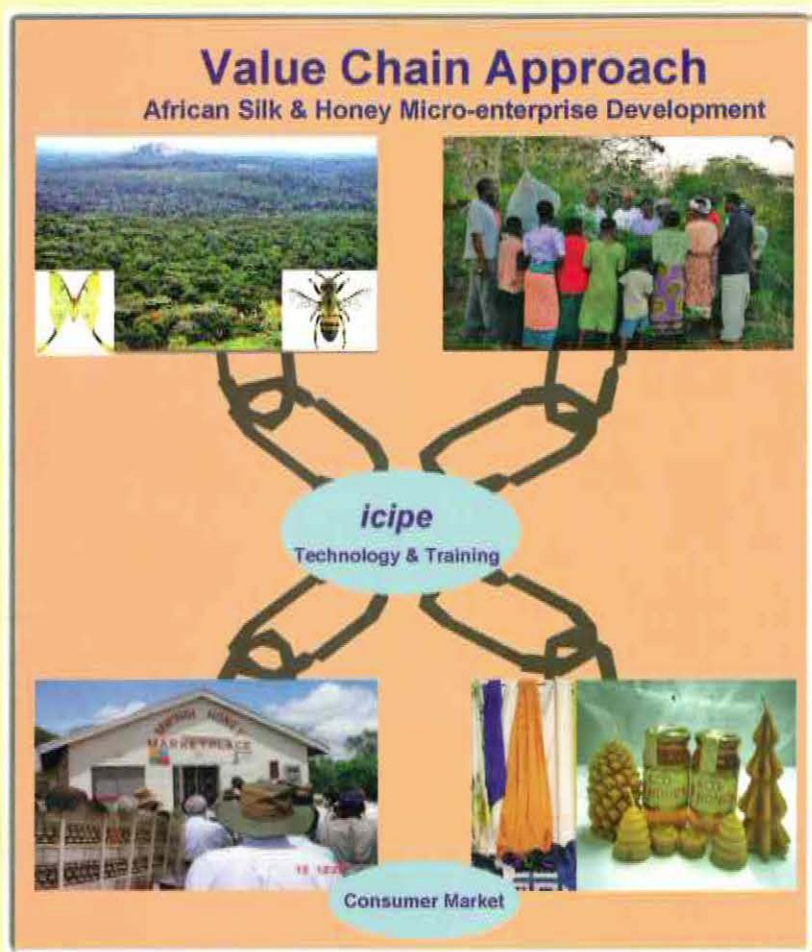


Development of Sericulture and Apiculture Products for the Poor in Fragile Ecosystems Using the Value Chain Approach

Proceedings of
the Trainers' Course and
IV International Workshop on the
Conservation and Utilisation of Commercial Insects
14th November to 8th December 2006



Sponsored by the International Fund for Agricultural Development (IFAD),
the Netherlands Ministry of Foreign Affairs and International Cooperation,
UNDP/GEF, Islamic Development Bank (IDB),
OPEC Fund for International Development (OFID) and *icipe*

Editors: S. K. Raina, E. M. Muli, E. K. Nguku and E. Kioko



icipe
African Insect Science for Food and Health

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Proceedings of the Trainers' Course and IVth International Workshop
on the Conservation and Utilisation of Commercial Insects

Raina S. K., Muli E. M., Nguku E. K. and Kioko E. (Eds)

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FOREWORD

The root cause of underdevelopment is poverty. In Africa, during the last three decades, there has been a decrease in production of traditional export crops, as well as unsustainable exploitation of indigenous forests and agricultural land. Poverty alleviation requires not only increased food production but also additional on-farm and off-farm income generation technologies for better distribution of the produce and profit, and for environment protection. The income of the underprivileged and resource-limited farmers must be enhanced so that their basic food requirements can be translated into *effective market demand*. Insects are notorious pests and vectors of diseases in agricultural production but their potential benefit to the environment is often overlooked. Among the many activities that might assist the poor to escape the vicious cycle of poverty, is raising honeybees (apiculture) and silkworms (sericulture).



Prof. Christian
Borgemeister
Director General, icipe

The delivery of income generating services to African countries through *icipe* will increase the outreach and sustainability of the community-driven enterprises. Natural resources for traditional honey and silk micro-enterprises exist in all ecosystems in Africa but these are inefficiently exploited. Micro-enterprise packages are particularly suitable as incentives in the context of participatory forest management (PFM) because: (1) they provide quick and significant rewards; (2) they can be managed using environmentally friendly technologies; (3) they use renewable resources (including forest resources) in a sustainable way and (4) they provide synergistic services and products (e.g. pollination and mulberry fodder for livestock). By linking them to productive forest buffer zones, commercial insects enterprises have motivated communities to maintain forest biodiversity and protect the environment as well as increasing their economic well-being. Impacts on economic well-being will be increased by a unique component of the *icipe* package: the empowerment of communities through ownership and operation of marketplaces in which value is added to bee and silk products through quality control, processing and packaging to national and international standards. This eliminates middlemen and generates more income at the community level. All of this needs to operate within a supportive enabling environment at local, district and central levels requiring an investment into policy support and institutional strengthening and awareness raising so as to allow informed decision-making.

It is within this context that *icipe* organised this workshop to provide a valuable opportunity for representatives of IFAD projects, Governments, NGOs and the private sector, to interact and share experiences to gain skills on the management of commercial insects. The workshop will also design an infrastructure template for the integration of sericulture and apiculture based farming systems with regional development operations in Africa. It will also encourage private investment, so that the positive impacts on community livelihoods are ensured, commercial profits are maximised and biodiversity and conservation benefits are maintained. It is such challenges that must be further addressed in this workshop among local, national and international participants to develop long-term policies, which will ensure sound management of sericulture and apiculture micro-enterprises to meet local peoples' needs, support the economy and promote biodiversity conservation in the regions.

Christian Borgemeister
Director General
icipe – African Insect Science for Food and Health
Nairobi, Kenya

PREFACE

Poverty in African countries is a manifestation of complex factors such as high population growth, fragile ecosystems due to environmental degradation, high unemployment, drought, low literacy, and limited access to resources, education and health services. Owing to poverty's large scope and multiplicity of factors, there is no single guaranteed approach to its eradication. *icipe* has been promoting income generating options such as sericulture (silk production) and apiculture (honey and hive products), which have been viewed as antipoverty tools for African communities. The delivery of income generating services to African countries through *icipe* will increase the outreach and sustainability of community driven enterprises. There is clear empirical evidence that the natural resources for traditional honey and silk exist in all ecosystems of African countries but are inefficiently exploited and hence are unprofitable due mainly to lack of trained manpower and poor infrastructure.

Insects are a critical natural resource of every ecosystem and the basis of the two most important income earners (honey and wild silk). Our understanding of their biodiversity, including distribution and function is poor. Besides serving as efficient pollinators and crop protection elements, insects, such as honeybees, stingless bees, silkworm and butterflies are good indicators of beneficial resource management of an ecosystem. This training will help to make communities, national institutions and IFAD projects more aware of the ecological and economic importance of insects and their forest habitats. The training will focus on insects' usefulness in supporting community-based efforts for minimising forest and associated biodiversity loss. The training will also develop synergies between medicinal plants use and honey production by increasing the plantation of the useful indigenous herbs for dual purpose. Similarly, the communities will learn to use *Acacia*, *Eucalyptus*, *Bridelia* and other useful forest trees not only for beekeeping but also for wild silkworm farming.

The main bottlenecks in modernisation of apiculture and the advancement of sericulture in African countries are the lack of training and infrastructure. On the silk front, it is the lack of appropriate wild or mulberry silkworm strains and their egg production facilities, lack of silk cocoons processing (postharvest) facilities and training. On the honeybee front, apart from honey and wax, there is fragmented theoretical knowledge on beehive products such as propolis, royal jelly, bee venom, pollen and several other products, which have both economic and medicinal values. These shortcomings are further aggravated by the lack of silk and honey marketplaces, limited market-outlets and weak market linkages.

Recently most African governments have developed environmentally conscious policies that have overhauled their ecological sector, with improved management capacity. Both the policy and regulatory frameworks stress the need for collaborative ecosystem management and support for the poor to generate income through economic restructuring and introduction of income generating activities. The political will is rebuilding capacity and embracing community-government-private sector partnership. It is within this context that *icipe* has organised this trainers' course to provide a valuable opportunity for representatives of IFAD projects and governments, NGOs and the private sector, to interact and share experiences to gain skills on the management of commercial insects. This will assist them to plan projects for their regions with more investment in training infrastructure for silk and honey enterprises development, to bring rural change and empower the rural poor to take control of their own businesses. This training will also provide a mechanism for improved management systems that can contribute towards increased income generating opportunities benefiting the rural communities and enhancing and strengthening their forward and backward linkages to production and marketing systems for both local and export outlets.

The workshop has been divided into six sessions, which will address:

1. Natural resource assessment and capabilities of networking among African partners

- in the management and implementation of sericulture and apiculture technologies
2. Identification of markets for silk and honey based products to facilitate farmers' access to markets.
 3. Implementation of value chain approach in the development, scale-up of production, branding and marketing of sericulture and apiculture products.
 4. Improvement of productivity of silk and honey based products through R&D.
 5. Improvement of managerial and technical capabilities of beekeepers and silk farmers through adaptation and dissemination of appropriate technologies.
 6. Recommendations for future biological and marketing research and development activities to solve local and regional problems.

It is envisaged that this workshop will allow critical reflection of conservation and income generation strategies and lead to recommendations for future research, development and implementation.

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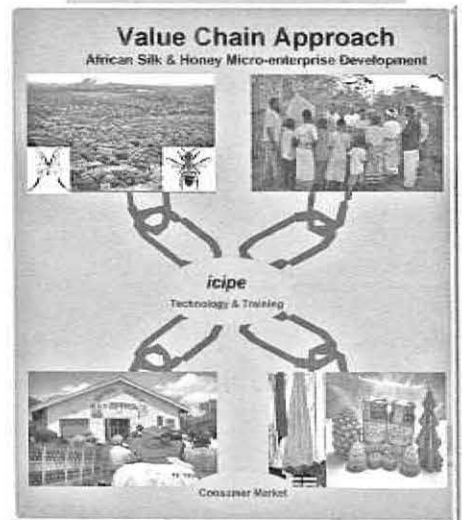
ACRONYMS AND ABBREVIATIONS

AAMP	Agricultural Modernisation Programme
ACP	Africa Caribbean and Pacific States
AEFIA	Apiculture et Exploitation de la Flore par les Insectes dans l'Adamaoua
ADB	African Development Bank
AGOA	African Growth and Opportunity Act
AIG-ICD	Alternative Income Generation-Integrating Conservation and Development
AMSDP	Agricultural Marketing Systems Development Programme
ARDEC	Agricultural and Rural Development Executive Committee
ARDI	Association for the Promotion of Integrated Development (Rwanda)
ASAL	Arid and semi arid lands
ASDC	Apiculture Scientifique pour le Développement du Cameroun
ASNAPP	Agribusiness in Sustainable Natural African Plant Products
BSF	Belgian Survival Fund
CAAS	Chinese Academy of Agricultural Sciences
CAP	Community Action Plan
CBET	Community-based ecotourism
CBO	Community based organisation
CBNRM	Community Based Natural Resource Management Programmes
CDE	Centre for Development of Enterprise
CDRF	Country Development Revolving Fund
CEPF	Critical Ecosystem Partnership Fund
CFM	Community forest management
CIDA	Canadian International Development Agency
CRB	Construction Registration Board
CRIAA	Centre for Research Information Africa Action
CSIR	Council for Scientific and Industrial Research
DDSP	District Development Support Programme
DFID	Department of Foreign International Development
DFL	Disease free layings
DSSP	District Development Support Programme
EACFE	East Africa Coastal Forests Ecoregion
EEC	European Economic Commission
EEP	Ethanollic extracts of propolis
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FDA	Focal Development Areas
FEG	Farmer extension groups
FIDA	Fonds International Pour Le Développement Agricole
FLO	Fair-trade Labelling Organisation
GIS	Geographical Information System
GMP	Good Manufacturing Practice
GONU	Government of National Unity
GOSS	Government of Southern Sudan
GPS	Global Positioning System
GSLRP	Gash Sustainable Livelihoods Regeneration Project
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
HMF	Hydroxymethylfurfural (Chemistry)
IBA	Important bird areas
ICD	Integrating Conservation and Development
ICDP	Integrated Conservation and Development Project
ICRC	International Committee of the Red Cross
ICS	Individual certification costs
ICT	Information Communication Technology
IDB	Islamic Development Bank
IFAD	International Fund for Agricultural Development
IGA	Income generating activity
ISA	International Silk Association
ISO	International Organisation for Standardization

IUCN	International Union for the Conservation of Nature
JICA	Japan International Cooperation Agency
KEBS	Kenya Bureau of Standards
KOAN	Kenya Organic Agricultural Network
KTB	Kenya top-bar hive
KWS	Kenya Wildlife Service
M&E	monitoring and evaluation
MAAIF	Ministry of Agriculture, Animal Industries and Fisheries
MAF	Ministry of Agriculture and Forestry
MARC	Melkassa Agricultural Research Centre
MDG	Millennium development goal
MIS	Management information system
MKEPP	Mt Kenya East Pilot Project
MOA	Ministry of Agriculture
MOARD	Ministry of Agriculture and Rural Development
MTE	Mid Term Evaluation
NAADS	National Agricultural Advisory Services
NARS	National agricultural research system
NCR	National Council for Research
NEF	Near East Foundation
NENA	Near East and North Africa Region
NGO	Non-governmental organisation
NIS	New information system
NIT	New information technology
NKRDP	Northern Kordofan Rural Development Project
NORPREP	Northern Region Poverty Reduction Programme
NR	National resources
NRC	National Council for Research
NTFP	Non timber forest products
OPEC	Organisation of Petroleum Exporting Countries
OPEP	Organisation Des Pays Exportateurs de Pétrole
PA	Protected area
PARFAR	Programme d'Amélioration du Revenu Familial Rural
PCU	Programme Coordination Unit
PDCRE	Smallholder Cash and Export Crops Development Project
PEAP	Poverty Eradication Action Plan
PFM	Participatory Forest Management
PMA	Plan for Modernisation of Agriculture
PRAs	Participatory Rural Appraisals
PRSP	Poverty Reduction Strategy Paper
PSDR	Rural Development Support Programme
PSOM	Programme for Cooperation with Emerging Markets
R&D	Research and development
SACCO	Savings and Credit Cooperative Organisation
SARDNET	Sericulture, Apiculture Research and Development Network in Africa
SKRDP	Southern Kordofan Rural Development Project
SRD	Sericulture Research Department
SSARP	Southern Sudan Agriculture Revitalization Programme
UCL	Universal Corporation Ltd
UNDP-GEF	United Nations Development Programme/Global Environment Facility
UNFCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organisation
USAID/OFDA	United States Agency for International Development/Office of US Foreign Disaster Assistance
WSRMP	Western Sudan Resource Management Programme
WWF	World Wildlife Fund, (now) Global Conservation Organisation

SESSION 1

Natural resource assessment
and capabilities of networking
among African partners
in the management and
implementation of sericulture
and apiculture technologies



INTEGRATED CONSERVATION AND DEVELOPMENT PROJECTS (ICDP): CAN BEEKEEPING AND HONEY PRODUCTION REALLY CONSERVE FORESTS? HOW CAN ONE TELL?

Alan Rodgers

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Abstract: Beekeeping/honey production fits into the theme of this Workshop "Development of Sericulture and Apiculture Products for the Poor in Fragile Ecosystems Using the Value Chain Approach" in that it produces products for the poor, in fragile ecosystems (tree based) and beekeeping offers incentives for participatory forest management (local benefits). How do you monitor an ICD 'honey' (silk) project to allow the evaluation of conservation success, i.e. are the forests being better conserved than without the project? WHICH forests? And WHO does the conservation? What is the objective of this 'Conservation'? Is this a honey project aimed at forests OR a Forest Conservation Project USING Honey/Silk as an incentive to conserve? WHERE IS THE FOCUS?

The theory behind ICD

This comes from the concept that if people are poor then they have little option but to use forest resources unsustainably (for timber, fuelwood/charcoal, grazing, etc.). The worst case is encroachment into forests. But if people have better incomes then they will not degrade forests. So let us improve their livelihood (let us be anti-poverty).

The history of ICD

Integrated Conservation and Development Projects (ICDP) offer the opportunity to simultaneously address two major societal goals: the promotion of socio-economic development and the conservation of nature (RIO 1992).

ICDPs are seen as part of sustainable development. For instance, linking "sustainable development and its principal tool, the Integrated Conservation and Development Projects (ICDP)". But where these projects are focused on the development needs of people, then conservation goals tend to be neglected.

"ICDPs are development projects that are carried out with environmental sensitivity". To others "ICDPs aim to conserve natural resources for local people", and the "sustainable management of the resource is the ultimate goal of the ICDP".

Conservation

There are two sets of issues:

- Is it enough if people stop cutting trees? This is a passive input to conservation as others will fill the vacuum. It is better if the community actively conserves (provide support, patrolling, planting, etc.).
- But is there enough incentive for such input? What is the hook that gets people so engaged in conservation?

Linking the 'D' to the 'C'

- If there is no link to the forest from the development inputs then there is little incentive to conserve

- Livelihood cash increases do not work (An example is the Mwingi Silk Project: The local community no longer chop their acacia trees, but they still need fuel poles, etc. so they chop acacias elsewhere!)
- Redirect the pressure (e.g. China).

The fallacy: Lots of examples

- India: Woodcutters and handicrafts
- Nigeria: Forests and pigs
- Tanzania: Coral reefs and nets, chickens
- Larger scale: TANAPA and communities.

So—just because we have raised incomes of a few people in an ICD project—this does not mean that behaviours will change and conservation of resources will be fine!

The *icipe*/GEF example

- Three forests of global importance
- All with serious degradation around the edges (the buffer), little government protection
- All with high densities of people around the forest who graze, collect fuel, etc.
- Concept—Can *icipe* Commercial Insects Programme reach enough people to improve livelihoods and reduce degradation of forests
- Partnership to Forest Department (and Nature Kenya for M&E).
- Honey going well, builds on past successes
- Silk starting up and will be slower
- Forest Conservation is ad-hoc
- Where are Associations? Where is responsibility? Where is MOU showing rights?
- What links (hooks) people to forestry?
- Can some beehives be in the forest?
- Problems of security, etc.—but hive surveillance is also forest surveillance
- Are the wild silkmths in the forest? Will people stop fires and tree cutting to protect larvae? Will people plant, e.g. *Bridelia* trees (a key host).
- Will the honey groups also register as Forest Associations and be responsible for their adjacent forest area?

Many conservation projects, including ICDPs, neglect M&E: Why?

- Absence of practical, low-cost, biological (and livelihood [socio-economic] approaches to assessing project outcomes
- Expertise to collect such data may not exist in many institutions
- Biological approaches to project M&E are difficult for community-based project teams to use and even more difficult to interpret.

Huge repertoire of M&E methodologies out there

- Detailed manuals from:
 - Birdlife International around IBAs and community support groups.
 - CEPF Manual (forest based).
- Livelihood methods, e.g. from PRSP process, CARE International
- Link to ongoing activity Forest Protected Areas and 'METT' (30 Questions)

Monitoring and indicators

- Activity based: "Yes we did the workshop"
- Process based: "Yes Forest Associations exist"
- Impact based: 1 "Yes livelihoods increased by 30%"
 2 "Yes the forest is improved. e.g.
 - Forest fires halved,
 - Seedling regeneration up by 55%
 - Pole cutting down by 40%
 - Goats excluded from forest area
 - No charcoal kilns in forest area.

Threat reduction assessment (TRA)

- Simple
- Participatory
- Adaptable
- Growing literature
- Assesses (not measures) the threat, not the resource.

There are difficulties, but:

The TRA approach to measuring project success is based on three key assumptions:

- The destruction of forests in our time-frame is human-induced
- Key threats to forest biodiversity at a given site can be identified and described
- Changes in levels of these threats can be measured or estimated (intensity, scale, etc).

Biological indicator approaches for project success are challenging to use:

- Density of primates or rare birds or silkmoths or stingless bees
- Regeneration of endemic or keystone tree species
- Frequency of pole cutting or density of charcoal kilns
- Reduction of bare soil and higher ground vegetation cover.

Not very sensitive over the short time frames that are relevant to project managers.

- Required data are difficult/expensive to collect
- Difficult to implement as part of daily project activities
- Scientific format may exclude locals
- Results are difficult to interpret/link to project.

Advantages of TRA approach

- Measures changes over short time periods
- Measures changes throughout the project, i.e. at all sites
- Compares different sites within the project
- Uses both social and biological data collection methods and types of data
- Produces results readily interpreted by all stakeholders, practitioners and community
- Can be done retrospectively to assess projects in progress
- Can consider each threat separately.

Lessons—Forest

- Forest and woodland supply most fuelwood resources (and new land for agriculture)
- So forest cover deteriorates and is lost
- Education is a low priority! So expect no change in the situation!

Lessons—Industrialise or not?

- Investment in education?
- Investment in electricity?
- Investment in computers?
- Investment in AIG-ICD such as honey?

So what do we do about it?

- Cannot 'fix' conservation (forest or PA) problem unless we 'fix' the income problem first. So rural development is needed that outstrips population growth! Scale issues!
- Must make destruction of forests/reserves a less desirable option for livelihoods than other options, for now it is the preferred option. Incentives are needed.

At local household level

- Increased need for cash in today's society (school fees, marriage, death, health etc.)
- Reduced cash income from crops (tea, coffee, pyrethrum). Cash comes from forests (timber, charcoal). But there is less land.
- Livelihood issues are immediate.
- Conservation issues are in the future.

Entry points

- National level value of forests and PAs suggests that Governments should invest in development inputs in PA adjacent areas (Government investment is minimal)
- Forests PAs do provide considerable benefits to household village economies (thatch, medicines, graze, food and fodder, fuel, food). This is not often recognised
- Therefore, do participatory valuation and conservation.

PFM, CFM, JFM processes

- Participatory Forest Management
- Community Forest Management on village land and village forest
- Joint Forest Management on Government land
- Incentives and 4 Rs (Roles, Rights, Responsibilities and Revenues).

Measuring impact, e.g. Capacity

- Older output: We trained 30 foresters in biodiversity, forestry.
- Newer outcome: The 30 trainees remain in service, and are posted to biodiversity-rich sites, are functional, and are involved in conservation process (writing, doing, educating, researching etc.).

Impact on forest

Indicators may be of different types

- Present/Absent, e.g. Business Plan or Management Plan in place and functional
- Quantitative:
 - Revenue up 200% in 5 yrs
 - Income/ha increases by 25% in project time-period
 - Charcoal kiln density down 70%
- Qualitative—TRA scores show threat reduced by 40%.

Examples of indicators

- At least 3 partnership MOUs in place with the private sector and communities by MTE
- Manpower training levels in field cadres show 50% increase above baseline
- Income from honey shows 50% increase and communities agree on conservation, e.g. by community patrolling
- Community Forest Guard level reaches 1 per 1000 ha.

Lessons learned

- Get more effective participation at all stages of preparation and implementation, from a full range of stakeholders
- More flexible designs, improved monitoring and introduce adaptive management
- More attention to building/ensuring effective institutional capacity
- Improving linkage between community development activities and conservation objectives (the 'Holy Grail' of CBC-ICD).

Do we know enough?

- Why so often do we launch into implementing projects even though we realise we do not have: (i) an adequate understanding of either ecological or socio-economic/political conditions, or (ii) real consensus between project supporters and communities on the objectives and on respective roles and responsibilities
- We all know that we should take the time to achieve these, but we feel under pressure to get the project off the ground.

Conflicting objectives

- Many ICDPs have two explicit objectives: biodiversity conservation and socio-economic development/improvement of livelihoods of local communities.
- The usual rhetoric is that the two are not incompatible or contradictory, but are in fact complementary, mutually reinforcing and even inseparable. This may be true in the long term, but practically speaking in the short term these objectives frequently do conflict
- For example, restricting access to harvesting of forest products may be essential for maintaining this resource for future generations, but can place hardship on the present generation.

Conclusion

- For practitioners and participants to successfully integrate conservation and development it is vital to **structure the learning that should take place from project implementation**
- Learning has not been part of the ICDP in the past. In the future, all projects must be designed and implemented using adaptive management
- Adaptive management, **the integration of design, management and monitoring to systematically test assumptions** to adapt and learn creates a framework to learn systematically from both project successes and failures as well as the successes and failures of others. So monitor and adapt.

TRANSBOUNDARY/CROSSBORDERS NATURAL RESOURCE MANAGEMENT

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Abstract: There are various international conventions for biodiversity conservation with strong national strategies for implementation at country level. The mechanism developed by EACFE has enabled the development of a common vision and strategy for crossborder natural resource management in the eastern Africa region.

Introduction

Cross borders natural resource management refers to any process of collaboration across boundaries that increases the effectiveness of attaining biodiversity conservation goal(s). The economic values of natural resources can easily turn into threats if exploited unsustainably. There are various international conventions for biodiversity conservation.

Various international conventions for biodiversity conservation (strong national strategies/ implementation)

The following are various international conventions for biodiversity conservation (strong national strategies/implementation):

- Poverty reduction
- MDGs
- CBD
- CITES/Lusaka agreement
- Ramsar
- Nairobi (convention)
- UNFCC
 - Through a series of COPs
 - Through agreed initiatives (e.g. IUCN, WWF and others such as global 200 Ecoregions).

Opportunities

- Ecological
- Social and cultural
- Economic and financial
- Institutional
- Political.

East Africa Coastal Forests Ecoregion Task forces have developed a mechanism to implement the EACFE ecoregion (trans-boundaries ecosystem) at the National (Kenya, Tanzania and Mozambique) (Figure 1) and at a Regional level (Kenya, Tanzania and Mozambique) (Figures 2–4). They are all articulated/chaired by Government Forest agencies.

The terrestrial coastal forests of Kwale include national reserves, forest reserves, sacred forests, private forest patches, ungazetted forests and woodlands.

The EACFE Trans-boundaries Ecosystem

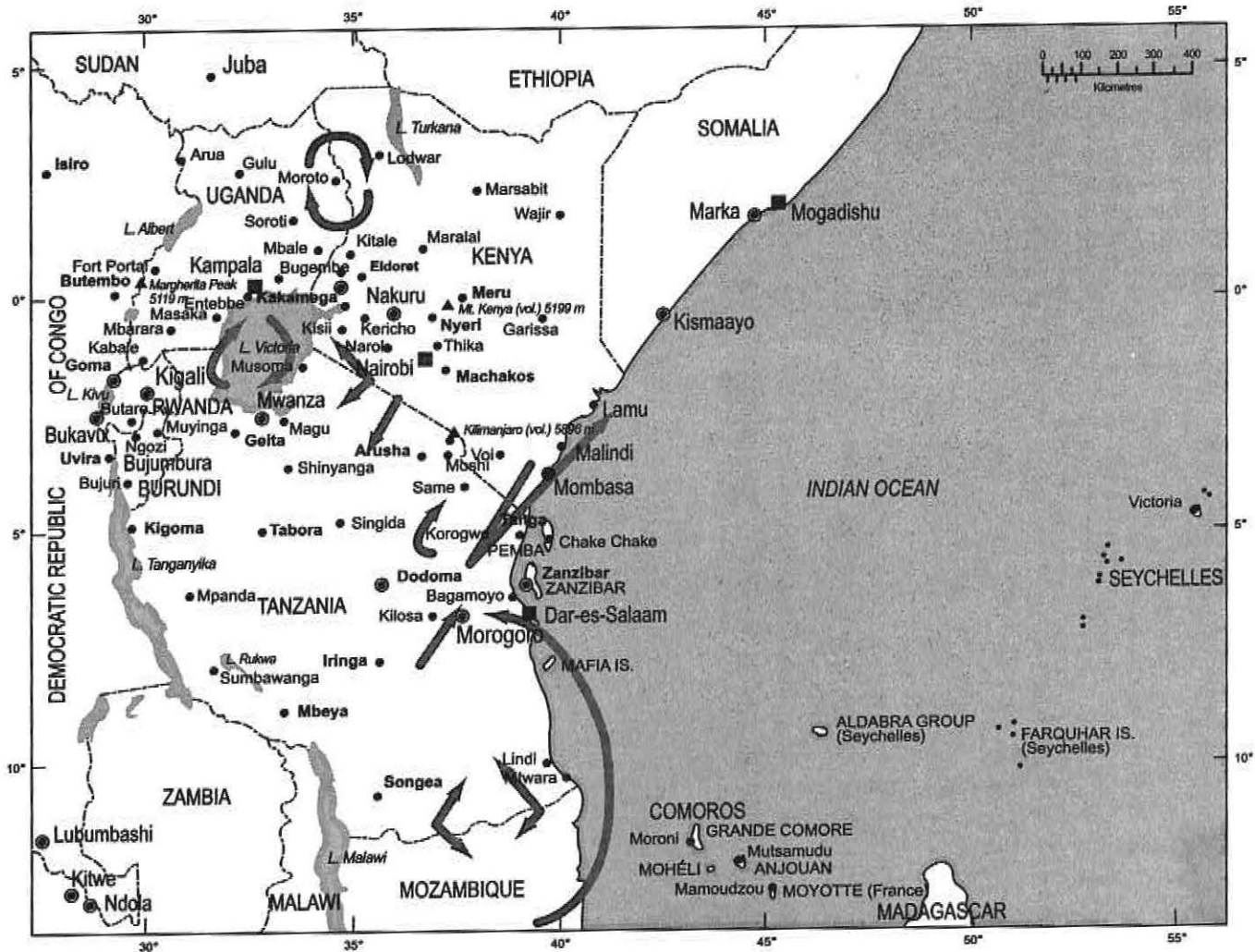


Figure 1. Crossborder Interactions (Tanzania-Kenya-Uganda)

