1993 and at this time marketing was a problem as there was only one exporter. Technoserve made loans to farmer groups to help bulk their nuts and introduced an auctioning system for the bulked nuts, thereby interesting more buyers in cashew purchasing. This action also helped in obtaining a better price for the producers.

However the prevailing bank interest rates have eroded profitability of this system. Therefore buyers/exporters were asked to pre-finance farmer groups to bulk nuts on a commission basis. Both these approaches have now developed and they were instrumental in improving farm-gate prices and increasing enthusiasm for cashew. From the initial level of 250 tons of raw nuts produced in 1993, production is now in the region of 5,000 tons and the price has increased from CD150 to CD 3,000 over the same time period. The estimated area under cashew is now 30,000 acres.

Other Technoserve activities:-

- Initiated the selection of mother trees in 1994 (but found that trees produced from the seed were very variable).
- Organised a trip to Nigeria for representatives of 5 societies to see cashew activities there; these people then became extension agents to help other farmers.
- Evaluated 5 insecticides for the control of sucking insect pests at 5 locations over 1 season (1995). Should have continued for 2 more years but funds ran out and research had no mandate for cashew at the time. Pest attack takes a heavy toll on cashew.
- In 1998, organised a cashew processing workshop with a consultant from Nigeria and a resource person from the Natural Resources Institute (UK).
- Farmer training but this was taken over by the NGO "Human Resources Development Assistance"; their contract was not renewed so this activity stopped.
- Imported Brazilian common seed from Nigeria (100kg, 2 tons, 4 tons, 16 tons and 10 tons in 95, 96, 97, 98 and 99 respectively; more is being imported this year.) It all comes from the same farm in Eastern Nigeria (visited later in the survey).
- Assisted in developing cashew processing – see earlier in this Annex.

Buyers do not need a licence to operate in Ghana, in fact there is very little government intervention in cashew.

Meeting with Mesidan Cashew Farmers Association (part of ADRA's extension work).
In 1996, when ADRA started their cashew-farmer groups programme, cashew was not common in this area; a few people had cashew and children were eating the fruits but the nuts were discarded and not sold.

This area has both forest and savannah agro-ecological zones, so in the forest they grow cocoa and in the savannah, they grow cashew and other annual crops

In 1996, this farmer group accepted the idea of a new crop as a replacement for cocoa. They received assistance from ADRA in the form of various inputs on a loan basis and free food, as explained above. All the cashew seed material came from ADRA.

The main problems facing this cashew group were:-

- Control of weeds due to the recommended inter-tree spacing
- Bush fires as a result of weeds

Pests and diseases were only minor (which is in contrast to the next farmer group). Yields were in the region of 30 kg from 2 acres (36 kg/ha), which is low, even for trees of 4 or 5 years old.

The group did not have any problems selling the raw nuts now and last year they sold for between CD 1,000 and CD 1,500 to Cashpro. The farmers sell individually.

The group is now a registered co-operative with a President, secretary and treasurer and officials attended the ADRA workshop for association officials.

Visit cashew field 1 km from the village of Mesidan.
This cashew farm was severely damaged by *Anoplocnemis curvipes*, with a high percentage of dead shoots, which were seriously affecting the yield.

Meeting with Koase Cashew Farmers Association.
This group has been working with ADRA in a similar manner to the Mesidan group. They were in the process of registering as a co-operative and they had also benefited from attending ADRA's workshop on running an association. There was no cocoa grown here, but they obtained income from selling food crops (intercropped between the cashew) in the local market.

Their main problems were:-

- Weeds and subsequent fires
- Insect pests – sucking pests and caterpillars

The farmers wanted to spray, but ADRA was unable to supply the insecticide because of USAID's (ADRA's funding agency) regulations regarding pesticide use.

This group was formed in 1997 and 2001 will be the first year of harvesting from cashew. They will sell to Cashpro or another buyer if they offer a higher price. The group hopes to bulk their raw nuts.

Visit 1st field of Mr Boachie Ameyaw (member of Koase Cashew Farmers Association).
Trees were widely spaced and the grass was approx. 70 cm tall: should a fire start here the damage to cashew would be considerable. A few trees were already dead due to fire in previous years.

Damage due to *Anoplocnemis curvipes* was severe and was significantly affecting yield and tree growth (Photo. 6, Vol.2). According to farmers the insect was most active early in the morning.

Visit field of Mr Kwaku Kra (member of Koase Cashew Farmers Association).
This farmer had 2 acres of trees 2.5 years old that originated from Brazilian dwarf seed material obtained from ADRA. The farmer had intercropped with egg-plant. A few trees had been killed by fire.

Anoplocnemis curvipes damage was severe on some trees but generally less severe than on the first field seen. There appeared to be more *Helopeltis* type damage. Also present were angular leaf spot disease and rust coloured algae, but both of minor importance.

Visit 2nd field of Mr Boachie Ameyaw.
The trees here were 4 years old and bee keeping was practised in the field. All trees were damaged by *Anoplocnemis curvipes*, but on some trees, nearly every shoot had been killed and was now shooting again. Three of these damaging insects were seen, 2 were mating (late afternoon).

Ghana, Thursday, 8 February.
Meeting at Savannah Agricultural Research Institute (SARI) in Tamale.
This agro-ecological zone was termed a moist savannah zone and hence a lot of rice was produced in the region. In the past, tree crops have not been exploited very much, due to the local belief that trees are from God and individuals should not interfere with them – however, nowadays beliefs are changing with regard to this.

There was concern regarding the encroaching desert to the north in Mali, Burkina Faso and Niger and the need to conserve rain-water.

Funding for research essentially stopped about 3 years ago. Salaries were paid but delays were experienced with that. Funding from GTZ, a long term supporter of SARI, stopped in 1998 and now there are a few DFID and American University collaborative projects. NARP funding finished in 1999.

The main problems facing the cashew industry were:-

- Bush fires, especially when plants were young.
- Lack of good germplasm.
- Shoot dieback.
- Drying of flowers.

Farmers intercropped with maize, groundnuts, soybeans and some who could afford it ploughed at the end of the rainy season to reduce weeds and the risk of fire. The cost of ploughing was CD 65,000 /acre.

Nigerian 'jumbo' nuts (Brazilian origin) had been imported for planting and could be bought for CD 20,000/kg, which was too expensive for most farmers. According to researchers, the weight of these nuts ranged from 9.1g to 10.6g, but the kernel out-turn ratio seemed low.

Visit University of Development Studies/SARI germplasm collection, Tamale.
This germplasm collection consisted of trees grown from seed taken from 60 selected local mother trees (Photo. 36, Vol.2). Eight seeds from each of the 60 mother trees were planted in only one replicate in 1997. Table A5.12 in Annex 5 provides some information on the first 30 accessions. Note that the nut weights given are from the original mother tree and not from the progenies planted in this trial; it is apparent that some of the mother trees are producing nuts of very low weight.

The block was reasonably well maintained; it was unfortunate that only 1 replicate was planted and more information needs to be obtained from the original mother trees.

Visited farm of Alhassan Salifu near Cheyohi village.
The area of cashew was 10 acres, planted in 1995. Many of the trees had an unhealthy appearance due to yellow mottled leaves, similar to that found at Atebubu (see above). Drying of flowers was also significant. There were quite a few shea nut trees growing in with the cashew (Photo. 61, Vol.2).

The yield from these trees was low, last year he only harvested 40 kg from 10 acres of 6 year-old trees (<10kg/ha). This question of low yields urgently needs further work. For the last 2 years he has not experienced any problems in selling his crop of cashew nuts.

Mr Salifu had recently planted another 5 acres and plans to plant another 5 acres this year (2001).

Meeting with farmers from Cheyohi village.
The main problems were:-

- Cattle damaging young trees
- Weeds and fire
- Drying of flowers caused by insects/midges
- Sucking insect pests.
- Financial resources lacking to enable ploughing at the end of the rainy season.

Mr Alhassan Tia planted 4 acres in 1995 and harvested 15kg or approx. 9kg/ha, which is still very low. This farmer and Mr Alhassan Salifu were the first to start cashew planting in this district; now >30 people have planted cashew. Seed was bought mainly from ADRA and nursery owners.

Visit farm of Sumani Alhassan, Libga village, Savelugu/Namton district.
This farmer stayed on the farm in order to try and prevent fire. He had made fire breaks but he did not have the resources to weed the whole area. Fires were started for a number of reasons, (1) to enable the hunting of small mammals, (2) accidentally, (3) because of grudges, (4) to increase new grass for cattle and (5) to remove weeds ready for land preparation.

Main problems included:-

- Drying of flowers (Photo. 21, Vol.2)
- Weeds and fire
- Bats in the rainy season – see below.
- Sucking pests.

The older trees flowered a small amount in the rainy season, producing larger nuts than in the dry season. The value of *Oecophylla* was not recognised by farmers or researchers, nests were often removed when pruning. The origin of the planting material was not known.

In 2000, he harvested 320kg from 3 acres of 12 year-old trees (256kg/ha) and 160kg from 8 acres of 7 year old trees (48kg/ha). Yields were low, but according to Dr Yidana, this was one of the better farms. In 2000, the farmer received between CD 1,062/kg and CD 1,188/kg. In 1999 there were no buyers, hence 3 bags were wasted; by contrast in 2000, there were 3 buyers each offering successively higher prices.

Ghana, Friday, 9 February.
Meeting at Plant Genetic Resources Centre, Bunso.
The Centre did not hold much cashew material because it does not grow particularly well here – the rainfall is too high. In 1997, Technoserve presented a few seeds originating from Brazilian clones CCP 09, 06, 109 and 76. There were also a few trees grown from seed from selected mother trees originally from the Volta region.

Visit Pokuase germplasm collection (near Accra).
The material used for planting this trial was seed from local mother trees. The performance of the mother trees was not evaluated, seeds were simply collected from trees around the vicinity. About 50% of the seedlings were dead.

Saturday, 10 February.
Dr. Topper flew from Ghana to Nigeria, was met at the airport by the other team members (Mr. Akin Ayodele and Mr Patrick Adebola) and then the team drove to Ochaja, Kogi State.

Nigeria, Sunday, 11 February.
Visit farm of Mr Yaya Umoru, Ochaja, Kogi State.
He had a 5 acre block of 12 year-old cashew and another 55 acre plot of 11 years old. From the 55 acres he harvested approx. 30 bags of between 90 and 100 kg. This converts to roughly 3000kg from 23 ha or 130kg/ha, which is low. The planting material for these blocks was obtained from the nearby CRIN sub-station, where Mr Umoru was employed. The nuts were mostly small, with a few trees giving larger nuts. 99% of the apples seen were yellow. The tree canopies were overlapping in places. In 2001 he was receiving N 40/kg (about $0.40) and there were no particular problems in selling his harvest of cashew.

He hired 6 people for clearing/weeding and harvesting, but relied mainly on family labour. The children collected the apples and nuts, brought them back to the farm house, detached the nut and the apple was thrown away (see Photo. 53, Vol.2). He grew only cashew and subsistence food crops.

His main cashew constraints were:-

- Labour costs
- *Analeptes*, the cashew girdler

Mr Umoru belonged to the Nigeria Farmers Association but derived no benefits from being a member. The joining fee was N 5,000.

Meeting with employees of the CRIN sub-station at Ochaja.
The station was established in 1967 and in 1971 CRIN was given the mandate for cashew research (other crops included cocoa, kola, tea and coffee).

The first cashew trees were established for forestry/environmental purposes; in the 1950's, the Eastern Nigeria Development Association planted 3 large cashew plantations and the Western Nigeria Development Association planted another 3 plantations. Selections from these plantations have been entered into breeder's trials at the sub-station.

CRIN has distributed 1.5 million seeds from selected trees, for planting by farmers. The present cost of this seed is N50/kg. They also distribute seedlings (CRIN seed raised in poly-bags) for N 5 per seedling but the actual cost is N 16, so these are heavily subsidised. They were only selling a small number due to high transport costs, as a result more than 70,000 seedlings were unsold.

Meeting with farmer groups at Ochaja sub-station (Photo. 47, Vol.2).
The main problems experienced by this group of farmers were:-

- Fire
- Cattle damaging young cashew
- Drying of flowers caused by the harmattan winds – see below
- Insect pests – thrips, borers, sucking pests and girdlers.
- Lack of extension services.

The harmattan (cool, dry winds from the north east) were blamed for the drying of flowers. One farmer gave an example that he normally harvested up to 50 bags (90 to 100kg each) but for the last 2 years when the harmattan has been bad, production had dropped to only 12 bags or a quarter of the expected yield. During the survey, the harmattan was blamed for a number of problems, but the drying of flowers was the most frequently quoted. This problem of flowers drying out with no production needs further research; in Ghana the cause was said to be small insects.

Most farmers obtained their planting seed from CRIN; others selected from local trees.

All the farmers belonged to the Nigerian Farmers Association and the perceived benefits of membership were mixed. About 10% had received loans of about $50 and about 50% had bulked their nuts to negotiate a higher price. In 2000, the price for raw nuts ranged from N20 to N 35/kg. They had no problems selling nuts but wanted to sell direct to exporters to get a better price. They had never considered processing.

Visit CRIN germplasm trials, Ochaja sub-station.
Some old plots have been designated for rehabilitation trials.

Block NW-7 was the original germplasm collection planted in 1977, with half-sib accessions from Brazil, India, Tanzania, other countries and locally selected material. There were 32 plots of 4 trees (i.e. 4 seeds from one tree) replicated twice, Photo. 37, (Vol.2) shows a map of part of the trial and Photo. 38, (Vol.2) shows one of the trees in this trial. 18 types have been selected for farmer planting.

Brazilian jumbo nut trial - Nuts from Kosoni Farm (Oro, Kwara State - visited later) were graded according to weight and then the whole 7ha block was planted according to nut weight, that is the smallest nuts at one end rising to the biggest nuts at the other (Photo. 39, Vol.2). Spacing was 9 x 9m. The nuts were not from selected trees.

Millennium block – Brazilian jumbo type nuts were being evaluated at different spacings, 9 x 9m, 8 x 8m and 6 x 6m. Again each plot was graded according to nut weight.

At another site were 25 locally selected trees, again 4 seeds from one tree per plot and replicated twice.

Only air-layering (marcotts) had been practised on a limited scale, no tip or bud grafting had been used.

Visit Innocents farm, owned by Chief Audu Ogbe at Oturkpa, Benue State.
The cashew farm was started in 1982 and added to year by year. The planting material was mainly local but also some jumbo nuts from Kosoni Farm (Oro, Kwara State) had been planted. There were big differences in apple colour (bright red, rose, yellow) and in nut size within the two different types.

Sucking pest damage was significant on some trees. They sprayed once in October/November but the employees met could not remember what for. There was no anthracnose on the "jumbo" trees.

Nigeria, Monday, 12 February.
Visit Premier Cashew Industry Farm at Orji River, Enugu State.
Planting of cashew started in the early 1950's by the Eastern Nigeria Development Association for environmental reasons, mainly erosion control. Only 38 ha remain out of an original 50 ha. The main problem is the branch girdler, *Analeptis trifasciata*, which can affect many trees. When the trees were young they were sprayed for insect pests. Thieving was bad but since an agreement with the local chief has been made, which includes an annual bonus, this problem has been minimised. The origin of the planting material was unknown other than that a British person brought the seed - the trees look very similar to old trees in Tanzania.