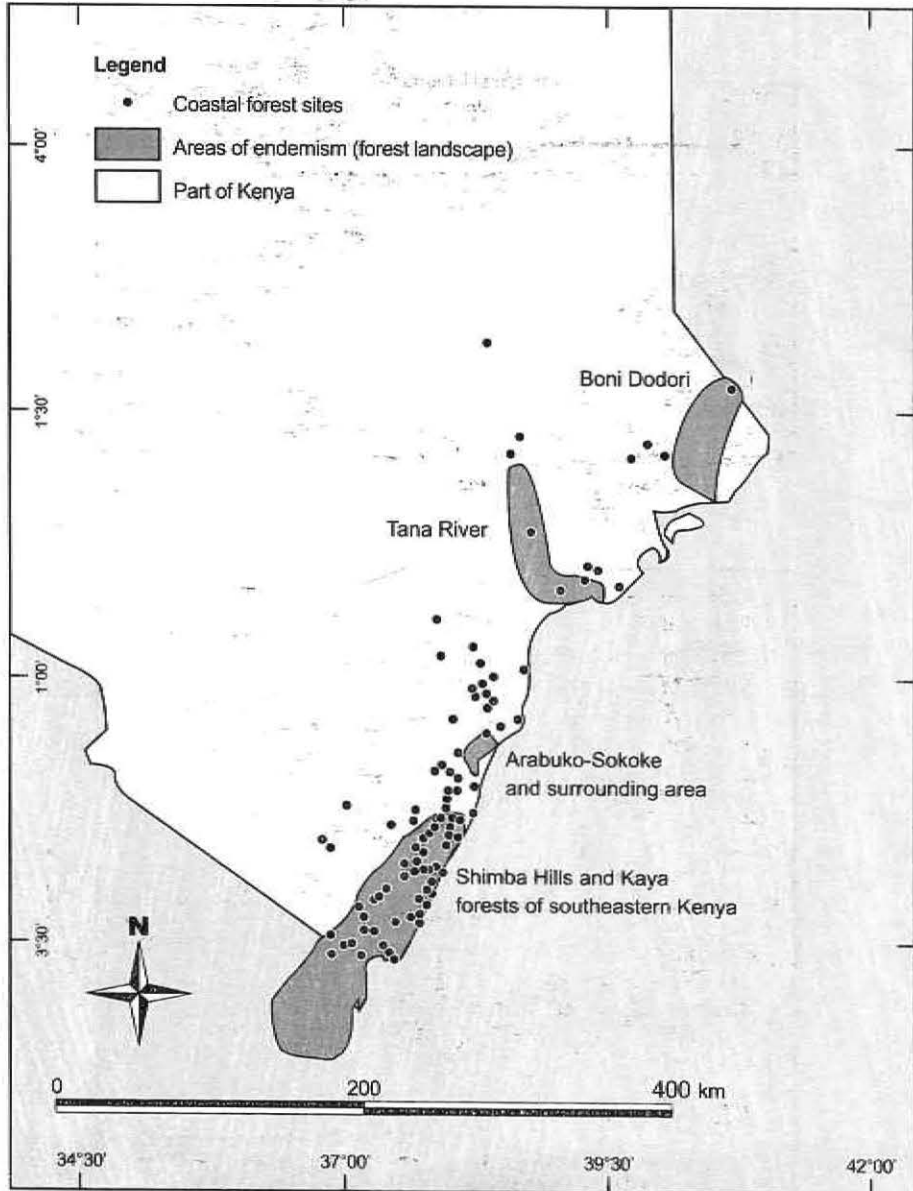


Figure 2. Kenya priority sites

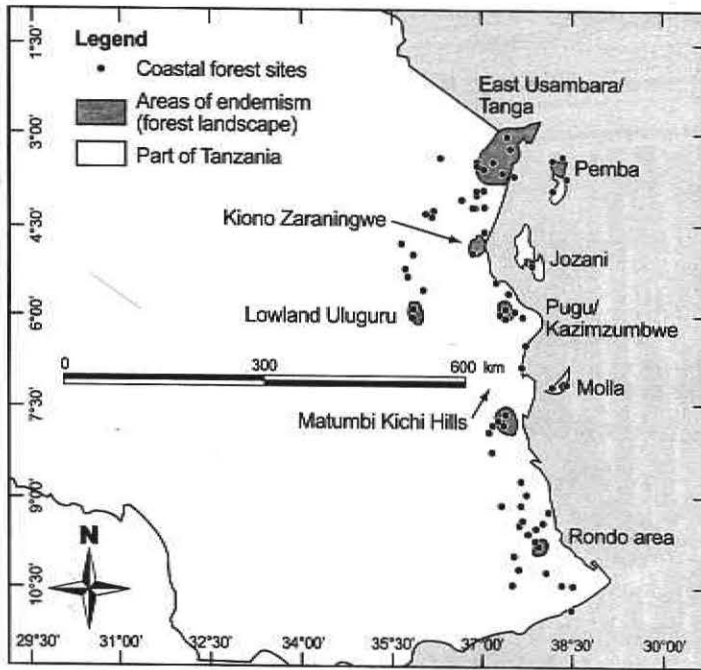


Figure 3. Tanzania priority sites

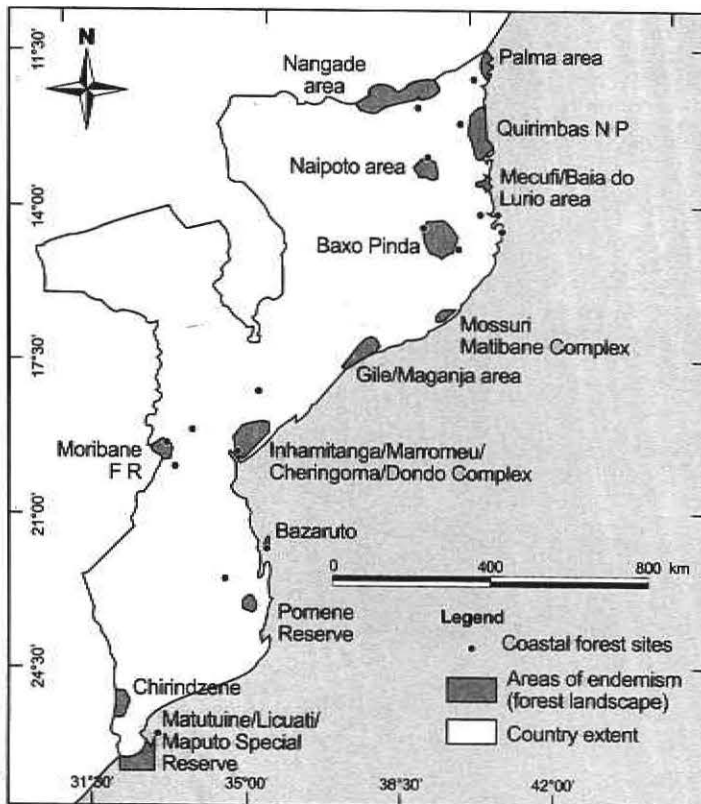


Figure 4. Mozambique priority sites

Lessons learned from EACFE

1. Forest Land Restoration Initiative: Approach adopted in collaboration with IUCN and other partners. Defined as: "a process that aims to regain ecological integrity and enhance human wellbeing in deforested or degraded landscapes".
2. Kaya Kinondo (Kenya) Ecotourism project (Mechanism put in place and launched 22 Jan 2005).
3. Forest Certification Process (FSC). Initiated a FSC process and maintained three FSC certificates.
4. Active CSO nurseries.
5. Shimba Hills Nature Trail.
6. Kaya Kinondo Financial Services Association.
7. Profitable herbal product initiative.
8. Initiated enterprise development with *icipe* (neem products, aloe products and beekeeping).

All these plus other lessons in the region enabled the development of a common vision and a strategy for a journey to achieve our goal.

EACFE implementation

Develop a common strategy

- Participatory/ partner initiatives
- (Incl. dev/funding partners)
- Communities brought to the centre of sustainable management (needs and priorities)
- Vision
- Targets
- Strategies
- National strategies and action plans
- Regional strategies and action plans
- Monitoring plans.

Key facilitators and leaders

- Forest department Kenya
- Forest and beekeeping division Tanzania
- Div. of Commercial Crops, Food and Forests Zanzibar
- Directorate of Wildlife and Forests Mozambique.

Conclusion

Eastern Africa Coastal Forests Ecoregion Strategic Framework for Conservation 2005–2025 developed. Envisaged result is a win-win situation for communities, governments and conservationists.

PROSPECTS OF INTRODUCING BEEKEEPING AND SERICULTURE IN THE IFAD MOUNT KENYA EAST PILOT PROJECT FOR CONSERVING THE NATURAL RESOURCES

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Abstract: Major causes of poverty in the project area are degradation and overexploitation of natural resources, population pressure/land subdivision, human/wildlife conflict, livestock diseases, landlessness, unemployment, droughts and lack of water for irrigation. The project aims to reduce poverty by promoting effective use of natural resources (NR), improving access to water and introducing better farming and water management practices for sustainable use of land and water resources.

Project objective

To reduce poverty of a targeted population of about 580,000 through improved food security and increased income levels of farmers and particularly rural women by promoting effective use of natural resources (NR), improving access to water and introducing better farming and water management practices for sustainable use of land and water resources.

Location

The project is implemented in selected sub-catchments of five rivers, namely Kapingazi, Ena, Tungu, Mutonga and Kathita in five districts: Embu, Mbeere, Tharaka, Meru Central and Meru South.

Project rationale

Mount Kenya is one of the five major water towers in Kenya. The area contributes about 49% of the River Tana flow. (The river is crucial to Kenya's development.) Mount Kenya National Park and Mount Kenya Forest Reserve were listed as World Heritage sites in 1997.

Causes of poverty in the project area

- Degradation and overexploitation of natural resources
- Population pressure/land subdivision
- Human/wildlife conflict
- Livestock diseases
- Landlessness and unemployment
- Droughts and lack of water for irrigation.

Implementation approaches

Project activities are implemented in selected river basins in identified focal development areas (FDAs). Activity identification is through participatory rural appraisals (PRAs) and development of community action plans (CAPs). CAPs are used to develop respective annual work plans and budgets (AWP and B).

Project funding

Funding is by IFAD.

An overview of beekeeping in the area

Introduction

Beekeeping is one of the nature based enterprises practised by target farmers in both the upper and lower parts of the project area (Table 1). However, in the upper parts of the project area the enterprise is not as important as dairy and horticulture farming.

Table 1. Status of beekeeping in the project area (No. of hives/district)

District/ Type of hive	Embu	Mbeere	Meru South	Meru Central	Tharaka	Total
Log hive	6950	41,952	33,344	21,000	213,330	316,576
KTB hive	1900	308	278	1550	95	4131
Langstroth hive	1000	95	226	110	9	1440
Total	9850	42,355	33,848	22,660	213,434	322,147

Average honey production rates in the project area

- Log hive: production from 2.7 kg/year–10 kg/year.
- KTB hive: production average from 20 kg/year.
- Langstroth hive: 30 kg/year.

An estimated 50,000 people are engaged in beekeeping but it is male dominated (MBE, THA, MES have highest number).

Marketing

Honey marketing is an enterprise with no organised marketing systems in place. Some organisations have taken up the challenge and are engaged in the full market chain, e.g. Honeycare, African Beekeepers Limited (MS and MBE—through supply of hives, extraction and marketing). Mount Kenya East Pilot Project (MKEPP) is developing strategies of partnering with stakeholders to enhance marketing.

Opportunities

- High on-farm tree cover within the project area
- Many rivers that cross the area provide forage
- Potential for irrigated agriculture within the project area could be major source of forage
- Commercialisation of the enterprise is allowing women and youth to have an alternative IGA
- Expansive land with a lot of forage (MBE and THA)
- The ongoing promotion of agroforestry.

Project support to beekeeping activities

- Training for both staff and farmers
- Procurement of demonstration materials
- The project is setting up apiary sites within FDAs as training sites
- Promotion of processing (As a start, the project has procured a steam wax extractor)
- Support to groups in registering honey products.

Constraints

- Pests and predators
- Low prices (Kshs 120/kg crude honey)
- High cost of modern hives
- Low occupancy/bee absconding leading to low yields for modern hives
- Lack of beekeeping skills (both staff and farmers).

An overview of potential for sericulture in the project area

Introduction

Sericulture—raising of silkworms to produce raw silk—is an important income-generating activity (IGA). Business involves mulberry cultivation, leaf collection, silkworm rearing, cocoon drying, reeling and weaving. Sericulture has been identified as a key NR based enterprise with huge potential in the project districts of MKEPP. In Kenya, sericulture is enjoying immense interest and attraction among farmers as a profitable cash crop. It has been identified as a promising sector for the development of farming communities as it offers opportunities for additional income generation, especially for the rural poor.

Potential for sericulture

Conditions for sericulture are favourable in the project area and potential for mulberry is immense. Most farmers, however, lack the basic knowledge to initiate sericulture as an IGA though some efforts have been noted in Mbeere district. MKEPP is in the process of undertaking sensitisation to promote sericulture and other nature based enterprises. Under the farm forestry initiative and the School Greening Programme, establishment of mulberry woodlots, construction of ideal silkworm rearing houses as well as transferring postharvest technologies has been planned in Mbeere.

The strategy by the project is aimed at assisting both women and youth groups interested in sericulture to attain self sustainability and to increase their income through silkworm farming.

The project has a budget of Kshs 9.6 million set aside for promotion of such nature-based enterprises under its Environmental Conservation component.

The way forward on sericulture promotion

MKEPP will undertake to promote sericulture through the following actions:

- Train the DFTs and DITs from relevant departments in sericulture
- Facilitate training to selected self help groups on sericulture
- Financially support proposals for Community Nature Based Enterprises project within the FDAs
- Avail mulberry cuttings for demonstration from reputable institutions
- Through established partnership, backstop groups in setting up cocoon production units and marketing system.

WILDLIFE CONSERVATION FOR LIVELIHOODS BY THE LOCAL COMMUNITY

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Abstract: Biodiversity conservation that encompasses wildlife is an investment that yields substantial local, national and global benefits. Since the Earth Summit in Rio de Janeiro (1992) biodiversity conservation has become one of the major concerns in the field of environment together with other concepts such as 'sustainable development' or equitable sharing of benefits generated from natural resources.

Mandate of Kenya Wildlife Service (KWS)

In 1989 the Kenya Government reviewed the 1976 Wildlife Conservation and Management Act, Cap 376 and created a body corporate (parastatal), the Kenya Wildlife Service. The overall mandate of KWS is to conserve and manage wildlife in Kenya. It has the sole jurisdiction over national parks and a supervisory role in the management of national reserves, and local and private sanctuaries. It has also the mandate to licence, control and supervise all wildlife conservation and management activities outside the protected areas.

Community involvement in wildlife conservation and livelihoods

Conservation in Kenya requires innovative solutions to help communities become better custodians of natural resources by benefiting from markets that alleviate poverty. More important is that wildlife should assume a positive role in the lives of the rural people as wildlife shares the land with the same people.

Examples of local community conservation and livelihoods incentives

Game bird shooting

Wildlife areas especially in Samburu, Kajiado, Isiolo, among others, are divided into bird shooting blocks. Some of the revenue accrued in such activities is ploughed back to the communities through development programmes.

Successful local community conservation and livelihoods initiatives: Ecotourism

- Community-based ecotourism (CBET) has become a popular tool for biodiversity conservation, based on the principle that biodiversity must pay for itself by generating economic benefits, particularly for the local people
- It provides both an incentive for conservation and an economic alternative to destructive activities
- The CBET links conservation and local livelihoods, preserving biodiversity while simultaneously reducing rural poverty, and achieving both objectives on a sustainable (self-financing) basis.

Income generating activities: Examples of community-based wildlife sanctuaries

- Mwaluganje—In Kwale, adjacent to Shimba Hills
- Il Ngwesi—In Laikipia, slopes of Mount Kenya
- Shompole—In Kajiado, near Lake Natron
- Kimana—In Kajiado, near Amboseli National Park

The communities manage these conservation areas for tourism. Revenue accrued lifts the livelihoods of the local communities.

Community participation in natural forest resource management

This enables the communities to access the forest resources both for their economic gain and local use. For example:

- Kipepeo—Butterfly farming in Arabuko-Sokoke forest
- Access to water, firewood, medicinal herbs for local use
- Beekeeping
- Establishment of tree nurseries—Agroforestry
- Bioprospecting and community involvement—Income generating initiatives through cultivation of wild plants (medicinal and aromatic). Natural products based enterprises, e.g. *Aloe secundiflora*, *Mondia whytei* and *Ocimum kilimandscharicum*.

Linking business and nature

The Il Ngwesi Community-Based Ecotourism Enterprises—Laikipia

- Community-owned and managed
- Combines local knowledge, business and nature—A model for conservation
- Group ranch area is 8700 hectares with 12-bed luxury lodge
- In exchange for maintaining the conservation area, Il Ngwesi Group Ranch receives multiple financial and social benefits for its 448 registered households.

Mwaluganje Elephant Sanctuary

- The Mwaluganje Elephant Sanctuary with an area of 36 km² is situated in Kwale, in the coastal region of Kenya
- Mwaluganje is one of the first community-owned and managed ecotourism ventures in Kenya
- In 2000 alone, the Mwaluganje community was able to allocate part of its revenue to sponsor 45 primary school pupils.
- The scheme has improved school enrolment and enhanced pupils' performance in an area that once had the lowest level of literacy in Kwale district.
- In the year 2001 this enterprise supported 13 employees who earned \$23,763 in wages.
- Dividends of US\$ 25,641 resulting from profits in sanctuary fees were paid out to the 160 shareholders.

Conclusions and recommendations

- Increased funding for biodiversity conservation is a prerequisite
- Wildlife tourism is a growing industry that has the potential for further expansion, hence it can be an important mechanism for local economic development and poverty reduction
- Empowering local communities by supporting community projects and other income generating activities enables them to link conservation issues to development.

STATUS AND PROSPECTS OF USING STINGLESS BEES FOR POLLINATION SERVICES

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Abstract: Wild and managed bees (e.g. honeybees) seem to be declining rapidly around the world. This is causing concern about the future of pollination services for crops and wild plants. Traditionally, agriculture relied on managed honeybees, *Apis mellifera*, for pollination of insect-dependent crops. But given recent problems of disease (e.g. varroa, small hive beetle) and defensiveness (e.g. African honeybees in the Americas) honeybee keeping has come under pressure. In addition, it has become clear that other bees can pollinate many crops more efficiently. For example, bumblebees are now pollinating greenhouse tomatoes and other greenhouse crops around the world. The threats to apiculture have led to the understanding that diversification of commercially available pollinators is needed to ensure food production in the future.

Stingless bees: An introduction

There are probably 400–500 species of stingless bees (Apidae, Meliponini) in the world, all of which are highly eusocial and inhabit the old and new world tropics. Their colonies contain from several hundreds to tens of thousands of worker bees, a single egg-laying queen and sometimes a couple of males. Reproduction is through swarming, but the process is different from that in honeybees. First the workers search for and select a new nest site, which they prepare for the swarm. Then, part of the colony's workers together with a virgin queen leave the mother nest and establish themselves at the new nest site. Then, the virgin queen mates (outside the nest) and starts producing the worker brood.

Stingless bees have recently become a popular study subject, which is reflected in an explosion of scientific papers in the last decades. One of the reasons for this popularity is undoubtedly the wide variety of biological and ecological features that the various species have, making them ideal for comparative studies. For example, in terms of foraging ecology they range from species showing largely solitary foraging (similar to bumblebees) to species using sophisticated communication systems (analogous to honeybees). This wide range in foraging features makes them suitable pollinators of crops. Moreover, they vary from about 2 mm to 2 cm in body size and can thus extract nectar and pollen from many different flowers (and in the process pollinate them). A recent issue of the journal *Apidologie* (2006, volume 37, issue 2) provides a state-of-the-art overview of stingless bee research and includes papers on biology, ecology, stingless beekeeping and pollination.

Global perspective on crop pollination

In a recent review, Klein et al. [1] collated all the information available on the pollination of the major human food crops. They found that 87 of 115 fruit, vegetable and seed crops depend upon animals (mainly insects) for pollination. These crops represent about 35% of the global volume of food production. Thirteen crops depend completely on animals for their pollination. These include watermelon, melons, gourds, pumpkins, kiwifruit, passionfruit, cashew, macadamia, cocoa and vanilla. In addition, animals are very important to 30 more crops, which include apple, strawberry, avocado, plum, peach, apricot, cherry, cucumber, coconut, mango, soybean, cotton, sunflower, broad beans and coffee. The global value of pollination by animals has previously been estimated to be more than 100 billion US-dollars [2].

Declines in pollination services?

Wild bees contribute substantially to the pollination of crops and crop pollination is generally better in landscapes containing more (semi-) natural habitat¹. However, wild bees have been proven to decline in various parts of the world (e.g. W-Europe) [3] and are thought to be under pressure from land use change and climate change worldwide. As a result, the International Initiative for the Conservation and Sustainable Use of Pollinators stated in 2000 that there is an urgent need to address the issue of worldwide decline of pollinator diversity. Traditionally honeybees have provided most of the applied pollination needs, but diseases such as varroa mites, foulbrood and hive beetles have made beekeeping more difficult and expensive in the western world. This has triggered the search for alternative pollinators. Bumblebees are now widely available for pollination, carpenter bees (*Xylocopa* spp.) have been used for passionflower pollination, leafcutter bees (*Megachile* spp.) pollinate alfalfa in the USA, and several *Osmia* solitary bees are used for pollination of apple and pear blossoms.

Why use stingless bees?

Stingless bees are among the potential alternative pollinators, since they play an important ecological role as pollinators of many wild plant species. Their role as crop pollinators has been assessed in 18 crops (see Table 1). Some crops are grown in open fields in tropical climates, but others are grown in enclosures such as cages and greenhouses. Eleven species of stingless bees across six genera have been found to forage effectively under enclosed conditions, indicating the potential of stingless bees as pollinators of greenhouse crops. An economic incentive for the use of stingless bees as commercial pollinators is that colonies can be kept (outdoors or indoors) for years and do not die after reproduction (like bumblebees do). At the moment, the main limitation to the commercial use of stingless bees for pollination services is the lack of knowledge of mass breeding. Artificial colony

Table 1. Crops pollinated effectively by stingless bees

Scientific name	Common name	References as cited by Slaa et al. (2006)
<i>Bixa orellana</i>	Annato	See Heard (1999)
<i>Persea americana</i>	Avocado	Can-Alonso et al. (2005), Ish-Am et al. (1999)
<i>Myrciaria dubia</i>	Camu-camu	See Heard (1999)
<i>Averrhoa carambola</i>	Carambola	See Heard (1999)
<i>Sechium edule</i>	Chayote	See Heard (1999)
<i>Cocos nucifera</i>	Coconut	See Heard (1999)
<i>Coffea arabica</i>	Coffee	Klein et al. (2003a)
<i>Coffea canephora</i>	Coffee	Klein et al. (2003b)
<i>Cucumis sativus</i>	Cucumber	Santos et al. (2004b)
<i>Theobroma grandiflorum</i>	Cupuaçu	See Heard (1999)
<i>Macadamia intergrifolia</i>	Macadamia	See Heard (1999)
<i>Mangifera indica</i>	Mango	See Heard (1999)
<i>Pourouma cecropiaefolia</i>	Mapati	See Heard (1999)
<i>Nephelium lappaceum</i>	Rambutan	Rabanales et al. (unpublished manuscript)
<i>Fragaria x ananassa</i>	Strawberry	Asiko (2004), Malagodi-Braga and Kleinert (2004), etc.
<i>Capsicum annuum</i>	Sweet pepper	Meeuwssen (2000), Cruz et al. (2004), Occhiuzzi (2000)
<i>Lycopersicon esculentum</i>	Tomato	Santos et al. (2004a); Sarto et al. (2005) etc.
<i>Salvia farinacea</i>	Ornamental flower	Slaa et al. (2000a,b)

After Slaa et al. (2006). For references see that publication.

reproduction needs to be further developed before these bees can become available as commercial pollinators. But given the range of species available and the range of plants used by them as food sources, it is merely a matter of matching bees to crops (see further below) and developing management techniques.

Rural economy: Pollinating pets, providing food and \$?

Besides being of potential use in commercial pollination, there are various benefits to stingless bees as a part of rural economy. I like to call them pollinating pets, because people enjoy having stingless bees around, but in the meantime they provide valuable pollination services and a bit of honey as well. (This is summarised in Figure 1.) Their role in the rural economy can be seen as threefold:

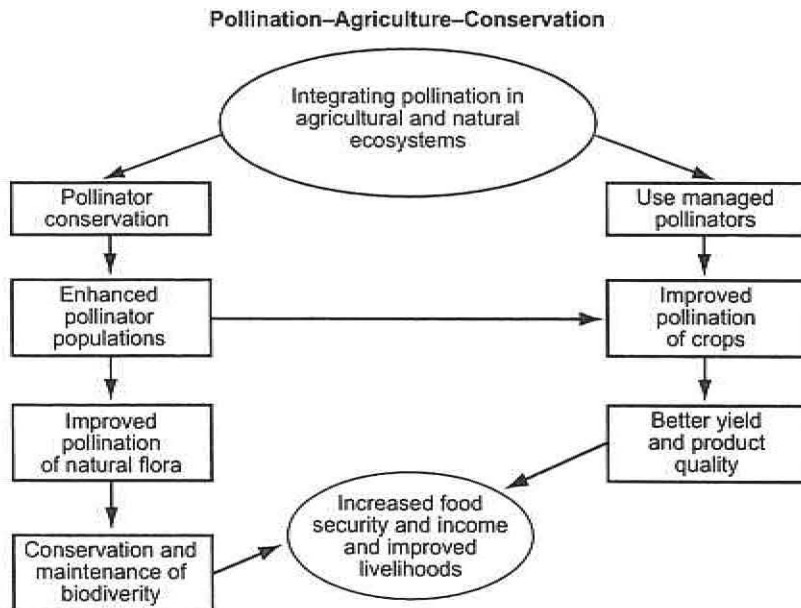


Figure 1. Schematic representation of how the interaction between agriculture, pollination and conservation may enhance food security and local income

Economic role as cash crop pollinators and honey producers

A small-scale farmer tends to grow a range of crops to sell at the local market. It is likely that at least some of these crops benefit from stingless bee pollination (e.g. fruits such as mango or avocado, or vegetables such as tomatoes or cucurbits). Having a couple of stingless bee hives around the house will undoubtedly increase the density of bee foragers at flowers and thus the fruit or vegetable harvest.

In Brazil and Mexico stingless bee honey from a range of species is being produced in marketable quantities. This seems unrealistic for Africa with the possible exception of *Meliponula bocandei*, a widespread species that is reportedly managed for honey production in some African countries. Even small quantities of honey can bring substantial income though. In Pernambuco (Brazil) a bottle of honey from the native stingless bee *Melipona scutellaris* is sold for the same price as a bottle of French champagne (Dr Paulo Nogueiro-Neto, pers. commun.). Especially if honey has a medicinal or traditional use the commercial value can be 3–10 times higher than that of honeybee honey.

Impact of stingless bee presence on human health

Many rural families in tropical Africa grow some of their own fruit, vegetables and staples. Again stingless bees (and other wild bees including honeybees) will visit and pollinate some of these subsistence crops and thus increase the family's food production and the variety of the people's diet. It would be of interest to carry out a study of what the actual benefits are of stingless bees in improving horticultural harvest. In addition, honey can be harvested in small quantities for own consumption as a sweetener or can be used to treat colds and other illnesses.

The ecological role of stingless bees

Finally there is another aspect of stingless bees as pollinating pets that will have a more indirect effect on the local people. By pollinating many wild flowers they are like ecosystem engineers in that their actions produce fruits and seed that are used by other wildlife and help in maintaining a healthy balance in the environment. For example, the populations of birds and ants might be boosted by the abundance of fruit and seed, which may lead to higher predation by these natural enemies of crop pests. Finally, pollinating pets keep reminding their owners of how we depend on our environment and as such raise awareness among the people.

Road to applied pollination with stingless bees

This all sounds very interesting, but is it realistic to think of stingless bees as manageable pollinators for our crops? Well there are a couple of important steps to be taken in this process (and not necessarily in the order that I describe them):

Matching crops with bees

First, one needs to identify a crop that may benefit from stingless bees for its pollination. While intuition and local knowledge may guide this process, only careful scientific study can prove the effect of a specific bee species on seed or fruit set and quality [4]. Excellent controlled experiments have been carried out on strawberries and ornamental plants (*Salvia* spp.) that compared the effect of the presence of bees and also the effect of different stingless bees and honeybees on the quality and number of the fruits produced. This has led to trials of stingless bee pollination in Japan, Brazil and Australia.

Research on bee biology

Detailed knowledge of the bee's biology and behaviour will be needed to adapt the bees to the crop pollination setting. Different bees are active at different times of the day and under different climate conditions. If the crop to be pollinated is a forest plant, the bee should be active under shady conditions (as forest bees are), whereas lowland crops in open fields might benefit more from pollinators adapted to savanna or open woodland conditions. Behaviour is very important as well, because some species have the tendency to bite holes in flowers to reach the nectar rewards or perform otherwise illegitimate flower visits that do not result in pollination.

However, most importantly, one needs to develop techniques for colony reproduction and growth to accommodate for the demand for bee colonies for pollination. Only in this way can one avoid the destruction of wild bee colonies (as many colonies are destroyed in the process of collection) and protect natural bee populations.

Meliponiculture: Local knowledge, development, training

In Africa, several local tribes possess knowledge about native species including stingless bees. Such knowledge should be collected and used in choosing bee species as potential pollinators and in the development of a stingless bee management strategy. Key elements in such development include: study of bee pests and diseases, monitoring of colony development, study of local honey flow to understand when colonies need to be fed or can be divided, development of rational hives to facilitate colony management and honey harvest with minimal destruction of the brood nest, developing techniques for colony division and eventually queen rearing. A lot of knowledge is available in Brazil (mostly in Portuguese), Mexico (in Spanish) and Australia (all in English) and can be found in Cortopassi-Laurino et al. [5] and by searching the Internet.

Legalisation of the bee trade and honey quality

When the use of stingless bees is promoted, it is very important to provide legal protection for the native bees and make sure that their natural populations are guaranteed for the future. If stingless bee honey will be marketed, there needs to be special consideration about the marketing. It cannot be marketed as 'honey', because this name is reserved for honeybee honey and only this honey fulfills the criteria of the quality standard for honey. Stingless bee honey has higher water content and tends to be more acid and thus does not qualify as 'honey' on the international market.

Conclusion

Stingless bees have the potential to become an integrated part of rural development and local economy in tropical Africa, particularly concerning their role as pollinators of human food plants. Knowledge of African stingless bees is rudimentary; therefore, a concerted effort has to be made to improve our understanding of these bees, exchange information on African stingless bees, start research cooperation on both applied aspects of stingless bee biology and on applied pollination. Once we have filled the gaps in our knowledge of these bees we can start to promote their use in local initiatives and potentially even in commercial organic farming systems. They can then also be used in sustainable ecosystem initiatives undertaken by NGOs and other groups, such as has been done by the Costa Rican NGO Arbofilia (see Figure 2).

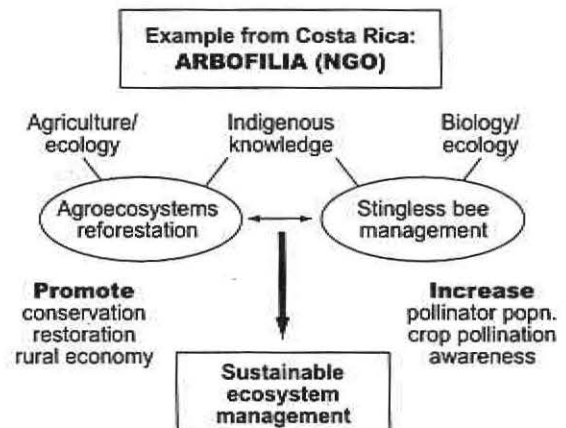


Figure 2. Example of integration of stingless bee management in an agroecology from the Costa Rican NGO Arbofilia

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SPATIAL DISTRIBUTION OF *ANAPHE PANDA* IN KAKAMEGA FOREST, KENYA AND ITS SIGNIFICANCE IN MONITORING FOREST BIODIVERSITY

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Abstract: Monitoring fluctuation of biodiversity in many IFAD/GEF projects is not an easy task. But skills in geographical information systems (GIS) and new information technology (NIT) can be a way forward. Geographical information system was used to monitor *Anaphe panda* (Boisduval) silkworm cocoon nests, egg clusters and the host plant *Bridelia micrantha* in two types of forest encountered in the Kakamega forest of western Kenya. More of the host plant *B. micrantha* and less cocoon nests and egg clusters were observed in the mixed indigenous forest whereas more cocoon nests and egg clusters and less *B. micrantha* were observed in the indigenous forest. In the indigenous and mixed indigenous forests *A. panda* host plant (*B. micrantha*), cocoon nests and egg-clusters were not randomly distributed.

Introduction

Insight on the spatial distribution of wild silkworms in indigenous forests and mixed indigenous forests is one of several challenges facing wild silk production in western Kenya. Furthermore information is required on spatial distribution of species to assist in developing management plans for conservation and their sustainable utilisation for income generation. The use of new technology like geographical information system (GIS) becomes necessary to analyse environmental changes with the aim of developing recommendations for sustainable biodiversity management.

Literature review

In Kakamega forest, five species of wild silkworms were identified for wild silk production, and *A. panda* (Boisduval) showed the most potential since it had a huge silk-nest that was communally weaved by 20–105 silkworms.

Monitoring studies

Plots were chosen randomly in each block and about 8.6% of the total area of each block was sampled. Sixty-five plots of 5000 m² each were chosen in Ikuywa block and seventy-one of the same dimensions in Isecheno block. Sampling was carried out from February to April 2006. This period has abundant *A. panda* egg clusters in the field and each egg-cluster contains about 250–460 eggs.

In each plot, all *A. panda* host plants (*B. micrantha*) above 0.50 m height were checked and recorded using a global positioning system (GPS). A tape measure was used for measuring the height. Cocoon nests were checked also in several other places, such as stones, cavities, holes or dead tree trunks in each plot. These were also counted and recorded using a global positioning system (GPS). Egg clusters were checked on the living crown of each *B. micrantha* tree using Binocular spectron 7*50 Multi-coated optics 123 M/1000 M for trees above 2.5 m height.

Results

Mean number of *A. panda* host plant *B. micrantha*, cocoon nests and egg clusters in two selected blocks

The mean numbers of *A. panda* host plant (*B. micrantha*), cocoons nests and egg-cluster from Isecheno and Ikuywa blocks are summarised in Table 1.

Table 1. Mean number of *Bridelia micrantha*, cocoons nests and egg clusters in each block

Blocks	<i>B. micrantha</i>		<i>Anaphe</i> cocoon nests		<i>Anaphe</i> egg-clusters	
	Mean	n	Mean	n	Mean	n
Isecheno	7.28 ± 2.96**	517	0.99 ± 1.01*	70	1.37 ± 1.07**	97
Ikuywa	5.89 ± 2.16	383	1.31 ± 1.20	85	1.82 ± 1.27	118

*Significant (P < 0.05), **Highly significant (P < 0.001).

Spatial distribution of *A. panda* host plant *B. micrantha*, cocoon nests and egg clusters in two selected blocks

The spatial distribution can be visualised in Figures 1, 2 and 3.

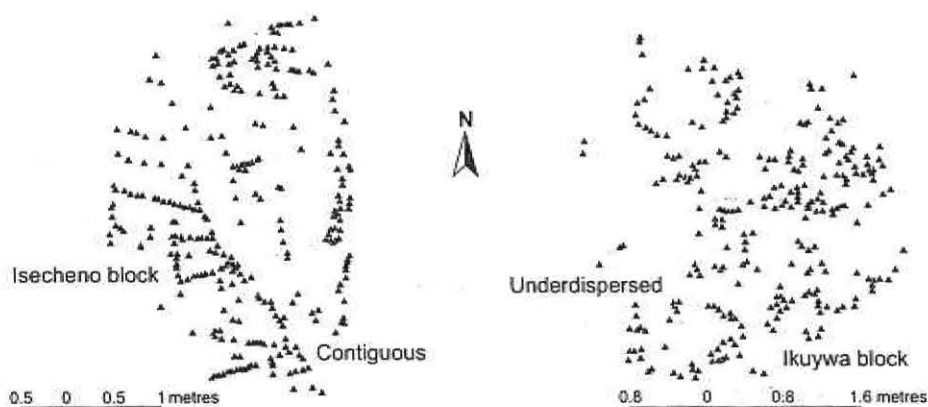


Figure 1. Geographical distribution of *Anaphe panda* host plant, *Bridelia micrantha* at Isecheno and Ikuywa blocks in the Kakamega forest

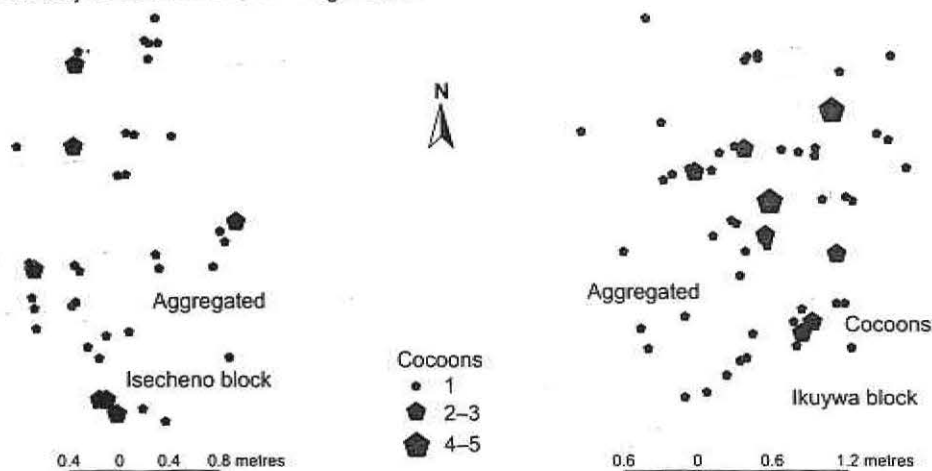


Figure 2. Geographical distribution of *Anaphe panda* cocoon nests at Isecheno and Ikuywa blocks in the Kakamega forest

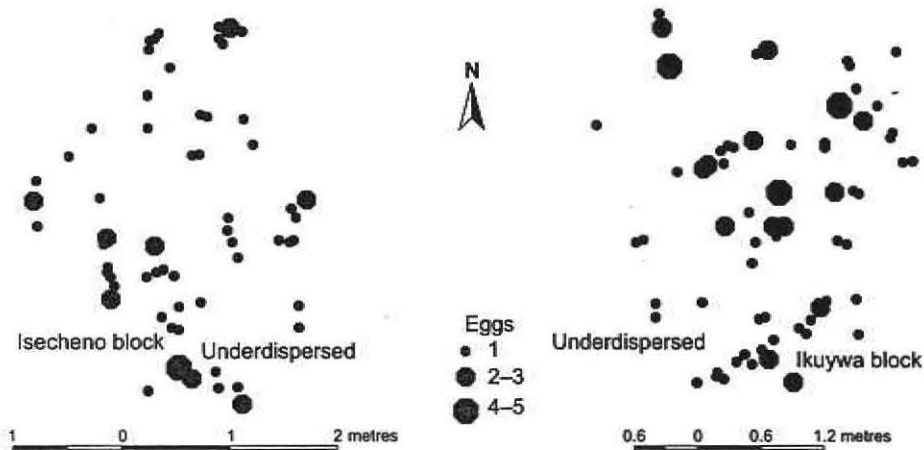


Figure 3. Geographical distribution of *Anaphe panda* egg clusters at Isecheno and Ikuywa blocks in the Kakamega forest

Conclusion

Geographical information system reveals that distribution of *B. micrantha* cocoons nests and egg clusters are not uniformly distributed in the two types of forest (indigenous and mixed indigenous). This confirms the insufficient populations in the wild. *Bridelia micrantha*, cocoon nests and egg-clusters were recorded at different densities in the indigenous forest and mixed indigenous forest. This study also reveals that *A. panda* host plant (*B. micrantha*), cocoon nests and egg-clusters are not randomly distributed in the Kakamega forest and they are overdispersed or underdispersed according to the type of forest (indigenous or mixed indigenous forest). This study recommends utilisation of geographical information system (GIS) for the long-term monitoring of biodiversity to determine population fluctuation (declining or increasing).

INTEGRATION OF APICULTURE AND SERICULTURE TO SUPPORT FOREST BIODIVERSITY IN NIGERIA

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Abstract: Nigeria is a country with a population of over 120 million people, spread across a land area of significantly changing vegetation. From the southern part of the country it is predominantly forest. This changes to savanna as we move northward.

Along the forest zone, deforestation is a major problem. Man is the sole factor exploiting the forest carelessly and ignorantly, distorting and destroying in the process the delicate biodiversity of the forest. A closer study of man's motives for this unproductive exploitation of the forest shows a selfish greed to make money. Trees are felled for timber and energy without any conscious effort to re-plant.

Over time, successive governments in Nigeria had promulgated policies to conserve the forest in the forest zone and to promote afforestation in the savanna/desert zones. Quite a few in Nigeria would confidently say that these policies have stood the test of time; especially in the checking of deforestation.

In simple language, the forest biodiversity in Nigeria is endangered. To check this, salvation lies in convincing the populace of the advantages to be derived from forest biodiversity. Also it must be explicitly shown to the government the possibilities of reducing the level of poverty by simple integration of apiculture and sericulture in the agriculture policy of the country.

A detailed analysis of the possibility for the integration of both apiculture and sericulture with a view to supporting forest biodiversity in Nigeria will be well worth the effort. Nigeria has the market potential. However, the success of the integration of these two laudable money spinning ventures will so much depend on governmental support /policy, international support/collaboration, extensive education/enlightenment, training (simplified), organisation, financial assistance, monitoring and evaluation and the marketplace.

A minimum action of five years will be required before any positive impact will be recorded.

Agriculture

Nigeria grows all tropical crops.

Forest biodiversity

Vegetative cover (previously classified into three types);

- (i) Tropical rainforest
- (ii) Tropical deciduous forest
- (iii) Dry woodland

Forests are now broadly delineated into two broad belts of vegetation types, namely the forest and savanna types:

- Saline water and freshwater swamp forests
- Tropical evergreen rainforest
- Derived savanna and
- Pure savanna

Hence, we have in Nigeria the Guinea, Sudan and Sahel savanna vegetation types.

Forests composition

Nigeria has both exotic and indigenous plant species.

- *Tectona grandis*
- *Eucalyptus*
- *Acacia*
- *Gmelina arborea*
- Neem and other indigenous species
- Guinea forest—like other Guinea forests—harbours the highest mammal diversity of about 551 mammal species, e.g. pygmy hippopotamus.

Functions of the forests

- Significant for its economic, social and ecological benefits
- Plays an important role in protecting the soil
- Ameliorate the environment
- Protect the water resources
- Provide 80% of the country's household domestic energy
- Contribute 2.5% to the nation's GDP.

Pressure on Nigeria's forests

Seventy percent of the population depends on the forest resources and pressure is exerted on the forests due to:

- Rapid population growth
- Unclear tenure system
- Reliance on forest resources for rural economy and rural livelihood
- Clearing for extensive agricultural and shifting cultivation
- Extensive commercial logging
- Firewood and pulp.

Other deforestation factors

- Non-involvement of the communities in forest resource management leading to non-monitoring of forests to stop bush-fire, illegal harvesting/farming and grazing
- Wariness of individuals to plant trees due to delayed and unclear forestry benefits
- Increasing number of inappropriate and inefficient sawmills cause wood waste and environmental hazards on existing forests
- Tenurial system has fragmented available land for tree planting
- Movement of timber lorries especially at night and sawmilling at night encourage illegal felling of timber.

Apiculture in Nigeria

- Modern beekeeping as distinct from honey hunting is not new in Nigeria
- As far back as 1927 a West Africa newspaper carried an article on beekeeping
- In 1930, C. K. Meek reported the Ngamo practice of keeping bees in plaited hives
- A more remarkable practice of keeping bees was recorded in *Farm and Forest* in 1942 about 'Sarkin Zuma' in Zaria.
 - They developed a system of keeping bees in cylindrical hives
 - The system accommodated the queen excluder thus dividing the hives into two chambers

- They introduced the use of smoke, which was gently introduced into the hive to induce the bees to crawl from the honey chamber to the brood chamber during harvesting
- In this manner, the bees produced another crop of honey.

'Sarkin Zuma' in Zaria—Organisation

- Beekeeping in Zaria was highly organised
- Each locality had a chief bees collector
- The chief bees collector maintained ethics and coordinated the beekeeping activities
- Had the secrets of preparation that were guarded and handed down from father to son
- The following ingredients were pounded in a mortar and placed in the hive as bait: (i) fruits of *Swartzia madagascariensis*, (ii) pods of *Bauhinia reticulata* and *Casaia garatensis*, and (iii) *Cymbopogon giganteous* inflorescence
- Hives were hung on trees in October
- The chosen trees were: (i) *Vitex cuneata*, *Ficus quaphelacarpa*, *Parkia filicoidea* and *Tamarin dusindica* among others
- As early as 1941, Zaria had become a collecting and processing centre of honey and beeswax
- Other tribes like the Tiv Igala, Ngamo and the Yoruba keep bees
- These are the different characteristics of the Tiv people of Bunue state:
 - Beekeeping is enveloped in spiritualism and mystique
 - Beginners must be initiated;
 - The art must be purchased with money and incantation
- These are the different characteristics of the Igala people of Kogi state who claim to have migrated from Egypt (former indigenous name was Kemet)
 - Keep bees prolifically and trading honey is big time business
 - Better understanding of the use of bee products.

Transformation of apiculture in Nigeria

- Beekeeping has undergone some transformation
- Wider acceptance
- Better technology to maximise production and profit is gradual
- A shift from traditional hives to Kenya Top-Bar is starting to grow
- The use of Langstroth hives will require more extension work
- The Beekeepers' Association of Nigeria is in place. It has branches in almost 2/3 of the 36 states of Nigeria
- Awareness, improvement and ethical practices being maintained.

Sericulture in Nigeria

- Mulberry silkworm rearing in Nigeria started only recently
- But silk production is not new to Nigerians
- The popular 'aso-oke' or 'ori' among the Yoruba tribe is a blend of cotton and silk
- The Yoruba are found mainly in the lowland rainforest and *Anaphe venata* (African silkworms) are found in this forest
- Areas like Iseyin in Oyo state or Ekiti state are known for the art of weaving silk
- Mulberry silkworm rearing is currently at the experimental stage in the country
- Ekiti state government in collaboration with the Raw Material Research and Development Council commenced production in 2003

- Dr Puttasway Gowda, an Indian expatriate, was contracted by Ekiti state government to give necessary expertise in production
- Production stops at cocoon stage
- Sericulture in Ogun state government is at the implementation stage.

Integration of apiculture and sericulture—A pillar for forestry support

- Bees are pollinators
- The presence of bees in the forest increases agricultural output
- Bees products like honey, bee venom, royal jelly, propolis and pollen command good prices and are excellent sources of income
- Beekeeping needs to be linked with the forests
- The practice promotes community participation in forest resources management
- Rearing of mulberry silkworm cannot be feasible without mulberry cultivation (a secondary forest establishment)
- Rearing of wild silkworm promotion among the rural populace will ensure the protection of its host plants
- The forest is conserved with the understanding that money is coming from its conservation
- A well-planned integration will certainly support Nigeria's forest biodiversity.

APICULTURE AND SERICULTURE AS INCOME GENERATION OPTIONS IN THE SUDAN AND PROSPECTS FOR INTEGRATION IN IFAD PROJECTS: STATUS AND CONSTRAINTS

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Abstract: Beekeeping has been practised in the Sudan since the days of King Taharqa (690–664 bc) and the Christian age in northern Sudan. A number of wild silkworm species are reported in the South and Central Sudan, but the identity and biology have not yet been investigated. There is no serious activity so far in spite of highly trained entomologists and forestry and conservation experts. However, the two enterprises have a huge potential to improve livelihoods, if only the constraints facing the enterprises are addressed. This can easily be achieved by integrating apiculture and sericulture in the ongoing IFAD projects.

Apiculture

History and status

Beekeeping has been practised in the Sudan since the days of King Taharqa (690–664 bc) and the Christian age in northern Sudan. The first modern hives were introduced in 1961 at the Faculty of Agriculture for educational purposes. In 1978 the National Beekeeping Project (NBP) was inaugurated by the Sudan National Council for Research (NCR). Another project was initiated by the American NEF in 1987, but did not last long. In 1988, apiaries were set up for the refugees in Gedarif area. The Sudanese Beekeepers Association was formed in 1988. Two well-organised companies are now involved in beekeeping. Their activities cover the White Nile, Blue Nile and Kordofan.

In southern states, beekeeping is practised in Darfur, Kordofan and Blue Nile. Southern Darfur has an estimated 100,000 Tagal with ownerships of 150–300 per person. In Kabom area there are about 2000 beekeepers who own 11,000. Sudan has annual honey exports of 20 tons.



Figure 1. Traditional beehive (Sudanese native hive) made of leaves of the doum palm

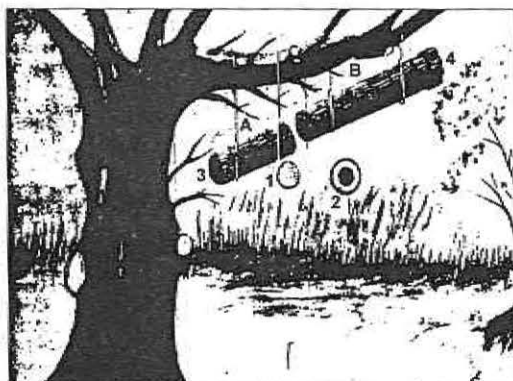


Figure 2. Improved traditional beehive (Khartoum hive): A, brood chamber; B, honey chamber; 1, queen excluder; 2, flange; 3, entrance hole; 4, rear

Traditional beekeeping

The common beehives used in the Sudan are shown in Figures 1, 2 and 3.

Constraints

- Viciousness of the local bees
- Dearth period during summer season
- Natural enemies, e.g. the northern carmine bee-eater *Meropus nubicus* (warwar bird), sphegid wasps and the greater wax moth *Galleria mellonella*
- Pesticides use in the major agricultural areas
- No apiculture unit in the Ministry of Agriculture and Forestry

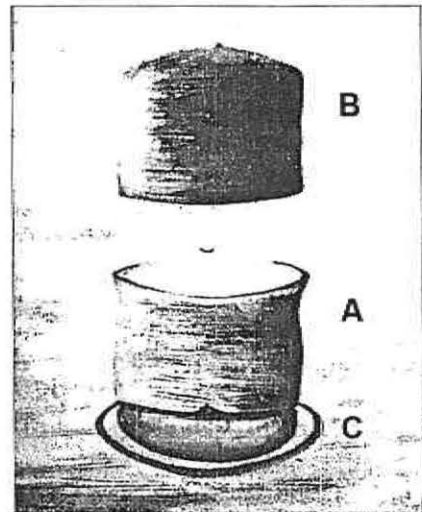


Figure 3. Omdurman (clay) hive: A, brood chamber; B, honey chamber; C, base

Other constraints are listed in Figure 4.

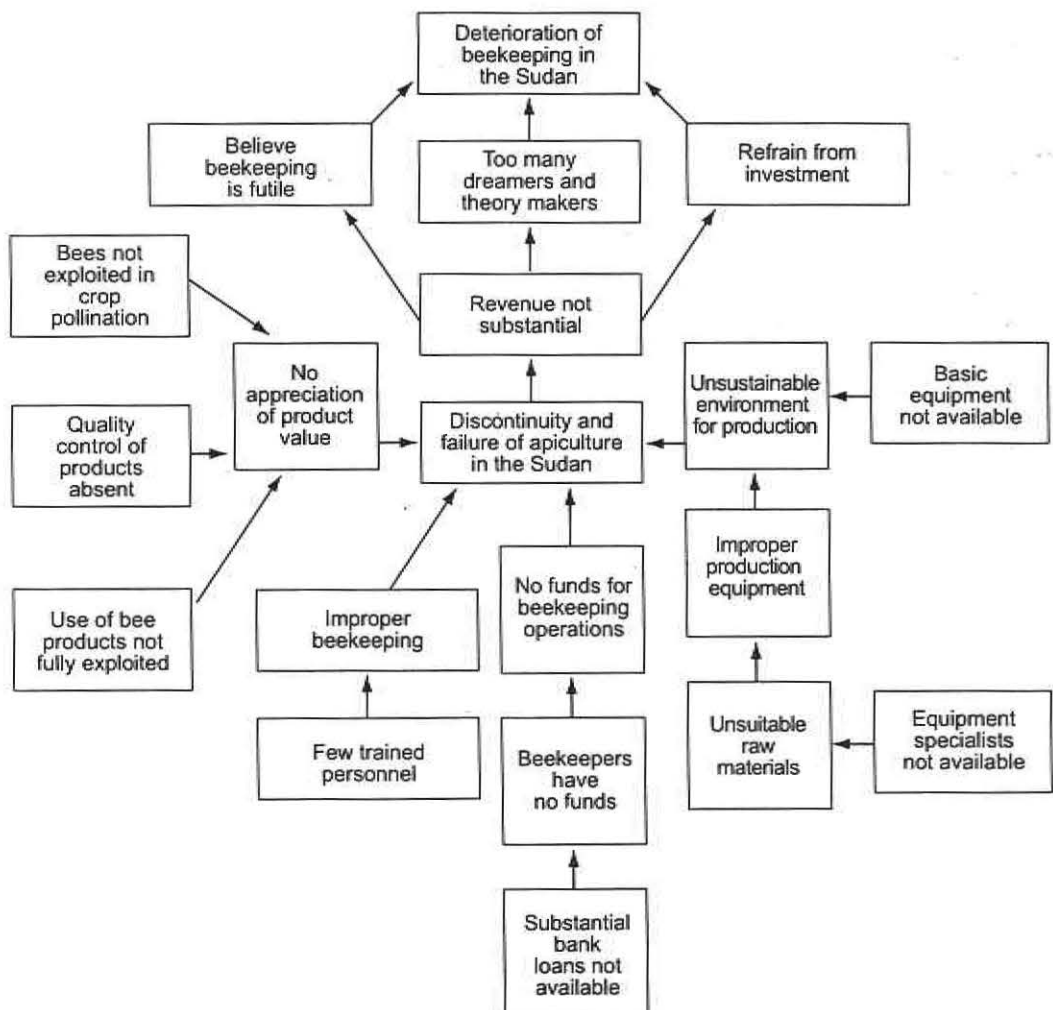


Figure 4. Flow chart of beekeeping constraints in the Sudan

Sericulture

History and status

In the late nineties the Forestry Department imported mulberry varieties and hybrid silkworm eggs from *icipe* but the endeavour was not viable. Later on, one farmer switched over from tobacco production to silk production and now imports hybrid eggs from China and exports raw silk to Egypt.

Constraints

A number of wild silkworm species are reported in the South and Central Sudan, but the identity and biology have not yet been investigated. There is no serious activity so far in spite of highly trained entomologists, forestry and conservation experts.

Sericulture and apiculture training

IFAD is the most active international organisation in the Sudan and has good and well orchestrated agreements with the Sudan Government. Four projects are fully operational in South Kordofan, Gash and Tokar Deltas. It is only a matter of seeking ways and means to incorporate these new activities in their already ongoing activities. This can be easily achieved as the proposed areas of apiculture and sericulture are within the domain of the IFAD projects.

Recommendations

- Authorities must give attention to commercial insects and their utilisation in income generation to improve rural economy
- Creation of pilot apiculture and sericulture units at MOA and other institutions
- Research activities in various aspects of apiculture and sericulture (native silkworm species)
- Management of local bees behaviour
- Crossing and selection of new strains with imported strains
- Encourage installation of modern apiaries and private sector in such a venture
- Activate quality control measures of bee products.

PROGRAMME FOR THE DEVELOPMENT OF SERICULTURE AND APICULTURE PRODUCTS FOR THE POOR IN FRAGILE ECOSYSTEMS USING THE VALUE CHAIN APPROACH

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Abstract: Introduction and scaling up of nature-based enterprises (bees and silk) in Africa have the potential to provide sustainable livelihoods for the rural poor.

Background

Sustainable livelihoods can be achieved in Africa through access to a range of livelihood resources which are combined in the pursuit of different livelihood strategies. The IFAD project on wild and domesticated silkworm rearing for silk production (sericulture) and honeybees rearing for beehive products (apiculture) is one such attempt to attain sustainability in rural income. The project was initiated by IFAD through *icipe* research initiatives in 1996. This has resulted in development of eco-friendly technologies being utilised by the smallholders in marginal land areas in Africa to raise their sources of income and improve their economies. Moreover, the regular charcoal production practices through forest destruction and wood burning have been minimised. The project has created a sense of ownership to the local communities for their lands and resources. Their household income was raised several fold through sale of silk cocoons/yarn/cloth and honey/wax to support their families' education and health. Their crop production has increased by keeping bees in the farm through pollination services. Their milk yield (from the cow) and meat (from the goat) have increased due to surplus mulberry leaves (silkworm fodder) fed to the cows and goats (Figures 1 and 2).

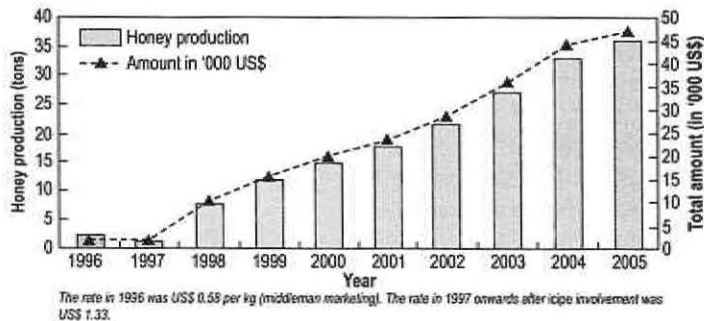


Figure 1. Impact assessment of honey production in Mwingi, Kenya: Income generation to 1800 farm families

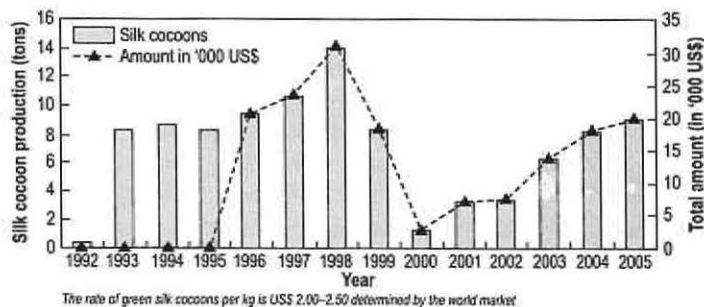


Figure 2. Effect of silk post-harvest setting and its impact on the revival of the silk industry in Bushenyi, Uganda: Income generation to 1200 farm families

Sustainable development of sericulture and apiculture products or any enterprise for that matter, is a journey, and therefore requires mechanisms to power it, set the pace, explore paths, check progress, and learn and adapt for government, civil society, business and donors alike.

Therefore, *icipe* has emphasised on the stepwise system of development in various phases of the project and not on an encyclopaedic 'master plan'. There is a special need to look at the future opportunities and threats posed by globalisation as drivers for sustainable development or constraints to it in the context of this project (Figure 3).

With IFAD's technical grants support, *icipe* has developed and validated apiculture and sericulture technologies and established several training bases and silk/honey marketplaces in 24 African countries. At this point more than 20,000 farmers, NGOs and NARS have been given long term and short term training courses to modernise the traditional practices of apiculture and introduce a new culture of silk farming. As a result of *icipe's* research backstopping and IFAD's financial support on this action research, these marketplaces comprising of 300–2000 household members have become fully operational where farmers bring their raw material, cocoons and honeycombs, which are then processed in a central location to develop final products for the market. The groups have democratically elected a chairman and were given full ownership to run their own businesses (Figures 4 and 5).



Figure 3. Training of trainers in wild silk farming in Mwingi Forest, Kenya



Figure 4. Mwingi honey marketplace, Kenya



Figure 5. Bushenyi silk marketplace, Uganda

Research priorities in this phase

A great deal of marketing research is needed in this transition and crucial last phase of the project. It is important to establish proper market linkages both locally and globally, for the new emerging products of sericulture and apiculture to add value to the basic silk and honey produced. The outcome of marketing research (being systematic and formalised) will be a sequence of research events, from diagnosing marketing information requirements through data collection to data analysis. This leads to the structuring of the research programmes around a series of stages comprised of research into the market, product, pricing, distribution, promotion, local capacity building and quality control (Figure 6 a–d). In addition, characterisation of specialised breeds of silkworm and honeybees, (earlier identified by the project), through micro-satellite DNA marker techniques will assist new and ongoing IFAD projects in various ecosystems in Africa (Rwanda, S. Sudan, Tanzania and Uganda) and NENA region (Yemen, the Sudan and Egypt) in selecting potential races for commercial production of silk and honey-based commodities (Figure 7). The study of the switch-on/off endocrine/hormonal mechanisms of the specialised products such as

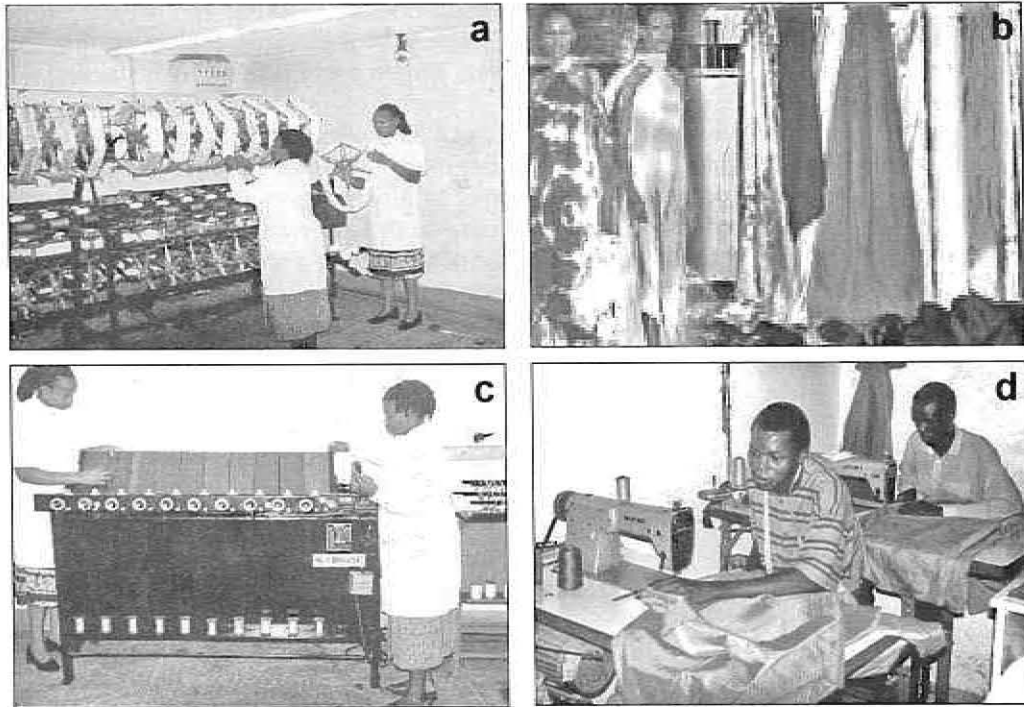


Figure 6. Capacity building in silk quality control in Kenya: (a) Winding machine for testing winding breaks in raw silk, (b) Kiko Romeo designs, (c) technicians filling the Seriplane with raw silk for testing neatness and evenness, and (d) Kenyan silk shirts and scarf making

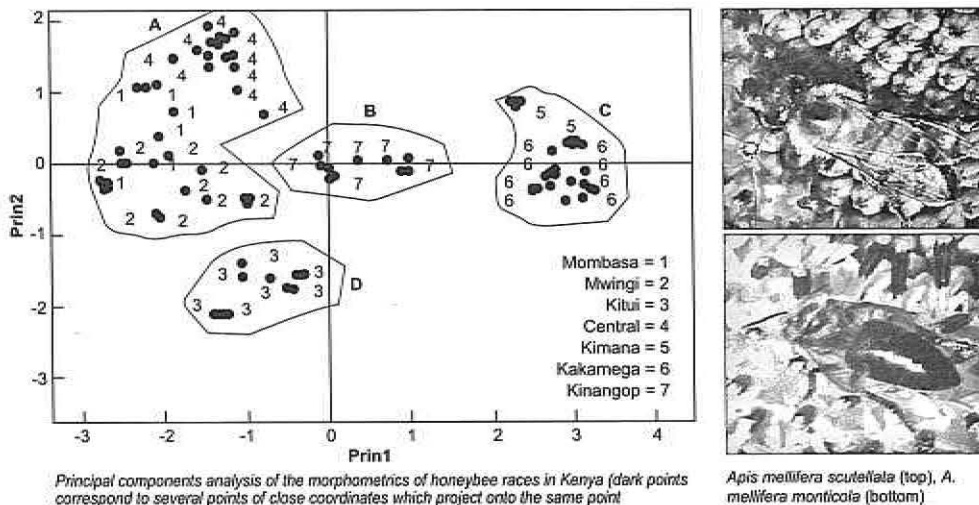


Figure 7. Race variations of the East African honeybee, *Apis mellifera*: Morphometrics (dark points correspond to several points of close coordinates which project onto the same point)

Figure 7. Race variations of the East African honeybee, *Apis mellifera*: Morphometrics

royal jelly, can double production through hormonal manipulation of the older worker bees. In the area of wild silk farming, the application of promising attractants or repellents (pull and push technologies) against insect parasitoids of silkworm larvae can resolve the 60% field losses in cocoon production. These research priorities are based on the work and results of the earlier phases of the IFAD grants awarded to *icipe*.