Visit Premier Cashew Industry Farm and Factory at Oghe, Enugu State.
This plantation was 530 ha in size and planting started in 1952, again by the Eastern Nigeria Development Association for environmental reasons, mainly erosion control. Enugu State has a high population density and the soil is prone to erosion. The source of planting material was not known, but the trees looked superficially similar to old trees in Tanzania. The main problems included:-

- Fire
- Thieving of nuts, some times the thieves are armed and take bags of cashew from the store.

In 1995, when security was good, production from the 530 ha amounted to 160 tons of raw nuts or approx. 300 kg/ha. In 2000, total production was only 30 tons. The yield was sold to local buyers. Last year a 4 litre container of raw nuts sold for between N80 to N200, with an average price of around N120.

Some of the trees looked quite good, giving high yields of possibly up to 50kg/tree and medium sized nuts (Photo. 40, Vol.2). Seeds from selected trees from here were used in CRIN's 1977 germplasm

collection. Both this plantation and the one above acted as sources of seed for farmers when cashew was commercialised.

The plantation was not well maintained and today was the first day for hiring people to harvest the crop.

On this site was an old cashew processing factory which stopped operating in 1979. In 1989 a new Japanese factory was commissioned, with an operating capacity which was said to be 54 tons of raw nuts per month or 650 tons per year, but Dr. Topper was sure the capacity was much higher than this, at least 2,000 tons per annum. This modern looking factory was totally vandalised in 1998 and is now beyond repair, although the buildings could still be put to good use after restoring the roof (Photo. 51, Vol.2). It was said that the employees had not been paid for some time and in their frustration, destroyed the factory. The factory produced mainly W320's, followed by W450's, but not too much reliance can be placed on this information. The factory must have cost more a few million US$ and was destroyed after only 9 years of operation.

Nigeria, Tuesday, 13 February.
Visited farm of Mr Olofu Ayakpo, Nyanya, Cross River State.
Mr Ayakpo started with 1 ha planted 3 years ago, he now has >5ha and increases the area under cashew year by year. The seed was from local trees. Some of the trees had flowered and the nuts were a reasonable size. He had received no help or information from extension. Minor constraints include algae and angular dark spots on leaves, and sucking pest damage.

Visit Cross River State Cashew Project Farm at Nyanya in Cross River State.
This is a State Government farm planted for production and presumably revenue purposes. The wisdom of having Government owned and run cashew plantations is very questionable.

100 ha were planted in August 2000 and the seed came from Innocents farm (see above), probably a mixture of local and 'jumbo' seed. Seeds were raised in poly-bags and transplanted.

There are 5 such state owned plantations in Cross River State and all were being affected by strike action by the workers. The Federal Government had introduced a minimum wage for Federal employees of N7,500/month and a minimum of N5,500 for State employees. State employees wanted a minimum wage of N6,500, which the Government has agreed to, providing the State rationalises its workforce, i.e. retrench a proportion of the workforce. The workers were on strike because they were against retrenchment. Casual labourers had not been paid for 5 months and are understandably angry at this situation.

An estimated 50% of the plantation had been lost to fire and will require replanting.

Farmers were paid compensation for their land and are allowed to continue intercropping between the cashew seedlings/trees until the canopies make intercropping unrealistic. The farmers then have to leave and find new lands, which apparently is not a problem in this area. Allowing farmers to intercrop also reduces the risk of fire.

Visit T. Y. Acres Farm near Takum, Taraba State.
A devastating fire in late December had virtually totally destroyed about 80% of the 250 ha of cashew (Photo. 28, Vol.2)). Most of the cashew will probably survive but there will be no yield from the fire burnt trees this year and possibly next year and many branches will have been killed. The fire was impossible to control even with 25 men and two tractors with water tanks. Strong harmattan winds assisted the fire.

The total farm area is 1,111 ha of which just under 250 ha was planted with cashew, commencing in 1990. Most of the cashew originated from local seed and <10ha is apparently of Brazilian origin, purchased in Ibaden. Before cashew, maize and soybean were grown. About 150 low-yielding trees have been top-worked.

The only major problem was fire and it is an annual problem on at least part of the farm. Photo. 27 (Vol.2) shows trees which have been repeatedly damaged by fire and exhibit many dead branches.

Fertiliser trials have been undertaken on 4 year old trees with positive effect.

There were very few cashew trees in the area outside T. Y. Acres Farm, one or two existed in the vicinity of peoples houses to provide shade. The nuts from the farm were sold to local traders. Last year the yield was approx. 275 bags (90kg per bag) from about 220 ha of unburnt cashew which is equivalent to 112.5kg/ha, which is quite low for 9 and 10 year old trees. The plantation was not making a profit, which is not surprising considering the low yields/ha, frequent fires and a range of highly paid staff (accountants, auditors etc.). As a result, they have stopped planting additional cashew even though there is much land still available.

Nigeria, Wednesday, 14 February.
Meeting at Agricultural Development Programme (extension) office in Lafia, Nassarawa State.
Mr Samuel Meshi (Director of Technical Services & Mr Alhadji Abugakar Lamino (Agro-forestry Officer in charge of tree crops).

This organisation was responsible for agricultural extension and they followed the Training and Visit system as advocated by the World Bank. In this state they had 156 Village Extension Workers (VEW's), a few of which have bicycles but the majority have no means of transport with which to get to their clients. The ratio of VEW's to farmers was 1 to 1,403. There were 24 Subject Matter Specialists (SMS's), of which 4 were tree specialists. Extension services were paid for by the individual States. There did appear to be interaction/collaboration with research, at least in this region. The T & V system is controversial in that it is:-

- often expensive and hence unsustainable in developing countries,
- deals with "contact" farmers and the information is supposed to trickle down to other farmers,
- uses regimented "do this" impact points which are often not refined to individual farmer's agro-ecological and socio-economic circumstances (whereas, if extension used a more knowledge based approach, then farmers could adapt the knowledge more easily to their own circumstances).

The mechanism of technology/knowledge transfer is of crucial importance if farmer clients are to benefit agriculturally. In Nigeria, the World Bank financed Phase 1 of a T & V programme but Phase 2 has not materialised to date and now it would appear that the extension service is poorly resourced – see comment on VEW transport above.

In other States visited, the extension service appeared to be totally lacking at least with regard to cashew.

Farmers in this State were very interested in cashew in order to improve their income and improve living standards. The main problem was fire; pests and diseases were minor. Planting material was either from local trees or from CRIN. Seed from CRIN were about 5 to 6g in weight (and some were even smaller) and this was smaller than the local nuts seen at the office of extension workers. Last year a proportion of the CRIN seed material was discarded due to lack of drying. Farmers preferred to plant directly into the ground, rather than raise seed in poly-bags and transplant. Unfortunately seed from CRIN arrives in July, a month or so after the time farmers normally plant cashew.

There was no processing of raw nuts in this state, but there was interest in processing the apples. Cashew apples were sold in the market and by the roadside (see Photos. 54 and 55, Vol.2)). There was no premium paid for better quality nuts, just one price for all raw nuts.

Other cash crops included mangoes, oil palm, citrus, sesame, rice, cassava, yam and vegetables.

Na Mairo & Sons Ltd Nigeria, Dome Road, Rimi Uka, Lafia (Tel 047 20014).
This company prefinances agents to go to villages, buy nuts and bring them back to the warehouse. He used about 100 agents and about 20% absconded with the money. Last year he paid between N22,000 and N50,000 for one ton and bought a total of 1,500 tons. The raw nuts were sold to

"Olam", a company based in Singapore. Olam prefinances Na Mairo & Sons Ltd, collects the nuts and ships them direct to India for processing. The local buyer gets between 10 and 15% commission. The top price paid by Olam last year was N58,000/ton.

Na Mairo & Sons Ltd also supplied 200 tons of nuts to Fugard Foods Ltd in Jos State for processing there. Fugard Foods Ltd are going to establish a processing factory in Nassarawa State.

Raw nut statistics from Nassarawa State – on average there are between 180 to 200 nuts per kg; 40% of nuts float in water. The kernel out-turn ratio (KOR) for nuts from Nassarawa State is given in Table A2.2. Providing these figures are correct, the %KOR is very high indeed, since normally it is about 30 to 35% at the time of shelling.

Table A2.2. Percentage kernel out-turn ratio for nuts from Nassarawa State

Type of nut	Kernel out-turn ratio, KOR
Sinkers	48 to 50%
Floaters	26 to 30%
Average for all nuts	40 to 41%

This company did not undertake any farmer extension activities. Farmers were reluctant to plant more cashew because it takes up too much space on their farms. There are 3 large buyers of cashew in this state and a buyers association, which helps to regulate quality.

Na Mairo & Sons Ltd also buy and sell sesame to Olam or to other buyers if the price is better. Sesame was all exported in its raw state.

Visited farm of Mr Abou Alhadji Uba, Lafia.
On this farm, panicles on some trees had dried out and were unproductive, whilst other trees were bearing well. The drying of flowers was attributed by many farmers to the "harmattan", but in one field it was apparent that this condition can vary from tree to tree. According to Mr Adebola, the harmattan actually benefits some tree crops like mango and oil palm, but for cashew the situation is still unclear.

There was a lot of cashew in this area and some of it was planted in the past to demonstrate ownership of land. At that time the apple was used and the nut discarded, now the nut is used and the majority of apples are discarded. However, this was the only area visited where there was a concerted effort to use the apples – they were sold in the town markets and along the road side (Photos. 54 and 55, Vol.2) and there was an interest in juice production.

Local nuts had been used for planting this farm. Mealybug was present on many panicles but not serious. No other problems were apparent, except for some panicles with dried flowers.

Nigeria, Thursday, 15 February.
Visited farm of General Jerry Useni, near Gwagwalada, Federal Capital Territory.
This was a large farm, part of which was planted with cashew, but due to the annual round of bush fires much of it had been permanently lost. On this visit, the remaining cashew had again been burnt (Photo. 29, Vol.2). As a consequence the farm has reverted back to growing annual crops and diversified into cattle, fish ponds and ostrich production. The owner was rarely on site.

Visit Awoniyi farms, near Kabba, Kogi State.
This was a new farm started in 1998 with a total of 38 ha planted to date and the plan is to add a further 500 ha. The initial planting was carried out under private contract, by ADP (extension), who raised the seedlings in poly-bags and transplanted them into the field. A lot of money was paid to ADP for this service but since 1998, there has been no support or interest in the farm from the extension services (ADP). Surrounding cashew farmers also received no support from extension. Mr

Awoniyi hopes to use the farm for workshops and training to promote cashew in the area and to encourage young people back into agriculture.

The planting material was seed purchased from CRIN and the resulting trees appear to be producing larger nuts than those produced by nearby indigenous cashew trees (see Photo. 44, Vol.2).

The main problems were:-

- cattle damaging young trees
- fire
- sucking pest damage
- stunted growth probably due to soil problems
- variegated grasshopper eating flowers and fruits

The Fulani people present on the farm at the time of purchase were being catered for by allocation of land and employment opportunities on the farm. Mr Awoniyi hoped to start processing both nuts and apples.

Meeting with His Royal Highness Oba P. A. Mesheko, traditional chief of Okebukun village near Kabba..
There were quite a few cashew farmers in the area, including His Royal Highness Oba P. A. Mesheko. The main constraints were said to be:-

- Fire
- Cattle
- Lack of extension or any support
- Low price for nuts – see below.

Last year the price for raw nuts ranged from N70 to N100 for one bowl full, which equals 2.5kg (N28 to N40/kg).

Visited Kosoni-Ola Farm, Oro, Kwara State.
This farm of 350 ha was planted entirely with Brazilian "common" seed imported from Brazil, Photo. 42 (Vol.2) shows an example of one of the trees. Planting started in 1986 and was finished by 1988 and then gapping. The total farm area was 500ha.

Nut size was variable but a high percentage of trees were giving a very good nut size (Photo. 43, Vol.2). It is from this farm that Ghana imports the Nigerian "jumbo" nuts. Kosoni Farm sells its nuts for N80,000/ton when it is for planting purposes, which is really too low a price for seed.

There were no major problems, a few trees had leaves with what appeared to be a soil deficiency symptom and a small percentage of apples had been punctured by sucking pests. Fire had not been a problem this year, but it had in the past.

Yields were not high, last year 250 ha produced only 50 tons, equal to 200kg/ha. More could be done to improve productivity, e.g. top-work unproductive trees, improved maintenance and more efficient harvesting. However this type of tree needs to be evaluated fully before recommending it to the farmer, e.g. for yield potential per ha, kernel weight, percentage kernel out-turn, etc.

The main observation was that there appeared to be no anthracnose symptoms on the trees, although there were black oily lesions on the nuts (Photo. 66, Vol.2), which needs further investigation. In Brazil this type of tree would be exhibiting severe anthracnose (Photo. 15, Vol.2), but here, there was none.

Nigeria, Friday, 16 February.
Visit Cashew Processing Industry Farm, Iwo, Osun State.
This was one of the plantations established by the Western Nigeria Development Association in the early 1950's, for erosion control and environmental reasons. The total size of the farm is 210 ha of which 164 ha were planted to cashew. Yields have been as high as 200 tons, more than 1 ton per ha, but last year it was down to 119 tons or approx. 725kg/ha.

The drop in productivity was attributed to:-

- Ageing tree population
- Insect pests, including defoliating caterpillars (they used the insecticide Decis to control them last year, this year it was not necessary), girdlers (cultural control) and sucking pests.
- Labour constraints for weeding and harvesting.

Fire was not normally a problem, mainly due to the complete canopy cover and hence lack of weeds.

The plantation is a Limited company, but the major share holder is the Government; the other large, old plantations have all been 100% owned by the Government.

The affiliated processing factory was closed last year due to technical problems and so the raw nuts were sold to a local exporter, Lag-Group of Lagos for N52,000/ton (approx. $520/ton). The factory is now operational but the nuts are going to be exported again – see explanation below.

Harvesting starts in January and finishes in May. Casual harvesters were paid N40/16kg tin of nuts and could fill between 5 and 10 tins per day. The nuts were generally small. Some trees were particularly high yielding (Photo. 41, Vol.2) and both red and yellow apples were produced on different trees. Some trees had yellow spots on leaves, which is symptomatic of a deficiency (Photo. 23, Vol.2).

Visit Allam Agro-Allied Farm, Oyo, Oyo State.
This was a large privately owned farm of 700ha in total with 450ha of cashew planted in 1991 and 1992. The seed for planting came from CRIN, but the farm manager complained that CRIN never came back to see how their material was performing and there was no support from extension. Nuts were of medium size but generally bigger than those seen in the last plantation. Photo. 45 (Vol.2) shows nuts of different sizes produced by the plantation.

Problems were:-

- Fire - but not this year so far.
- Resources for weeding
- Insect borers kill some trees

Last year fire damaged 50% of the farm; so far this year there has not been a problem, but if cattle herders go through the farm then they would set fire to it. Fire breaks had been made around the outside. Tractors slashed between the trees and hired labourers slashed under the canopies. The cut grass and weeds were just left lying on the ground, so if a fire did start, the damage could still be substantial.

Yield last year was only 26 tons from approx. half of the plantation (fire damaged the rest), which equates to about 118kg/ha, which is low. **More quantitative yield information is required from a representative number of farms from the different states over the years**.

Stealing and the drying of flowers were not problems here.

There were 12 permanent staff and the farm hired 35 to 40 harvesters; nuts were dried for 7 days on the drying floor and then put into the store. Melagro Company bought the nuts last year and exported them.

Visit Cashew Processing Industries factory, Ibadan, Oya State.
The factory was commissioned in 1990 and was purchased from Oltremare of Italy. The oil bath mechanism had to be by-passed due to scorching or browning of kernels. Why this should be was unclear, since the Oltremare technology for roasting nuts works well in other factories around the world. Steam roasting was introduced and the machinery for that was fabricated in Nigeria.