These research priorities are absolutely essential in the last phase of the project, which upon its completion will develop a full package of practices for the rural poor. This will

raise the incomes of the rural people and empower them to participate in new trade opportunities, opening new products for the silk and honey markets. The project during this phase will also assist several other IFAD projects in the NENA region co-financed partly by OPEC and IDB, particularly in the Sudan, Yemen and Egypt through training and technology dissemination.

The project is also committed to assisting UNDP/GEF project in three Kenyan forests to save their biodiversity and ecosystems through introduction of the income generating options of sericulture and apiculture. The project is also supporting rural communities through the grants from Toyota Foundation, the Netherlands Government projects, Biovision, Switzerland, OPEC and IDB funds. A full package of sericulture and apiculture practices is being developed in this third phase of the project using the value chain approach (Figure 8). This will help rural poor communities to enhance their capacities, skills and assets, while not undermining the natural resource base.

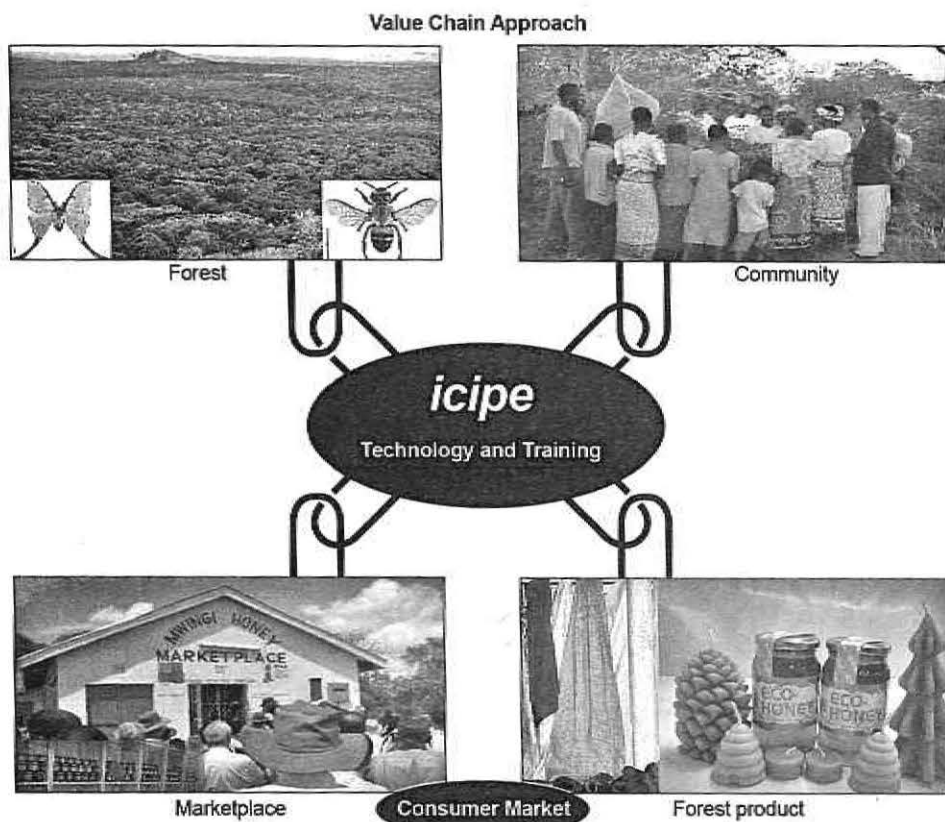


Figure 8. Development of sericulture and apiculture products for the poor in a fragile ecosystem using the value chain approach

Goal

The goal of the programme is to develop value chains that can be used in diverse agroecological conditions to enhance the income of the poor, especially women, the landless and marginal farmers in remote areas of the East and West Africa region, and the Near East and North Africa region ('the regions') linked to IFAD-financed programmes/projects in not less than 8 countries within the regions (the 'programme area').

Objectives

The objectives of the Programme are to improve:

- Value addition and marketing for sericulture and apiculture products and facilitate the access of the produce of the poor to the markets (Figure 9);
- Productivity through biological research for apiculture and sericulture; and
- The technical and managerial capabilities of beekeepers and silk farmers through the adaptation and dissemination of technologies and best practices (Figure 10 a–d, 11,12 and 13).



Market busters

It is an action taken by the silk/honey firm that changes the game to deliver markedly superior performance

Five strategies to create marketbusters:

1. Transform the customers' experience
2. Transform your offerings
3. Redefine profit drivers
4. Exploit industry shifts
5. Enter new market.

Figure 9. Marketing information system of honey- and silk-based products marketing strategies



Figure 10. (a) Carpenter at Shinyalu constructing Langstroth hives for the local Kakamega community; (b) hive colonisation in Kakamega Forest; (c) stingless bees hives being supplied in Kakamega; (d) established meliponary in Ileho, Kakamega



Figure 11. Mulberry silkworms rearing in Kakamega



Figure 12. Farmers' training in forest conservation



Figure 13. Beekeeping training to the trainers

Progress towards achieving project objectives

The programme shall include activities in the programme areas within the following three components to achieve the programme's objectives:

Identification of the market potential for apiculture and sericulture products

Activities shall include: (a) completing a market study to identify the market potential for apiculture and sericulture products, through identification of potential markets and players in the value chain, (b) assessing the profit margins at each stage and (c) formulating a strategy to maximise the returns to producers. This includes examination of the possibility of creating a common brand (preferably fair-trade certified) for the products developed and providing quality assurance (International Organisation for Standardisation [ISO] certified) and organic certification for apiculture enterprises in the focal areas. To ensure that a comprehensive market study is carried out, identification shall also include: (a) customer requirements and market standards; (b) the training needs of stakeholders; and (c) private sector companies willing to work with and train community groups on marketing and business aspects (see Figures 8 and 9).

Research action

Activities shall include (a) research in molecular, hormonal and semi-chemical interventions at various levels of adaptive research to enhance the productivity of sericulture and apiculture; (b) development of micro-satellite DNA markers to characterise the different

breeds of honeybees and silkmths bred to phenotypes in various ecosystems; (c) a study of the switch-on and -off endocrine/hormonal mechanisms of the royal jelly production system in the potential breeds of honey/stingless bees (Figure 14) and exploration of manipulations to maximise the royal jelly production for additional hive value; (d) screening of potential repellents and attractants for the insect parasitoids of wild silkmth larvae; and (e) development of 'pull and push' techniques to control insects in the field and minimise silk cocoon losses (Figure 15).



Figure 14. Meliponiculture through queen (arrow) rearing

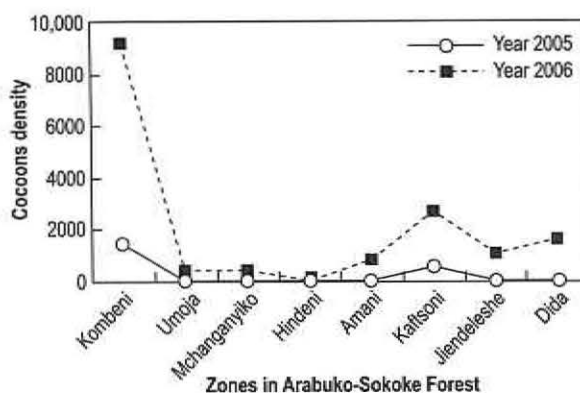


Figure 15. (a) *Gonometa positica* cocoons on *Acacia reficiens*, (b) population density of *G. positica*

For the development of 'push and pull' techniques to control insects in the field and minimise silk cocoon losses of the wild silkmth *Gonometa positica* in Arabuko-Sokoke forest, Kenya, the specific activities shall be the focus and include the following:

- A study of the density of wild silkmth, *G. positica* population in relation to host plant abundance in different zones of Arabuko-Sokoke forest
- A record of the percentage of healthy and parasitised population in the major and minor host plants.
- Methods to protect the wild population in the field.
- Wild silk farming enterprise for community livelihood and forest conservation.

Technical assistance

Activities shall include: (a) compiling a manual of operations to assist projects in developing comprehensive income-generating programmes in sericulture and apiculture products through a value chain approach; (b) provision of continuous technical backstopping and support for the implementation of training and capacity building activities among beekeepers, silk farmers and rural entrepreneurs in pro-poor projects; (c) technical assistance supplemented by conducting research, field testing and the production of species suitably adapted to agro-climatic conditions; (d) preparing and implementing capacity building workshops and training courses to assist the poor in undertaking these income-generating activities; (e) disseminating improved methodologies and insect resource knowledge and conservation practices; (f) establishing market linkages identified through the study; and (g)

conducting workshops for the dissemination of results and to exchange experiences and lessons learned.

Outputs

The Programme's output is to improve the technical and managerial capabilities of approximately 6000 beekeepers and 3000 silk farmers in the programme area through the technologies promoted.

Importance of IFAD support

To overcome market pressures and to lead a genuine sustainable development, additional measures are provided by IFAD in this project to give African exporters both the capacity and the market linkages (connections) to shape these requirements to their advantage. Through additional research and training, a new generation of enterprises in apiculture and sericulture will come to the fore which will be committed and capable of achieving world-class standards in quality, the environment and social matters. Through IFAD/OPEC and IDB's financial support, the role of *icipe* aims to take up this challenge with an overarching mission of enabling African countries and NENA region exporters and traders to respond, anticipate and ultimately shape the environmental and social dimensions of the market, thereby capturing a greater share of the value-added trade. By focusing on the practical needs of African countries exporters and traders, *icipe* is proposing to fulfill this mission of sustainable livelihoods in three main ways: (a) Information exchange; (b) promoting innovation and (c) brokering solutions. Two particular priorities for *icipe* are: (a) voicing the concerns of African countries producers in implementing existing environmental and social standards imposed by the export market and working together with standard setters to ensure that these concerns are taken into consideration, (b) co-designing mutually agreed upon standards and codes through dialogue between different stakeholder groups involving consumer groups, industry, buyers, financial institutions, NGOs and researchers from the North and South in annual workshops. (Refer to these proceedings and the NENA regional workshop proceedings published in 2007).

Ownership

The project will empower the communities, through appropriate technology and training, to maintain their own business activities reducing the role of middlemen and allowing silk farmers and beekeepers to improve their livelihood. Marketplaces for silk and honey based products can succeed only if local communities understand biodiversity distribution and value. The project will make them realise through training how the biodiversity of silkworms and honeybees features in their lives and aspirations and they will learn how to manage bioregions to meet their needs without damage. (Case study Mwingi, IFAD TAN 2007).

Replicability and leverage

The project has developed low-technology approaches combined with social and market support to produce economically viable activities in the sericulture and apiculture products development. These are easily adaptable to local circumstances and hence find ready uptake in different areas throughout East Africa. Demand for the honey- and silk-based products is increasing in East Africa as markets become aware of the assured availability of good quality products. Quality honey and silk markets already exist but are difficult to access for smallholder farmers. This is what the project has overcome. The result of

value adding and capacity building of the target community through training to process the silk and honey-based products provides an important mechanism and leverages the marketplace development with strong marketing linkages and assured markets.

Lessons learned

- Beekeepers and silk farmers need to collate necessary volumes of silk- and honey-based products harvested in a sustainable manner over wide areas by their respective groups.
- The whole market chain (from producers to market) should be tackled through action research from technology through quality control, market research and promotion, etc.
- A sound commercial partnership is required to be established by private entrepreneurs on behalf of producer groups.
- Developing markets for new products is a long and expensive exercise, the chances of success increase dramatically with a sound understanding of market requirements, through market research.
- It is essential to enter the market for the natural resource products at the highest possible level in the market chain and negotiate substantial benefits for commercial partners.

Capacity building

This project trained beekeepers (over 6000) and silk farmers (3000) in five East African and three NENA region countries through short and long term training workshops. The project also built African capacity by supporting 6 MSc and 3 PhD level students from the NENA region and 4 MSc and 3 PhD level students from East Africa. The project retains the existing staff and hires new supervisors in NENA region, Tanzania, western Kenya, in Rwanda and Southern Sudan, Congo, Cameroon, Ghana through NARS. Each staff member has a specific research and development area, and is also required to conduct training courses. One-day training for farmers is held twice a month and each year there are longer (2 month) courses for group representatives. Although local operational capacity has been created, technical backstopping is still weak, and depends overly on *icipe* core staff and availability of funds.

Technology dissemination

As well as the local developments in East Africa described above, three international workshops have been held to demonstrate the newer technologies. These generated significant interest, and as a result, *icipe* staff have been asked to assist in the development of apiculture and sericulture in Ghana, Nigeria, Senegal, Côte d'Ivoire, Zambia, Zimbabwe, Ethiopia, Eritrea, Syria, Congo, Cameroon, Rwanda, Yemen, Algeria, the Sudan, Namibia, Madagascar, Libya, Tunisia, Morocco and Egypt. A network of interested partners has been established called SARDNET (Sericulture Apiculture Research and Development Network) (Figure 16). So far training has been provided at *icipe* in Nairobi to representatives of IFAD projects and Government and NGOs of all the above countries. Further developments are in process awaiting funding (see below). This will help develop market linkages with private traders in various countries and launch new products to accomplish brand franchise growth. This is the fourth international workshop being held in Nairobi for natural resource assessment and capabilities of networking among African partners in the management and implementation of sericulture and apiculture technologies.

Several on-site demonstration workshops and training will be carried out during the project period.

Sericulture, Apiculture Research and Development Network in Africa (SARDNet Africa)

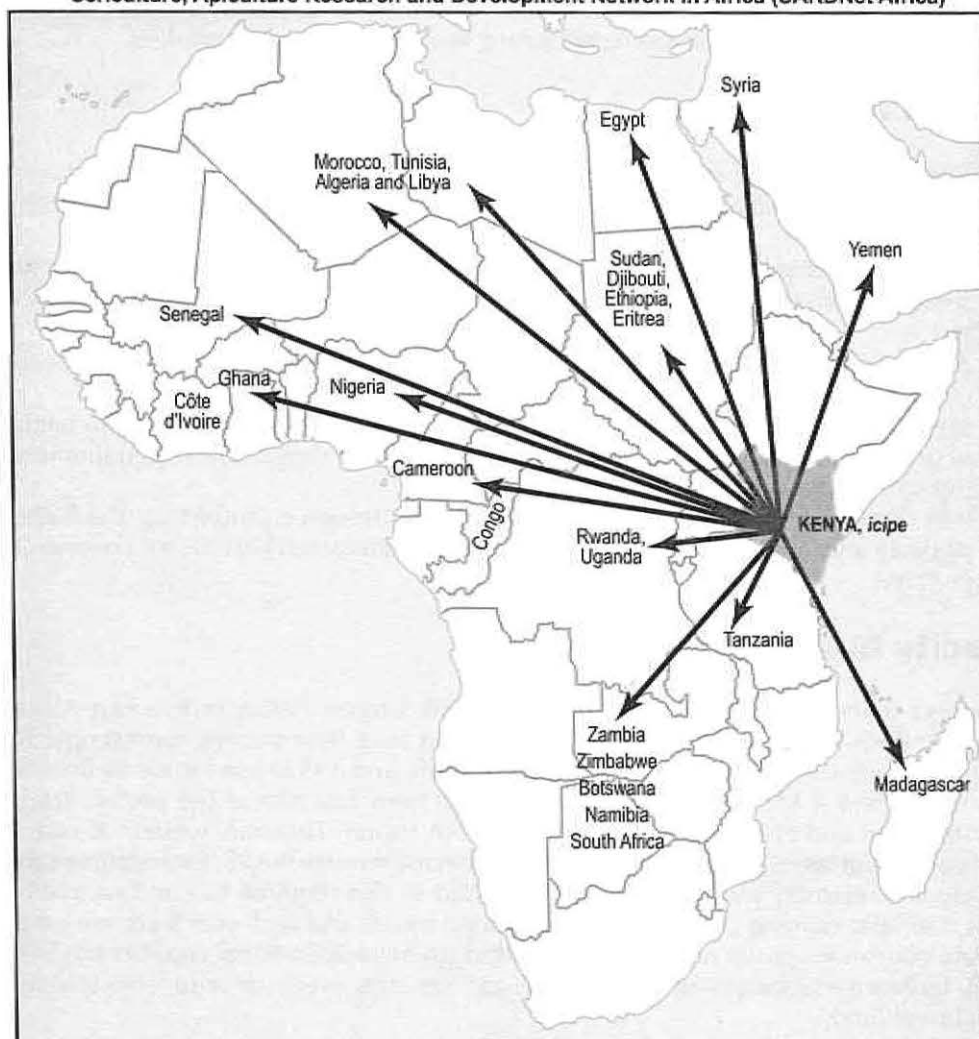


Figure 16. Natural resource assessment and capabilities of networking among African partners in the management and implementation of sericulture and apiculture technologies

Economic and social benefits

- Economic returns to smallholder apiculture and sericulture practices will generate revenue in a number of ways and increase the production and income by 15%.
- Quality honey and wax have ready and established markets. Wax has commercial and industrial value, especially in the cosmetic and candle industries.
- The sale of colonies by queen rearing will provide additional income. Other high value products, such as royal jelly, bee venom, propolis and pollen are in high demand by pharmaceutical companies and may be produced at a later date.
- During nectar and pollen gathering, honeybees effect pollination and improve the quality and quantity of crops, a benefit enjoyed by the whole community, as well as the beekeeper.
- Silk is a lucrative product. Cocoons or raw silk will provide regular income as the growth cycle may be as little as 30–40 days.
- In addition to feeding silkworms, mulberry leaves can serve as animal feed and provide fruit. After reeling, silkworm pupae can be used as fish or chicken feed.

- Economic values will be enhanced by quality control procedures for sericulture and apiculture products.
- A quality control laboratory will test honey, hive products, cocoons, raw silk, twisted yarn and silk cloth, to ensure the products meet the industry standards.
- Marketplaces in several focal points in East Africa will be established with full ownership of the rural community, with a 50% women representation and market linkages for the various products developed through private entrepreneurs (Table 1 and Figure 17).

Table 1. Economics: Honey-based products
Value added cash income from honey obtained from hive

Types of beehive	No. of hives	Honey harvested (kg/hive)	Middleman purchases (US\$/kg)	After marketplace established farmers receive (US\$/kg)	Total sale of honey per hive through middleman (US\$)	Community empowered to sell honey to trader (US\$)
Traditional	1	7	0.38	1.03	2.69	7.18
Langstroth	1	20	0.38	1.41	7.69	28.21

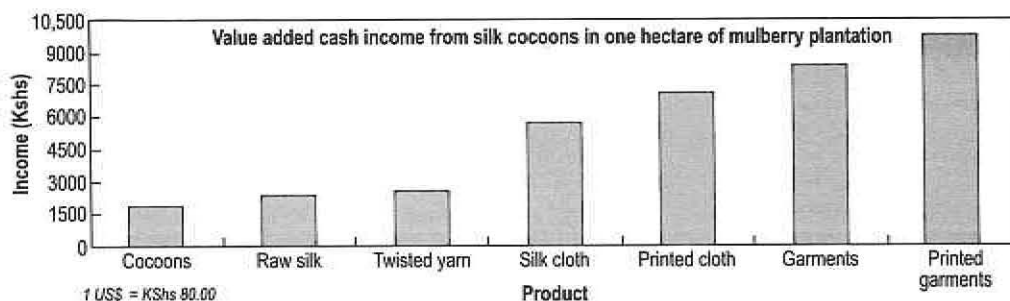
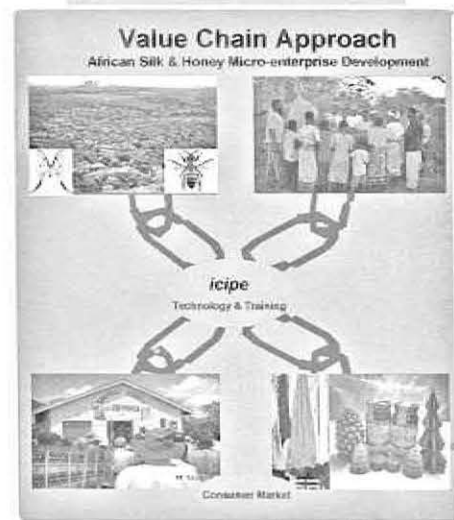


Figure 17. Economics: Silk-based products

SESSION 2

Identification of markets
for silk- and honey-based
products to facilitate farmers'
access to the market



CURRENT GLOBAL SILK MARKETS AND THE PROSPECTS OF AFRICAN SILK ENTERPRISES

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Abstract: The climate in many African countries is suitable for sericulture. Earlier efforts to establish sericulture in countries like Uganda, Nigeria, Ghana and Botswana have been reported. Good training facilities are available at *icipe*, Nairobi, Kenya. In some cases, cocoons were produced and exported. However, one main drawback is lack of processing facilities. The major contributing factor in silk production in the silk producing countries has been cheaper labour costs. Silk producers in countries like Japan, France and Korea have slowly withdrawn from silk production due to high labour cost occasioned by industrialisation. On the other hand, they continue in value addition activities, producing expensive products for the rich. With the investment going up and stiff competition from China, India has been facing ups and downs in silk production. However, garment manufacturing has been progressing well with increasing exports. There has been a growing demand for affordable silk products among middle-income groups, which requires bulk production. With vast stretches of arable land with good climate, African countries have good potential for bulk production of silk. But processing facilities are a must. It is also necessary to develop skills for producing silk goods for high end users.

History

The silk trade started even before the Silk Road was officially opened in the Second Century BC. The Egyptian female mummy with silk discovered in the village of Deir el Medina near Thebes and the Valley of the Kings, dating back to 1070 BC, was probably the earliest evidence of the silk trade. During the second century BC, the ambassadors of the Chinese emperor, Han Wu Di travelled along Persia and Mesopotamia, with gifts (including silk) and reached Baghdad in 97 AD.

One of the most dramatic findings made in 1907 by Aurel Stein was more than 10,000 manuscripts and silk paintings, silk banners and textiles sealed in a room at the Caves of the Thousand Buddhas near Dunhuang, a station on the Silk Road in north-west Gansu, dating back to 1015.

Chinese silks were widely worn by the rich and noble families of Rome a few decades after the battle of Carrhae in 53 BC. The Roman Emperor Heliogabalus (AD 218–222) wore only silk. In 380 AD, Marcellinus Ammianus reported,

"The use of silk, which was once confined to the nobility, has now spread to all classes without distinction, even to the lowest."

The craving for silk continued to increase over the centuries. The price of silk was very high in Rome. The best Chinese bark (a particular kind of silk) cost as much as 300 denarii (a Roman soldier's salary for an entire year)! Many sources quote that Roman citizens' demand for imported silks was so great as to be damaging to the Roman economy.

Silk products

Unlike other textiles, silk-wearing traditions and demand go back a long way [1]. A good example is India, where the local demand greatly exceeds supply, thus growing as the largest importer of raw silk, despite being the second largest producer in the world. Local

demand has been fast growing in China, with the silk goods available within affordable price range. This pattern is also likely to repeat itself in Vietnam.

World silk production during recent years

Silk constitutes 0.2% of the global textile fibre market [2], but valued over 20 times that of cotton. The world trade in silk is about US\$ 8 billion. The world raw silk production has shown a gradual increase from 80,989 metric tons to 125,605 metric tons from 1998 to 2004 (Table 1) and a majority of this is mulberry silk (Table 2). This is mainly because of the increase in the raw silk production by China to 102,560 metric tons (81.65%). India's production has almost been stagnating at around 16,500 mt (around 13.1%) while there has been a gradual decline in most other countries. Chinese silk is still the cheapest.

Table 1. World raw silk production (includes all types): [Unit: tons]

Country	1998	1999	2000	2001	2002	2003	2004 (P)	% Share
China	57,500	56,959	61,648	64,567	68,600	94,600	102,560	81.65
India	15,544	15,214	15,857	17,351	16,319	15,742	16,500	13.14
Japan	1080	650	557	431	394	287	263	0.21
Brazil	1821	1554	1389	1485	1607	1563	1512	1.20
Korea Republic	210	200	165	157	154	150	150	0.12
Uzbekistan	1500	923	1100	1260	1260	950	950	0.76
Thailand	900	1000	955	1510	1510	1500	1420	1.13
Vietnam	862	780	780	2035	2200	750	750	0.60
Others	1572	1250	1952	1692	3814	1500	1500	1.19
Total	80,989	78,530	84,403	90,488	95,858	117,042	125,605	100.00

Note: Figures for India are for the financial year April to March.

Source: ISCC and from data compiled by Central Silk Board from earlier volumes of *Sericologia*.

P: Provisional.

Table 2. World mulberry raw silk production [Unit: tons]

Country	1998	1999	2000	2001	2002	2003	2004 (P)	% Share
China	49,430	55,990	60,000	62,560	64,100	76,324	85,000	80.06
India	14,260	13,944	14,432	15,842	14,617	13,970	14,620	13.77
Japan	1080	650	557	431	394	287	263	0.25
Brazil	1821	1554	1389	1485	1607	1563	1512	1.42
Korea Republic	210	200	165	157	154	150	150	0.14
Uzbekistan	1500	923	1100	1260	1260	950	950	0.89
Thailand	900	1000	955	1510	1510	1500	1420	1.34
Vietnam	862	780	780	2035	2200	750	750	0.71
Others	1684	1250	1952	1692	3814	1500	1500	1.41
Total	71,747	76,291	81,330	86,972	89,656	96,994	106,165	100.00

Data in Tables 1 and 2 have since been updated by the International Sericulture Commission (see their website).

Current world trade

The participants in international silk trade can be divided into four categories, viz., (i) raw silk producers (Uzbekistan and Vietnam); (ii) producers of raw silk and processed silk goods (Brazil, China, India, Thailand and Uzbekistan); (iii) silk converting countries entirely

Table 3. Country-wise quantum of silk exports: (Quantity in metres)

Country	2000	% of total export	2001	% of total export	2002	% of total export
China	63,338	69.57	62,410	69.93	65,063	70.81
India	12,922	14.19	11,812	13.23	12,110	13.18
Korea						
Republic	3684	4.05	3669	4.11	3378	3.68
Vietnam	--	--	1750	1.96	1975	2.15
Brazil*	1474	1.62	--	--	1415	1.54
Japan	852	0.94	1020	1.14	1080	1.18
Hong Kong**	8772	9.64	8588	9.62	6862	7.47
Total	91,042	100	89,249	100	91,883	100

Source: ISA, France.

* **export and re-export.

Table 4. Silk exports 2000–2004 (Product group: 261)

Reporter	Value (US\$ '000)				
	2000	2001	2002	2003	2004
China	330,982	281,245	267,644	238,530	236,056
Italy	3203	3778	9335	9093	14,502
Japan	2157	1103	635	3243	12,143
Germany	25,212	21,702	12,135	13,568	9304
Romania		23	192	3610	8681
Turkmenistan	3465				
USA	2059	2183	2299	2641	2588
India	11,348	11,337	4141	2895	2208
Vietnam	3695	1277	4298	2024	
Brazil	1323	2116	2531	2256	1715
United Kingdom	2164	1516	1440	1259	1207
Iran (Islm. R.)	162	675	237	652	
Azerbaijan	134	80	35		613
Yemen			565		
Switzerland	2380	1564	823	812	555
Indonesia	61	133	186	289	419
Thailand	4169	3316		415	
Singapore	1652	1996	577	849	374
France	67	161	194	60	330
Korea	333	99	43	22	267
Turkey	270	18	10	343	216
Australia	3478	459	1126	814	157
Mozambique	155				
Spain	367	137	34	14	146
Pakistan	429	112	122		
Kenya				29	110
Paraguay	591	89	100	169	70
Kyrgyzstan	354	524	346	196	50
Malaysia	871	292	8	18	36
Netherlands	87		486	258	35
Ireland	150	3	117	4	5
Israel			302	1	
Colombia	118	0	8		0

Source: COMTRADE database of the United Nations Statistics Division.

Table 5. Silk imports 2000–2004 (Product group: 261)

Reporter	Value (US\$ '000)				
	2000	2001	2002	2003	2004
India	105,991	134,243	135,209	138,353	135,962
Italy	108,504	92,860	63,145	59,199	56,625
Japan	87,071	60,567	48,911	43,417	43,429
Korea Rep.	43,724	35,845	34,981	26,986	27,286
Vietnam	15,396	16,886	15,457	16,475	
China	14,301	10,170	7103	9695	15,516
Romania	1060	2482	8911	7666	14,948
Germany	33,756	21,819	14,249	15,806	10,645
France	9161	11,266	8330	5259	6683
Bangladesh	23,289	14,357	4423	4597	5207
Nepal	10,233			4943	
Turkey	2815	3795	2933	2952	3854
Thailand	8980	11,077		2560	
UAE	3338	2444			
UK	3597	3350	2781	1493	2206
Switzerland	5365	3468	2721	2217	2165
Uruguay	97	413	1471	2015	1865
Spain	1110	1204	805	894	1179
Tunisia	1579	1470	960	1255	1170
Singapore	1869	2507	752	1136	1110
Pakistan	468	335	351	671	913
Bulgaria	4	60	312	1459	762
Paraguay	168	896	631		570
Egypt	202	287	1120	530	568
Peru	320	334	285	322	400
USA	633	770	653	677	294
Saudi Arabia	21	4	32	282	
Ireland	179	233	841	392	261
Indonesia	1008	429	411	178	235
Poland				74	229
Nigeria	9	11	5896	229	
Iran (Islm. R.)			44	215	
Canada	315	172	115	192	195
Belgium	188	238	211	161	185
Finland	3	12	4	43	153
Hong Kong	14,567	4242	959	1847	146
Malaysia	718	75	115	46	124
Brazil	1061	340	397	25	119
Azerbaijan				1100	110
South Africa	7	58	109	79	102
Australia	169	82	36	73	97
Greece	288	399	157	100	85
Netherlands, The	145			75	76
New Zealand	37	123	58	68	53
Philippines	159	205	160	167	51
Mexico	31	83	117	38	39
Croatia	121	26		0	2
Mozambique	183	0	1		

Source: COMTRADE database of the United Nations Statistics Division.

dependant on imported raw materials (France, Germany, Italy, Japan, the Republic of Korea, Switzerland and the United Kingdom); and (iv) countries neither producing raw silk nor processing it (certain European countries, Australia, New Zealand, Canada, US and most African and Latin American countries).

It is difficult to estimate the world trade in silk garments and accessories as national trade statistics are either not standardised or not detailed enough. In most countries, the silk garments are classified along with other fibres like linen, cashmere and ramie. In terms of

quantities, China is the largest exporter (Table 3), but in terms of value its share is 38%, that of India (8%) and the remaining (US\$5 billion) is within Europe, which is all value added haute couture ready-to-wear items in which developing countries have no significant share [2]. The other countries in the export trade are Korea and Thailand while Japan is a net importer.

China has been the largest producer as well as the largest exporter of silk (Tables 1, 2, 3 and 4). India the second largest producer has been the largest importer of silk. Almost all silk producing countries have been the traditional silk consumers except Brazil, where silk production has been initiated by Japanese trading houses. Various European countries like France, Italy, Germany, UK and Switzerland have been converting the silk imported from China into high quality and exclusive end products which only the very affluent could afford. Also there was a boom in some European countries for handloom silk products like cushion covers for interior decoration especially from India and Thailand.