Now nearly all of the original Oltremare machinery is obsolete, with only the ovens and packing machine operational (packed into tins with CO_2). The company had introduced Indian type hand

shelling machines in 1999 (made in Nigeria), and either one or two people operate one machine. Apparently 2 people can shell up to 60kg of raw nuts in one 8 hour shift.

After shelling the KOR was 28% and by the end of processing it was 22%.

There were marketing problems. The company needed credit to process, to purchase raw nuts, pay for labour, buy consumables (e.g. gloves), but the bank will not loan any money until a letter of credit has been issued by the prospective purchaser of kernels; and they are finding it difficult to find buyers, especially overseas.

Therefore they hope to sell raw nuts from the Cashew Processing Industry Farm at Iwo, Osun State (see above) to finance processing of other people's nuts under contract.

CNSL, shells and wood were used to fire the steam boiler.

Nigeria, Saturday, 17 February.
Debriefing meeting and reception at CRIN headquarters in Ibadan.

Drive to Lagos.

Depart Nigeria at 2350 hr.

Note - petrol crisis.
The subsidised pump price was N22/litre and the Government wants to increase this to N30/litre. There was large scale resistance to this tax increase because in the past, such increased government revenues never benefited the public. Consequently there was very little fuel and huge queues at the petrol stations. There was a black market and prices reached N100/litre. Because of the very tight schedule, purchasing fuel from the black market was an absolute necessity.

ANNEX 3

WEST AFRICA CASHEW SURVEY 2001

QUESTIONNAIRE - GUINEA

Completed by :-
Mr. Souret DIAORA
Dr. Mahmoud CAMARA

Environmental data.

Table A3.1. CLIMAT DE LA GUINEE MARITIME (ZONE DE BOKE)

Mois	Pluviométrie	Humidité	T° maximum	T° minimum	Phenology
Janvier	0	53	39.7	14.4	Déb nouaison
Février	T	58	38.4	15.7	Fructification
Mars	T	53	40.5	17.7	Maturité
Avril	9	55	40.1	19.9	
Mai	105	67	38.5	20.9	Fin cycle
Juin	258	76	35.0	20.4	
Juillet	485	75	32.8	20.7	
Août	424	82	32.4	20.5	
Septembre	545	92	33.1	19.7	
Octobre	317	78	33.9	20.1	
Novembre	67	69	35.5	18.1	Déb floraison
Décembre	2	58	35.7	14.4	Floraison

Table A3.2. CLIMAT DE LA HAUTE GUINEE (ZONE DE KANKAN)

Mois	Pluviométrie	Humidité	T°maximum	T°minimum	Phénologie
Janvier	2	38	36.5	18.8	Déb nouaison
Février	1	35	38.1	13.3	Fructification
Mars	24	38	38.9	17.0	Maturité
Avril	67	49	38.8	20.2	
Mai	134	63	37.1	19.6	Fin cycle
Juin	204	73	33.2	18.8	
Juillet	262	77	32.2	18.9	
Août	322	75	31.7	18.8	
Septembre	304	77	32.7	18.9	
Octobre	131	75	33.9	19.0	
Novembre	20	57	34.7	13.9	
Décembre	1	46	35.2	11.0	

NB. Average from 1960 to 1990.

Comments regarding environmental data

Les possibilités agro-pastorales de la Guinée sont immenses et variées. Dans le pays, on distingue quatre régions naturelles : la Guinée maritime, la Moyenne Guinée, la Haute Guinée et la Guinée Forestière.

Le climat guinéen est favorable à la diversification de la plupart des cultures tropicales et subtropicales.

Cashew production

Table A3.3. Guinea- annual raw cashewnut production figures from 1997- real or estimated

Year	Number of tonnes of raw nuts produced	Source of information if estimated put « Est »	Production figures from the FAO STAT database*[1]
1994			No records
1995			No records
1996			No records
1997	2-3000 tonnes	Est	No records
1998	3-4000 tonnes	Est	No records
1999	4-6000 tonnes	Est	No records

FAO STAT database*[1] – These data are for compariosn only and might not be correct, so please complete the other columns from your own information sources.

Avant 1997, l'anacardier n'était pas considéré dans le cadre de l'exploitation commerciale mais plutôt sylvicole. Les statistiques de production n'existent pas . Les opérateurs économiques se débrouillaient à collecter les noix pour l'export.

Table A3.4. Guinea-annual raw cashewnut EXPORT figures from 1997

Year	Number of tonnes of raw nuts EXPORTED	Country/Contries raw nuts exported to	Source of information if estimated put « Est »
1997	1200 tonnes	G. Bissau- Côte d' Ivoire	S.Douanes-O.Economiques
1998	2500 tonnes	G. Bissau- Côte d' Ivoire	S.Douanes-O.Economiques
1999	3500 tonnes	G. Bissau- Côte d' Ivoire	S.Douanes-O.Economiques

Le projet cadre pour l'exportation des produits agricoles (PCPEA) et la société de production et de commercialisation d'intrants agricoles (SPCIA) commence à mettre sur place une structure viable pour l'export de l'anacarde.

Processing capacity

Hand processing
Describe what is available in terms of equipment used, where is it manufactured, number of units, etc.

Currently there is no local hand processing of nuts in Guinea.

Mechanical or factory processing.
None.

Guinea – Research capacity

Main cashew research station : Foulaya-Kindia
Sub-stations involved with cashew : Bordo-Kankan

Table A3.5. Guinea-Full-time senior cashew research personnel

Name	Education/Qualification	Area of research Eg. Breeding, pathology	Based where
Souret DIAORA	Ingénieur Agronome	General agriculture	Foulaya-Kindia

Total number of full-time cashew research technicians :- 3

Comments on staffing levels and quality of staff

Chercheur principal :
Souret Diaora, Ingénieur Agronome
4 ans d'études sur l'anacardier
Stage en RCI (1998) sur le thème, 'Conception expérimentale'.
Voyage d'étude en Guinée Bissau en 1998 (durée 2 semaines)
Voyage d'étude au Brésil en 2000 (durée 2 semaines)

Techniciens :
1. Mamadou Rafiou Diallo: Contrôleur des Travaux agricoles
4 ans de travaux pratiques sur l'anacardier
Nématologue au laboratoire du CRAF

2. Moussa Condé : Ingénieur Zootechnicien

Une année de pratique sur l'anacardier

3. Morlaye Soumah : Contrôleur des travaux agricoles
Observateur
Une année de pratique sur l'anacardier.

Collaborators: Dr Mahmoud Camara, directeur du centre.
Ousmane K. Soumah , Coordinateur scientifique du centre
Dr Sankarella Diallo, chef programme Agrumes du centre
Dr Moridjan Sangare, Coordinateur scientifique du centre
Sidiki Keita (Chef de programme mangue)

Other comments :
Pour une plus grande efficacité, il serait souhaitable pour le chercheur principal de :
1. Faire une formation en langue anglais
2. Faire une formation approfondie en culture de l'anacardier (amélioration végétale)
3. Training in information flow.

Table A3.5. Guinea - Annual cashew research budget

Year	Amount GFr	Comments
1998	3 068 000	Recurrent costs only
1999	3 253 700	Recurrent costs only
2000	3 919 500	Recurrent costs only

The above funds were for on-station work (Foulaya), there was no budget for off-station research.

Cashew extension capacity
Biefly describe how cashew extension works along with the level of investiment and input into this in the country

L'initiative individuelle des agriculteurs prend une dynamique et les supercifies consacrées à la culture de l'anacardier ont augmenté ces dix dernières années (1989-1999).

L'aire de culture de l'anacardier en Guinée est limitée principalement à la Guinée maritime (région de Boké) et à la Haute Guinée (région de Kankan) où plus de 400.000 hectares de terres sont disponibles.

Guinea - General information on existing farmers trees

For each major cashew region or district complet the following :
1. Name of region or district : Two regions : Upper Guinea (Kankan)
Guinea Maritime (Boké)
2. Estimate approximately what percentage of the total trees were planted in the following time periods :
Before 1970 (trees > 30 years old) 7%
1970-1980 (trees 20 to 30 years old) 10%
1980-1990 (trees 10 to 20 years old) 20%
1990-2000 (trees 1 to 10 years old) 63%
3. Did the farmers use seed or grafted seedings or both as planting material? If necessary answer for each time period separately.
The farmers use seed as planting material.
4. Where did the farmer obtain the planting material - extension service, trader, from his own trees or from another farmer? (If necessary answer for each time period separately)
Extension service (station research, SNPRV)
Societe privée (SPCIA).
Other farmers
5. Where did the planting material come from if it was not local, i.e. country of origin? (If necessary answer for each time period separately).
Guinée Bissau and Ivory Coast , (the research station has material from Brasi).

Characteristics of breeding material

Table A3.6. Résultats de la caractérisation des noix, amandes et pommes

Variétés	Production kg	Poids noix, g	Poids amande, g	Rendement décorticage en %	Poids pomme, g	Brix pomme, %
A1	3.5	4.8	1.2	25	30	11.4
A10	9.4	14.1	3.6	25	125.2	11.6
A11	5.6	7.1	1.9	27	136.5	10.7
A12	2.7	7.5	2.1	28	143.5	11.3
A13	3.6	7.5	1.9	25	102	11.6
A14	6.1	8.6	2.2	26	82.3	10.6
A15	5.1	6.1	1.9	31	110.2	11.6
A16	4.3	7.1	2.2	31	93.4	11.6
A17	4.3	7.2	1.5	21	89.3	12.6
A18	2.7	7.6	1.7	22	115	10.7
A2	4.2	6.7	1.7	25	100.9	9.7
A21	1.9	6.4	1.3	20	132.5	9.7
A22	3.9	7.3	1.9	26	99.5	10.7
A23	5.2	2.5	0.7	28	42.5	10.7
A24	5.5	4.4	1.3	25	65.4	11.4
A25	4.8	7.8	1.9	24	103.5	6.7
A26	5.9	6.3	1.7	26	117.5	9.7
A27	5	7.9	1.9	24	112	12.7
A28	4.6	7.3	1.9	26	97.5	11.7
A29	1.3	4.9	1.2	24	56.5	9.4
A3	5.1	8.1	2.1	26	125.8	7.4
A30	1.7	10.4	2.2	21	96.8	9.4
A31	3.5	9.3	2.5	27	98.7	9.5
A32	2.6	8.2	2.2	27	106.3	10.4
A33	4.7	8.7	2.3	26	103.4	9.7
A34	5.2	8.4	2.1	25	107.2	9.7
A35	6.5	9.7	2.5	26	111.2	11.4
A37	3.7	9.1	2.5	27	89.5	10.3
A36	9.2	7.9	2.3	29	105.4	10.4
A38	4.1	8.6	2.2	26	88.8	10.1
A39	7.2	9.1	2.4	26	96.6	10.6
A40	4.5	9.9	2.3	23	92.7	9.7
A41	3.2	6.2	1.3	21	87.2	11.1
A42	2.7	8.5	1.9	23	87.5	10.4
A43	10.6	9.3	2.6	29	92.8	10.7
A44	5.1	8.3	1.6	19	95.8	10.5
A45	6.3	9.8	2.2	22	91.7	10.1
A46	5.9	10.8	2.3	21	90.8	7.4
A47	8.2	9.8	2.9	30	100.5	11.3
A48	8.9	9.6	2.7	28	103.7	10.9
A49	4.4	8.5	2.1	25	99.1	9.9
A5	6.3	5.7	1.6	28	130.9	9.6
A50	3.3	7.5	1.9	25	135.5	9.6
A51	4.5	9.1	2.7	30	117.5	8.8
A52	5.6	8	1.7	21	125.1	9.2
A53	12.1	12.1	3.1	26	97.7	10.3
A54	8.3	8.2	1.6	20	106.4	10.7
A56	10.2	8.7	2.7	31	132.5	11.1
A57	11.3	8.7	2.5	29	121.3	10.2
A58	4.5	8.2	1.8	22	115.4	6.9
A59	5.5	8.8	1.9	22	106.6	7.7
A6	2.5	8.2	2.2	27	135.4	12.1
A63	6	8.5	1.7	20	95.9	8.5
A64	3.9	10.5	2.4	23	113.4	10.5
A69	5.2	6.5	1.4	22	127.2	8.9
A7	3.7	7.5	2.1	28	137.4	10.6
A70	7	8.5	1.7	20	98.5	9.3
A74	6.6	10.5	2.1	20	134.3	10.5
A8	6.9	7.1	2.1	30	110.6	12.1
A80	1.2	4.2	1.1	26	31.5	6.5
A9	7.2	7.6	2.1	28	101.2	10.6

Table A3.7. Accessions obtenues après l'enquête des vergers en

A. Guinée Maritime Nord et en Haute Guinée .

N°	Accessions	Origine	Année
1	Yt1	Boké (sogoboli)	1997
2	Yt2	Boké (sogoboli)	1997
3	Yt3	Boké (sogoboli)	1997
4	Md	Mandiana	1998
5	Fl	Gaoual (Foulamory)	1997
6	Em	Boké (sansalé)	1997

B. Introductions en cours d'étude

1	Lt1	R.C.I (Lataha-Korogho) 1997	
2	Lt2	R.C.I (Lataha-Korogho)	1997
3	D1	Brésil	1998
4	D2	Brésil	1998
5	D3	Brésil	1998
6	D4	Brésil	1998
7	D5	Brésil	1998
8	Gb1	Guinée-Bissau	1998
9	Gb2	Guinée-Bissau	1998

Table A3.7. Résultats de la première sélection.

	Noix				Amandes					
Clones accession	Poids noix	Fourchette de poids	Classement noix	Facilité de séparation noix/pomme	Poids amandes	Fourchette de poids	Rend amandes	Adhérence tégument	% amandes complètes	Classement amande
\8	7,1	6,1 – 8,9	Moyenne	Facile	2,1	1,5 – 2,6	28	N . adh.	80	210
\12	7,5	5,8 – 9,5	Moyenne	Difficile	2,1	1,4 – 2,8	28	N . adh.	84	210
\15	6,1	5,2 – 7,8	Moyenne	Difficile	1,9	1,2 – 2,1	31	N . adh.	90	240
\16	7,1	6,5 – 9,4	Moyenne	Difficile	2,2	1,7 – 2,7	31	N . adh.	92	210
\31	9,3	7,1 – 0,8	Moyenne	Facile	2,5	2,1 – 2,8	27	N . adh.	87	180
\32	8,2	7,2 –10,5	Moyenne	Facile	2,2	1,9 – 2,7	27	N . adh.	95	210
\37	9,1	7,4 –10,9	Moyenne	Difficile	2,5	2,1 – 2,9	27	N . adh.	97	180
\43	9,3	6,9 –11,3	Moyenne	Facile	2,6	2,2 – 2,9	29	N . adh.	89	180
\47	9,8	7,5 –11,6	Moyenne	Facile	2,9	2,2 – 3,2	30	N . adh.	94	180
\48	9,6	7,0 –11,5	Moyenne	Facile	2,7	2,1 – 3,1	28	N . adh.	96	180
\51	9,1	6,8 –11,1	Moyenne	Facile	2,7	2,0 – 3,2	30	N . adh.	92	180
\53	12,1	10,4 –14,6	Grosse	Facile	3,1	2,5 – 3,7	26	N . adh.	86	150
\56	8,7	7,3 –10,8	Moyenne	Facile	2,7	2,1 – 3,1	31	N . adh.	93	180
\10	14,1	12,4 - 16,5	Grosse	Difficile	3,8	3,1 – 4,1	25	N . adh.	90	150

Pests and diseases of cashew in Guinee.