China

Besides production, China continues to dominate in its exports. A quarter century ago, 80% of the silk exported from China consisted of raw silk and silk yarn. At present, much of the exports have been in the form of semi-finished and finished products. Chinese silk producers started their own processing first into semi finished fabric and then into finished products such as dyed and printed fabrics, accessories (shawls, scarves, ties) and garments. This for the first time ended the European-centered silk trade. Affordable silk garments were successfully offered to the European consumers.

India

India has been the second largest producer of silk and also the largest importer (Table 1, 2 and 5). Its exports amount to 8% of the world silk trade in terms of value [3]. Over 80% of the silk goods produced in India are consumed internally. Exports from India are mostly the finished goods and largely dependent of imports from China due to the poor quality of the silk produced. Most of the exports are to USA (Table 6). Around 60% of the Indian silk products are made on handlooms. In western countries, handloom silk fabrics have always been popular particularly in interior decoration, such as bedspreads, curtains, cushion covers and lampshades. Though in small quantities, products from non-mulberry silks are becoming popular due to their natural colours and ethnic designs. Much is yet to be done on the finishing.

Japan

Once the largest producer of silk, traditionally, Japan has been the largest silk consumer. Japan in the 1960s relied entirely on local silk production, mostly for kimonos. The country now depends on imported silk goods, particularly from China. Kimonos still absorb about 50% of the total raw silk consumption in Japan, down from 90% in the 1970s. Silk is little used in interior decoration.

Table 6. Country-wise export from India (in million US\$)

Importing countries*	2003-2004	2004-2005	2005-2006 [P]
USA	158.11	181.42	206.06
UK	43.53	57.58	69.74
Italy	30.83	45.86	54.29
German P. Rep.	36.31	36.47	44.22
UAE	63.03	33.53	38.39
Spain	33.59	32.98	40.33
Hong Kong	28.48	29.03	35.77
France	20.16	23.82	30.29
Saudi Arabia	15.22	19.90	16.19
Singapore	19.16	17.08	15.41
Others	156.28	163.21	170.84
Total	604.70	640.90	721.53

*Refers to the top 10 countries; [P] Provisional

Source: Monthly statistics of Foreign Trade of India. DGCI&S, Kolkata.

Other Asian countries

Other Asian countries like Thailand, Bangladesh, Cambodia, Laos and Vietnam have limited handloom production. Other minor silk producing countries include the Islamic Republic of Iran, the Democratic People's Republic of Korea, Turkey, Bulgaria, Egypt, Malaysia, Bangladesh, Indonesia, Laos and Cambodia. Handloom products have no competition from China as there has been no handloom production from China.

Italy and France

Italy and France have been importers of raw silk and producing high quality products. Italy has been traditionally the largest importer, processor and exporter of silk products in Europe. Over 80% come from China. Italy is well-known for highly developed skills in silk processing (finishing, dyeing and printing silk fabrics). France is another country with a considerable silk processing industry. For centuries, Lyon has produced silk fabrics of the highest quality for domestic consumption and for export. More than 70% of silk fabrics in the French market have been traditionally used for clothing. There has been a decline in the use of silk for haute couture, which had a niche market. There are signs that silk may have a growing market also for interior decoration use as curtains, wall covers, bedspreads and upholstery. France exports top quality silk fabrics to the US markets.

United Kingdom

The silk processing industry has been diminishing. There has been limited demand for high priced luxury end goods. This has been the third largest market after US and Germany. The market is controlled by large retail chains known to sell quality products at reasonable prices.

Switzerland

Switzerland has traditionally been involved in the European silk trade and processing for the luxury end goods. It has been suffering from high processing costs and there has been a shift towards other competing fibres.

United States

The US market is one of the world's largest, and imports include garments, interior decoration fabrics and accessories. Silk processing capacity is virtually nonexistent. Imports of silk goods were valued at about US\$ 2 billion in 1997; 10% was for home furnishing. Unlike European consumers, US consumers do not have a long tradition of using silk. The United States has been a pioneer market for imported Chinese knitted silk products, initially mainly thermal underwear, and now also elegant casuals in the form of T-shirts and polo neck sweaters. Easy care is a 'must' in the United States, so it is important to develop fabrics with easy-care properties to compete with other fibres. Silk is now blended with Lycra® for stretch and other luxury fibres such as linen and cashmere. Silk blends with cotton, viscose and stretch fibres in products such as velvet, stretch lace and stretch denim are in good demand. Around 90% of imports are apparels.

Germany

Germany is by far the largest and most competitive European market for textiles and clothing, including silk. The German consumer favours natural fibres. Production, import and sale of any consumer goods containing the azo-dyes, which on decomposition produce any of

the 20 suspected carcinogenic amines is banned. Germany has been importing a variety of silk garments, accessories (particularly silk cushion covers) and interior decoration fabrics. Silk garments are imported mainly from China. India and Thailand have been relatively successful in this market with their handloom silk products for home furnishing. The market is quality-conscious and prepared to pay a premium for good quality.

United Arab Emirates

UAE has developed into a significant market for silk products especially saris and fabrics. The duty rates are low and the Emirates has a long history of trade in the Gulf and with East Africa. Approximately, 80% of the imported goods are re-exported and Dubai is the hub of this trade.

Product categories

The products traded can be categorised into (i) raw silk, silk waste, silk yarn and grey fabric; and (ii) finished silk fabrics (dyed or printed), ready-made garments, made-up goods and items for interior decoration. The first category of products is supplied largely by China, which accounts for 80% (US\$ 1830 million as per Chinese Silk Export Import Corporation, 1999). Brazil and Vietnam supply a small quantity. Among the countries in the second category, China supplies dyed and printed fabrics (14.6 million metres as of 1988) and is the largest exporter of this category. European countries produce only high value finished fabrics for tailoring.

Silk is being offered in different exclusive areas such as heritage silk: the kimono, sari, printed and signed scarves, designer garments and accessories, and pleasure silk, products worn by consumers for comfort and pleasure.

Innovative products

Apparel

Silk, besides being expensive, is also difficult to maintain and has limited consumers. 90% of the silk products are women's wear. Silk products for men are largely limited to shirts, neckties, handkerchiefs, socks and underwear. Introduction of 'sand-washed silk', which is cheaper and easy to maintain, brought considerable change in men's wear resulting in the appearance of a wide range of garments like trousers, jackets, shirts, suits and shorts. Other products include 'thermal underwear' used by skiers and mountain climbers, knitted silk goods like T-shirts, camisoles, polo-neck sweaters and cardigans. Knitted products of silk blends with cotton, linen and viscose have a good demand among middle category buyers in Europe and US. Luxury fibres such as cashmere, alpaca and camel hair are also blended with silk.

Silk-based creams

There are 18 amino acids in silk, of which glycine, alanine, serine and tyrosine are key components [4]. These acids make silk a natural moisturiser, which is readily absorbed into the skin.

Ecological and social issues

Western European countries led by Germany have been more conscious on matters related to the production process, e.g. child labour, social clauses, social labels and the use of dangerous chemicals and dyes.

Future challenges

- With the disappearance of International Silk Association (ISA), the collection of data on the production, import and export of silk and silk goods has become more complicated. During the quota regime, silk received a preferential status. In the liberalised trading system, the competition has become tougher with the consumers having more options both in terms of cost and quality.
- New sand-washed silk brought a wider range of affordable silk products within the reach of millions of consumers during the 1990s. Competition from high-tech synthetics has eaten away the market share. Raw silk prices fell by half threatening sustainability of this industry. Traditional producers have been cutting back on labour-intensive silk production.
- In 1988, exclusive, and for women only, silk was a luxury product for Europe and North America, destined only for those who could afford its exclusivity and high price. No silk products in large quantities were available to customers in medium price brackets. About 90% of silk products available in Western markets were meant for women only. Silk should be marketed as an environmentally friendly, luxury product.

Demand for silk blends and knitted silk

Silk blends are one way to answer the challenge from synthetic fibres. Lately, silk has been blended with other fibres, such as cotton, linen, wool and even polyester. Developing country silk producers have not yet progressed very much in this field. They need to develop their research and technology to offer competitive new products.

Knitted silk products are an answer to the market demand for comfort, expressed during the sand-washed silk boom. Consumers, especially in the United States, were attracted by these garments that were soft, comfortable, casual and easy to maintain. Knitted silk has the advantage of being a casual, yet 'quality' silk product, and can fetch attractive market prices. China has made progress in this product category. After introducing silk thermal underwear for outdoor living, other types of knitted silk garments are now being exported, such as T-shirts, camisoles, polo neck shirts and sweaters. This trend should be followed, as it may have a reasonable growth potential for a number of silk producing developing countries.

A study conducted in 1999 in US, Japan, China and UK provided the following directions for repositioning silk to:

- Return to creativity
- Put silk into everyday life and make it easier to use
- Offer versatile silk adapted to a variety of circumstances (silk blends and knits)
- Recover silk's original mythical and cultural dimensions.

International Trade Centre (ITC) acts with silk industry

ITC has worked with firms, national governments and industry associations to promote silk and silk products in silk-producing developing countries, particularly in Asia. ITC has closely monitored world production and trade in silk goods, working with key industry players such as the International Silk Association, the International Sericulture Commission and relevant organisations in developing countries, including the China National Silk Import and Export Corporation, the Central Silk Board of India, the Indian Silk Export Council, the Thai Silk Association and others.

ITC projects gave an opportunity to local silk industries, particularly in China, India, Malaysia and Thailand, to develop products and markets. ITC provided technical assistance for silk fabric dyeing and printing, design, pattern-making and grading, cutting and other silk production techniques. Participating companies were introduced to new markets and

customers through market contact missions in foreign markets. The message was always the same: move towards silk processing and finished products, to improve value-addition, and stay competitive.

ITC worked with producers of knitted silk products in the Democratic People's Republic of Korea, to help the country launch a new knitted silk goods collection in European and Japanese markets.

Prospects for African entrepreneurs

The climate in many African countries is suitable for sericulture. Efforts were made in the past to establish sericulture in countries like Uganda, Nigeria, Ghana and Botswana. Good training facilities are available at *icipi* in Nairobi, Kenya. In some cases, cocoons were produced and exported. One of the main drawbacks could be lack of processing facilities. The major contributing factor in silk production in the silk producing countries has been cheaper manpower. Leading silk producers like Japan, France and Korea, have slowly withdrawn from silk production due to high labour cost due to industrialisation. On the other hand they have continued in value addition activities producing expensive products for the rich. As mentioned earlier, there has been a growing demand for affordable silk products among middle-income groups, which requires bulk production. With vast stretches of arable land with good climate, African countries have good potential for bulk production of silk. But processing facilities are a must. It is also necessary to develop skills for producing silk goods for high end users.

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IFAD'S AND GOVERNMENT OF SUDAN'S STRATEGIC AND PROPOSED THRUSTS FOR LIVELIHOOD IMPROVEMENT

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Abstract: IFAD and the government of the Sudan agreed to focus on the rural poor, particularly in the traditional rainfed agricultural sector. The project's strategy involves three thrusts, namely: (i) the strategy to support the livelihood strategies of the target groups, which focus on improving both the productive capacity of the rural households and providing an enabling institutional environment, (ii) the strategy to empower both men and women to fully participate in the development process and (iii) to recognise that IFAD has a role to play in promoting good local governance.

IFAD and GOS

IFAD and the government of the Sudan agreed to focus on the rural poor, particularly in the traditional rain fed agricultural sector. Hence, all the IFAD ongoing funded projects are in the rain fed areas, namely Northern Kordofan Rural Development Project (NKRDP), Southern Kordofan Rural Development Programme (SKRDP), Gash Sustainable Livelihood Regeneration Project (GSLRP) and Western Sudan Resource Management Programme (WSRMP).

The main thrust of the strategy is to support the livelihood strategies of the target groups, which focus on improving both the productive capacity of the rural households and providing an enabling institutional environment. This implies, for example, that livestock development and natural resource management are given a prominent place in project support.

The second thrust is to empower both men and women to fully participate in the development process. Women's access to decision-making at the local level is promoted as a way of addressing their strategic needs, and to mitigate the effects of cultural factors that preclude or limit their presence in the public arena. In line with this, in all the community development committees, women are represented by 30%. Moreover, women are represented on the Board of Directors of the projects.

The third thrust is to recognise that IFAD has a role to play in promoting good local governance. The issue of natural resources management is well addressed in WSRMP project with natural resources governance structure and the necessary reforms and investments for its improvement as a necessary corollary to poverty reduction and sustainable development. IFAD has become a leading agency for rural development in the Sudan and enjoys a high level of credibility with its partners in the country. Since the Country Strategic Opportunities Paper (COSOP) was launched in 2002 there are four ongoing projects where IFAD accelerated the rate of project approvals.

IFAD and GOS will continue to support decentralisation efforts and the establishment of rural grassroots organisations that are more responsive to the needs of the local women and men. The capacity building of the local communities supported by IFAD and GOS, is aiming at enabling local organisations to integrate poverty alleviation into their workplans.

IFAD supported income-generating activities are through rural credit and recently, microfinance credit to the rural poor. Hence the introduction of commercial insects in the Sudan especially in the IFAD's project areas will find a good environment to flourish and become one of the corollaries to poverty reduction.

RESEARCH COMMERCIALISATION AT *icipe*

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Abstract: Further to *icipe*'s intellectual property policy (2000) and strategic planning review (July 2002), a research commercialisation agreement was concluded between *icipe* and Bridgeworks AG in June 2004. Recent initiatives include private sector collaboration with Saroneem Biopesticides and Biop Company Limited, and the *icipe* TechnoPark, Bioprospecting Programme for Naturub, Mondia and Mozigone products and the Commercial Insects Programme for EcoHoney and silk.

About Bridgeworks

Bridgeworks is a venture capital (VC) company that incubates and commercially exploits technologies and services associated with agriculture, environment, health and nutrition. It is an international investment and fund management group that was founded in 2004 as Bridgeworks AG (Zurich, Switzerland) and Bridgeworks Africa Limited (Nairobi, Kenya).

The research commercialisation agreement between BW and *icipe* was concluded in June 2004.

Bridgeworks resources

- Technical and commercial team of domain experts (Project Managers) in animal health, human health, crop protection, environmental science, intellectual property management and VC investment
- Further to initial funding received from Swiss "angel" investors, plans are in place to establish a fully-fledged VC fund by mid-2007, towards attracting investment from both local and international sources into promising bioscience enterprises within East Africa.

Selected recent initiatives

- *icipe* TechnoPark
- Private sector collaboration: Saroneem Biopesticides and Biop Company Limited
- Bioprospecting Programme at *icipe*: Naturub, Mondia, Mozigone products
- Commercial Insects Programme at *icipe*: EcoHoney and silk.

Elements of the *icipe*-BW agreement

- Grant to BW of right of first refusal to commercially exploit *icipe*'s research outputs
- Commercialisation Committee (CC) consisting of *icipe* and BW representatives meets periodically to define, plan, coordinate and execute commercialisation projects
- income streams to *icipe* (percentage of research commercialisation revenue) to be paid by BW into proposed Trust Fund
- *icipe* has first option to provide development services to BW commercialisation projects
- *icipe* insulated from commercialisation risk and potential liability.

Commercialisation strategy

Stages

1. Pre-screening
2. Due diligence
3. Involvement of scientific and industrial advisory board
4. Commercialisation strategy defined
5. Commercialisation executed.

Options

- Venture creation and management
- Technology licensing
- Hybrid solutions.

Legacy projects

Biop Company Limited

- Founded by *icipe* researchers in 1999 to manufacture and market biopesticide products in East Africa
- Transformed in 2002 into a vehicle for commercialising herbal products for use as cosmetics and medicines as well as in agriculture (biopesticides, fertilisers)
- BW acquisition of majority shareholding (75%) in September 2004
- Provision of investment finance towards upgrading of production facilities
- Ongoing management support and strategy development.

AfriCert Limited

- Initiated by *icipe*'s Plant Health Division in 2003 with support from development agencies GTZ and DFID
- Provides certification services to small-scale farmers and exporters of agricultural produce
- BW active at board-level participation (until October 2005)
- Provision of bridging finance to support operational expenditure
- Identification of secondary investor and securing of follow-on investment capital.

'AfriBiop'

- *icipe* and Chinese biopesticide manufacturer Kernel entered into technical collaboration in April 2002, with Chinese Ministry of Science and Technology providing support for delivery of *Bacillus thuringiensis* (Bt) production equipment valued at US\$ 1 million
- Biopesticide production demonstration facility installed in October 2003
- Negotiations ongoing for BW to enter into joint venture (JV) agreement with Kernel towards scaled-up commercial production and marketing of Bt biopesticides for application in agriculture and public health, with associated service agreement to be concluded between resultant JV and *icipe*
- Ongoing/impending activities:
 1. Preparation and submission of technical dossiers towards experimental use and marketing authorisation by regulatory authorities
 2. Environmental and safety audit of Bt factory

3. Test Bt production/formulation
4. Field efficacy trials of Bt formulations.

Next steps at *icipe*

Project management

- Strategic implementation for legacy projects
- New project screening and pipeline development.

Client relationship management

- Research commercialisation helpdesk service
- Account management by designated Project Managers
- Internal and external communication
 1. Commercialisation handbook
 2. Departmental meetings
 3. Seminar and workshop series
 4. E-newsletter
 5. Internet/intranet web pages
 6. Field demonstration.

***icipe* projects under screening**

Animal Health

- Tsetse fly repellents.

Environmental Health

- Vertically integrated commercial insect ventures (apiculture and sericulture).

Human Health

- Mosquito baits and repellents.

Plant Health

- Fruit fly IPM package (attractant and fungal pathogen)
- Biopesticides for grasshopper and locust control
- Biocontrol agents for management of thrips and termites.

HISTORY OF KENTE CLOTH AND ITS VALUE ADDITION THROUGH DESIGN INTEGRATION WITH AFRICAN WILD SILK FOR EXPORT MARKET IN GHANA

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Abstract: The Republic of Ghana, formerly known as the Gold Coast, is named after the medieval Ghana Empire of West Africa. The Ashanti people of Ghana developed kente in the Seventeenth Century AD, though it is believed to have its roots in a long tradition of weaving in Africa dating back to 3000 BC. The origin of kente is explained by both legendary and historical accounts. Kente in the past was woven from cotton and silk yarns imported from Europe and Asia, but now Lurex® and spun rayon are used in addition to cotton and silk. Silk yarns are usually considered the most prestigious and are, therefore, the most highly valued. Kente is no more a reserve of royals but for people of all social classes and is one of the world's best known and most widely revered textiles. It is produced in greater quantity, exported to more places and incorporated into a greater variety of forms than any other African fabric. The value and prestige of kente cloth can be increased by blending it with African silk to offer designs characteristic to only the African sub-region, with the aim of attracting the large export market both locally and internationally. The CIP in *icipe* is currently exploring this option as a way of adding value to African silk textiles so as to attract high export value. In the long-term the technology will be adopted by the Ghanaian textile industry to boost her textile exports. This marketing opportunity is facilitated by the fact that Ghana now enjoys duty-free exports of indigenous Ghanaian textiles to the larger US market under AGOA.

Background

The Republic of Ghana is named after the medieval Ghana Empire of West Africa [1]. Geographically, old Ghana is 500 miles north of the present Ghana, and occupied the area between rivers Senegal and Niger. Some inhabitants of present Ghana had ancestors linked with the medieval Ghana. Before March 1957, Ghana was called the Gold Coast named by the Portuguese who came to Ghana around the Fifteenth Century and discovered its gold wealth. Ghana is located in West Africa with a land surface area of 239,460 km² (area including inland waters) and shares boundaries with Côte d'Ivoire in the west, Burkina Faso in the north, Togo in the east and the Gulf of Guinea of the Atlantic Ocean in the south. The 2006 population estimates is 22,409,572 and a real growth rate of 2.14%. The age structure is as follows; 0–14 years constitute 38.8%, 15–64 years constitute 57.7% and 65 years and over forms 3.5%. The unemployment rate is 20% (1997 estimate) and the population below poverty line constitutes about 31% (2003 estimate). The female labour force is 51% and current agriculture labour force is 60% (1999 estimate) [2,3,4].

History of kente cloth

The term kente comes from the word 'kenten', which means 'basket' because the first cloths were woven out of raffia and were dubbed 'basket cloths' with patterns resembling those of a basket [5]. Although the Ashanti people of Ghana developed kente in the Seventeenth Century AD, it has its roots in a long tradition of weaving in Africa dating back to about 3000 BC. The origin of kente is explained with both a legend and historical accounts [6].

A legend has it that a man named Ota Karaban and his friend Kwaku Ameyaw from the town of Bonwire (now the leading kente weaving centre in Ashanti) learned the art

of weaving by observing a spider weaving its web during a hunting expedition. Taking a cue from the spider, they wove a strip of raffia fabric and later improved upon their skill. They reported their discovery to their chief Nana Bobie, who in turn reported it to the Asantehene (the Ashanti chief) at that time. The Asantehene adopted it as a royal cloth and encouraged its development as a cloth of prestige reserved for special occasions [6].

Historical accounts trace the origin of kente weaving to early weaving traditions in ancient West African Kingdoms that flourished between 300 AD and 1600 AD. Some historians maintain that kente is an outgrowth of various weaving traditions that existed in West Africa prior to the formation of the Ashanti Kingdom in the Seventeenth Century. Archaeological research has dated examples of narrow-strip cloths woven in West Africa as early as the Eleventh Century AD and perhaps earlier. Some examples of woven fabrics have been found in the caves of the Bandiagara cliffs in Mali. These cloths, used in burial ceremonies, probably during the medieval Ghana, Mali and Soghai Empires, have technical and aesthetic features similar to many of the narrow-strip cloths in many parts of West Africa [5,6].

Many features of such cloths appear in the early and later narrow-strip cloths woven in Ashanti. Given these historical accounts, it is believed that the Ashanti craftsmen might have learned weaving skills from other peoples living north and west of them and later developed their unique style of cloth. While kente cloth may have its roots in Eleventh Century West African weaving traditions, weaving in Africa as a whole was developed earlier. Elsewhere in Africa, archaeological excavations have produced such weaving instruments as spindle whorls and loom weights in ancient Meroe Empire which flourished between 500 BC and 300 AD. In other African civilisations in the Nile Valley such as Kemte (Egypt) and Nubia or Kush, there is an abundance of pictorial and archaeological evidence proving the existence of a weaving industry as early as 3200 BC [6].

Materials, techniques, uses and symbolism of kente

Kente cloth is woven on a horizontal loom that has between four and seven treadles or heddles (treadles help regulate the design; four produce a simple design, seven or more produce a complex design). The pieces are woven into narrow strips that are about four inches wide and five to six feet long. The garments are made custom to fit a male or female. They also vary in colours and design. Yarns for weaving come in a variety of forms and qualities. In the past, yarns were either spun from locally grown cotton or unravelled from cotton and silk cloths imported from Europe and Asia. Today, factory made cotton, silk, Lurex® or spun rayon yarns are obtained from factories in Ghana and outside Ghana. Various colours of yarns may be combined in particular ways to reflect the symbolic significance of the cloth [6,7].

Quality of yarns used in weaving a particular cloth reflects on the level of prestige associated with the cloth. Silk yarns are usually considered the most prestigious and are, therefore, the most highly valued. Silk cloth, in the past, was reserved for royalty and the wealthy. Several strips are carefully arranged and hand-sewn together (some weavers now use sewing machines) to obtain a desired size. Tradition has it that mainly men weave kente. Women, in the past, played a significant role by spinning raw cotton into yarns, dyeing yarns into desired colours (white, golden yellow, pink, purple, blue, green, turquoise, black, maroon, orange and red), sewing strips together to form large cloths and assisting in the marketing of the cloths. Today, factory spun yarns have replaced hand-spun yarns, and therefore, the woman's role is mainly in the area of sewing strips together and marketing the cloth [6].

Kente cloth is documented to be traditionally woven by the Ashanti and Ewe tribes who wore them at ceremonies and other important events. Traditionally, the size, pattern and colour are determined by gender, age, marital and social status. The Ashanti weaver refers to kente as 'nwentoma' (woven cloth) to distinguish it from the factory-made cloth ('ntoma')

and the 'adinkra' cloth that is stamped ('ntiamu ntoma') by the block-print technique. The 'nwentoma' is of various categories: 'ahwepan' (plain weave); 'topreko' (plain weave with simple weft inlays); and 'faprenu' (double weave technique that hides the warp threads). The warp threads are laid in such fashion to give a name and meaning to the cloth. At the same time, the weft designs or motifs are each given a name and meaning. These names and meanings reflect Akan beliefs, historical events, individual achievements, proverbs, philosophical concepts, oral literature, moral values, social code of conduct, human behaviour, social and political organisation in the Akan society, or may be named after all manner of people and certain attributes of plant and animal life. Thus, kente is used not only for its beauty but also for its symbolic significance. There are over 300 different types of cloth designs, each with its name [6,7,8].

Originally, kente cloth was the preserve of royalty and was worn only at joyous social or ceremonial functions. It was not meant to be used for commonplace daily activities or as an ordinary wear. Its use for making clothing accessories was limited to items deemed sacred or special and were used only for special occasions. In many cases the use of kente has a sacred intent. It may be used as a special gift item during such rites and ceremonies as child naming, puberty, graduation, marriage and soul-washing. It may also be used as a symbol of respect for the departed souls during burial rites and ancestral remembrance ceremonies. Its significance as a symbol of prestige, gaiety and glamour is evident during such community celebrations as festivals and commemoration of historical events, when people proudly wear the best of their kente cloths to reflect the spirit of the occasion [7,8].

Kente cloth is no longer reserved just for the royals: it is for people of all social status. In the past, only royals patronised kente cloth from artisans. Now with economic prosperity, it has become feasible for the non-royals to express a demand for kente cloth. In a small retaliation a kente was designed and named "wonya wo ha a, wonye dehyee" meaning "you may be rich, but you are not of a royal descent." The royals wore this to distinguish them from the non-royals who had adopted wearing kente in the late eighteenth and early nineteenth centuries. However, an individual may not decide to make their own design and wear it. Royalty must first be offered the design and if it is declined then it is permissible to wear for a non-noble [7,8].

These days both hand-woven and printed kente cloth is more widely available to ordinary folk and has been adopted as the Ghanaian national dress. Even in the United States, kente cloth is more than just fashion. African-Americans wear it as a statement of pride in their motherland. The kente cloth helps Africans and those of African descent to maintain and keep their cultural identity.

Ghana achieved its independence from Britain in 1960. At that time, the kente transitioned from a cloth worn only by royalty to a cloth of the people, being a symbol of national pride. Ordinary citizens began to buy kente, a majority of which being affordable 'factory' versions, they wore them for special celebrations. A new trend began and now it extends from Africa to include the United States where African-Americans keep this symbol of their cultural identity close to them as an important symbol to highlight their heritage, and to be worn on days such as those during Black History month celebrations. African-Americans hold close to them and renew their pride with their motherland by wearing a kente cloth for more than just reasons of fashion; it is for inspiration, and a reflection of the art of their African ancestors from Ghana [6,7,8].

Political considerations of kente

The largest known kente cloth, measuring about 12 x 20 feet (3.66 x 6.1 m), is the piece Ghana presented to the United Nations in 1960. This cloth is called 'tikoro nko agyina', which means, one head does not constitute a council. This was to state that Ghana was taking its legitimate place in the new world order ushered in by the wave of decolonisation that was sweeping through Asia, Africa and other colonised territories. A popular kente

cloth, 'Fathia Fata Nkrumah' (Fathia befits Nkrumah) was renamed 'Obaakofo Mmu man' (One man does not rule a nation) as soon as Nkrumah was overthrown in a military coup in 1966. During his inauguration as President of Ghana in January 2001, Mr J. A. Kufuor wore a kente cloth called 'Dako yesere', which means we will smile one day [7].

Integration of African silk in the design of kente cloth for the Ghana textile export market

Kente is one of the world's best-known and most widely revered textiles. It is produced in greater quantity, exported to more places and incorporated into a greater variety of forms than any other African fabric. The value and prestige attached to kente can be increased by blending the kente cloth with African silk (e.g. *Gonometa* silk, *Anaphe* silk, *Epiphora* silk, *Argema* silk, etc.) to offer designs characteristic to only the African sub-region, which will attract a large export market locally and internationally. The Commercial Insects Programme in *icip*e is currently undertaking this research, but the technology and label of the textile will be credited to Ghana and adopted by the Ghanaian textile industry as the homeland of kente. This marketing opportunity is facilitated by the fact that Ghana now enjoys duty free exports of indigenous Ghanaian textiles to the larger US market under the African Growth and Opportunity Act (AGOA).

The AGOA provide duty free access to the US market for substantially all products exported from 37 eligible sub-Saharan African countries. It is the cornerstone of the Administration's trade and investment policy toward sub-Saharan Africa, aimed at promoting free markets, expanding US-African trade and investment, stimulating economic growth, and facilitating sub-Saharan Africa's integration into the global economy. As of April 2006, 25 countries were eligible to receive AGOA apparel benefits. Of these countries, 14, (including Ghana) also qualify for AGOA's provisions for hand-loomed and handmade articles [9].

The current stable democratic governance and the goodwill enjoyed by Ghana from the international community and the determination by the Ghanaian government to support all local micro-enterprises aimed at enhancing private sector participation and development as well as accelerating economic growth has positioned Ghana well to exploit the benefits of African silk and its incorporation into traditional kente designs as value addition to attract higher prices at both the local and international export market. This will help realise the government's immediate goal of alleviating rural poverty and the broader vision of becoming a middle-income country by the next two decades (originally known as vision 2020). Ghana is among a dozen African countries short-listed to meet the millennium development goal (MDG) target of halving poverty by 2010 after lifting significant percentages of their citizens above the poverty line, according to a World Bank report released in Washington on Monday 23rd October, 2006 [10].

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L'IMPACT DU PROJET CRDA IFAD EN TUNISIE

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Résumé: Cette étude était conducté sur l'impact du projet CRDA IFAD en Tunisie. Elle consiste des cultures maraichères sous abris, de l'aspect technique, du type de sol recommandé pour les cultures sous serres, des besoins en eau des principales cultures maraichères sous serre, des besoins en eau de chauffage, de choix des espèces maraichères et saison de cultures des variétés recommandées, des densités des plantation et de protection phytosanitaire.

Les cultures maraichères sous abris

- **Projet type 1:** La production maraichère sous serres chauffées par les eaux géothermales
- **Projet type 2:** La production maraichère sous serres non chauffées, la presentation du secteur des cultures maraichères de plein champ et sous abris occupent en Tunisie une moyenne de 140.000 ha.
 - Les cultures maraichères sous abris (abri-serres, les serres, serres multitunnels et les petits tunnels) représentent seulement 6,2% de cette superficie, soit 8650 ha.

Aspect technique

Serres et abri serres

La serre est un artifice de production de contre-saison (cultures de primeurs et d'arrière-saison) et permet une production à l'unité «surface-temps» bien supérieure à ce qu'autorise la culture en plein air (Tableau 1).

Tableau 1. Cultures de primeurs et d'arrière-saison

Type de l'abri	Sup (ha)	% de la sup totale	Cultures	Gouvernorat
C. sous serres non chauffées	1250	15	Piment, Tomate, Melon	Monastir, Sidi Bouzid Mahdia et Sfax
C. sous petits tunnels	7300	85	Pastèque, Piment	Sfax
C. sous serres chauffées	100	1	Tomate Concombre Melon, Gombo	Gabés, Kébili, Tozeur

Petits tunnels nantais

Le petit tunnel couvre le sol sur une largeur de 80 à 120 cm et à une hauteur de 50 à 70 cm au-dessus du sol (Figure 1). Il se compose d'arceaux en fer galvanisé N°24 mesurant 2.30 à 2.50 cm de longueur, de contre-arceaux en fer, galvanisé N° 16 mesurant 2 m de longueur. Pour les tunnels sont utilisés pour une période relativement courte (2 à 3 mois) pour avoir une récolte précoce, leur mise en place se fait en automne ou au début du printemps (février-mars).



Figure 1. Petits tunnels nantais

Abri-serres ou serres monotunnel

Les abri-serres ont une largeur de 7 à 9,6 m, une hauteur de 2,80 à 4,7 m et une longueur de 60 m, soit une superficie couverte de 420 à 540 m². Les serres multitunnels ou multichapelles. La serre multitunnel est constituée de trois (ou plus) grands tunnels jumelés et raccordés sur un chéneau. Généralement, chaque serre a une superficie de 1500 m² environ (longueur = 60 m, largeur = 27 m et hauteur-faîtage = 5,9 m), constituée de trois tunnels (9 x 3 = 27 m).

La distance entre les arceaux d'une serre renforcée est de 1.5 m au lieu de 2 m habituellement.

Type de sol recommandé: Cultures sous serres non chauffées

Les sols recommandés pour les cultures sous serres non chauffées, doivent avoir une texture grossière.

Cultures sous serres chauffées

- Les sites d'implantation des entités géothermiques (Sud du pays) sont constitués de sols profonds, de texture sableuse. Ces sols sont généralement pauvres en matière organique, leur utilisation pour les cultures maraîchères devrait prévoir l'apport fragmenté de fumure de fond et l'apport massif de fumure organique pour améliorer la fertilité et la structure de ces sols.

Besoins en eau des principales cultures maraîchères sous serre

La quantité d'eau d'irrigation des cultures maraîchères sous serres sont données pour une serre de 500 m²:

- L'eau d'irrigation recommandée doit avoir une charge totale en sel inférieure à 1,5 g/l et un pH de préférence de 7,5.
- Les besoins en eau de chauffage des cultures sous serres chauffées sont évalués à environ 10 l/s/ha.

Besoins en eau de chauffage

Les besoins en eau de chauffage des cultures sous serres chauffées sont évalués à environ 10 l/s/ha. Les exigences de température de certaines espèces sont données dans le Tableau 2.

Tableau 2. Exigences de température de certaines espèces

Espèces	Température		Humidité (%)
	Jour (°C)	Nuit (°C)	
Tomate	20–25	14–18	60–90
Melon et Concombre	18–20	14–20	60–90

Tableau 3. Espèces cultivés selon le calendrier et leurs besoins en eau

Espèces	Besoins en eau	Période
Piment	500 m ²	Novembre–Juillet
Tomate continue	500 m ²	Septembre–Mai
Melon:		
• Primeur	320 m ²	Janvier–Mai
• Arrère-saison	220 m ²	Septembre–Décembre
Concombre:		
• Primeur	250 m ²	Janvier–Mai
• Arrère-saison	200 m ²	Septembre–Décembre

Choix des espèces maraîchères et saison de cultures

Les espèces cultivées sous abris appartiennent principalement à deux familles les cucurbitacées et les solanacées (Tableau 3). Leur culture peut durer 6 à 10 mois. Selon le calendrier on distingue:

- Les cultures de primeur, se fait sous tunnel (janvier à juin) et sous serre (octobre à juin) et se localisent dans les zones côtières grâce à la texture légère et aux conditions climatiques tiède en hiver. Elles peuvent être pratiquées dans le sud en bénéficiant des eaux géothermales.
- Les cultures d'arrière saison, intéressent toute la Tunisie, elle débute fin d'été et se termine en hiver (pour le melon) ou peut se prolonger en été pour la tomate et le piment.
- La culture continue: elle concerne les tomates, débute en septembre et se termine en juin. La production est destinée à 100% à l'exportation.

Variétés recommandées

Les variétés recommandées pour les espèces cultivées en serriculture sont:

- Tomates: Elena, Argenta, Durinta, Thomas, Cencara, Bochra, Neziha
- Piments: Marconi, Chargui, Andalus, Sonar, Lamyo
- Concombres: Avir, Pepinex, Vercor
- Melon: Pancha, Calipso, Mansour, Dalton.

Densités de plantation

Dans une serre il y a 8 lignes. Les plantes sont conduites en lignes jumelées (économie d'eau), sur des banquettes (2 lignes/banquette), ce qui donne par espèce:

- Tomates: 35 cm * 80 cm * 140 cm; 3 plants/m²
- Piments: 50 cm * 80 cm * 140 cm; 2 plants m²
- Concombres: 40 cm * 80 cm * 120 cm; 2 plants/m²
- Melon: 35 cm * 80 cm * 140 cm; 3 plants/m²: conduite sur un seul bras.

Protection phytosanitaires

L'efficacité de la protection phytosanitaire se base tout d'abord sur le respect des mesures prophylactiques suivantes:

- Planter sur sol sain
- Utiliser des variétés résistantes
- Tailler les plantes et éviter des micro-climats favorables aux maladies
- Pratiquer le paillage noir
- Assurer l'aération de la serre
- Traiter préventivement la culture
- Respecter l'assolement
- Déplacer la serre tous les deux ans
- Enlever les résidus de la culture précédente
- Désinfecter les ficelles de palissage.

Les traitements chimiques préventifs sont donnés par espèce dans le Tableau 4.

Tableau 4. Traitement chimiques préventifs par espèces

Espèce	Maladie et ennemi	Matière active (MA)	Concentration de MA
Tomate	Mildiou	Fosethyl-Al +Oxychlorure de CuLure	25 + 43%
	<i>Botrytis cinera</i>	Iprodione	50%
	Ordium	Fenarimol	120 g/l
	Acariens	Birenthrine	25 g/l
	Insectes	Deltamethrine	120 g/l
Melon et Concombre	Ordium	Fenarimole	120 g/l
	Mildiou de Cuba	Fosethyl -Al	80%
	<i>Botrytis cinera</i>	Iprodione	50%
	Acariens	Birenthrine	25 g/l
	Insectes	Deltamethrine	25 g/l
Piment	Ordium	Fenarimol	120 g/l
Haricot	Anthraxose	Manebe + Carbendazine	50 + 6%

DEVELOPING MARKETING INFRASTRUCTURE: EXPERIENCES FROM AMSDP

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Abstract: Rural marketing infrastructure development is part of the interventions by the Agricultural Marketing Systems Development Programme (AMSDP) that aims at removing the constraints to the effective operation of an agricultural marketing system. The objective of this particular intervention is to reduce the cost of marketing agricultural products due to poor roads, inadequate marketplaces and insufficient storage facilities. The interventions are training, rehabilitation of roads and bridges, upgrading of market facilities and rehabilitation of storage facilities. In addition, offices of engineers in the districts and regions are equipped with computers and motorcycles. The infrastructures are expected to be sustained due to the fact that the local authorities at district and village levels are ready to run and maintain them. The contribution of 5% to the cost of construction gives the local authorities a sense of ownership. The villagers are going to be trained on how to maintain the structures. Materials used for construction of the structures are all locally available hence replaceable.

The following have been identified as positive contributing factors to success: good collaboration from District council staff; existence of Construction Registration Board (CRB)—being a regulatory board helped to ensure structures are of good quality and contractors are held responsible for poor performance and enthusiasm and participation of the beneficiaries. On the other hand, the following factors constrained the progress under the component: bureaucratic disbursement procedures have greatly constrained the performance of contractors; lack of equipment and capital to local contractors have led to slow process in construction and rehabilitation of rural infrastructure; and districts have not been committed to contributing the 55% for supervision works in the construction and rehabilitation of rural infrastructure.

Introduction

The Agricultural Marketing System Development Programme is a seven-year programme implemented in the Southern and Northern zones in Tanzania covering 8 regions in 38 districts. The aim of AMSDP is to remove the constraints to the effective operation of an agricultural marketing system and assist small-scale producers, processors and traders to acquire the capacity and interest to participate on favourable terms in the open market. It is believed that market actors (producers, traders and processors) armed with adequate understanding of the competitive market and the necessary capacity will take optimal advantage of such a marketing system.

Programme objectives

The long-term goal of the AMSDP is to increase incomes and food security of the rural people in Tanzania. The intermediate goal is to improve the structure, conduct and performance of the agricultural marketing systems. Thus, the specific objectives of the programme are twofold:

- to stimulate the increase and diversification of production by smallholders; and
- to increase the number of medium-scale entrepreneurs who interact with small-scale producers and traders in the rural areas.

The programme covers four components, namely:

- The Agricultural Marketing Policy Development
- Producer Empowerment and Market Linkages

- Financial Market Support Services
- Rural Marketing Infrastructure.

Rural marketing infrastructure development

This component, which is funded by the ADB, was designed to address the high marketing transaction costs associated with inadequate road infrastructure and market facilities in rural areas. The component targets 35 districts and is planned to be implemented over five years.

Main outputs

Two major outputs are expected from this programme component:

- Improved access of smallholder producers and traders to agricultural markets and market infrastructure;
- Enhanced capacity of district councils to plan, supervise and maintain infrastructure in a sustainable and cost effective manner.

Activities

Under this component the programme is designed to undertake the following activities:

- Rehabilitation of market facilities at 140 marketplaces
- Rehabilitation of 1136 km of rural feeder roads together with associated bridges and culverts
- Capacity building of the districts and regional authorities as well as local communities
- Provision of engineering consultancy services for the design and implementation of the ADB funded marketing infrastructure component.

Implementation

The activities of the rural marketing infrastructure component, like any other components within the programme, are implemented based on the beneficiary demand and private sector driven concepts, giving priority to rural access or feeder roads which link marketplaces to productive areas in the districts.

The selection of the marketing infrastructure in a particular district is based on demand from the grassroots/farmers groups, demonstrating relevance of the infrastructure to be developed to the local communities and the commitment of the user groups/village and ward councils to own, utilise/operate and maintain the completed infrastructure. On the other hand, the implementation of road works and other market support infrastructure is executed through competent civil works contractors, under the supervision of the district engineers and the consulting engineer for the Regional Roads with backstopping from the Programme Coordination Unit (PCU Engineers). The procurement for goods, works and services follows the Bank's rules using the relevant Bank Standard Bidding Documents, coordinated by the PCU.

Institutional capacity building

Training and equipments are provided to districts and local communities. District engineers, regional secretariat engineers and technicians have been trained in work planning, tendering, contract management, supervision and technical auditing. In addition, village communities are trained in rural access roads construction and maintenance, and maintenance of marketplaces. Local authorities and communities are supported in establishing management boards for marketplaces.

The regional secretariat engineers in 8 focus regions, 40 district engineers and 40 technicians were trained in work planning, tendering, supervision, maintenance and technical auditing for the civil works. In addition, 19 groups comprising of 188 villagers have been trained in infrastructure planning, maintenance, and source of revenues for sustainability of the improved infrastructures. The other targeted categories to be trained include ward councillors.

Equipment provided to the local authorities include computers, scanners, printers and motorcycles provided to the district engineers' offices in 36 districts. District Road Management System Software has also been installed in the districts.

Positioning of structures

The markets have been selected in places that already exist as transaction places for agricultural goods but lack proper building infrastructure. The markets selected for upgrading are to provide an improved and hygienic space for marketing agricultural commodities. The storage facilities have been selected where there is time lag between harvesting and selling of the product. The roads have been selected to access areas where there is agricultural production, which cannot easily be transported to buyers or cannot be accessed by buyers due to poor roads. An integrated approach is observed as much as possible whereby the different structures are provided in the same areas so as to maximise the potentials available. However, this has proved difficult in a number of cases due to the political nature of the district councils which favours distribution of services to as many areas as possible.

Rural roads rehabilitation and improvements

Since May 2005 a total of 11 rural roads, which cover 249.6 km, were under rehabilitation. These incorporated construction of 4 bridges and unnumbered culverts. The district engineers were responsible for the surveys, tests, designing, tender administration and supervision of the construction of the roads. A total of 7 rural roads covering 136.1 km have been completed and this amounts to 63% of roads under rehabilitation.

Rural market centres rehabilitation and improvements

Ten market facilities have been upgraded covering 10 districts. The National Construction Council was engaged by the programme to design the markets. The district engineers were responsible for the tender administration and supervision of the construction of the market buildings. To ensure that the market centres that also serve as information centres are effectively utilised to achieve the intended objective sustainably, the programme is supporting the beneficiaries together with the local authorities to develop the market centres' management structures.

Rural storage facilities

Six storage facilities in six districts have been rehabilitated and two new warehouses have been constructed in another two districts. Groups participating in the inventory-lending scheme use the warehouses. The programme in collaboration with other institutions has facilitated the development of strong rural microfinance institutions that are operating the inventory-lending scheme (Ware House Receipt System) in collaboration with commercial banks.

Impact and sustainability of the provided infrastructure

Assessing the potential impact of the interventions by considering the expected services to be provided by the structures and the beneficiaries of the services and evaluating sustainability of the interventions by looking at the maintenance plans is as follows:

Services provided

The roads are going to provide easy accessibility to the markets for the agricultural produce of the areas along and near the road. The markets will provide an improved venue for trading the agricultural goods and accessing information. The storage facilities will provide a possibility of storing agricultural produce until good prices are offered.

Beneficiaries

The beneficiaries in the case of roads will be the villagers along the road and nearby villages. The farmers are already using the completed storage facilities to store their crops. The district officials will have easy access to the villages in the area. Apart from agricultural market access, there will be other benefits such as easier access to hospitals, schools and other services.

Maintenance planning

The local authorities at district and village levels are ready to run and maintain them. The contribution of 5% to the cost of construction gives the local authorities a sense of ownership. The villagers are going to be trained on how to maintain the structures. Materials used for construction of the structures are all locally available hence replaceable. It will therefore be within the communities' capacity to sustain the structures.

Lessons learned

Factors for success

The positive contributing factors to success include:

- Good collaboration from local authorities staff
- Existence of Construction Registration Board (CRB)—being a regulatory board helped to ensure structures are of good quality and contractors are held responsible for poor performance
- Enthusiasm and participation of the beneficiaries.

Constraints

The following factors constrained the progress under the component:

- Bureaucratic disbursement procedures have greatly constrained the performance of contractors
- Lack of equipment and capital to local contractors have led to slow process in construction and rehabilitation of rural infrastructure
- Districts have not been committed to contributing the agreed 55% for supervision works in the construction and rehabilitation of rural infrastructure.

INTRODUCING APICULTURE AND SERICULTURE IN IFAD PDCRE CASH CROP PROJECT FOR INCOME GENERATION IN RWANDA

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Abstract: Rwanda is mineral resource poor where 90% of the population relies on agriculture for food and income generation. The population (65%) is below the poverty line. Very low productivity for the subsistence type of agriculture results in food insecurity and poverty. Production of traditional cash crops like coffee and tea is not stable. This phenomenon is exacerbated by fluctuating prices on international markets. (GDP per capita: USD 280 [<100 in 1994]).

In Rwanda, labour distribution is 60 to 90 days, being the maximum time effectively spent by each household in farming activities. We have three cropping seasons.

The government's strategy consists of shifting the agriculture from the self-subsistence role to a commercialisation orientation with a view to strengthening its contribution to food security. The new agricultural policy and strategies focus on this area. The way forward for Rwanda lies in the diversification of income generating options. For example, more profitable options like passion fruits and cape gooseberry fruit growing have picked up very easily.

Rwandan 2020 vision and poverty reduction strategy programme considers agriculture as one of the most important pillars, provided it is transformed from subsistence to demand-driven and market oriented vision.

Introduction

- Rwanda's land area is 26,336 square kilometres.
- Population: > 8.5 million.
- There are two rainy seasons: March–May and October–November (average rainfall of 110–200 mm per month).
- The average temperature is 24.6–27.6 °C (hottest months: August, September)
- The altitude ranges from 1000–4500 m above sea level. Rwanda is called the country of a thousands hills because of its hilly landscape.
- The main water bodies are Lakes Kivu, Muhazi, Ihema, Bulera, Ruhondo and Mugesera.
- The vegetation in Rwanda ranges from dense equatorial forest in the northwest of the country to tropical savanna in the east.
- The main national parks/animal reserves are Akagera and Virunga volcanoes national parks (mountain gorilla park) and Nyungwe Park (natural forest).
- The highest point is Karisimbi volcano (4507 m).
- Rwanda borders Uganda to the north, Tanzania to the east, Burundi to the south and Democratic Republic of Congo to the west.

IFAD PDCRE cash crop project

Project objectives

The new cash and export crops is one of the components of the PDCRE IFAD project. Its objectives are to:

- Identify and promote the diversification of crops
- Clear the importance of these crops by costs of production, profitability and competitiveness studies

- Establish a credit fund in favour of the farmers through micro-finance institutions
- Improve information and communication towards farmers about the prices and the opportunities on the market
- Search for new markets, realise market studies and all other appropriate surveys.

Sericulture and apiculture

The project's approach towards the new cash and export crops is demand driven, although sericulture as a top priority is considered to be promoted in rural areas, but apiculture is following the above approach.

Apiculture

There is no national organisation for beekeepers groups, which may protect and defend their collective interests. Beekeepers work individually or in small groups (65% of them in the remote areas as traditional farmers). Organisations are small, a situation that makes it difficult for them to procure production equipment, training skills, financial services and to a big extent market access. Currently there are approximately 15,000 beekeepers in Rwanda.

Beekeeping in Rwanda is still at the traditional level (Table 1). Bees reared are the indigenous wild type that are in no sense domesticated. (A mountain race likely to occur in high altitude areas like the volcanoes national parks.) Generally this practice involves traditional skills and equipment.

Before 1994, the Ministry of Agriculture and Animal Resources had built and equipped apiculture centres which were transferred to ARDI (CBOs). Unfortunately all of them were destroyed during the war and none has been rehabilitated to date. Apiculture centres were very useful for beekeeping training and collection of honey product for further processing.

There are very few modern technology beehives like frame beehives (Langstroth and Kenya top bar models), which are able to increase production to between 30 and 50 kg per season (Table 1).

Table 1. Summary of beekeeping situation in Rwanda

Province	Number of beekeepers	% of women	Number of beehives	Production per hive (traditional) (kg)	Price per kg (US\$)
Western	6500	25	9500	3	2.5
Northern	3650	15	5600	3	1.8
Southern	3800	28	4250	3	2.5
Eastern	2150	9	1890	3	1.5

Strengths

- Conducive physical environment: natural vegetation, water and farm crops and wild plants form good resources for beekeeping
- Many people have traditional skills and modern skills have been extended to some farmers
- Many CBOs are interested in working in the honey sector
- The Ministry of Agriculture and Animal Resources has expressed strong interest in reviving the honey sector

- There are several donors interested in the beekeeping sector
- Land is becoming smaller day by day thus several farmers and the government are looking for alternative economic activities. Beekeeping is one of these alternatives.

Weaknesses

- Lack of business skills (beekeepers and CBOs)
- Low marketing skills (beekeepers and CBOs)
- Lack of commercial organisation strategies
- No product promotion
- No linkage between producers and traders
- Poor diversification of retail packaging materials
- Low product prices
- Lack of appropriate production technology to improve on quality and quantity, traditional skills and local equipment
- Lack of vital physical infrastructure—Access to containerised systems, road, sea transport, rail systems etc.
- No coordination between beekeeping and other sectors—Agriculture, environment, forestry, tourism, craft industry, etc.
- Lack of market information
- Lack of beekeeping sector policy
- Lack of capacity to organise the local producers.

Sericulture

It is early to tell about sericulture but it is seen as a promising sector for development of rural economy, through employment and income generation. (There is abundant manpower in rural areas due to unemployment.) Sericulture in Rwanda will be based on *Bombyx mori* silkworm rearing and moriculture. For the moment, there is no forest for wild sericulture. There is need for heating and cooling during the rearing period. Rwandan conditions are suitable for sericulture. In addition mulberry trees will contribute to erosion control.

Progress

Since sericulture has been considered as a top priority, the GOR has contacted its development partners to get assistance in the implementation of a sericulture project (FAO, *icipe*, IFAD). Some progress has been made, with the assistance of IFAD and GOR own funds.

Mulberry cultivation

The ISAR research institute has a collection of several mulberry varieties on 2 ha. Cuttings of Kanva-2 variety have been imported from Uganda and planted on a total area of 10 ha, distributed on 4 sites located in the 4 provinces.

Mulberry is grown at Nyagahanga site in Eastern province, Rushashi site in Northern province, Karongi site in Western province and Nyanza site in Southern province with a total of 10 ha for the 4 sites.

In collaboration with local authorities in districts, farmers are being organised into cooperatives for mulberry planting and later on, building silkworm rearing house.

The way forward

Apiculture

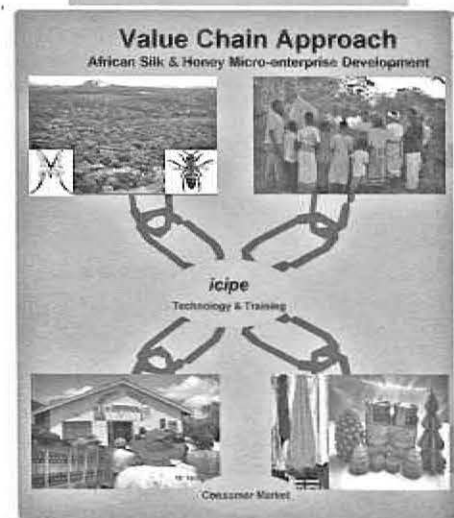
For beekeeping, it will be the same demand-driven approach. Support will be provided to local initiatives such as the Nyungwe forest project which supports beekeepers in the natural forest of Nyungwe.

Sericulture

For sericulture, development partners are invited to assist to scale up the current project. IFAD is completing an MTR of the project. Among them, *icipe* should play an important role.

SESSION 3

Implementation of value chain approach in the development, scale-up of production, branding and marketing of sericulture and apiculture products



SERICULTURE SITUATION AND IMPLEMENTATION IN EGYPT

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Abstract: Egypt has produced silk since the early Islamic period. Reclaiming the desert is one of the government objectives for extending the agricultural frontiers. This policy will help in expanding sericulture activities to the desert reclaimed land. The traditional rearing method covering more than 90% of the silkworm rearing in Egypt depends on raw materials for making racks and trays. The modern rearing methods being carried out by the SRD and the private investors, represent less than 10% of silkworm rearing by introduced simple technology. In spite of the limited production of cocoons, marketing of dried cocoons represents the main constraint facing expanding sericulture. Because of the high unemployment rates of the rural areas in Egypt's economic structure, sericulture is a suitable option. The SRD is conducting a project for promoting sericulture activities in Egypt for three years (2003–2006) focusing on addressing the major constraints facing the industry.

Introduction

Sericulture is one of the most labour intensive activities in the world. It involves both agriculture and industry and requires direct human involvement. Several third world countries have therefore identified silk production as a promising sector for development of rural employment opportunities and hard currency earnings. Egypt has to import silkworm eggs from other countries as it does not have the capacity to produce its own supply. Egypt has produced silk since the early Islamic period.

Silkworm rearing and processing of raw silk remained for many years activities for the landless who used low income methods. Reclaiming the desert land is one of the Government objectives for extending the agricultural frontiers. This policy will help for expanding sericulture activities to the desert reclaimed land.

The Sericulture Research Department (SRD) is the only organisation responsible for promoting and developing sericulture in Egypt. The SRD is engaged in research, training and extension activities involving different sericultural activities.

Mulberry trees

The mulberry tree is a common sight in many areas of the Delta. Farmers do not seem to nurture or care for them. Rearers harvest their leaves by climbing the old trees for feeding the larvae.

In north Egypt, the total number of mulberry trees is more than the capacity of silkworm egg boxes actually reared. It is difficult to rely on this traditional method for more than one rearing season per year. Recently the private sector has been involved in modern sericulture activities by planting mulberry gardens and achieving four rearing seasons per year.

Silkworm rearing

Traditional sericulture

The traditional rearing method covering more than 90% of the silkworm rearing in Egypt depends on raw materials for making racks and trays. The silkworms are reared in a private

room for their care and protection. Casuarinas and cotton branches are used for mounting. Consequently, the most abundant silkworm diseases are flacherie and grasserie which cause damage to the cocoon crop. Rearers dry their cocoons under the sun.

The average yield of a cocoon crop is about 8 tins in a dry case per box (16 kg) of fresh cocoons (one tin = 20 litres = 1.25 kg). The low yields are due to the inadequate rearing conditions and poor maintenance of mulberry trees. Trials are being conducted to improve this traditional method of silkworm rearing using the simple sericulture rearing technologies.

Modern sericulture

The modern rearing methods are carried out by the SRD and the private investors who represent less than 10% of silkworm rearing by the introduced simple technology in rearing. The SRD and the private sector usually have four rearing seasons in spring, summer, early autumn and late autumn.

Average yield of cocoons per box is about 10 tins of dry cocoons (20 kg of fresh cocoons). The local production is 12–13 tons of fresh cocoons.

Marketing

In spite of the limited production of cocoons, marketing of dried cocoons represents the main constraint facing the expansion of sericulture.

These are the reasons:

- There is no convenient system for cocoon marketing
- There is stiff competition between (the price of) imported and locally produced cocoons and raw silk
- The average of cocoon production per silkworm egg box is still not satisfactory despite the efforts of the SRD staff
- By establishing the multi-end reeling machine, the marketing problem has been partially solved
- A new system for cocoon grading and marketing has been adopted by the SRD according to the number of cocoons per litre by using three grades of classification.

Major problems

- Non-replacement of the destroyed mulberry trees for expanding traditional sericulture
- Shortage of land/fields for introducing modern sericulture activities
- Inadequate cocoon production (Farmers are small-scale family units that are unable to rear large quantities and get high incomes)
- The youth do not take part in cocoon production and this is an obstacle for increasing cocoon production
- Lack of adaptive modern technology, appropriate facilities and equipment for silkworm rearing
- Inadequate governmental, technical and financial support
- Absence of well-organised state, cooperative or private mechanisms for the absorption and processing of the produced cocoons
- Lack of grainage facilities
- Lack of adequate training and extension services
- Lack of policy for sericulture industry
- Lack of strong cooperation from international organisations
- Lack of ways and means of accessing potential markets.

Projects

The SRD is conducting a big project for promoting sericulture activities in Egypt for three years (2003–2006) focusing on unemployed newly graduated youth in two governorates. Activities include mulberry plantation, young and grown silkworm rearing, cocoon marketing, post cocoon processing and weaving.

Major achievements

- Mulberry gene bank including 45 mulberry varieties
- Different types of high yielding mulberry farms
- Silkworm disease protection strategies (disinfectants)
- Mulberry fields in the desert, irrigated by primary treated sewage water
- Different types of rearing houses for different instars
- Production of silk filaments with different denier using the multi-end machine.

Conclusion

Because of the high unemployment rates of the rural areas in Egypt's economic structure, sericulture forms a suitable option. Sericulture has an enormous potential as a source of income. The basic conditions, potential and demand for prosperous sericulture are presented. If the constraints mentioned above are addressed through long-term programmes, sericulture will grow rapidly in Egypt and provide steady income to the farmers.

VALUE ADDITION THROUGH TEXTILE DESIGN: KEY TO CREATING MARKET DEMAND FOR SILK IN AFRICA

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Abstract: Much of Africa has a long history of weaving or working with silk in textiles. Currently, the supply of wild and cultivated African silk, spun or reeled, is limited. If textiles in Africa are to incorporate silk or to be woven with silk, then this supply issue, as well as the issue of reliable, affordable silk must be addressed. The design elements available in Africa are limitless. There are many logical ways to approach, harnessing these elements and creating unique fabrics. Handwoven textiles in particular lend themselves to the design elements unique to Africa. By targeting the high end market and producing quality original handloomed pieces in silk with designs inspired by the spirit of Africa, much value can be added to silk.

Silk weaving traditions in Africa

Many countries in Africa have long traditions in working or weaving with silk. Madagascar, a country with a long tradition of cloth weaving, has a culture where silk cloth is integral to its customs and daily life. Lambas are used as wraps for warmth and are woven from handspun wild silk. There are records from the fourth century AD that imported silk cloth was unravelled and used in weaving in Ethiopia. These fibres were used for cloth for royalty and religious ceremonies. Ethiopia continues with its silk weaving, expanding its market to pillows and fine handwoven articles for interiors and clothing. Egypt has its own tradition with silk, beginning with silk embroidery on linen, dating back to the thirteenth–fifteenth centuries. Fine silk embroideries are found in exquisite linens from the sixteen–eighteenth centuries in other Northern African countries. Geometric designs dominate the designs from Northern Africa. West Africa is known for its unique cotton or wool cloths, and for its diverse surface designs on woven cloth. In particular, Ghana and neighbouring countries are known for their traditional strip weavings known as kente or ewe cloth, which are sometimes woven in silk. Silk embroidery on Nigerian clothing is reserved for the elite. Many of the traditional cotton or wool cloths have or can be adapted to silk [1].

Silk supply and needs

Before going further into potential of adding value to silk through the production of textiles and textile designs, the implementation of everything beyond this point is contingent upon the availability and affordability of reliable, consistently high quality threads. I cannot stress enough the need for high quality threads for the weaver and fibre artist. A bottleneck in the entire chain of production to marketing of silk products is created if the production of threads falters substantially in quantity or quality. If the weavers/handworkers in silk cannot get their supply, they cannot complete their orders. What follows will be a decline in reliance on the local silk thread and possibly even a withdrawal from buying local silk. The necessary silk fibres for the weavers and artists must be reliably available if there is to be a demand created for these fibres.

Common techniques used to create unique textiles

There are many avenues of approach to add value to silk through textiles. The following are four common techniques. Needlework is used all over Africa for anything from clothing to

home furnishings to ceremonial textiles. Surface designs on completed fabric include dyes, prints, resists, discharges and more. West Africa in particular, is known for its excellence in this field. Surface designs can also be applied to the warp or threads under tension on the loom, prior to weaving of the cloth. Three dimensional effects can be created through piecework with completed fabrics or through thread and weaving choices. Weaving itself is a great way to create unique textiles. Any of the first three techniques can be applied to a uniquely woven fabric and therefore a totally original piece is created. The majority of these techniques can be done in silk.

Design elements in weaving and the potential of weavers in Africa to capitalise on this uniqueness

Design is an entire multi day workshop in itself. I will illustrate just a few of them to give you an idea of the potential available. Design techniques can be applied either while weaving and/or after the cloth is woven. All elements can be applied to handwoven textiles.

Traditional patterns/drawings

Applying patterns, pictures, or designs on fabric is a long tradition in many African nations. Some areas of Africa do not have strong cloth weaving traditions, but are areas rich in the use of designs and patterns that are applied to the body, animal skins, bark cloth and other materials.

Geometric shapes

Geometric patterns are found not only on cloth, but in other fibres where weaving is done such as sisal, pandanas, raffia and banana fibres. They are also used in body art. Geometric patterns easily lend themselves to weaving.

Realistic shapes

Surface designs and weaving techniques, especially those which involve weft manipulation like tapestry and inlay, lend themselves to pictorial pieces.

Freeform or asymmetrical designs

Freeform designs are often the signature of African pieces and are particularly known from West Africa. Surface techniques, needlework and fibre manipulation techniques during weaving all lend themselves to this form of expression.

Ratios

Inserting colour or texture variations in the form of stripes of varying widths creates variable effects. Stripes can be inserted in arithmetic or geometric progressions or a wealth of other progressions. The possibilities are endless.

Music and words

Codes can be formed to translate a music score or words into weaving drafts. Again, this area of expansion is limitless.

Colour

This is another huge area in design. Colour can be applied to the entire length of warp or weft, or parts of warp or weft, or applied later as a surface design or in needlework.