Insectes nuisibles

***Helopeltis anacardii* (Miridae)**

A. Description

Il est le ravageur le plus important de l'anacardier.Le mâle adulte mesure 4.5mm de long et la femelle 6mm avec de longues antennes .Ils sont de couleur orangé brun. Les nymphes et les adultes ont une petite prohibérence en forme de poil émergeant du thorax. Les adultes peuvent vivre 2à3 semaines. Après une pré-oviposition de 12 jours , la femelle pond de 3 à 4 œufs par jour jusqu'à ce qu'elle meure .

Les œufs sont enchâssés dans les tissus tendres près de l'extrémité des jeunes pousses florales ou végétatives. L'extrémité des œufs présentent 2 minces filaments blancs, en forme de tube respiratoire émergeant des tissus. Il y a 5 stades durant la nymphose, le cycle total dure 48 jours.

B. Symptômes

L'helopeltis s'attaque aux rameaux, feuilles, fruits.

a- sur rameaux

1. En début de développement
- Un avortement du bourgeon terminal
- Un dessèchement des jeunes feuilles immatures ou de déformation « cuillère retournée »

2. Sur des jeunes rameaux, la tige présente dans le sens de la longueur des trainées noirâtres, à un stade plus avancé, il se produit une crevasse allongée avec des épaississements sur les bords, souvent bordé de brun noir. Le jeune rameau fini par se déssecher.

3. Sur rameaux florifère, l'axe floral est attaqué de même que les axes secondaires, même s'il ya nouaison les panicules floraux se dessèchent.

En cas d'attaque très précoce sur l'axe florale, celui-ci devient très court et se présente comme le « balai de sorcière »

b- sur feuilles – formation de traces nécrotiques le long des nervures. Les nymphes et adultes sucent les feuilles les inflorescences et même les jeunes noix et les pommes. Ces feuilles sont cernées (généralement les jeunes feuilles et se dessechent ;

c- les lésions sur fruits sont brûnâtres ou noires, en forme de ponctuation circulaire. Les fruits immatures attaqués chutent.

d- Attaque en pépinière : compte tenu de l'âge de la plantule l'attaque lui est fatale (dessèchement total).

***Apate terebians* (Bostrychidae).**

Cet insecte foreur envahit les branches et provoque leur dessèchement. Il creuse des galeries dans le bois des troncs et des branches principales. On observe sur les zones attaquées des exsudations de gomme et des débris de bois et après avoir dégagé l'écorce, on note plusieurs galeries convergentes vers une cavité située à la base de l'arbre.

***Analeptes trifasciata* fabricius (cérambycidae).**

Ce charançon, appelé aussi « ciseleur de tige » d'anacardier, cause des dégâts importants dans les vergers.

L'adulte a une taille d'environ 55 mm et ses antennes dépassent 70 mm. Les élytres ont 3 larges bandes transversales de couleur orange séparées par 2 bandes noires irrégulières. La base et l'extrémité des élytres sont noires.

***Pachnoda* sp.**

Ce coléoptère de couleur jaunâtre se reconnaît par la lettre Y dessinée en noir sur ses élytres traversée par des bandes latérales noires. Leur dégât se fait sur les pommes en maturité sur lesquelles ils se nourrissent en groupe.

Les termites

Cet insecte xylophage aux pièces buccales broyeuses s'attaque généralement aux jeunes plants dont il détruit les racines.

Maladies
La maladie la plus répandue est l'anthracnose (*Colletotrichum gloeosporioides)* qui attaque les parties aériennes (rameaux, feuilles, fleurs, fruits. Son action en Guinée n'est pas très importante, les quelques arbres dépistés sont arrachés et brulés.

Autres problèmes liés à la production
1- Divagation des animaux
2- Feux de brousse
3- Méconnaissance des techniques de production
4- Absence de ligne de crédit
5- Difficulté d'acquisition du matériel végétal
6- Enclavement de certaines zones de production.

Bibliographie - Guinee

1- Etude du développement de la culture de l'anacardier dans la région de Boké,
Rapport de mission du 28 mai /11 juin 1998 ;
Raul Sardinha.

2- Guide pratique du planteur pour la culture de l'anacardier,
Fiche technique, 1998.
Diaora Souret.

3- Les cultures perennes en Guinée maritime (Dubréka, Boké) ; octobre 1999.
Dr M. Tidiane Sankarela Diallo.

4- Rapport de mission 1998.
Martin Philippe.

5- Rapport de mission : PCPEA-IRAG-SNPRV-SOCOPRONA
Côte d'Ivoire (Odiénné et Korogho) du 17-28 mars 1999.

Other West African Countries

6- La culture de l'anacardier, 1977
Mario Agnoloni – Franco Giuliani.

7- Multiplication végétative de l'anacardier.
Le greffage de bourgeon terminal (tip-graffing).
A. Lefebvre.

8- Etude sur l'anacardier.
Régions écologiquement favorables à la culture de l'anacardier en Afrique Francophone de l'Ouest, 1973.
P. Goujon. – A. lefebvre., - Ph. Le turcq

9- La filière anacardier en Guinée Bissau, novembre 1886
MDRA.

10- Filière anacardier en R.C.I. (extrait : composante recherche/développement).
J. Rey, CIRAD-FLHOR.

11- Etude de l'amélioration de production de noix de cajou en RCI, 1971.
A. Lefebvre.

ANNEX 4

WEST AFRICA CASHEW SURVEY 2001

QUESTIONNAIRE COTE D'IVOIRE

Completed by :-
Akadié Jean-Baptiste DJAHA

Environmental data

Table A4.1. Cote d'Ivoire - average monthly environmental data

MONTH	RAINFALL MM	HUMIDITY	MAXIMUM TEMPERATURE	MINIMUM TEMPERATURE	PHENOLOGY *[1]
January					Nouaison
February					Fructification
March					Maturité
April					Maturité
May					Maturité
June					
July					
August					
September					
October					
November					Floraison
December					Floraison

*[1] –enter months of flushing (new red shoots), panicle emergence, flowerinf, harvesting ; if ther are two separate periods of flushing etc, please add.

Comments regarding environmental data :
La pluviométrie dans les zones de production varie de 1 200 mm à 1 500 mm.
La temperature maximale est 35°c et la température minimale, 18°c
Il y a six mois de saison sèche (novembre à mai) cinq mois de saison humide (juin à octobre).

Cashew Production data

Table A4.2. Cote d'Ivoire - annual raw cashwenut production figures from 1970 - real or estimated

Year	Number of tonnes of raw nuts PRODUCED	Source of information If estimated put "Est"	Production figures from the FAO STAT database *[1]
1970			300
1971			400
1972			380
1973			224
1974			350
1975			450
1976			350
1977			500
1978			500
1979			550
1980			600
1981			1,100
1982			1,300
1983			2,200
1984			2,200
1985			3,500
1986			6,000
1987			5,000
1988			3,000
1989			9,000
1990			7,000
1991			9,000
1992			10,000
1993			20,000
1994			20,000
1995			20,000
1996			20,000
1997			21,000
1998			28,000
1999			28,000
2000			28,000

*[1]-These data are for comparison only and mignt not be correct, so please complete the other columns from your own information sources.

Notes for above table :-

--

Table A4.3. Cote d'Ivoire - annual raw cashwenut EXPORT figures from 1970 (NB No data prior to 1980).

Year	Number of tonnes of raw nuts EXPORTED	Country / Countries raw nuts exported to	Source of information il estimated put "Est"
1979			
1980	500	Inde	Document interne CNRA
1981			
1982			
1983	3 000	Inde	"
1984			
1985			
1986			
1987			
1988			
1989			
1990			
1991			
1992	7 000	Inde	"
1993	14 000	Inde	"
1994			
1995			
1996	26 000	Inde	"
1997	51 000	Inde	"
1998			
1999	80 000	Inde	"
2000			

Notes for above table :-

La hausse des prix d'achat aux producteurs a entraîné l'accroissement des superficies cultivées ; ce qui explique l'augmentation de la qualité de noix exportées.

Table A4.4. Cote d'Ivoire - annual raw cashwenut PROCESSING figures from 1970 (NB No data prior to 2000).

Year	Number of tonnes of raw nuts PROCESSED IN COUNTRY		Source of information il estimated put "Est"
	By hand	Mechanically	
1996			
1997			
1998			
1999			
2000	1 400 T	2 000 T	SODIRO et CAJOUCI

Notes for above table.

--

What happens to the processed cashewnuts ?
Are they exported (if so, to where ?) or consumed locally ?

La capacité d'usinage des deux unités de transformation ivoiriennes (SODIRO et CAJOU-CI) n'excède pas 5 000 tonnes.

Processing capacity

Hand processing
Describe what is available in terms of equipment used, where is it manufactures, number of units, ect.

Environ 1 400 T/an pour la SODIRO

The equipment for the SODIRO factory was virtully all imported from India, and therefore uses the Indian style of hand shelling machines.

Mechanical or factory processing
Details of factories
--

Number : -
1

Type of processing : -
Oltremare

Capacity : -
2000 T/an pour CAJOU-CI

Les unités de transformation de Korhogo et d'Odienné ont les deux composantes :
- manuel
- mécanique

Research capacity
Main cashew research station : - Station de recherche de Lataha/Korhogo
Sub-stations involved with cashew : - Station de recherche de Lataha/Korhogo

TableA4.5. Cote d'Ivoire - Full-time senior cashew research personnel

Name	Education / qualification	Area of research Eg breeding, pathology	Based where
DJAHA Akadié J.B.	Ingénieur + DEA	Agronomie et Physiologie	Station de Lataha Korhogo

Total number of full-time cashew research tehnicians : - 01

Comments on staffing levels and quality of staff : -
Other part time personnel :-
1. COULIBALY Félix, Phytopathologiste
2. HALA N'Klo, Entomologiste
3. N'DA Adopo Achille, Physio-biochimiste
4. KOFFI Edo, Technicien Supérieur de Recherche (Agronomie)
5. ILBOUDO Denis, Auxiliaire Technique

Table A4.6. Cote d'Ivoire - Annual cashew research budget

Year	Amount	Comments
1995	-	
1996	-	
1997	-	
1998	-	
1999	-	
2000	-	

Jusqu'à présent aucun fond n'a été affecté à la recherche sur l'anacardier.

Il n'existe pas de sous-station. Mais lorsque certaines informations sont nécessaires, les parcelles paysannes sont sollicitées pour confirmer ou infirmer celles obtenues en station.

Cote d'Ivoire – Cashew extension capacity
Briefly describe how cashew extension works along with the level of investment and input into this in the country.

L'ANADER (Agence nationale d'Appui au Développement Rural) est le principal service d'encadrement de la culture de l'anacardier. L'ANADER utilise deux méthodes :

- la formation des paysans au champ à travers les parcelles test et les unités de démonstration : cas des petits exploitants.
- Le conseil de gestion qui concerne les exploitations d'un haut niveau et les agriculteurs qui maîtrisent l'itinéraire technique de la culture.

L'ANADER est appuyé par certaines ONG (ARK, ARN) et projet (CECI) qui assurent aussi la diffusion des informations techniques en milieu rural.

Cote d'Ivoire – General information on existing farmers trees
For each major cashew region or district complete the following : -

1. Name of region or district : - Nord de la Côte d'Ivoire
2. Estimate approximately what percentage of the total trees were planted in the following time periods : -

Before 1970 (trees > 30 years old)	5%
1970-1980 (trees 20 to 30 years old)	10%
1980-1990 (trees 10 to 20 years old)	15%
1990-2000 (trees 1 to 10 years old)	70%

3. Did the farmers use seed or grafted seedlings or both as planting material ? If necessary answer for each time period separately.
   Les exploitants utilisent
   Les noix d'anacarde comme semence
4. Where did the farmer obtain the planting material (extension service, trader, from his own trees of from another farmer) ?
   If necessary answer for each time periode separately
   Jusqu'en 1990, la plupart des vergers ont été créés gratuitement. Actuellement des exploitants achète ses semences à la Station CNRA de Lataha.
5. Where did the planting material come from if it was not local (i.e. contry of origin) ?
   Brésil, pays limitrophes.

   If necessary answer for each time period separately
   Local

Repeat for each major cashew region or district

Région Nord de la Côte d'Ivoire :

- Odienné
- Tengrela
- Korhogo
- Ferké
- Boundiali
- Dabakala
- Séguéla
- Mankono
- Bondoukou
- Tanda
- Bouna
- Katiola

Zones d'extensions :
- Centre de la Côte d'ivoire
* Daoukro
* Tiébissou
* M'Bahiakro
- Est de la Côte d'Ivoire
* Agnilbilékrou
- Ouest de la Côte d'Ivoire
* Touba

Information on existing breeders blocks or selected planting material of interest.

A. Formal breeders triais

Please provide information on all formal breeders'trials as follows : -

Location and name of block : -.....
Date planted : -.....
Number of years of reliable yield and other data : -.....

Table A4.7. Description of cashew breeding trials at.....

Accession name or number *1	No. of reps	No.of entries per rep	Origin-country or region	Planted as seed or graft	Average yield/tree kg	Nut weight, gm	Other comments, i.e. useful characteristics
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
Etc.							

*1 –If the original accession number has changed, put the original name/number in the comments column.

Notes for above table

--

Copy above table and repeat for each major separate trial.

Characteristics of important breeding material

Referring to accessions listed in breeder's tables above, please provide additional information on accessions of most importance.

Table A4.8. Additional information on the most important breeders material.

Accession name or number	Tree height at maturity, metres	Nut size, big, medium, small	Apple colour	Leaf shape	Leaf size	Other comments, i.e. useful characteristics
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8. etc						

Notes for above table

--

Information on other cashew planting material which is not included in formal breeders, trials, either because its potential is stille being evaluated (i.e. trees in farmers fields) or because it is being followed-up in on-farm trials after release from the research institute.

Please provide details.

--

Pest and diseases of cashew in Cote d'Ivoire. (See Table A4.9.)

Please arrange in order of economic importance all significant pests and diseases. Do not include very minor pest and disease. Include a brief description of damage and its economic importance, known natural control information and other recommended control methods: -

Insectes : Helopettis, Borer, Thrips, punaises, termites
Maladies : Anthracnose (très faible)
Autres problèmes : Feux de brousse, divagation des animaux, rongeurs.

Table A4.9. Cote d'Ivoire pests and diseases of importance.

Common name	Local name	Species	Damage	Known natural control information	Other recommended control methods
Punaises		Helopettis	Cause le dessèchement des rameaux floraux. Il y a alors baisse de la production.	Aucun traitement n'est fait en milieu paysan.	
Borer			Creusent des galeries dans les troncs et les branches des arbres. Il s'ensuit le dépérissement et la mort soit de la branche atteinte soir de tout l'arbre.	Lutte mécanique : suppression des parties de végétal atteintes	
Anthracnose			Pourriture des fruits	Pas de traitement	
Autres problèmes : - Feux de brousse - Divagation des animaux - Rongeurs					

Literature

Please list all important internationally and regionally published papers and reports (including consultants reports) emanating from Cote d'ivoire regarding cashew.

1-/ Symposium Anacarde à Yamoussoukro, du 12 au 14 juin 1997.

2-/ REY (J.Y.) – Présentation de la filière "Anacarde" en Côte d'Ivoire. Document interne CNRA.