Inspirations from events in culture or nature

This area of design often requires more insights into your environment. One can observe, for example, the dancing of a traditional Maasai group, noticing their movements and the colours worn by them. The resulting piece should reflect both the action observed and the colours worn. In observing nature, careful observation will result in the inclusion of colours and their proportions in the final piece. This attention to detail will make all the difference in determining if the final piece is merely attractive or is compelling.

Weaving

Thread choice

The choices to the weaver for thread type are multiple. One needs to select thread from thick to thin, bumpy or smooth, glossy or not, multi-strand or single ply, highly twisted or slightly twisted, degummed or not, and variations between and beyond these. Choices to include non-silk threads such as cotton also need to be made. All choices determine the outcome of the final woven product, depending on the amount of threads used and in what drafts.

Weaving draft

This is the actual weave structure of the cloth, determined by how the loom is threaded and the weft or threads not under loom tension, are inserted. Original patterns can be created, found in books, or on Internet sites. The options here are also tremendous.

Major advantages of silk handwoven materials and silk textiles in Africa

Products are unique

With hand made pieces, styles can be easily diversified. Thread and technique variations are more easily implemented with handwovens than in automated factories.

Africa is filled with inspirational material

This continent emits energy in terms of inspiration from nature and rich cultural heritage and traditions. Designers must tap into these resources. Colour, design elements and styles of textiles must reflect the diversity and creativity of Africa. Africa as a whole has inspired the rest of the art world for centuries, and each region of Africa holds its own unique art. I believe this spirit can be expressed with woven silk and other silk textiles. If value addition through textile design is to be a key to creating a market demand for silk in Africa, designers and producers must be on the look-out for new ideas and inspirations, and ways to approach their textiles. They must be willing to stretch themselves a bit beyond their comfort zone and step towards the unknown in their designs. They will need to lay new ground. I would love to see Africans embrace their potential and run with it.

Conclusions

- There must first be a reliable, consistent supply of silk threads in the quality and quantity desired, at affordable prices, if African textiles with silk are to be competitive in the market. The product produced must sell for more than the sum of the parts. There is a need for coalitions with the private business sector and the scientific community to overcome bottlenecks in production of thread. The quality, quantity, and price of reeled and spun silk will be major factors in attracting artisans, weavers and other producers in making products from silk.
- Working with silk requires care and attention. Workers must be trained, supervised, and urged to improve their skills.
- I see the potential for silk textiles in Africa going to the specialty or higher end niche markets. I cannot see Africa competing with China and India on the commercial silk textile market. At the same time, products must be within the price range of those at the higher end are willing to pay. One should consider markets in Africa as well as overseas.
- To effectively compete in the specialty market, the quality of all materials, from threads to the completed product, must be consistently excellent. There must be quality control.
- Reproducibility is mandatory if pieces are more than one-of-a-kind works of art. Records are a must and they must be used.
- The edge in the market is also dependent on new designs. Copying someone else's work is a real problem. Creation of new designs is essential if any group is to succeed.

Reference

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PRESENT STATUS OF SERICULTURE IN GHANA AND ITS PROSPECTS FOR INTEGRATION IN IFAD PROJECTS

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Abstract: Sericulture is an agricultural-based self-employing rural industry with enormous potential for generating employment and improving socio-economic conditions of rural people. Sericulture is an important tool for poverty alleviation, rural development and environmental replenishment. It therefore fits into the socio-economic structure of rural Ghana. Sericulture and the silk industry was introduced into Ghana in 1992 through the initiative of the author of this paper. He founded the Sericulture Promotion and Development Association, with an objective of introducing, developing and promoting sericulture and the silk industry in Ghana. The Association has successfully introduced sericulture into the country. Only bivoltine silkworm rearing is done. Silkworm rearing is done five times in a year (i.e. April, June, August, October and December). Silkworm eggs consumption is between 50 and 100 boxes per rearing season. Average yield per box is 20 kg.

In April 2002, the Director General of the FAO of the UN approved the project—TCP/GHA 2802 (A)—Sericulture and Silk Processing Development in Ghana with an overall objective of assisting small-scale farmers in cocoon and raw silk production through provision of basic techniques and essential equipment and tools for silkworm rearing and cocoon processing, while making additional income opportunities available to them. The Sericulture Promotion and Development Association, Ghana is venturing into non-mulberry silkworm rearing, i.e. ericulture. Ericulture is the rearing of a special breed of silkworms (*Philosomia ricini*) on leaves of host plants like cassava, castor and pawpaw. In January/February 2006, this author, with the assistance of some members of the Association, successfully hatched eri silkworm eggs brought from India and reared the worms on cassava leaves, producing good quality cocoons of international standard. The feed base for eri-silkworms is in abundance in the country. There is, therefore, scope for the development of ericulture in Ghana.

Like all new countries in the sericulture industry, Ghana is confronted with a number of problems including lack of high yielding and drought resistant mulberry varieties, irregular supply of silkworm eggs, lack of extension and research support and lack of adequate governmental support. IFAD has been operating in Ghana since 1980 and has since financed 13 projects and programmes. Four such programmes and projects are ongoing. They are Rural Enterprises Project-Phase II, Northern Region Poverty Reduction Programme, Rural Financial Services Project, and Root and Tuber Improvement and Marketing Programme. These programmes and projects are designed to alleviate poverty and foster economic development. There is the potential of incorporating sericultural activities into these IFAD sponsored ongoing programmes and projects in the country.

Introduction

Ghana is 672 kilometres long and 563 kilometres wide with a total area of 239,460 km². The country lies just north of the Equator and the Greenwich Meridian passes through it.

Ghana comprises 10 regions and 138 districts with a population of 20 million. Population density is 77 persons/km² with the majority of people living in the southern districts. About 75% of the population is rural.

Agriculture is the mainstay of the Ghanaian economy. The agricultural sector supports about 70% of the total population economically through farming, distribution of farm produce and provision of other agricultural related services. It accounts for over 42% of

GDP and, therefore, significantly affects the rest of the economy. Throughout the country, rainfall is the principal determinant of cultivation.

The country is one of the most favoured countries in Africa in terms of rainfall, temperature, humidity, sunshine and soils for mulberry cultivation and the rearing of silkworms. Unemployment and underemployment are some of the major problems facing the country. Labour is, therefore, available for sericulture activities since sericulture is a labour intensive industry. The country has good potential for sericulture and the silk industry, which could open up existing possibilities for the diversification of the country's agriculture, industry and export base.

Sericulture

Sericulture is an agroindustry and comprises four major activities to fabric, viz

- mulberry cultivation
- silkworm egg production
- silkworm rearing
- silk reeling, twisting, weaving, dyeing, spinning and fabric finishing.

Each major activity results in marketable products, which form the raw material for the next activity in the series.

Sericulture plays a unique role in the economies of countries practising the industry. Its uniqueness lies in the fact that sericulture activities not only engage the rural households in the cultivation of mulberry and in silkworm rearing, but also encompasses in their fold a whole range of reelers and weavers. Sericulture is, therefore, an industry par excellence.

Silk has grown from its traditional status and cultural bondage to a commercial venture in the past few decades. Silk, the most precious natural fibre, has its own place in the textile world. For the past 5000 years, no fabric in the world has 'conquered' this fabric that is widely recognised as the queen of textiles. In fact, this is the magic of silk.

Sericulture and the silk industry in Ghana

Sericulture was introduced into Ghana through the initiative and efforts of the author of this paper after receiving training in tropical sericulture in India. In 1992, he founded the Sericulture Promotion and Development Association, Ghana to introduce, develop and promote sericulture and the silk industry in the country. He remains the driving force behind the sericulture industry in the country.

Silkworm rearing

Bivoltine silkworm rearing is done in the country. Silkworm rearing is done five times in a year (i.e. April, June, August, October and December). There are occasions where farmers have reared worms six times in a year. For efficient rearing and making maximum use of leaves, it is recommended that farmers do an average of 4 rearings in a year.

Silkworm eggs consumption is between 50 and 100 boxes per rearing period. In April, June, August and October 100 boxes per rearing is done. During that period, there is enough moisture in the soil to support luxuriant plant growth thereby resulting in good leaf yield. In December, the dry season sets in and the soil moisture content is less and thus leaf yield is affected and as such only 50 boxes are reared during that period. Average cocoon yield is 20 kg per box. A good number of farmers have established mulberry farms but do not have the facilities for rearing silkworms. The farmers in this category are more than those doing rearing. Once these farmers are given the necessary support, the number of DFLs consumption will automatically increase.

Sericulture Promotion and Development Association, Ghana

The Sericulture Promotion and Development Association, Ghana is a non-profit company limited by guarantee and incorporated under the companies code 1963 (Act 179) by the registrar of companies in Ghana on the 27th May 1994 to introduce, develop and promote sericulture and the silk industry in the country to among others, create employment, generate income and diversify the country's agriculture, industry and export base. The Association, however, started operating in the country in the second half of 1992.

The Association, which used to have a membership of 5000, now has a membership of 1500 active farmers who have established mulberry farms, but for lack of funds to construct rearing houses and rearing equipment, are not doing any serious rearing. A small percentage of this number, doing silkworm rearing, is unable to keep the pilot cocoon and silk processing factory running properly because of the insufficient supply of cocoons to the factory. The reduction in the number of cocoon farmers is attributable to a number of factors including lack of support from the government to construct rearing houses and equipment and the fact that the cocoons produced initially (i.e. until 2004) could not be sold because there was no processing facility locally and the quantities produced were not enough for export.

Objectives of the association

The long-term objective is to establish silk production in Ghana as a rural industry creating employment opportunities for men and women and producing silk for local consumption and for export.

The medium term objective is to establish silk production in Ghana to provide raw material for the kente weaving industry in the Ashanti and Volta regions and the smock weaving industry in the three northern regions.

The short term objective is to assist members of the association to expand their activities to boost cocoon production to feed the cocoon and silk processing factory, establish a silkworm egg production facility and also provide training opportunities for others with an interest in entering the industry.

Eri-culture in Ghana

The Sericulture Promotion and Development Association, Ghana through its Founder and Technical Director is venturing into non-mulberry silkworm rearing. It has introduced ericulture, the rearing of eri silkworms (*Philosamia ricini*) on the leaves of cassava (*Manihot esculenta*) and castor (*Ricinus communis*).

After attending the twentieth triennial congress of the International Sericultural Commission in Bangalore, India in December 2005, the Technical Director travelled to Hyderabad where he had exposure to ericulture (the rearing of a special breed of silkworms which feed on the leaves of cassava and other plant species).

He returned to Ghana in January 2006 with a quantity of eri silkworm eggs which he hatched and successfully reared with the assistance of some of the Association members and produced good quality cocoons of international standards.

Cassava is an important food crop in Ghana. It is grown in all the 10 regions of the country. The Government of the Republic of Ghana has launched a special initiative on cassava with the aim of processing the tubers into starch for export. A large hectareage of cassava has been cultivated under the programme but after harvesting the tubers not much is done with the leaves.

The ericulture initiative will enable the cassava farmers to make additional income from the cassava leaves which otherwise would have gone to waste. Castor, another host plant

whose leaves are fed to eri silkworms grows widely in the country. Pawpaw, also a host plant for eri silkworms, is cultivated for local consumption and export. Other plants can be fed to eri silkworms. The feed base for eri silkworm rearing in the country is in abundance. There is, therefore, scope for the development of ericulture in Ghana.

The Food and Agriculture Organization (FAO) and sericulture development in Ghana

In 1997, the Sericulture Promotion and Development Association, Ghana started lobbying the Government of Ghana through the Ministry of Food and Agriculture (MOFA) for technical assistance to develop and promote sericulture and the silk industry in the country.

In 2000, the Association, with technical assistance from Prof. Raina of *icipe* assisted MOFA to prepare and submit a proposal on sericulture development in Ghana to FAO for funding.

In April, 2002, the Director-General of the FAO approved the project—TCP/GHA 2802(A)—Sericulture and Silk Processing Development in Ghana and allocated US\$ 384,000 to finance it. Among others, the amount covered the purchase and installation of cocoon and silk processing machinery and the services of the international partnership programme consultants specialised in cocoon production, cocoon and silk processing as well as a national consultant and FAO technical backstopping services.

The overall objective of the project is to assist small-scale farmers in cocoon and raw silk production through provision of basic techniques and essential equipment and tools for silkworm rearing and cocoon processing, while making additional income opportunities available to them.

Immediate objectives were:

- Strengthening institutional capacity of the Council for Scientific and Industrial Research (CSIR) in sericulture science and management skills in cocoon production, and processing of cocoon to silk products
- Improving training and extension networks for transfer of techniques and dissemination of information for production of cocoons and silk fabric
- Introduction of new skills and methods to small-scale farmers for production of cocoons for raw silk, silk yarn and silk fabrics production.

The assistance, especially the installation of the cocoon and silk processing machinery, marked a turning point and a significant landmark in the history of the sericulture industry in Ghana, in that it salvaged the industry from eminent collapse and gave it a major push into sustenance. The TCP has brought a lot of relief to sericulture farmers because now they know where to sell their cocoons. Small-scale farmers and officials of relevant government institutions have been trained in cocoon production to enable them increase cocoon productivity.

Engineers and technicians of the Institute of Industrial Research of CSIR and members of the Sericulture Promotion and Development Association have also been trained in the operation and maintenance of the cocoon and silk processing machinery.

With the establishment of the factory, farmers are now encouraged to go into cocoon production because they are now assured of a ready market at the factory for their produce. The FAO's Technical Cooperation Programme (TCP) has contributed immensely to strengthening the capacities of Ghanaian research and extension institutions in sericulture and addressing some of the needs of sericulture farmers.

IFAD operations in Ghana

IFAD has been operating in Ghana since 1980 and it has since financed 13 projects and programmes.

IFAD operations in Ghana are guided by its country strategy based on a regularly updated socio-economic and poverty analysis. The strategy targets smallholders with emphasis on women and other vulnerable groups and has three main thrusts:

- Improving food security and arresting environmental degradation in the northern savanna areas
- Assisting resource poor subsistence farmers in the southern, central and western regions
- Enhancing income generating activities.

Four IFAD sponsored projects and programmes are ongoing and they are:

- Rural Enterprises Project—phase II;
- Northern Region Poverty Reduction Programme;
- Rural Finance Services Project;
- Root and Tuber Improvement and Marketing Programme.

These programmes and projects are designed to alleviate poverty and foster economic development and cover a wider geographical area.

The goal of IFAD's operations in Ghana is to enable the rural poor to improve and diversify their livelihoods in a sustainable manner.

The following are the programmes and projects objectives and goals:

1. The overall goal of the Rural Enterprises Project—Phase II is to build competitive micro- and small enterprises in rural areas in eight out of Ghana's 10 regions covering 53 districts.

The project seeks to:

- improve living conditions in rural areas
 - increase incomes of women and the vulnerable through increased self and wage employment.
2. The development goal of the Northern Region Poverty-Reduction Programme is to improve the livelihoods and living conditions of poor rural communities, with emphasis on women and vulnerable groups, through deepening and broadening of rural development services and community and individual self-help capacity. It covers all the 13 districts in the Northern Region.
 3. The Rural Financial Services Project seeks to increase the yields and incomes of small-scale farmers through access to credit, savings and other financial services. Micro-enterprises and other off-farm activities also generate income especially for women.

The goal of this project is to help the Government of Ghana broaden rural financial services and build the capacity of the financial sector to enable the rural poor to improve their incomes. The project covers the whole country.

4. The Root and Tuber Improvement and Marketing Programme's development goal is to enhance food security and incomes of poor rural households in Ghana, with special emphasis on women and other vulnerable groups.

The programme, which is nationwide, has as its objective the building up of competitive, market-based and inclusive commodity chains for roots and tubers, supported by relevant, effective and sustainable services that are accessible to the rural poor. It aims to support the emergence of both of an inclusive private sector that is deeply anchored in the realities of Ghana and of a stronger public sector capable of improving the policy and regulatory environment and delivering the required public goods.

The Ghana government's overriding goal is poverty reduction through economic growth, rural development and expansion of employment opportunities, and improved access to public services.

The government's concerns are taken care of by the IFAD funded projects in the country and are also addressed by the sericulture industry in the country. Due to its employment potential, low investment cost and high foreign exchange earning capacity, sericulture is an important factor in the economic development of many developing countries including Ghana. The sericulture industry, is therefore, an important agriculturally-based self-employed rural industry with enormous potential for generating employment, improving socio-economic conditions of rural people, and an important tool for poverty alleviation, rural development and environmental replenishment. It rightly fits into the socio-economic structure of the rural areas of the country.

The goals of the IFAD funded projects are benefits derived by individuals, communities and the country. IFAD projects and sericulture can be said to be bedfellows or Siamese twins and therefore integrating sericultural activities into IFAD projects or establishing a linkage between them will be in the right direction since they complement the efforts of each other.

In 2004, the Ghana Sericulture Association started lobbying the Rural Enterprises Project Secretariat to absorb sericulture as one of its activities since sericulture falls within the project components and there are sericulture farmers in all the districts they operate in.

The Chief Technical Advisor of the Northern Region Poverty Reduction Programme sees sericulture as having potential in the area of operation of the programme more especially as the mulberry plant is drought resistant and has the potential to fight environmental degradation (i.e. erosion, deforestation and desertification). The three Northern regions of the country are faced with severe drought and desertification. He therefore sees reason for the linkage of sericulture activities with NORPREP.

The Roots and Tuber Improvement and Marketing Programme Coordinator was overwhelmed about the ability of sericulture to make use of cassava leaves for the economic gains for cassava farmers and sees marrying the two as a healthy venture.

Under the Rural Financial Services Project, sericulture farmers could be given loans to establish, expand and maintain their mulberry farms and also construct appropriate rearing houses and equipment to step up cocoon productivity.

Problems facing the sericulture industry in Ghana

The constraints/problems facing the sericulture industry in Ghana include:

- A lack of high yielding and drought resistant mulberry varieties. Assistance is therefore needed to establish a mulberry germplasm to be able to select the varieties suitable under the agroclimatic conditions in the country.
- The major problem facing sericulture farmers is that of regular silkworm eggs supply. There is no systematic silkworm eggs supply programme. Assistance is therefore needed to order eggs in the short to medium term and to establish a silkworm egg production facility in the long term to produce eggs locally at cheaper and affordable prices to farmers.
- Inadequate and poor infrastructural facilities like rearing houses and rearing equipment especially mountages. Farmers need to be resourced to enable them construct good and appropriate rearing houses and equipment and also establish, expand and maintain their mulberry farms.
- Lack of extension and research support for the industry. The Technical Director is over-burdened with extension and research activities. He is the only source of technical information on sericulture in the country. He therefore needs more training to keep him abreast with new technological developments in the industry since the sericulture industry is dynamic.

- Lack of transport for visiting farmers to give them technical assistance and to distribute eggs and collect cocoons from them. This has always been a source of worry to the Association. The FAO has withdrawn the vehicle it provided for use during the TCP period. The Association therefore needs means of transport.
- Cocoon farmers need more training in cocoon production to enable them produce better quality cocoons and also increase cocoon yield per box of silkworm eggs.
- The factory staff need further training in the running and maintenance of the cocoon and silk processing machinery. They only received a one-week training from the cocoon and silk processing consultants under the TCP, which is woefully inadequate.
- Lack of adequate governmental support (technical and financial), and of a short/medium/long term sericulture development strategy as well as trained manpower for the establishment of essential institutions that will promote effective research and development activities.
- Lack of training and regular continuing professional education to empower the leaders of the sericulture industry with practical and intellectual tools.

The way forward for the sericulture industry in Ghana

The sericulture industry in Ghana doubtlessly has enormous potential and scope for development.

Farmers' interest in sericulture has heightened with the construction of the cocoon and silk processing factory. When farmers are given the necessary support, cocoon productivity will increase resulting in over production because the existing factory has a capacity of only 50 kg of cocoons per shift of 8 hours and it will not be able to process all the cocoons envisaged.

Some farmers from Nigeria, Burkina Faso, Niger, Senegal and the Gambia who attended a workshop in Ghana have been sensitised on the sericulture industry and mulberry planting materials from Ghana were supplied to them. The farmers have reported that the plants are thriving in their respective countries and they are looking to Ghana to buy their cocoons when they start cocoon production until such time that they are able to establish processing factories.

With this in mind, the Association is planning and looking for assistance to establish another factory with a bigger capacity in the middle belt (i.e. Ashanti region) where the bulk of kente weavers are located to absorb the excess cocoons that will be produced. An alternative is to set up small-scale reeling units in the cocoon production areas to process cocoons into yarns to supply to the kente weavers and the silk processing factory for processing into silk fabric.

The Association will intensify its educational programme to get more farmers on board to produce enough cocoons to feed the second factory. One of the future plans of the Association is to produce silkworm eggs locally, and the Association is collaborating with the Animal Research Institute of the Council for Scientific and Industrial Research (CSIR) to achieve this objective.

The Association is looking at ways and means of incorporating silk handicrafts into its activities to diversify sericulture products from the country. The handicrafts cottage industry is an ancient industry in Ghana. Integrating the sericulture industry into it will lead to the production of unique silk handicrafts, which will find ready market locally and internationally. After all, one of the objectives of the Sericulture Association is to use sericulture and the silk industry to diversify the country's cottage industry and export base.

The Association will explore the possibility of establishing linkages with the ongoing IFAD loan programmes and projects like the Rural Enterprises Project, the Northern Region Poverty Reduction Programme, the Root and Tuber Improvement and Marketing Programme and the Rural Financial Services Project. Sericulture rightly fits into these projects.

Conclusion

The sericulture industry has a lot of potential in Ghana for a number of reasons, which include:

- Availability of labour. About 30% of the youth between the ages of 15 and 35 years are either unemployed or underemployed. The government has embarked on a national youth and job creation programme and sericulture is being lobbied to make it a component of the programme.
- Availability of arable land and water for irrigation.
- Good climate conditions (rainfall, temperature, humidity and sunshine) for the sericulture industry.
- Silk yarn has a ready local market in the cocoon and silk processing factory and kente weaving industry.

The prospects for the integration of sericulture activities into IFAD projects are quite high. The initial groundwork has already been made with the contact persons of these projects.

If the linkages are established, the rural poor, women and other vulnerable groups whose interests IFAD projects and the sericulture industry are serving will benefit and the economy of the country will improve.

IMPACT OF IFAD PROJECTS IN SOUTH KORDOFAN ON INCOME GENERATION ACTIVITIES: BEEKEEPING

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Abstract: The South Kordofan Rural Development Programme (SKRDP) is funded by IFAD and executed under implementation and subsidiary with the South Kordofan State Ministry of Agriculture. The overall goal of this programme is to improve and sustain the living standards of the smallholder farming and pastoralist households. South Kordofan has an environment suitable for beekeeping. The dominating practice is honey hunting, but traditional beekeeping with log hives has been in existence for a long time in some areas. Several constraints face the beekeeping industry.

Introduction

The South Kordofan Rural Development Programme (SKRDP) is funded by IFAD and executed under implementation and subsidiary with the South Kordofan State Ministry of Agriculture. The overall goal of this programme is to improve and sustain the living standard of the smallholder farming and pastoralist households including those headed by women in the programme area by assuring their food security and providing them with social services and a secure environment where they can manage their community affairs.

Beekeeping, as an income generation activity, was not included in the first phase of the programme. However, in the second phase, beekeeping emerged as a priority need for some communities. As a result, two extension officers were trained in beekeeping.

Status of beekeeping in South Kordofan

South Kordofan lies in Savanna Region and most of the southern parts are covered by dense *Acacia* and broad-leaved tree forests, grasses and herbs. This environment makes the area suitable for honeybees. The dominating practice in this area is honey hunting during the dry season where honey hunters collect large quantities of honey and wax. Also, the traditional beekeepers with log hives are found in some areas. The latter have a better chance of harvesting honey during the two honey seasons (Sept.–Oct. and Feb.–Mar.). *Zizyphius* spp. and *Acacia seyal* trees are the major honey sources in the area, although other good honey sources (trees and herbs) exist.

Modern beekeeping is lacking in South Kordofan State. In 1995, the author of this paper established an apiary in Kadugli area. Langstroth, Kenya top-bar and loghives were used. All hive types used were well accepted by the bee swarms and produced good quantities of honey.

Beekeepers in the area earn a good income and beekeeping is considered to be the best activity compared to traditional farming and livestock keeping.

Beekeeping projects in South Kordofan

After the ceasefire and the end of security problems, NGOs working in the area introduced beekeeping as an income generation activity in their programmes. In 2006, Save the Children of the United States of America (SC-USA) in South Kordofan region (funded with US\$ 20,000) had executed a beekeeping project with the coordination of the University of Dilling. Eighty traditional beekeepers and honey hunters were trained in basic beekeeping,

namely honey and beeswax production. Each trainee was provided with two Kenya top-bar hives, a bee suit and the essential equipment.

Major constraints to beekeeping in South Kordofan

- Lack of knowledge about beekeeping
- The high aggressiveness of bee colonies has subjected them to destruction and burning by honey collectors
- Seasonal forest fires during the dry season destroy thousands of wild bee colonies and nectar sources
- Lack of training for beekeepers
- Unavailability of beekeeping equipment and modern hives and their high costs
- Absence of honey producers' associations subjects the honey trade to middlemen who are the actual beneficiaries of honey trading, leading to weak marketing channels not in favour of the producer.

LA SITUATION ACTUELLE DE LA SERICICULTURE AU RWANDA

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Résumé: Le Rwanda est un pays dont l'économie repose sur l'agriculture. Le café et le thé constituent la principale source de revenus au paysan. La promotion des cultures génératrices de revenus dont la sériciculture serait un moyen d'améliorer le niveau de vie du paysan qui reste encore très bas. En effet, les conditions climatiques et édaphiques du Rwanda sont propices à la culture des mûriers et à l'élevage du vers à soie. La sériciculture ne demande pas beaucoup d'investissement et le pays dispose de la main d'oeuvre suffisante pour mettre en action toutes les activités y relatives.

Introduction

Le Rwanda est un petit pays situé au centre de l'Afrique avec 26.338 km² pour une population de plus de 8.000.000. La majorité de sa population (95%) vit de l'agriculture.

Les principales cultures sont: le bananier, le haricot, la patate douce, la pomme de terre, le manioc, le maïs, le café, le blé, le soja, le petit pois et le thé. Le café et le thé constituent la principale source de revenu des paysans. La majorité de la population (60%) vivent en dessous du seuil de pauvreté.

Dans le cadre de faire face à ce problème plusieurs mesures ont été prises notamment la promotion des cultures de rente dont la sériciculture. Cette dernière a été initiée pour la première fois en 2001 à l'Institut des Sciences Agronomiques du Rwanda avec la culture des mûriers en commençant par la collection des variétés locales. C'est en 2004 que les variétés exotiques ont été introduites.

En cette même année, un essai de l'élevage du vers à soie (*Bombyx mori*) a été réalisé avec succès.

Objectif

- Faire la sériciculture la principale activité, génératrice de revenu pour les paysans
- Préservation de l'environnement par le biais de la moriculture.

Réalisations

Depuis l'initiation de la sériciculture au Rwanda en 2001, les activités suivantes ont été réalisées:

1. Collection et multiplication des variétés locales.
Une prospection a eu lieu dans tout le pays et trois variétés ont été identifiées.
Il s'agit de *Morus alba*, *Morus nigra* et *Morus indica*.
Après leur plantation nous avons constaté qu'elles semblent toutes résistantes aux maladies mais qu'elles présentent une faible productivité suite à leur petite surface foliaire.
2. Introduction des variétés exotiques.
Six variétés en provenance de *icipe*, Kenya ont été introduites.

Ces variétés sont:

- Kanva-2
- Thika
- Thailand
- S41

- S36
- Embu.

Toutes ces variétés se comportent bien mais Kanva-2 s'est montrée plus performante même si elle est sensible aux différentes maladies.

Cinq autres variétés en provenance du Corée du Sud sont aussi en experimentation.

Actuellement, dans tout le pays on compte douze (12) ha de mûriers dont 2 à l'ISAR et 10 autres réparties dans les quatres provinces du pays sous la supervision du Ministère de l'Agriculture.

Contraintes

La sériciculture étant nouvelle au Rwanda, elle rencontre pas mal de contraintes entre autres le manque de sensibilisation et de connaissances pratiques, le manque de fonds ainsi que les doutes sur le marché.

Conclusion et perspectives

D'après l'expérience déjà acquise, les conditions climatiques et édaphiques du Rwanda sont favorables à la sériciculture.

Economiquement, la sériciculture ne demande pas beaucoup d'investissement d'où la faisabilité par les fermiers Rwandais.

La grande main d'oeuvre disponible au Rwanda pourrait être utilisée.

Vu l'intérêt de l'élevage du vers à soie, les mesures adéquates doivent être entreprises au Rwanda:

- La sensibilisation des fermiers par le canal des autorités administratives
- La mobilisation des fonds pour la culture des mûriers et l'instauration des structures d'élevage de vers à soie ainsi que des unités de transformation de la soie.
- Consolider le programme de la sériciculture à l'ISAR et doter à ce dernier d'un laboratoire bien équipé, capable de produire les oeufs de vers à soie pour tout le pays, d'identifier les maladies et de contrôler la qualité de la soie
- Une enquête de prospection doit être menée dans les savanes encore existantes afin de détecter la présence des vers à soie sauvage.

Recherche du marché et la mise en place d'un point de vente (marketplace).

IMPACT OF IFAD/AAMP SUPPORT PROGRAMME IN RURAL LIVELIHOODS WITH SPECIAL REFERENCE TO MICRO ENTERPRISES IN UGANDA

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Abstract: The Government of Uganda conceived and formulated development policy frames with emphasis on Poverty Eradication Action Plan (PEAP) to ensure increased farm income through increased production, productivity and competitiveness by rural small-holder farmers. AAMP is a 6-year programme funded by IFAD/AAMP/GOU to achieve the above by investigating key areas that could commercialise rural smallholder farmers. The design and implementation strategy hinges on flexible participation development management approaches through stakeholders institutions where prioritisation is made or through the three-year development plans at sub-counties.

Programme impacts in economic (income), social and capacity building of staff and farmer groups and household levels are evident. Employment opportunities and value addition and accessibility is evident. Research technologies have been disseminated and adopted widely a case of NEGICA II and Langstroth reading and queen bee technologies. Thanks go to Mr Muiru from *icipe* 2002 for his introduction of technologies in beekeeping in Uganda, the private sector and community based organisations linkages and networking have eased and improved marketing and value addition to farm products.

Participatory development processes/approaches empower the farmers with production, marketing and value addition for sustainable utilisation of resources and changing the farmers subsistence production to commercial production. Networking and collaboration with technological research and development partners ensures successful smallholder incomes growth and wealth creation investments at household and community level and value addition at marketing and agroprocessing.

Background

The Government of Uganda conceived and formulated the Poverty Eradication Action Plan (PEAP) and Plan for Modernisation of Agriculture Programme (PMA) to ensure increased farm incomes, production, productivity and competitiveness earned by smallholder farmers and hence reduce poverty.

Area Based Agricultural Modernisation Programme (AAMP) designed and funded by IFAD/ADB focuses on several key areas of investment that will commercialise agriculture.

The vision is that, at the end of the programme period (July 2002–July 2008), participating smallholder farmers and economic interest groups would have improved their livelihoods through increased production and increased yields through agricultural commercialisation will increase incomes at household level.

The goal is increased incomes among smallholder farmers in the programme area (13 districts of SW Uganda).

The mission is to facilitate an economic transformation process of smallholder subsistence farmers to commercial farmers.

The programme purpose centres on areas that cause low or poor agricultural production and productivity, poor infrastructure and accessing improved agricultural inputs and technologies, extension service delivery and poor farmer organisations and marketing issues and linkages.