3-/ DJAHA (A.J.B.), 1999 – Synthèse d'informations sur la culture de l'anacardier. Document interne CNRA.

ANNEX 5

WEST AFRICA CASHEW SURVEY 2001

QUESTIONNAIRE GHANA

Completed by :-

Dr. A. K. ASANTE and members of the November 2000 stakeholders meeting financed by ADRA.

Environmental data

Table A5.1. Ghana - average monthly environmental data - GREATER ACCRA

Month	Rainfall Mm	Humidity	Maximum temperature	Minimum temperature	Phenology *[1]
January	11.2	70.8	32.1	23.4	
February	22.7	73.1	32.1	24.1	Harvesting
March	57.1	74.9	32.5	24.3	Harvesting
April	96.8	76.4	32.2	24.3	
May	131.1	78.7	31.2	24.0	
June	221.9	82.5	29.2	23.5	
July	66.0	82.4	28.0	22.7	
August	28.2	80.9	28.0	22.3	
September	67.3	80.1	29.1	22.4	Flushing
October	61.7	79.8	30.5	22.9	Panicle Em
November	27.7	77.9	30.5	29.0	Flowering
December	18.1	75.4	30.4	29.1	

Table A5.2. Ghana - average monthly environmental data - KOFORIDUA EASTERN REGION

Month	Rainfall Mm	Humidity	Maximum temperature	Minimum temperature	Phenology *[1]
January	31.9	69.1	32.8	20.5	
February	65.9	68.1	33.9	21.8	Harvesting
March	107.0	75.1	33.3	22.1	Harvesting
April	132.4	79.8	32.9	22.3	
May	157.5	82.8	31.8	22.1	
June	203.8	85.1	29.9	22.0	
July	138.0	85.9	28.6	21.7	
August	93.7	85.0	28.5	21.6	
September	171.9	83.4	29.7	21.9	Flushing
October	223.6	81.9	31.1	21.9	Panicle Em
November	60.5	79.3	31.9	21.6	Flowering
December	41.7	79.1	31.6	20.8	

Table A5.3. Ghana - average monthly environmental data - TAMALE-NORTH. REGION

Month	Rainfall Mm	Humidity	Maximum temperature	Minimum temperature	Phenology *[1]
January	2.1	25.6	35.4	19.5	
February	8.6	28.2	37.6	22.9	Harvesting
March	52.4	38.5	37.7	25.1	Harvesting
April	82.5	55.7	35.9	25.0	
May	114.3	66.2	33.9	24.1	
June	158.1	76.0	31.5	22.7	
July	158.1	79.2	30.2	22.4	
August	200.6	80.7	29.8	22.2	
September	231.4	81.9	30.5	21.9	Flushing
October	75.8	72.5	33.1	22.3	
November	11.1	51.3	35.2	20.9	Panicle Em., Flowering
December	3.6	34.9	35.0	18.8	

*[1] - enter months of flushing (new red shoots), panicle emergence, flowering, harvesting; if there are two separate periods of flushing etc, please add.

Comments regarding environmental data:

Rainfall data covers 30 years

Table A5.4. Ghana - average monthly environmental data - KUMASI-ASHANTI REGION

Month	Rainfall Mm	Humidity	Maximum temperature	Minimum temperature	Phenology *1
January	15.1	19.0	31.9	20.4	
February	63.1	21.0	33.4	22.0	Harvesting
March	132.5	24.6	32.9	22.4	Harvesting
April	129.3	26.4	32.2	22.3	
May	174.3	26.7	31.2	22.2	
June	216.3	26.4	29.5	21.6	
July	157.5	33.1	28.1	21.2	
August	90.8	24.9	27.7	21.0	
September	168.7	25.7	28.6	21.3	Flushing
October	155.2	26.1	30.1	21.5	
November	74.0	25.5	31.2	21.7	Panicle Em., Flowering
December	25.5	22.7	30.6	20.8	

*1 - enter months of flushing (new red shoots), panicle emergence, flowering, harvesting; if there are two separate periods of flushing etc, please add.

Comments regarding environmental data:
Rainfall data covers 30 years

Cashew Production Data

Table A5.5. Ghana - annual raw cashewnut production figures from 1985 – real or estimated

Year	Number of tonnes of raw nuts PRODUCED	Source of information If estimated put "Est".	Production figures from the FAO STAT database *1
1985			0
1986			0
1987			500
1988			500
1989			500
1990	75	Technoserve	500
1991	90	- do -	500
1992	100	- do -	500
1993	140	- do -	500
1994	200	- do -	1,000
1995	300	- do -	1,000
1996	550	- do -	1,500
1997	700	- do -	7,500
1998	1010	- do -	7,500
1999	2239	- do -	7,500
2000	5000	Est	7,500

*1 - These data are for comparison only and might not be correct, so please complete the other columns from your own information sources.

Notes for above table.
These are the only data available.

Table A5.6. Ghana - annual raw cashewnut EXPORT figures from 1990

Year	Number of tonnes of raw nuts EXPORTED	Country/ countries raw nuts exported to	Source of information If estimated put "Est".
1990	15.5	India, UK. USA	Ghana Export
1991	30.0	- do -	Promotion
1992	50.7	- do -	Council
1993	120.0	- do -	(GEPC)
1994	600.0	- do -	
1995	289.0	- do -	
1996	541.3	- do -	
1997	3571.6	- do -	
1998	1822.6	- do -	
1999	5571.6	- do -	
2000			

Notes for above table.

Cashew export started only in 1990.

Export figures (Table A5.6) are greater than production figures (Table A5.5), this is because of cross-border trade mainly from Cote D'Ivoire to Ghana.

Table A5.7. Ghana - annual cashewnut processing figures from 1994

Year	Number of tonnes of raw nuts PROCESSED IN COUNTRY		Source of information If estimated put "Est".
	By hand	Mechanically	
1994			
1995	3		
1996	5		
1997	8		
1998	18		
1999	28		
2000	60		

Notes for above table.

Processing figures do not include production from Thaitec (in Accra), the first cashew processing factory in Ghana.

What happens to the processed cashewnuts?

Cashewnuts processed in Ghana are sold locally. However, in 1999 the first trial export of 0.5 MT. of cashewnuts was made to the United Kingdom

Processing capacity

Hand processing

Describe what is available in terms of equipment used, where is it manufactured number of units, etc.

Small scale processing units use steamers, cutters/shellers and dryers (ovens). All processing equipment are fabricated in Ghana. Only one processing unit uses a mechanical roaster. Currently there are 13 small scale processing units in Ghana

Mechanical or factory processing.

Details of factories:-

None

Number:

None.

Ghana - Research capacity

Main cashew research station:- CRI, Kumasi.
Sub-stations involved with cashew:- Ejura, Pokuase, Nyankpala-Tamale

Table A5.8. Ghana - Part-time senior cashew research personnel

Name	Education/ qualification	Area of research Eg breeding, pathology	Based where
Nutsugah	Ph.D	Agronomy	SARI, Tamale
Yidana	Ph.D	Agronomy/Breeding	UDS, Tamale
Opoku-Ameya	Ph.D	Agronomy	CRIG, Tafo
Mpere	M.Sc.	Agronomy	PGRC, Bunso
??	Ph.D	Agronomy	KNUST
??	Ph.D	Agronomy	LEGON
Asante	Ph.D	Agronomy, Breeding, Entomology, Pathology	CRI

Total number of full-time cashew research technicians:
None

Comments on staffing levels and quality of staff:-
All the staff are engaged in at least one or two assignment plus cashew. No one is a full time cashew research officer, all the above staff are only working between 5 and 10% of their time on cashew.

Table A5.9. Ghana - Annual cashew research budget

Year	Amount	Comments
1995		
1996		
1997		
1998	¢ 23,000,000	Nothing has been received since then.
1999		
2000		

Cashew extension capacity
Briefly describe how cashew extension works along with the level of investment and input into this in the country.

In Ghana cashew extension is carried out by both MOFA and the NGOs. Notable among the NGOs are ADRA, Technoserve and Cashpro. They are engaged in:

1. Training farmers and entrepreneurs on post harvest handling, processing.
2. Arrangement of equipment for farmers
3. Introduce appropriate technologies to farmers.
4. Sponsor group of farmers on educational tours
5. To assist processors to own processing plant
6. To help farmers to build own warehouses
7. To help farmers with Agro chemicals, cutlasses and spraying machines
8. To assist farmers during picking of cashew nuts
9. To disseminate Agricultural information and link them to the NGOs.

Information on existing breeders blocks or selected planting material of interest.

A. Formal breeders trials
Please provide information on all formal breeders' trials as follows:-

Location and name of block:- Pokuase, CRI Experimental Field.

Date planted:- 22/2/2000

Number of years of reliable yield and other data:- None

Table A5.10. Description of cashew breeding trial at Pokuase

Accession name or number *1	No. of reps	No. of entries per rep	Origin - country or region	Planted as seed or graft	Average yield/ tree Kg	Nut weight , gm	Other comments, i.e. useful characteristics
1. AK 2000-01	1	5	Ghana	Seed	-	-	
2. AK 2000-02	1	5	Ghana	Seed	-	-	
3. AK 2000-03	1	5	Ghana	Seed	-	-	
4. AK 2000-04	1	5	Ghana	Seed	-	-	
5. AK 2000-05	1	5	Ghana	Seed	-	-	
6. AK 2000-06	1	5	Ghana	Seed	-	-	
7. AK 2000-07	1	5	Ghana	Seed	-	-	
8. AK 2000-08	1	5	Ghana	Seed	-	-	
9. AK 2000-09	1	5	Ghana	Seed	-	-	
10. AK 2000-10	1	5	Ghana	Seed	-	-	
11. AK 2000-11	1	5	Ghana	Seed	-	-	
12. AK 2000-12	1	5	Ghana	Seed	-	-	
13. AK 2000-13	1	5	Ghana	Seed	-	-	
14. AK 2000-14	1	5	Ghana	Seed	-	-	
15. AK 2000-15	1	5	Ghana	Seed	-	-	
16. AK 2000-16	1	5	Ghana	Seed	-	-	
17. AK 2000-17	1	5	Ghana	Seed	-	-	
18. AK 2000-18	1	5	Ghana	Seed	-	-	
19. AK 2000-19	1	5	Ghana	Seed	-	-	
20. AK 2000-20	1	5	Ghana	Seed	-	-	

*1 – If the original accession number has changed, put the original name/number in the comments column.

Notes for above table.
The plots have just been established

Location and name of block:- Ejura, CRI Experimental Field
Date planted: 20/5/98
Number of years of reliable yield and other data:- None

Table A5.11 . Description of cashew breeding trial at Ejura

Accession name or number *1	No. of reps	No. of entries per rep	Origin - country or region	Planted as seed or graft	Average yield/tree Kg	Nut weight , gm	Other comments, i.e. useful characteristics
1. E98-01	1	8	Brazil	Seed	Gm		
2. E98-02	1	8	Brazil	Seed	Gm		
3. E98-03	1	8	Brazil	Seed	Gm		
4. E98-04	1	8	Brazil	Seed	Gm		
5. E98-05	1	8	Brazil	Seed	Gm		
6. E98-06	1	8	Brazil	Seed	Gm		

* - If the original accession number has changed, put the original name /number in the comments column.

Notes for above table.
Trees are not bearing

Location and name of block: - CRIN, EASTERN REGION

Number of years of reliable yield and other data:- 5 years

Table A5.13. Description of cashew breeding trial at BOLE

Accession name or number *[1]	No. of reps	No. of entries per rep	Origin - country or region	Planted as seed or graft	Average yield/ tree Kg	Nut weight, gm	Other comments, i.e. useful characteristics
1. RIT I	1	10	Openmarket	Seed	5.2	4.8	
2. RIT II	1	10	- do -	Seed	6.8	5.4	
3. R2T 4	1	10	- do -	Seed	7.0	4.8	
4. R2T8	1	10	- do -	Seed	5.8	6.6	
5. R3T I	1	10	- do -	Seed	6.2	5.2	
6. R3 T 3	1	10	- do -	Seed	8.9	5.6	
7. R3T 5	1	10	- do -	Seed	6.8	5.4	
8. R3T II	1	10	- do -	Seed	5.3	4.6	
9. R5T 14	1	10	- do -	Seed	7.8	4.5	
10. R6T17	1	10	- do -	Seed	6.3	4.5	
11. R7T1	1	10	- do -	Seed	5.2	4.9	
12. R7T 14	1	10	- do -	Seed	6.6	5.2	
13. R9T4	1	10	- do -	Seed	5.8	4.6	
14. R9T12	1	10	- do -	Seed	5.4	4.8	
15. R14T1	1	10	- do -	Seed	5.5	3.9	
16. R15T14	1	10	- do -	Seed	6.3	5.5	
17. R15T16	1	10	- do -	Seed	5.6	4.9	
18. R25T6	1	10	- do -	Seed	5.6	4.7	
19. R25T7	1	10	- do -	Seed	5.1	5.3	
20. R 25T9	1	10	- do -	Seed	5.9	4.4	

Notes for above table - Seed just purchase from the market in groups of 10 nuts and planted!
Average data for 5 years

Location and name of block: - Nyankpala Horticultural Plots, UDS, Tamale
Date planted:- 1997
Number of years of reliable yield and other data:- None

Table A5.12 . Description of cashew breeding trial at UDS

Accession name or number *[1]	No. of reps	No. of entries per rep	Origin - country or region	Planted as seed or graft	Average yield/tree Kg	Nut weight, gm	Other comments, i.e. useful characteristics
1. RA 1	1	8	Ghana	Seed		3.70	
2. NAA 2	1	8	Ghana	Seed		5.56	
3. KK 3	1	8	Ghana	Seed		5.56	
4. SO 4	1	8	Ghana	Seed		5.43	
5. V 5	1	8	Ghana	Seed		4.76	
6. A 6	1	8	Ghana	Seed		6.21	
7. RL 7	1	8	Ghana	Seed		10.0	
8. JSS 8	1	8	Ghana	Seed		5.26	
9. AM 9	1	8	Ghana	Seed		5.88	
10. TK 10	1	8	Ghana	Seed		5.46	
11. AM 11	1	8	Ghana	Seed		10.0	
12. A 12	1	8	Ghana	Seed		6.67	
13.MFM 13	1	8	Ghana	Seed		4.00	
14. RB 14	1	8	Ghana	Seed		4.16	
15. FE 15	1	8	Ghana	Seed		6.62	
16. CKB 16	1	8	Ghana	Seed		4.54	
17. T 17	1	8	Ghana	Seed		4.16	
18. SCA 18	1	8	Ghana	Seed		5.71	
19. AM 19	1	8	Ghana	Seed		6.25	
20. SO 20	1	8	Ghana	Seed		3.03	
21. BY 21	1	8	Ghana	Seed		5.95	
22. DD. 22	1	8	Ghana	Seed		5.78	
23. EV 23	1	8	Ghana	Seed		6.53	
24. MFA 2	1	8	Ghana	Seed		6.49	
25. AE 25	1	8	Ghana	Seed		6.25	
26. VAS 27	1	8	Ghana	Seed		6.25	
27. AG 27	1	8	Ghana	Seed		3.70	
29. BS 29	1	8	Ghana	Seed		7.69	
30. KS 30	1	8	Ghana	Seed		6.25	

* - If the original accession number has changed, put the original name /number under comments.

Notes for above table:

Nut weight is from the mother tree, data represents only 1 year.
Only the first 30 out of 60 accessions are shown in Table A5.12.

Information on other cashew planting material which is not in formal trials.
There could be other cashew planting material which is not included in formal breeders trials, either because its potential is still being evaluated (i.e. trees in farmers fields) or because it is being followed-up in on-farm trials after release from the research institute.

Please provide details.
Not available

Ghana - General information on existing farmers trees
For each **major** cashew region or district complete the following:-

Name of region or district:- Greater Accra
Estimate approximately what percentage of the **total** trees were planted in the following time periods:-

Before 1970 (trees >30 years old)	3%
1970-1980 (trees 20 to 30 years old)	10%
1980-1990 (trees 10 to 20 years old)	10%
1990-2000 (trees 1 to 10 years old)	77%

Did the farmers use seed or grafted seedlings or both as planting material?
Seeds are mostly used: By seed
Where did the farmer obtain the planting material (extension service, trader, from his own trees or from another farmer)?
Extension service (90%) others collect from other farmers (10%)
Where did the planting material come from if it was not local (i.e. country of origin)?
Brazil, Nigeria,Mozambique

Name of region or district:- Ashanti
Estimate approximately what percentage of the **total** trees were planted in the following time periods:-

Before 1970 (trees >30 years old)	10%
1970-1980 (trees 20 to 30 years old)	12%
1980-1990 (trees 10 to 20 years old)	7%
1990-2000 (trees 1 to 10 years old)	71%

Did the farmers use seed or grafted seedlings or both as planting material?
Seed.
Where did the farmer obtain the planting material (extension service, trader, from his own trees or from another farmer)?
Extension service (80%) others collect from other farmer
Where did the planting material come from if it was not local (i.e. country of origin)?
India, Nigeria, Brazil, La Cote D`voire

Name of region or district:- Northern Region
Estimate approximately what percentage of the **total** trees were planted in the following time periods:-

Before 1970 (trees >30 years old)	10%
1970-1980 (trees 20 to 30 years old)	5%
1980-1990 (trees 10 to 20 years old)	7%
1990-2000 (trees 1 to 10 years old)	78%

Did the farmers use seed or grafted seedlings or both as planting material?
Seed.
Where did the farmer obtain the planting material (extension service, trader, from his own trees or from another farmer)?
Extension Service (90%) others collect from other farmers (10%)
Where did the planting material come from if it was not local (i.e. country of origin)?
Brazil, Nigeria, Mozambique

Name of region or district:- EASTERN REGION

Estimate approximately what percentage of the **total** trees were planted in the following time periods:-

Before 1970 (trees >30 years old)	2%
1970-1980 (trees 20 to 30 years old)	5%
1980-1990 (trees 10 to 20 years old)	10%
1990-2000 (trees 1 to 10 years old)	83%

Did the farmers use seed or grafted seedlings or both as planting material?

Seeds are mostly used

Where did the farmer obtain the planting material (extension service, trader, from his own trees or from another farmer)?

Mostly from extension service (90%) others collect from other farmers

Where did the planting material come from if it was not local (i.e. country of origin)?

Brazil, Nigeria

Pest and diseases of cashew in Ghana.

Please arrange in order of economic importance all significant pests and diseases. Do not include very minor pests and disease

Species: *Anocplocnermis curvipes*

Common name: Pod sucking bug

Local language name: Atee

Order Hemiptera:

Family: Coreidae

Brief description of damage and its economic importance:-

The damage cause shrinkage and dropping of immature fruits

Known natural control information

No work has been done

Other recommended control methods

Application of various systemic insecticide using motorized blower.

Other comments:-

Live on young shoots and foliage

Species: Helopeltis antonii (more likely *Helopeltis anacardii*)

Common name: tea mosquito (Sucking bug)

Local language name -

Order: Heteroptera

Family: Miridae

Brief description of damage and its economic importance:-

Attacks inflorescence causing blight

Known natural control information:

None yet

Literature

Please list all important internationally and regionally published papers and reports (including consultants reports) emanating from Ghana regarding cashew.

1. Majeed, C.A. (1991). Cashew development in Ghana. International Trade Centre, UNCTAD/GATT. Project No. Gha/87/004
2. Dontor, Albert (1990). The cashew- A potential export crop. Export product development, Agricultural Section. P.16-19
3. The Cashew industry in Ghana. A report on a meeting of stakeholders of the cashew industry in Ghana. November 2000

ANNEX 6

WEST AFRICA CASHEW SURVEY 2001

QUESTIONNAIRE NIGERIA

Completed by :-
Mr. E. Akin Ayodele
Mr. Patrick O. Adebola

Environmental data

Table A6.1. Nigeria – average monthly environmental data

Month	Rainfall mm	Humidity	Maximum temperature	Minimum temperature	Phenology*[1]
		N/A			Flowering
January	1.9	N/A	32°c	22°c	Harvesting
February	4.3	"	34°c	23°c	Harvesting
March	12.5	"	32°c	23°c	Harvesting
April	30.5	"	31°c	23°c	-
May	29.5	"	30°c	22°c	-
June	42.3	"	28°c	21°c	
July	52.0	"	26°c	21°c	Flush
August	54.0	"	25°c	20°c	Flush
September	58.0	"	26°c	21°c	Panicle emerge
October	31.4	"	28°c	21°c	Panicle emerge
November	14.2	"	31°c	22°c	Flowering
December	4.6	"	32°c	21°c	Flowering

*[1] – enter months of flushing (new red shoots), panicle emergency, flowering, harvesting; if there are two separate periods of flushing etc, please add.

Comments regarding environmental data:
R/H not immediately available.

Table A6.2. Nigeria – annual raw cashewnut production figures from 1970

YEAR	Number of tonnes of raw nuts PRODUCED	Source of information If estimated put "Est"	Production figures from the FAO STAT database*1
1970	727	"EST"	25,000
1971	2,000	"	25,000
1972	2,000	"	25,000
1973	2,300	"	25,000
1974	2,000	"	25,000
1975	2,100	"	25,000
1976	2,500	"	25,000
1977	2,500	"	25,000
1978	2,500	"	25,000
1979	3,000	"	25,000
1980	15,000	"	25,000
1981	18,500	"	25,000
1982	20,000	"	25,000
1983	18,600	"	25,000
1984	16,750	"	25,000
1985	16,000	"	25,000
1986	15,000	"	25,000
1987	15,000	"	25,000
1988	15,000	"	25,000
1989	18,000	"	25,000
1990	22,000	"	30,000
1991	25,000	"	45,000
1992	25,000	"	55,000
1993	25,933	"	75,000
1994	27,480	"	85,000
1995	28,389	"	95,000
1996	30,000	"	110,000
1997	36,000.	"	125,000
1998	36,000.	"	152,000
1999	39,000	"	176,000
2000	40,000	"	176,000

*[1] These data are for comparison only and might not be correct, so please complete the other columns from your own information sources.

Notes for above table:
The estimation of tonnage was based on the actual hectarage and on the production of 0.6 metric tonne/ha.

Table A6.3. Nigeria annual raw cashewnut EXPORT figures from 1970

YEAR	Number of tonnes of raw nuts EXPORTED	Country/countries raw nuts exported to	Source of information if estimated put "Est"
1970	727	NA	Nigeria port Authority and Federal Produce Inspection Service.
1971	NA	"	
1972	"	"	
1973	"	"	
1974	"	India	
1975	"	NA	
1976	"	"	
1977	"	"	
1978	3,000	"	
1979	NA	"	
1980	"	"	
1981	"	"	
1982	"	"	
1983	"	"	
1984	"	"	
1985	"	"	
1986	"	"	
1987	"	"	
1988	"	"	
1989	6,100	"	CBN Annual Report 1991 and Nigerian Port Authority, Lagos
1990	6,200	"	
1991	10,280	"	
1992	12,160	"	
1993	10,593	"	"
1994	14,785	"	"
1995	1,960.	"	Federal Produce Inspection Service
1996	9,214	"	
1997	NA	"	
1998	18,000	"	EST
1999	25,000.	"	"
2000	25,000	"	"

NA – Not available.

Notes for above table:
Generally 25% of annual production is processed

Table A6.4. Nigeria – annual cashewnut processing figures from 1970

Year	Number of tonnes of raw nuts PROCESSED IN COUNTRY		Source of Information if estimated put "Est"
	By hand	Mechanically	
1970	NA	NA	
1972	"	"	
1973	"	"	
1974	"	"	
1975	"	"	
1976	"	"	
1977	"	"	
1978	"	"	
1979	"	"	
1980	"	"	
1981	"	"	
1982	"	"	
1983	"	"	
1984	"	"	
1985	"	"	
1986	"	"	
1987	"	"	
1988	"	800	From CRIN Records.
1989	"	NA	
1990	"	"	
1991	"	"	
1992	"	"	
1993	"	"	
1994	"	"	
1995	"	"	
1996	"	"	
1997	"	"	
1998	"	"	
1999	"	"	
2000	"	"	

NA – Not available.

Notes for the above table:

Generally 25% of annual production is processed.

What happens to the processed cashew nuts?

Are they exported (if so, to where?) or consumed locally?

They are exported to Europe, including Russia and U.S.A.

Processing capacity

Hand processing

Describe what is available in terms of equipment used, where is it manufactured, number of units, etc.

Not known

Mechanical or factory processing

Details of factories:

Mechanical Processing Factories.:-

(i)	Premier Cashew Processing Ltd., Akama, Oghe, Enugu State	1,500 tonnes
(ii)	Cashew nut Processing Industry Ltd., Eleyele, Ibadan.	800 tonnes
(iii)	Asafra International (Nigeria) Ltd., Owerri, Imo State	1,000 tonnes
(iv)	JOF Ideal Family Ltd., Plot 6/7, Light Independent Estate, Owo.	750 tonnes
(v)	Reliance Owerri	750 tonnes

Type of processing:
Mechanical Processing into roasted nut

Capacity:-
Factories have capacities between 750 and 1500 metric tones of kernels/annum.

Nigeria – Research capacity

Main Cashew Research Station:- Headquarters, Cocoa Research Institute of Nigeria, PMB 5244, Ibadan, Oyo State. Nigeria.
Sub-stations involved with Cashew:- CRIN Substation, Ochaja, Kogi State – Nigeria
CRIN Substation, Uhonmora, Edo State – Nigeria.

Table A6.5. Nigeria- Part-time senior cashew research personnel

Name	Education/ qualification	Area of research e.g. breeding, pathology	Based where
Mr. E. Akin Ayodele	B.Sc. M.Sc.	Soil Scientist	Ibadan
Dr. E.B. Esan	B.Sc. Ph.D	Breeder	Ibadan
Dr. A.A. Adeyemi	B.Sc. M.Sc. Ph.D.	Agronomist/FSR	Ibadan
Dr(Mrs) F.A. Okelana	B.Sc. M.Sc. Ph.D	Entomologist	Ibadan
Dr. O. Olubamiwa	B.Sc. M.Sc. Ph.D	Animal Scientist	Ibadan
Mr. T.C.N. Ndubuaku	B.Sc. M.Sc	Entomologist	Ibadan
Rev. O.O. Oduwole	B.Sc. M.Sc.	Agric Economist	Ibadan
Dr. A.O. Famaye	B.Sc. M.Sc. Ph.D	Agronomist	Ibadan
Mr. S.O. Agbeniyi	B.Sc. M.Sc. M.phil	Pathologist	Ibadan
Mr. P.O Adebola	B.Sc. M.Sc. M.phil	Breeder	Ibadan
Mrs. T.O Akinwale	B.Sc. M.Sc.	Food Scientist	Ibadan
Mr. O.S. Ibiremo	B.Sc. M.Sc	Soil Scientist	Ibadan
Mr. L.E. Yahaya	B.Sc. Msc.	Chemist	Ibadan
Mr. O.M Aliyu	B.Sc. M.Sc.	Breeder	Ibadan
Dr. T. Adejumo	B.Sc. M.Sc. Ph.D	Pathologist	Ibadan
Mr. R. Shittu	B.Sc. M.Sc.	Agric. Economist	Ibadan
Mrs. E.A. Adeyemi	B.Sc. M.Sc.	Agronomist/FSR	Ibadan
Mr. S.O. Aroyeun	B.Sc.	Food Scientist	Ibadan
Mr. H.A. Otunoye	B.Sc.	Pathologist	Ibadan
Mr. L.A. Ahmed	B.Sc	Agronomist	Ibadan

Total number of full-time Cashew research technicians: 10

Comments on staffing levels and quality of staff : Adequate

Other comments:
The above scientists work on 5 crops.

Table A6.6. Nigeria – Annual Cashew research budget

Year	Amount	Comments
1995	$2,000	Partly World Bank Assisted
1996	$4,200	"
1997	$20,000	"
1998	$28,000	"
1999	$10,000	Nigeria Government Funding
2000	$12,000	"

Cashew extension capacity
Briefly describe how cashew extension works along with the level of investment and input into this in the country:

1. In order to sustain and increase production, the latest production techniques and processing technologies are made available to farmers. This has been achieved through the extension staff of ADP and Ministry of Agriculture.
2. Subsidized land clearing facilities through the appropriate agencies.
3. In-put supply such as planting materials, fertilizers, chemicals to be supported by government and processors
4. Publicity to enhance farmers' awareness of on-farm campaign regarding advances in the maintenance of their farms
5. Production of farmers guides in relation to control of diseases and establishment methods.
6. Ready market that will accept cashew produce.
7. Establishment of linkages with the ADPs to effect distribution of inputs.
8. Release of selected high yielding genotypes to farmers to increase their production.

GENERAL INFORMATION ON EXISTING FARMERS TREES

Table A6.7. Information on existing farmers trees in various regions of Nigeria.

Name of Region	Percentage of Total trees planted				Type of Planting Material	Source of Planting Material	Country of Origin
	Before 1970	1970 - 1980	1980-1990	1990-2000			
1. Oyo State	60	20	10	10	By seed	Extension Services, from his own tree from other farmers and from imported nuts.	Nigeria, Brazil, Tanzania, India, Kenya and Mozambique
2. Osun State	60	20	10	10	By seed	"	"
3. Kwara State	20	20	50	10	By seed	"	Nigeria, Brazil
4. Kogi State	25	50	10	15	By seed	"	Nigeria, Brazil, India
5. Benue Stat	20	25	40	15	By seed	Local/imported	Kenya, Tanzania and Mozambique/local selected Brazilian nuts.
6. Abuja F.C.T	10	10	20	60	By seed	"	Local
7. Nassarawa	20	20	40	20	By seed	"	Local
8. Taraba State	10	10	20	60	By seed and by grafted seedlings	"	Local
9. Cross River	5	10	15	70	By seed	"	Local and imported nut from Brazil
10. Enugu State	60	10	10	20	By seed	"	

Notes on the above table:- The estimate of 10 out of the 36 states of the Federation that grows cashew can only be given. It should be noted that the crop is grown in all ecological regions of the country from the rainforest to the sahel Savannah.

Information on existing breeders blocks or selected planting material of interest.
Formal breeders trials.

Location and Name of block.- N8/1 cashew plot, CRIN HQs.
Date planted:- 20th July 1983
Number of years of reliable data:- 6.

Table A6.8. Description of Cashew breeding trial at CRIN HQs

S/N	Accession name or number	No. of reps	No of entries per rep.	Origin country or region	Planted as seed or graft	Average yield/tree kg	Nut weight gm	Other comments i.e. useful characteristics.
1	G008	4	1	Local	Seed	12-14*	5.6	High yielding between 12-14kg/tree/year; good adaptation and good canopy formation
2	G012	"	"	"	"	"	3.5	
3	G016	"	"	"	"	"	3.6	
4	G040	"	"	"	"	"	5.3	
5	G052	"	"	"	"	"	5.6	
6	G079	"	"	"	"	"	5.3	
7	G108	"	"	"	"	"	6.4	
8	G112	"	"	"	"	"	7.6	
9	G114	"	"	"	"	"	7.1	
10	G118	"	"	"	"	"	5.8	
11	G128	"	"	"	"	"	6.4	
12	G132	"	"	"	"	"	6.5	
13	G136	"	"	"	"	"	5.6	
14	G158	"	"	"	"	"	6.2	
15	G162	"	"	"	"	"	7.3	
16	G168	"	"	"	"	"	6.7	
17	G172	"	"	"	"	"	4.7	
18	G178	"	"	"	"	"	6.6	
19	G180	"	"	"	"	"	5.0	
20	G182	"	"	"	"	"	4.7	
21	G186	"	"	"	"	"	5.6	
22	G190	"	"	"	"	"	7.6	
23	G194	"	"	"	"	"	6.4	
24	G204	"	"	"	"	"	8.2	
25	G208	"	"	"	"	"	5.0	

*Notes on the above table:- The individual yield records of all the accessions is not available. However available records showed that the accessions yields between 12 and 14kg of raw nuts per tree annually.

Characteristics of important breeding material

Table A6.9. Additional information on the most important breeders material

Accession number	Tree height at maturity metres	Nuts size, big medium, small	Apple colour	Leaf shape	Leaf size length X breadth (cm)	Other comment i.e. useful characteristics
G 112	-	Big	Green-Yellow	Oblong	10.9 x 6.0	High yielding, good adaptation, good canopy formation prolific shoot flushing, nut size and weight.
G 114	-	"	"	Oblong	11.8 x 6.3	
G 128	-	"	"	Ovate	11.2 x 6.4	
G 132	-	"	yellow	Oblong	10.3 x 7.	
G 162	-	"	Red	Ovate	11.1 x 6.8	
G 168	-	"	Red	Obovate	13.9 x 8.0	
G 178	-	"	Yellow	Oblong	13.4 x 8.1	
G 190	-	"	Red	Ovate	11.6 x 6.3	
G 194	-	"	Yellow	Ovate	12.2 x 7.1	
G 204	-	"	Yellow	oblong	14.0 x 8.1	

Note for above table:- The records of the tree height was not available as at the time of this report but the trees ranged between 6 – 15 metres in height. All the listed accessions produce big nuts that ranged between 5.5 – 8.5g in size.

Information on other Cashew planting materials which are not in formal trials

In addition to the local collections, Cocoa Research Institute of Nigeria has acquired a large number of exotic cashew selections from other cashew producing countries such as Tanzania, Kenya, Mozambique, Brazil and India. All these were at present being conserved in several plots and seed gardens at CRIN Headquarters and other substations. The collections currently being maintained are shown in the table below:-

Table A6.10. Cashew germplasm collection in CRIN as at year 2000

CRIN Headquarters and Ochaja substation	G – series: 8, 12, 16, 40, 52, 79, 108, 112, 114, 118, 128, 132, 136, 158, 162, 168, 17 178, 180, 182, 186, 190, 194, 204, 208 and Ajakabu series.
CRIN Headquarters	NP1 – 94, SE 1 – 75, EP 1 – 62, S1 – 172
CRIN Headquarters	1999/2000 Brazilian nut – Oro selections
Ochaja substation	Brazil 244, T12/1, Wyndkeglan 443, A.Madras 1/61, Tno.1, Trichur 1, Brazil 12, UD 18 TAO 40, H3/17, Kottarakara 29, Ullalo 27, Challode, FR 226, Oghe 26, Eruwa 188, Eruw 48, FR2, Iwo 222, FR 89, Iwo 89, H3 – 13, K22 – 1, BLA 139 – 1 A.Madras 4/62, Madras A/61, Madras 2/61.
Uhonmora substation	G.series:- 12, 34, 40, 47, 52, 59, 79, 136, 158, 162, 168, 172, 173, 178, 181, 182, 18 186, 190, 191, 194, 204, 207, 208, 209.
Ochaja substation	1997 Brazilian nut – Oro selections, 1999/2000 Brazilian nut – Oro selections.

PESTS OF CASHEW IN NIGERIA

Species:- ***Analeptis trifasciata*** **Fabricius**
Common name: Cashew stem girdler or longhorn bettle
Local language name:-
Order: *Coleoptera*
Family: *Cerambycidae*

Brief description of damage and its economic importance
The adult scrapes the bark of the cashew stem and branches and lay her eggs. Larva hatching from the eggs, bore into branches, feeds and tunnels insides. The adult girdles sapwood until a thin layer is left at the centre. In windly situation the infested stem snaps at the point of girdling. The leaves dry up while the branch remains hanging. In heavy infestation, the canopy is very adversely affected, fruiting is impaired and yield is drastically reduced.

Known natural control information: None

Other recommended control methods - Regular inspection of tree canopy for damage symptoms and hand picking of adult insects. Applications of various systemic insecticides to the trunk and branches to prevent development of immature larvae.

Other Comments - It is the most economically important pest of mature cashew plantation in Nigeria.

Species: ***Selenotrips rubrocinctus*** **Giard**
Common name: Red Banned Thrip
Local language name:
Order: *Thysanoptera*
Family: *Thripidae*

Brief description of damage and its economic importance - This pest attacks cashew leaves mainly but it can be found on flowers, young fruits and shoot tips. Both young and mature cashew can be infected and damage, infested leaves turn yellow and later grey, giving the leaves a silvery

appearance. Infested young cashew plants or trees becomes defoliated and yield is consequently reduced.
Known Natural control information - None
Other recommended control method - Application of various insecticides e.g. Rogor and Basudin 600DE.
Other comments - None.

Species: ***Pachnoda cordata* (Durry)**
Common name: Cashew Pseudo-apple scrapper
Local language name:
Order: *Coleoptera*
Family: *Scarabaeidea*

Brief description of damage and its economic importance - This pest feeds on the buds, blossoms, leaves and mostly fruits of cashew. Damage induces pseudoapple fermentation, infestation by fruit flies and rotting. Loss of yield could be high during attack.
Known Natural control information - None
Other recommended control method - Application of various insecticides e.g. Rogor and Basudin
Other comments - None.

Cashew Diseases in Nigeria

Name of disease: **Inflorescence blight/flora shoot dieback disease**
Local Name: None
Causal organism: *Lasiodiplodia theobromae* (*Botryodiplodia theobromae*)
Order: *Sphaeropsidaes*
Family: *Sphaeropsidiaceae*

Economic Importance
The disease is widely distributed on numerous host plant species, it is of major importance in Nigeria, prevanlent during the flowering period (August – December). It has been found to reduce the total cashew nut yield per hectare by 38.7%.
Recommended control:
The use of resistant genotypes
Combination of fungicide – Insecticide (Benlate and roger) at 1.5g a.i/L and 1.0g a.i/L respectively to be sprayed at 3 to 4 times.

Name of disease: **Rots of Immature cashew**
Local Name: None
Causal organisms: *Aspergillus tamari; Pencillium citrium; Lasiodiplodia theobromae*

Order:	*A. tamari*	-	*Eurotiales*
	P. citrium	-	*Eurotialis*
	L. theobromae	-	*Sphaeropsidales*
Family:	*A. tamari*	-	*Eurotiaceae*
	P. citrium	-	*Eurotiaceae*
	L. theobromae	-	*Sphaeropsidiaceae*

Economic importance - Immature nuts producing sugary exudate become infected. Infected nuts later turned dark and dry. It reduces nut production per inflorescence.
Local/natural control - Avoidance of high rainfall areas for cashew cultivation.
Recommended control - Field spray of benomyl (banlate) and dimethoate (rogor) at 1.5g a.i./L and 1.0g a.i./L respectively at pre-bloom and full bloom stages.

Name of disease: **Rot of pseudoapple**
Local name: None
Causal organisms: *Gestrichum candidum, Mucor spinosus Aspergillus niger, Penicillium citrium and Botrodiplodia theobromae*

Order:	*G. candidum*	-	*Moniliales*
	M. spinosus	-	*Mucorales*
	A. niger	-	*Eurotiales*

	P. citrium	-	*Eurotiales*
	B. theobromae	-	*Sphacropsidales*
Family:	*G. candidum*	-	*Moniliaceae*
	M. spinosus	-	*Mucoraceae*
	A. niger	-	*Eurotiaceae*
	P. citrium	-	*Eurotiaceae*
	B. theobromae	-	*Sphacropsidiaceae*

Economic importance - Pseudoapple infection usually starts following wound created by sucking and piercing insects. Apple later become shrivelled and dark brown in colour. It occurred on 26 – 100% of the bruised, undisinfected and unprotected apples.
Local or natural control - Early harvesting.

Name of disease: **Storage disease of harvested nuts**
Local name: None
Causal organism: *Paecilomyces variotii Aspergillus niger, Fusarium solani and Penicilluim citrium*

Order:	*P. variotii*	-	Eurotiales
	Penicillum citrium	-	Eurotiales
	A. niger	-	Eurotiales
	F. solani	-	Moniliales
Family:	*P. variotii*	-	Eurotiaceae
	Penicillum citrium	-	Eurotiaceae
	A. niger	-	Eurotiaceae
	F. solani	-	Tubercularaceae

Economic importance - Mouldiness to invasion by a complex of fungi favoured by high relative humidity in the storage room. Nuts lose viability in return.
Local control - Store nuts in dry and well aerated place.

LITERATURE ON CASHEW IN NIGERIA

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ANNEX 7

SUSTAINABLE TREE CROPS PROGRAM
West and Central Africa

IMPLEMENTATION OF YEAR ONE ACTIVITIES

Activity Document

Proposal from BioHybrids Agrisystems Ltd

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SUSTAINABLE TREE CROPS PROGRAM
West and Central Africa

IMPLEMENTATION OF YEAR ONE ACTIVITIES

Activity Document

West Africa Cashew Survey

1. Purpose

To establish the following with regard to cashew in West Africa:-

1. The pest and disease status, current situation and potential problems
2. The availability of a range of germplasm and data on its past local performance (from reports, etc)
3. Research capability within the different countries
4. The potential for collaboration in cashew R & D

With a clear picture of the above, it is proposed that it will be possible to construct a regional plan of action for cashew research and development in West Africa.

In the longer term, the opportunity exists to catalyse a sustainable increase in small holder income from cashew in West Africa and thus, in an environmentally friendly way, improve their livelihoods.

2. Relevance

The survey will be a collaborative effort with the major institutions in the 4 different countries involved. At this stage, it is likely that these institutions will be mainly government research institutes, but involvement of NGOs interested in cashew, (e.g. Technoserve in Ghana) will be encouraged. Any inputs from other countries in the region will of course be welcome and indeed, encouraged. Thus, this initial survey will not only help to integrate the information and expertise in the region but also provide a useful opportunity for the local scientists to be in direct contact with each other and share information about their respective research, development and extension activities.

One of the outputs of this work will be to provide an organisational framework of research and development opportunities for the region. In the longer term it is anticipated that these institutes will engage in **collaborative** projects to develop the potential of cashew in West Africa. This will involve relevant research ranging from breeding, crossing and selection to crop protection and on-farm husbandry. Eventually this will be integrated with extension activities and social dimensions. In other words, through a participatory process transfer new technologies and knowledge to smallholder farmers. This in turn will promote sustainable tree crop systems that increase productivity, generate greater income, and protect the environment.

For reference, Annex 1 contains the goal and objectives of STCP and the goal and objectives of the Research and Technology Transfer component.

3. Background

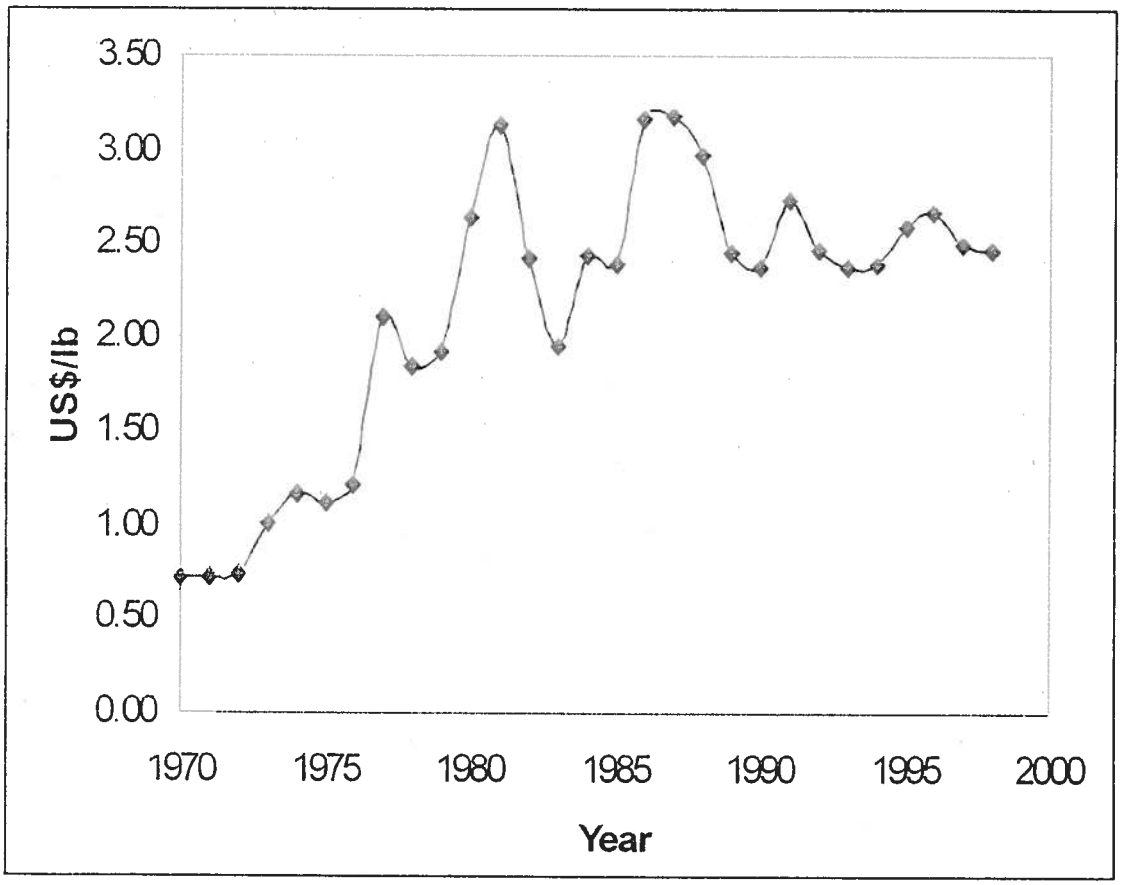
One of the objectives of this work is to obtain a clear picture of the status of the crop as well as the research strengths in the different countries and then build upon this using a co-ordinated approach.

Cashew in Africa is usually grown in semi-arid environments with poor soils in areas of low and variable rainfall - cashew grows well under these circumstances. In these resource poor, fragile environments, the opportunities for farmers to generate income are often very limited. Demand for cashew is good and prices have shown a generally sustained increase over the past 30 years, see Figure 1. This is in contrast with some other tree crops, for example, coffee and cocoa, where prices have declined dramatically over recent years.

In addition to the potential of cashew for generating income, it has also been used for soil improvement and conservation (Young A., 1997, p48).

The establishment or expansion of small scale processing plants can add value to the product and create employment at many levels. Based on price history, cashew can offer a more stable environment for rural development.

Figure 1. Cashew prices (W320 grade) in US$/lb since 1970.



4. Value Added by This Work

Each country will become more aware of the status of the crop and activities related to it in other countries within the region, thereby allowing research workers to share ideas, new technologies, knowledge and problems. The opportunities for regional cross cutting problem solving will be significantly enhanced and any duplication of effort minimised. It will provide the basic underlying data and information on which research, development and extension activities for cashew can be based in the future.

Also the consultants can bring with them valuable experience and information from other cashew growing areas in the world and other tree crop systems. See for example:-

Proceedings of the International Cashew and coconut conference – trees for life, the key to development. Editors Topper, C.P., Caligari, P.D.S., Kullaya, A. K., Shomari, S. H., Kasuga, L. J., Masawe, P. A. L., and Mpunami, A. A. Dar Es Salaam, Tanzania, 1997. 534pp.

Assessment of Options and Opportunities for Tree Crop Development in East and West/Central Africa. Topper, C.P. and Caligari, P.D.S., 1999

Cashew Study Tour in East Africa, 16th to 28th September, 1999. Topper, C.P. and Caligari, P.D.S., 1999

5. Methodology

Personnel:
One international cashew consultant, knowledgeable in cashew pest and diseases, agronomy and basic breeding work will work together with an in-country co-ordinator from each of the countries. The in-country co-ordinators will need to be senior cashew scientists or similar, designated specifically for the role. They will need to have the background and experience to make significant inputs and the energy and commitment to help drive the project forward. It would be useful if the in-country co-ordinator was also part of the survey team – see "Step 2" below.

Input will also be made by an internationally recognised cashew and tree crops breeder, Professor Peter Caligari of BioHybrids Agrisystems Ltd and the University of Reading.

Step 1 – Collection of available data, prior to survey visit

Together with in-country co-ordinators, a compilation of existing knowledge available in the different countries will be made as follows:

1. In-country information will be collated by the relevant co-ordinator with the aide of a comprehensive Questionnaire
2. Review of country reports (before, during and after the actual survey)
3. Review of the internationally/regionally published literature

Step 2 – Survey visit

Visits will be made to all the major cashew growing areas, relevant research institutes, germplasm collections and other involved organisations in Guinea, Cote D'Ivoire, Ghana and Nigeria. Guinea Bissau, although not an 'STCP country', will also be visited because of its importance as a major cashew producing country in the region (subject to safety considerations and suitable logistics).

It is envisaged that a small team composed of a breeder, a crop protection specialist, a driver and the consultant will be sufficient to complete the work in terms of visiting trials, germplasm collections, research institutes and farmers' cashew areas. It should be noted that the budget is not sufficient to cover the expenses of more people than this. It would seem sensible that the in-country co-ordinator should be either the breeder or the crop protection specialist from the host country.

Step 3 – Compilation of Information, Data and Production of Report.

Draw together all available information
Produce report covering

- Background
- The pest and disease situation
- The availability of germplasm and its performance
- Outline research capability within the different countries
- Report on the potential for collaboration in cashew R & D
- Generate action plan

6. Assumptions

Countries will be ready to participate fully in the project and able to commit suitable personnel as well as providing the essential local logistical (**especially a vehicle for the period of the field visits**) and knowledge inputs.

7. Indicators

- Identification of the in-country co-ordinators will mark an initial stage in the project.
- The production and receipt of the Questionnaires.
- A brief progress report will be made in December 2000 - outlining progress and logistical preparation for field survey
- The first survey will be made in January 2001 to Guinea, Guinea Bissau and Cote D'Ivoire.
- The second survey will be made in February 2001 to Ghana and Nigeria.
- A brief progress report will be made in February 2001 – outcome and summary of the field survey
- A final report will be produced in May 2001.

8. Budget Summary

Item	Cost $	Cost $ In-country	Comments
Costs for Guinea, G. Bissau and Cote D'Ivoire survey			
Travel costs, London – Guinea - Cote D'Ivoire - London	2,000		
BioHybrids consultancy fees, 20 days @ $350/day		7,000	
Vehicle, Guinea, G. Bissau, Cote D'Ivoire		Host country to provide	
Vehicle running costs		1,000	$50/day
Hotel and breakfast, 4 persons x 20 days @ $60/day		4,800	Actuals
Per diem, 4 persons x 20 days @ $30/day		2,400	
Local incidental costs, meeting at airport, taxis, etc		400	$20/day
Translations, photocopying, summary report etc, Guinea	350		
Translations, photocopying, summary report etc, Cote D'Ivoire	350		
Costs for Ghana and Nigeria survey			
Travel costs, London – Ghana – Nigeria - London	2,000		
BioHybrids consultancy fees, 14 days @ $350/day		4,900	
Vehicle, Ghana		Host country to provide	
Vehicle running costs, Ghana		350	$50/day
Hotel and breakfast, Ghana, 4 persons 7 days @ $60/day		1,680	Actuals
Per diem, Ghana, 4 persons x 7 days @ $30/day		840	
Ghana incidental costs, meeting at airport, taxis etc		140	$20/day
Ghana translations, photocopying, summary report etc	350		
Contribution towards Guinean to participate in Ghana survey		1,885	($2500 + airfare)
Vehicle, Nigeria		Host country to provide	
Vehicle running costs, Nigeria		350	$50/day
Hotel and breakfast, Nigeria, 4 persons x 7 days @ $60/day		1,680	Actuals
Per diem, Nigeria, 4 persons x 7 days @ $30/day		840	
Nigeria incidental costs, meeting at airport, taxis, etc		140	$20/day
Nigeria translations, photocopying, summary report etc	350		
General costs			
BioHybrids consultancy fees, 26 days @ $350/day	9,100		
BioHybrids overheads, administration costs	800		
Services of Tree Breeding Consultant, 5 days @ $350/day	1,750		
Overall Contingency	1,705	2,840	10%
Total	18,755	31,245	
Overall total		50,000	

Co-financing

It is hoped that USAID Guinea will provide funding for at least one Guinean scientist to participate in the Ghana/Nigeria part of the survey.

9. Responsibilities:

Overall co-ordinator: BioHybrids Agrisystems Ltd

Country co-ordinators:-

Table 1. Names and addresses of appointed in-country co-ordinators

Co-ordinators name	Address
Souret DIAORA	BP 1523 Boulevard de Commerce, Conakry, Guinea. Tel (224) 45-42-62 Fax (224) 45-42-46
Akadie Jean Baptiste DJAHA	CNRA, BP 856, Korhogo, Cote D'Ivoire. Tel (225) 36-86-09-71 Fax (225) 36-86-03-26 Email Kgo.cnra@aviso.ci
A. K. ASANTE	Crops Research Institute, Ghana. Fax 233-51-60396/60142 Email jotoo@ghana.com & crig@crig.org
Edward Babatunde ESAN	Cocoa Research Institute of Nigeria (CRIN), Nigeria Email detak@skannet.com

BioHybrids Agrisystems Ltd will be responsible for:-

Producing the necessary Activity Plan

Produce the budget outline and be responsible for handling or co-ordinating all financial aspects.

Providing the necessary expert consultants for the in-country surveys and providing the integrative knowledge on cashew, particularly in relation to crop protection, breeding , propagation and husbandry.

Analysing and integrating the data generated.

Produce final report.

Country co-ordinators will be responsible for:-

Completing comprehensive cashew questionnaire
Compiling all relevant literature for their country and summarise the main findings
Organising survey logistics
- Plan itinerary within the allocated number of days
- Arrange transport (vehicle, driver, etc)
- Arrange accommodation
- Arrange meetings
- etc

Providing additional information, before, during and after the survey, as appropriate

10. Deliverables:

Two progress reports to be sent to all concerned parties.

Comprehensive report produced covering:

- Background
- The pest and disease situation
- The availability of germplasm and its performance
- Research capability within the different countries
- The potential for collaboration in cashew R & D
- Action plan

11. Implementation

Table 2. Activity timeframe and estimated number of days worked for both consultant and in-country co-ordinators.

Time/ month	Activity	Number of consultant days	Number of co-ordinator days/country				
			GU	CD	GH	NI	TOT
October	Design questionnaire.	1	0	0	0	0	0
	Send out to in-country co-ordinators	0					
November	Complete questionnaires.	0	3	3	3	3	12
	Analyse questionnaires	3	0	0	0	0	0
	Finalise survey travel plans	1	1	1	1	1	4
December	Review of the internationally/regionally published literature	4	0	0	0	0	0
	Collect country reports	0	1	1	1	1	4
	Summarise main findings of country reports	0	6	6	6	6	24
	Review germplasm details	2	0	0	0	0	0
	Produce first progress report	1	0	0	0	0	0
January	Visit Guinea, Guinea Bissau and Cote D'Ivoire.	20	0	0	0	0	0
	Guinea co-ordinator, travel	0	7				7
	Cote D'Ivoire co-ordinator, travel	0		7			7
February	Visit Ghana and Nigeria, including travel	14	0	0	0	0	0
	Ghana co-ordinator, travel	0			7		7
	Nigeria co-ordinator, travel	0				7	7
April	Finish compiling information	5	5	5	5	5	20
	Review germplasm details	3	0	0	0	0	0
	Produce second progress report	1	0	0	0	0	0
May	Complete final report.	10	0	0	0	0	0
	Total consultancy days	**65**	**23**	**23**	**23**	**23**	**92**

The estimated number of work-days for each in-country co-ordinator is 23 days including days travelling with the consultant. The Guinea co-ordinator is likely to be travelling additional days to cover Guinea Bissau and Ivory Coast and possibly Ghana and Nigeria.

12. Beneficiaries

Initially research and development institutions, NGOs, etc currently involved in research and development. In the longer term, smallholder farmers in semi-arid environments

13. Detailed Budget

The detailed budget as per IITA instructions has been completed and is attached as a separate Microsoft Excel file.

14. References

Young A., 1997 Agroforestry for Soil Management. CAB International.

ANNEX 8

SUSTAINABLE TREE CROPS PROGRAMME

(Adapted from the first STCP Newsletter (September/October 2000)

Fruit and nutrient tree crops offer significant opportunities for smallholders to generate income in Africa, and at present tree crop products account for a large proportion of foreign exchange derived from agricultural trade. In addition, tree crop systems also play a critical role in increasing and sustaining biodiversity and the sound management of natural resources. Despite the actual and potential benefits derived from tree crop systems in Africa, inadequate attention has been given to their development.

A comprehensive examination of the needs and options for a sustainable tree crop programme was conducted during 1999 and 2000, including consultation with a broad range of stakeholders involved with tree crops. A number of workshops have been held culminating in the Sustainable Tree Crop Development Forum in Washington D.C. in October 1999 and a consensus was reached that the STCP should be implemented on a regional level, its goal and objectives being:

Goal
To improve the well-being of smallholder farmers through the development of sustainable tree crop systems that increase productivity, generate income, conserve biodiversity, use natural resources sustainably, and offer stable development prospects and long-term economic incentives

Objectives
To promote public and private sector partnerships in order to provide stakeholders with an organizational framework and policy environment to allow them to:

1. **Maintain increased productivity of high quality tree crop products, over the long term, with an emphasis on farm rehabilitation and reclamation of deforested land;**
2. **Improve efficiency in the marketing chain, so that it delivers fair prices to farmers and quality products to end users;**
3. **Make African tree crop products competitive in international markets;**
4. **Improve the socio-economic situation of farmers;**
5. **Conserve the natural resource base and biodiversity.**

The Sustainable Tree Crop Programme (STCP) constitutes a co-ordinated effort by industry, governments and research, development and conservation agencies to facilitate the improvement of smallholder agricultural systems based on tree crops, in Africa. It was agreed that co-operation and collaboration across the board was necessary, as the full range of issues that need attention is well beyond the manageable interests of a single organization or group, from either the public or private sector.

The four components of the STCP

To address the programme objectives efficiently, a framework with four component areas has been adopted. The general approach taken within each component is to build on the existing efforts and activities of relevant stakeholder groups, to add value to them, and to co-ordinate future collaborations. The goals and priority activities of the four components are listed below.

Grower and Business Support Services
Goal: To create the capacity and motivation for smallholder farmers in the region to form strong associations, create viable businesses, increase productivity, improve quality and adopt production techniques which do not result in clearing new forest.

Purpose: To provide smallholder farmers in the region with an integrated package of services which: increase their knowledge of crop production techniques and pest and disease control; improve their management of natural resources and the conservation of biodiversity; provide them with greater access to training, extension, finance, markets and information; and facilitate the formation of farmer-owned businesses.

Areas of Activity:

1. Farmer organization
2. Training and extension
3. Financing mechanisms

Research and Technology Transfer

Goal: To improve the well-being of smallholder farmers through the development and transfer of technologies for sustainable tree crop systems that increase productivity, generate greater income, and protect the environment.

Purpose: Through multi-institutional partnerships and in collaboration with farmers to provide farmers with the technology and skills required to

1. Maintain increased productivity of high quality tree crop products, over the long term,
2. Make their product competitive in international markets,
3. Reduce risk through the diversification of tree crop systems,
4. Sustainably use the natural resource base and conserve biodiversity while increasing productivity.

Areas of Activity:

1. Diagnosis of constraints and opportunities and impact of tree crop systems,
2. Germplasm improvement and multiplication,
3. Integrated pest and disease management,
4. Rehabilitation of existing tree crop plantations,
5. Establishment of tree crops on deforested land,
6. Improved post-harvest management,
7. Information and knowledge sharing,
8. Technology dissemination and adoption.

Policy Change and Implementation

Goal: To identify and promote policy and strategy options that improve the efficiency of the tree crop sector(s), and, concurrently, raise the welfare of the farms and firms engaged in tree crop production, marketing, storage, finance, product manufacturing and promotion.

Purpose: To improve access to and use of knowledge regarding approaches, tools, tradeoffs and payoffs for tree crop policy options and interventions, that help sector leaders and policy makers use resources efficiently, and guide development efforts.

Areas of Activity: (illustrative)

1. Regional public-private policy forum.
2. Incentives for smallholder adoption of sustainable systems.
3. Improving the economic efficiency of development resources.
4. Increasing smallholder economic benefits of environmental (carbon sequestration and biodiversity) elements of tree crop systems.
5. Enhancing competition, promoting efficient trade and transparent rules and operating systems.
6. Finance: Mechanisms and options to foster investment.
7. Establish an environmental certification system to ensure environmental accountability.

Market and Information System Development

Goal: To educate and inform smallholder cocoa producers about the types of strategic market and information systems activities necessary to enhance the sustainable production and marketing of tree crops.

Purpose: To develop with smallholder farmers' strategies and activities that will:

1. Help farmers to make economic decisions about product quality;
2. demonstrate the importance of and allow participation in the development of grades, standards and product certification;
3. Foster access to and use of market, environmental and technical information; and
4. Allow farmers to learn how to develop and use tools to benefit from sustainable production and marketing strategies.

Areas of Activity:

1. Market segment development
2. Consensus building
3. Information technology use

Beneficiaries

The smallholder tree crop farmers are the primary beneficiaries of this programme. They will experience a conducive production environment, have access to information and appropriate technologies, improve their management skills, participate in farmer businesses, and sustainably manage their natural resources and biodiversity. Extension agents will be trained in new approaches and technologies. Researchers and policy makers will become more efficient through regional collaboration, information exchange and capacity building. Traders will be dealing with organized farmer groups and be knowledgeable of industry quality requirements. The industry will benefit from direct access to organized farmer groups, researchers, and policy makers to ensure stable production and quality.