The expected outputs identified by the interest groups and rural communities include:

- Increased involvement of the private sector in support of further commercialisation of smallholder agriculture
- Improved capacity among economically active farmers to organise themselves to gain better access to rural services (technical, financial and marketing)
- Improved rural infrastructure and sustainable management systems for these infrastructures
- Increased public sector capacity to perform its role in responding to production needs.

Programme design and implementation strategy

The programme has four components

- Agricultural commercialisation involving:
 - Business development and improved market linkages
 - Technical identification and support to farming enterprises
 - Capacity building
 - Rural financial services training.
- Community mobilisation involving:
 - Skills development
 - Stakeholder mobilisation
 - Institution development.
- Rural infrastructure development involving:
 - Rehabilitation of rural feeder roads
 - Infrastructure developments, e.g. community roads, livestock water supply, livestock disease control structures, markets and storage facilities
 - Infrastructure development training facilities.
- Programme facilitation involving:
 - Support to district and sub-counties in use and management of funds
 - Capacity building.

The programme implementation is done by the public sector through production, community development and works technical staff. They liaise with administrative and farmer institutions to mobilise, sensitise, identify, prioritise, plan, implement, supervise, monitor and evaluate the programme activities in their areas of jurisdiction. The participatory development management approaches are the cornerstone for programme implementation and allow flexible innovative initiatives. These have greatly impacted on livelihoods of smallholder farmers' attitudes and production and yields to commercialise agriculture. Poverty analysis, household income and expenditure analysis and gross margin analysis of all micro farm enterprises to select most profitable enterprises in every sub-county were done (based on land holding, size per household, population density, technology available, marketability, profitability, mass production, climate, soil conditions, availability of infrastructure, potential for high value addition, local production skills, knowledge, availability of service providers, public and private sector partnerships, potential for specialisation, export potential, resources availability, revolving support, demonstrations, trials and exposure tours/shows field days) and have increased adaptability.

Under agriculture commercialisation, the programme operates a revolving fund to support smallholder agricultural enterprise development through farmer groups in form of packaged technologies (seed/breed stock) and other inputs which have to be recovered for further support to new groups. To date the programme has supported over 1980 groups and 330 have benefited from recoveries.

The major enterprises are shown in Table 1.

Impact of AAMP support programme in rural livelihoods

The programme has registered remarkable impact on these interrelated areas:

- Attitude change from subsistence to commercial farming through orientation of demand-driven service of participatory planning in commercial farm production (gross margin analysis) and the improved and high yielding technologies introduced, skills, knowledge and practices of these profitable enterprises. Fifteen (15%) of the groups have undergone log frame approach trainings and they are seasonally reviewed to make action plans for their groups. At household level, the farmers have developed the same plans using the LFA planning tool. Mobilisation through drama village meetings and radio talk shows has good mobilisation effect in rural communities. The capacity building trainings of groups in leadership and group dynamics, proposal writing, LFAs and exposure visits have empowered farmers as trainers to the local communities. The same groups have evolved into marketing associations and into savings and credit co-operative organisations (SACCOs) in Ntungamo (Kigarama banana group) and in Kabarole (Kakoga rice group) districts. These new SACCOs have enabled rural communities to access financial services in their localities. This is a result of increased incomes from their prioritised enterprises. They are benefiting from the programme trainings in the SACCOs. Leadership exposed to democracy, accountability and transparency have become Local Government leaders (a case of Chairman LC.III of Kitagata sub-county).
- As a result of training, introduction of new technologies, plus support of high income generating farm enterprises, farm production and productivity have increased and are translating into improved household incomes and better planned livelihoods for participating smallholder farmers in the programme areas.
- These have enabled farmers demand for rural infrastructure developments like stores and value addition facilities/agroprocessors. In Kabarole, before the programme started, only 5 farmers grew rice but after successful trials, commercial production started in 2003/2004 season and now over 1500 farmers are growing it.
- Private investors have installed one large rice milling and grading plant in Fort Portal town and in other rice growing districts of Rukungiri and Kanungu.
- Rice now has become a major cash crop and one with highest gross margin/net income for smallholder farmers. Wet processing equipment for coffee enables smallholder farmers more than double their farmgate incomes. Irrigation technologies for dry season farming have enabled farmers get a steady income (a case of Mubuku Irrigation Scheme in Kasese and use of the treadle pump on streams).

Linked to the rehabilitated feeder and community roads, farmgate prices have increased due to accessibility by traders and linkages to better markets (A case of improved banana farmgate prices from Ugshs 1500 to 4000 per bunch in Kabarole as a result of accessibility).

Table 1. Smallholder agricultural enterprise development

Enterprises	No. of groups
Goat improvement	552
Apiary	371
Pig production	287
Irish potato production	161
Upland rice	148
Vanilla	67
Coffee	43
Dairy cattle	38
Pineapples	28
Fish farming	27
Passion fruits	29
Horticulture	20
Banana	16
Others	103

Source: Report by PFT May 2006, MOLG.

- Higher adoption rates of commercial enterprises of high incomes is an impact through exposure tours, shows and market linkages for sustainability. Market information collection, analysis and dissemination has enlightened the farmers.
- The popularisation of Langstroth beehives to farmer groups and linking them to processors and packaging NGOs have increased their production levels of harvest from 10–18 kg per harvest using KTB to 30–40 kg per harvest using Langstroth. At household level a good number of farmers have improved their livelihood. This is indicated by better permanent houses, children being sent to good schools, accumulation of household assets, better household nutrition status and health services accessibility.
- Extension staff of the Production and Community Development have been facilitated, trained and exposed in the new approaches and technologies to effectively and efficiently deliver services and link with the private sector service providers.
- The training packages to farmers' groups have sustainable and cross cutting issues attended to especially in the areas of gender, HIV/AIDS, environmental concerns related to new technologies, human rights as well as obligations and natural resource utilisations and management. The majority of the farmers group members are women.
- On sustainability, the revolving fund support has been adopted by other programmes and the farmer institutions (farmer fora and farmer groups) have been strengthened and plans developed, reviewed and linked to other services like SACCOs, input dealers, processors and buyers. (The production groups formed marketing associations then saving groups [SACCOs] and the investment has initiated sustainable mechanisms to improve livelihoods.)

Implementation constraints

- As adoption increases and more groups are formed, follow-ups and technical guidance are constrained especially on new technologies.
- The recovery of some enterprises is slow as some take long to get to commercial production.
- Trials of apples and mangoes take time to fruit otherwise they have potential to increase incomes where they have been tried.

Successful approaches and lessons learned

- Programme design and implementation strategy utilises PMA frameworks and flexible approaches of project identification, prioritisation, support of technologies, skills, knowledge and information that promote agricultural commercialisation through high value, high production and productivity linked to market demand
- To commercialise agriculture other key players and investments are required to enhance sustainable development in rural areas
- Data analysis on household and community incomes and expenditure patterns are necessary tools to change farmers' attitudes towards commercial farming
- Technical guidance, follow-ups, supervision, monitoring and evaluation of each intervention is necessary to capture impacts at all levels
- Farmer empowerment; identification and diffusion of technologies and approaches enhance self-esteem, confidence sustainability and planned use of hard earned incomes
- The identified marketable enterprises attracted agroprocessors and other input dealers (a case of rice and market linkages, infrastructure developments)
- LFA trainings have changed attitudes of farmers from subsistence to commercial
- Some technologies require more case studies before introduction though they may be appropriate, e.g. animal traction, apriary development and skills development.

Conclusion

- Successful approaches, technologies and lessons learned should be replicated to benefit more farmers to enhance farmer empowerment
- Link farmers to agroprocessors and markets so that the chain is sustainable and savings culture adopted through use of SACCOs
- Intensify on exchange visits, field days, participation in agricultural shows and training to promote commercial production
- Strengthen farmer institutions (groups, farmer fora, SACCOs, marketing associations) to ensure sustainability
- Enhance adoption and recovery of inputs, follow-ups and emerging issues
- The IFAD/AAMP support has had lasting impact on rural livelihoods through earning higher incomes from their products.

PREMIUM MARKET ACCESS THROUGH ORGANIC CERTIFICATION

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Abstract: Organic premiums in the international market include organic standards non-physical value addition. Organic standards offer a template for quality, independently verified traceability system, independently verified production and management system, monitoring from soil and seed to finished product, attracts premium prices in export markets and attracts higher demand in a competitive market.

What is the premium market looking for?

The premium market is looking for:

- Clean, wholesome, unadulterated food.
- Ethical and accountable products. The 'feel good factor!' Icons in the marketplace are 'organic', 'fair-trade', 'sustainable'.

What are the advantages?

- Certified organic products have a competitive advantage over conventional products.
- Organic buyers willing to establish long term trading relationships.
- There is an international market growth for natural products and ingredients. Consumer demand for endorsed 'organic', 'natural', 'healthy', 'environmentally sound', 'ethical' or 'fair traded' products.
- The majority of Western buyers will now offer a premium price of up to 300% for *certified* organic products (Table 1).

Table 1. Percentage price premiums for certified organic products

Products	Typical organic premium (%)
Fruits (fresh, dried, canned)	15–20
Essential oils	0–300
Honey	30–70
Nuts and dried fruit	40–50
Tea	15–20
Coffee	20–25

Organic premiums in the international market

- Organic standards mean non-physical value addition
- Organic standards offer a template for quality
- They offer independently verified traceability system
- They offer independently verified production and management system
- Monitoring from soil and seed to finished product is possible
- They attract premium prices in export markets
- They attract higher demand in a competitive market.

Market demands a fair deal for all

Fair-trade

Fair-trade advice can be found at:

- www.EqualExchange.com/www.Traidcraft.com
- Goodness Direct—www.goodnessdirect.co.uk
- Training and auditing facility.

What are the advantages of fair trade?:

- Greater market demand
- 20–30% price premiums
- Fair-trade markets are governed by the international fair-trade standards which fix exportation controls in EU/US countries. Fair-trade Labelling Organisation (FLO) provides accredited inspections
- IFAT is the international co-ordination and regulatory body.

Several organisations promote and support the development of fair-trade, e.g.:

- Traidcraft Exchange, UK.
- Fair-Trade Assistance in the Netherlands (www.fairtrade.nl www.traidcraftplc.co.uk)
- Partner companies: Traidcraft PLC and Geba
- Fair-trade Company, i.e., info@twin.org.uk Europe/USA is a private labelling fair-trade organisation.

Evaluate for export

- Technical production and processing expertise
- Size, demand and character of the market
- Product specifications—Quality, hygiene standards, processing techniques, packaging materials guide prices
- The right trading partner
- Some Western companies are interested in developing partnership with companies in LDCs (organic and fair trade standards, cost and expertise)
- Statutory requirements and buyer specifications.

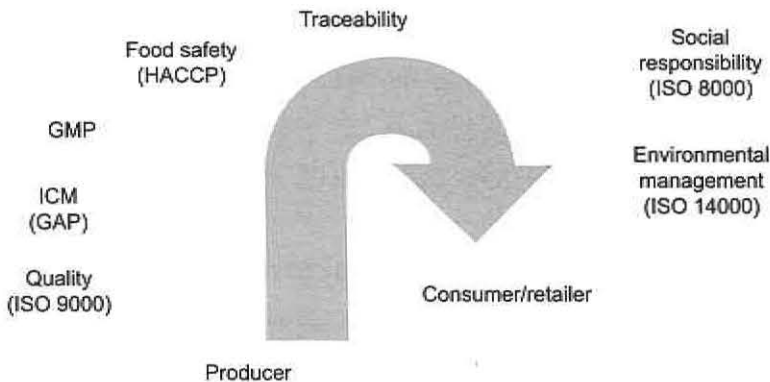


Figure 1. Evaluation of a product for export from the producer to the consumer/retailer

Organic certification

Organic certification has three components:

- Certification of the land and product
- Certification of the system
- Certification of the processing centre.

Group of nucleus farms

Each nucleus group acts as one farm unit with regard to standards. This implies very close cooperation of farmers. Farmers are not 'one' management. One ICS operator is responsible for the nucleus groups.

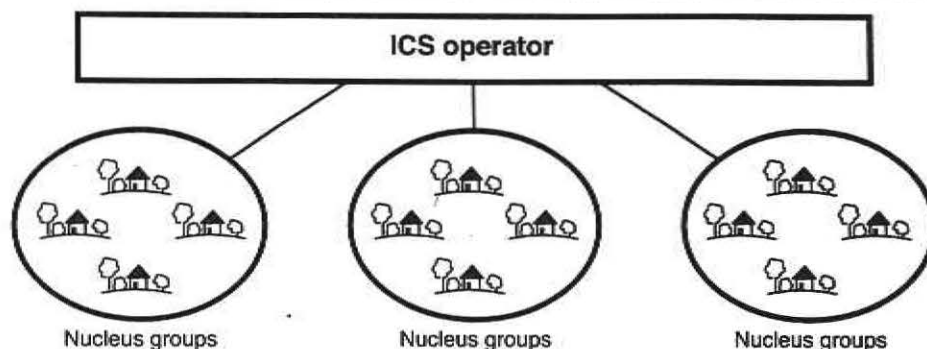


Figure 2. Several nucleus groups form one farm unit with regard to standards

Individual certification costs (ICS)

- Facilitate access to certification for small farmers
- Reduce costs of compliance for small farmers and transfer part of responsibility for compliance check to small farmers' organisations
- Build quality management capacity at small farmers organisations
- Quality assurance regarding the respective standard
- Homogeneity (location, production system, size, common marketing)
- Based on family labour
- Limited capacity in marketing, administration, communication
- Individual certification costs unbearable, individual certification costs disproportionately high
- Economic viability and administrative feasibility of the group (minimum and maximum group size).

Basic elements of the ICS

- Focus on evaluation of system, not inspection of individual farms
- First certification when basic requirements achieved and minimum 80% of the complete ICS is in place
- Risk assessment by external evaluator
- Sampling procedure for random farm re-inspection
- A documented description of the ICS, management and organisational structure (internal regulation, internal approval procedures)
- Allocation of responsibilities (one person per section), staff qualification policy
- Updated farmer list, group contract with certifier, inspection protocols, individual farm reports
- Documentation by farmer (registration, formal commitment by farmer, field records, yields, etc.)
- Risk addressing management
- Documented postharvest procedures.

Fair-trade Labelling Organisation add-ons

- Documentation of cost distribution among group members
- Financial flows and traceability
- Democratic decision making
- Use ICS as tool to help first level organisations to check second level organisations.

Examples of organic certification companies operating in southern and eastern Africa

International:

- Ecocert
- SACert
- IMO
- SGS
- KRAV(KKAB)
- SKAL
- BDOCO
- BioSwiss
- Cere
- Soil Association

National/regional:

- Afrisco (SA)
- Ugocert (Uganda)
- TanCert (Tanz)
- Encert (Kenya)
- Africert (Kenya)

Product information organic buyers need from suppliers

- Identification
- Microscopical characteristics
- Microbiological characteristics
- Level of active ingredient
- Water soluble extractive
- Percentage of foreign matter present
- Nutritional data
- Moisture content
- Ash content
- Acid insoluble ash
- Level of chemical contaminants, e.g. pesticides, heavy metals
- Toxins/aflatoxins.

What organic importers need from suppliers

- Good manufacturing practice (GMP)
- Good agricultural practice (GAP)
- ISO 9000
- HACCP
- Documented quality manual and procedures
- Relevant quality control and assurance
- Product specifications
- Safety data sheets
- Stability assurance
- Quarantine and positive release system
- Foreign body control
- Supplier audits and questionnaires
- Aseptic production areas
- Traceability.

What organic buyers need from suppliers

- Reliable quality
- Reliable quantities
- Ability to handle exportation bureaucracy and logistics
- Conformation to their conditions of supply
- Effective communication
- No over-promising!
- Traceability
- Fulfilment of all organic certification protocols
- Consistency in specification
- Clear pricing structure.



Figure 3. Getting it right from the start!

Trade barriers?

These are the trade barriers:

- Cost of production
- Infrastructure
- Statutory standards
- Entry prices
- Access to technical advice.

Jumping the entry barriers

Food products

Standards on microbial and fungal contamination, e.g. aflatoxins (overall total 5 ppb in the EU and 20 ppb in the USA), salmonella (absent in 25 g samples).

Non-food agriproducts

Registration of exporters is required by most markets, e.g. the EU, as is compliance with CITES provisions for plants imports.

Tariffs

Check tariffs for the specific markets and products. General information on access to the EU markets is available on www.cbi.nl/accessguide and on tariffs on www.douane.nl and for the USA tariff information is on <http://dataweb.usitc.gov>.

EU tariffs and trade can be found on www.douane.nl and for the USA tariff and trade statistics information is on <http://dataweb.usitc.gov>.

Quality/Quantity

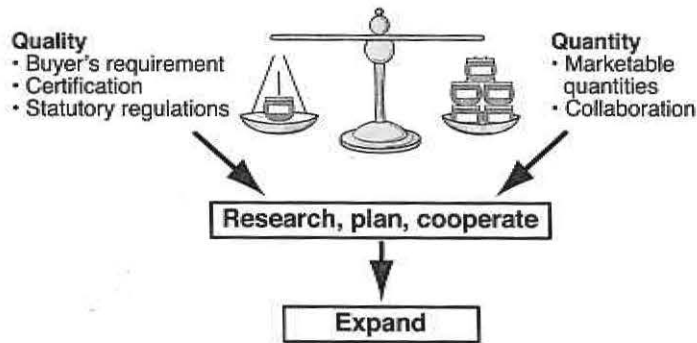


Figure 4. Product development

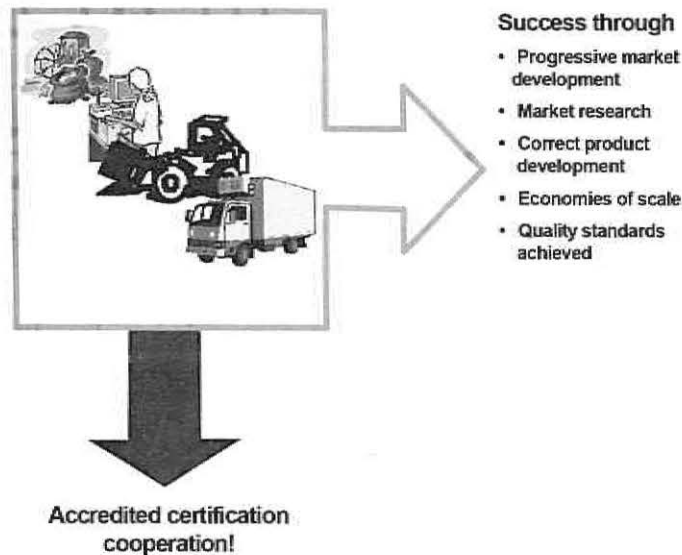


Figure 5. Achieving high value products

Credibility

- Networking
- Membership to trade associations
- Organic certification.

Summary

- Marketing from a national position
- Market awareness—The icons!
- Market penetration—Supply and quality assurance
- Shared overheads and infrastructure
- Cost of certification, trade promotion, economies of scale, marketing costs, freight costs, promotion campaigns, product development and research, etc.
- Increase high value product opportunities.

Market development support

Support agencies and financial institutions:

- Loans for trade finance
- Seed capital for producer organisation (to be developed)
- Grants for capacity building, quality improvement of producer and marketing organisations
- Grants for BDS-providers, lobby organisations and organisations involved in standards.

Aid to trade

- Initiatives operate through EU country to strengthen trade partnerships with developing countries (PSOM, CDE, PPP schemes, etc.)
- USAID Trade Development and Diversification schemes
- ACP countries are also entitled to some import tariff relief under the Lome Convention
- Green tokens.

Further information can be gained from international agencies, embassies and websites.

Financial institutions

- Ethical banking—Green banks
- Low interest loans
- Pre-harvest finance
- Micro-finance for small-scale producers (TRIDOS, Cordaid, RABOBANK).

INTÉGRATION DE L'APICULTURE ET LA SOIE SAUVAGE DANS LA CONSERVATION DE LA FORÊT ET LE DÉVELOPPEMENT RURAL DANS LE NORD CAMEROUN

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Résumé: L'élevage des abeilles dans le but de récolter le miel et ses divers dérivés est une activité en expansion au Cameroun et notamment dans sa partie septentrionale. L'Adamaoua, l'une des provinces du septentrion Camerounais est la principale zone apicole; cette région jouit d'un climat de type soudano-guinéen à température modéré, d'une végétation à savanes arbustives et arborées. On y rencontre principalement cinq groupes humains dont les activités vont de l'élevage à l'agriculture qui exercent de fortes pressions sur l'environnement. L'apiculture généralement considéré comme activité secondaire a une production annuelle de l'ordre de 200 à 450 milles litres par an est non négligeable et occupe une place de choix dans l'amélioration du revenu familiale en milieu rural. Elle bénéficie des atouts tels qu'un climat favorable à la prolifération des colonies d'abeilles mellifères, une végétation riche, très diversifiée et un intérêt manifeste des populations à majorités pauvres. Néanmoins, les feux de brousses, la destruction de certaines plantes sous investigation du bétail et humains, la récolte sauvage par le feu et les actes de vandalisme tel que le vol des ruches et la destruction des essaims d'abeilles restent les grandes difficultés rencontrées pour cette activité. Cependant, il serait ironique d'oublier le rôle indéniable que joue les abeilles dans la nature. Car responsables de près de 80% de pollinisation des spermaphytes, elles pérennisent l'environnement sans pollution; réunissant la prouesse de récolter dans les fleurs ce dont elle a besoin pour élaborer le miel et les autres produits de la ruche dont la commercialisation ici sur le marché local et l'exportation vers les pays voisins fait de l'apiculture une source importante de revenus pour le monde rural. La soie sauvage quant à elle incite de plus en plus un grand intérêt dans le domaine textile de part la multitude de qualité qu'elle offre; entre autre son caractère doux au touché, sa souplesse, sa légèreté et sa mauvaise conductibilité à la chaleur. Cependant cette matière première est très rare et sa production nécessite une double protection: celle des chenilles productrices de soie et des plantes avec lesquelles elles sont phytophages. Au Cameroun et dans le grand Nord en particulier très peu d'informations sont données sur la sériciculture d'autant plus que la plus part d'espèces de plantes et chenilles séricicoles répertoriées sont absentes dans cette région. Néanmoins l'intégration de la sériciculture dans les moeurs des populations du grand Nord Camerounais pourrait améliorer les revenus des populations locales et protéger l'environnement. Car, tout comme avec les abeilles on ne peu délier chenilles productrices de soie et les plantes avec lesquelles elles se nourrissent. Ainsi, l'apiculture et la sériciculture apparaissent comme étant des réponses appropriées pour résoudre en grande partie les différents enjeux et problématiques de l'environnement et du développement rural.

Présentation du Cameroun

Pays d'Afrique centrale localisé dans le golf de guinée, le Cameroun est un pays ayant une superficie de 475.422 km². Avec une population de plus de 15.000.000 d'habitants soit une densité de 31,55 h/km². Le Français et l'Anglais sont les langues officielles et on y rencontre au moins 200 dialectes. Les principaux groupes humains sont les Bantous, Semi bantous, Pygmées, Bamilékés, Peuls et Foulbés.

Présentation du grand nord camerounais (Province de l'Adamaoua)

Le grand Nord du Cameroun regroupe trois vastes provinces à savoir. L'extrême Nord, le Nord et l'Adamaoua; ayant respectivement les climats de type: sahélien, soudanien et soudano-guinéen. Une population très diversifiée dont les principales activités sont l'élevage, l'agriculture la pêche et l'artisanat.

L'Adamaoua province du septentrion camerounais est un plateau situé entre le 5^{ème} et le 6^{ème} degré de latitude Nord, le 10^{ème} et le 11^{ème} degré de longitude Est; il couvre environ 6.200 km². Pour une population de près de 724.000 habitants; elle est la plus vaste des dix provinces que compte le Cameroun mais à peine les 4,82% de la population totale.

Le climat est du type soudano-guinéen, doux et frais, caractérisé par deux saisons d'égales longueur: une saison de pluie qui s'étend de mi-mars à mi-septembre et une saison sèche qui va de mi-septembre à mi-mars; la pluviométrie est monomodale et varie de 1.200 à 2.000 mm, tandis que la moyenne est de 1479 mm avec un coefficient de variation de 9,8%, la température moyenne annuelle oscille entre 22 °C et 24 °C et une hygrométrie relative de l'air est maximale de 80% de juillet-août.

La végétation du plateau de l'Adamaoua est une savane arbustive et arborée à prédominances des espèces *Daniellia oliveri* et à *Lophira lanceolata*. Au nord l'Adamaoua domine sur plus de 400 m la Bénoué par une falaise abrupte descendant en pente douce vers le Sud et l'Est. La partie occidentale est limitée par les massifs volcaniques. L'Adamaoua est une zone de transition entre la forêt du Sud et la savane arborée du Nord.

La population humaine de l'Adamaoua est très hétérogène et composé principalement de Mboum, Dir, Peuls, Mambila, Tikar, Kaba, Haoussa, Mbororo et péré. La mise en valeur des ressources naturelles passe principalement à travers l'élevage bovins, l'agriculture qui exerce de fortes pressions sur l'environnement et secondairement, la pêche et l'apiculture et l'artisanat.

Politique gouvernementale pour la conservation de la forêt

Dans le souci de protéger l'environnement, l'Etat du Cameroun en créant les Ministère de l'Environnement et de la Protection de la Nature et celui de la Forêt et de la Faune a mis en place une législation forte pour réduire et contrôler les différentes conséquences des pressions exercées sur l'environnement à travers:

- La loi n°94-01 du 20 janvier 1994 portant régime des forêts, de la faune et des pêches et ses textes réglementaires spécifiques sur la gestion des forêts et de la faune
- Décret n° 95-01/PM du 23 août 1995 fixant les modalités régime légal des forêts et de la faune
- Loi n° 94-01 du 2à janvier 1994 portant régime des forêts, de la faune et des pêches et ses textes réglementaires spécifiques sur la gestion des forêts et de la faune
- Décret n° 95-531/PT du 23 août 1995 fixant les modalités d'application des régimes des forêts
- Décret n° 95-678/PM du 18 décembre 1995 instituant un cadre indicatif d'utilisation des terres en zone forestière méridionale
- Décret n° 95-466/DM du 20 juillet 1995 fixant des modalités d'application du régime de la faune.

Ce texte participe à la mise en oeuvre du plan d'action Forestier National (PARFAR) à travers les grandes stratégies adoptées en matière de gestion durable des ressources forestières et faunique du Cameroun. Et concrètement sur le terrain les organismes tel

que l'ANAFOR, le PAFRA les associations et ONG participent à cet effort de l'Etat du Cameroun à protéger son environnement. A travers:

- L'identification des sylvicultures privés et leurs appuis
- La création des pépinières pour le reboisement la distribution de ces plants aux paysans
- L'animation des populations pour connaître leurs besoins par rapport aux-activités sylvicoles
- Encadrer les pépinières privées dans la production des plants.

Apiculture

Etat général de l'apiculture au Cameroun

Au Cameroun l'apiculture est jusqu'alors à de 90% à l'état traditionnelle avec près de 12.000 apiculteur recensés sur le territoire national, on dénombre environ 63.000 ruches réparties comme suit: 80% de ruches traditionnelles, 15% de ruches Kenyanes et 5% de ruches à cadre. La production annuelle de miel varie entre 787.500 kg à 1.764.000 kg par an soit une production de 12,5 à 28 kg/ruche/an cette production est cependant très insuffisant pour la consommation locale; ce qui est à l'origine du gros déséquilibre entre l'exportation qui s'élève à 23 tonnes et l'importation qui s'élève à 6 tonnes. Sur le marché local le litre de miel se vend entre 500 et 800 FCFA et les grossistes qui importent prennent généralement le litre entre 350 et 400 FCFA. Les autres produits de la ruche tel que la cire communément utilisé dans la fabrication des bougies, le venin d'abeilles utilisé pour ses vertus thérapeutiques pour les maladies tel que le rhumatisme, les névrites et les névralgies, le propolis et la gelée royale riche à 70% de protéides, 1% de glucides et en un facteur de croissance. Sont aussi commercialisés et constitue aussi une importante source d'entrée de revenus familiale.

Apiculture dans le nord Cameroun en particulier dans l'Adamaoua

L'Adamaoua est la province la plus vaste du septentrion Camerounais, les activités principales de sa population que sont l'élevage et l'agriculture, exercent de fortes pressions sur l'environnement. L'apiculture dont la production annuelle est de l'ordre de 200 à 450 mille litre par an est non négligeable et occupe une place de choix dans l'amélioration du revenu familial en milieu rural.

Cette région bénéficie pourtant de plusieurs atouts au développement de l'activité apicole tel que:

- Un climat favorable à la prolifération des colonies d'abeilles mellifères et à la formation du miel dans les ruches
- Une végétation riche et une faible variation qualitative de la flore de cette province d'un lieu à un autre
- Un intérêt manifeste des populations de la région pour l'apiculture et un fort engouement pour les formations apicole
- Une propension galopante du public à l'utilisation accrue des produits naturels en l'occurrence ceux issus des ruches
- La présence d'un centre universitaire qui met en place progressivement un lexique de termes apicoles en langues locales et l'introduction de l'apiculture dans le programme de formation en cours au Département des Sciences Biologiques.

Bien au delà de ces quelques atouts ci-haut cités, l'apiculture dans la région de l'Adamaoua présente quelques difficultés pour son bon développement entre autre:

- Les feux de brousses qui sont un apanage de cette région pendant la longue saison sèche

- La destruction de certaines plantes à potentielles apicoles sous investigation du bétail et humaines lors de la création des champs
- La récolte sauvage qui consiste à utiliser le feu pour éloigner ou brûler les abeilles afin de s'approprier du miel
- Le vandalisme humain par destruction de certaines ruches et de certains ruchés
- Le vol de ruches et la destruction des essaims d'abeilles
- Et enfin l'état rudimentaire des ruches utilisées qui sont purement traditionnel à près de 98% et formé d'un assemblage de bambous et de pailles
- Les mauvaises conditions de hygiène de récolte, conservation et emballage du miel destiné à la commercialisation.

L'apiculture dans le grand Nord du Cameroun souffre d'un manque d'encadrement ce qui le laisse toujours à l'état traditionnel néanmoins quelques travaux notamment ceux des projets AEFIA (Apiculture et Exploitation de la Flore par les Insectes dans l'Adamaoua) et ASDC (Apiculture Scientifique pour le Développement du Cameroun) oeuvres fortement dans:

- La formation des apiculteurs à l'apiculture modernisée afin d'améliorer de leurs productions
- Le recensement des plantes à valeur apicole afin de pouvoir les protéger et les multiplier
- La formation des apiculteurs à l'amélioration de la qualité des produits apicoles mis sur le marché ainsi que des sessions de formation des gics d'apiculteurs et apicultrices à la fabrication de quelques produits dérivés des produits récoltés dans les ruches
- La formation des universitaires et techniciens spécialisés en apiculture dans le centre universitaire de la place.

Apiculture et conservation de la flore

La flore camerounaise comme celle d'ailleurs comporte un nombre plus ou moins important de plantes dont les fleurs sont visitées régulièrement par les abeilles pour récolter du nectar et du pollen; abeilles et fleurs sont indissociables et le mutualisme qui les lie a conduit à la co-évolution et à la diversification des espèces que l'on connaît aujourd'hui. L'apiculture qui passe automatiquement par la pérennisation des abeilles et leurs environnements est donc à ne point douter une activité incontournable pour la conservation de la biodiversité car l'abeille est à elle seule responsable de plus de 80% de la pollinisation des spermaphytes grand groupe dans le quels on rencontre la plus part des arbres fruitiers. La zone du grand Nord camerounais étant une région de savanes arbustives et arborées qui subit de fortes pressions juxtaposant la zone semi aride, les opérations de reboisement, l'activité sylvicole et la protection de la flore trouverons en l'apiculture un partenaire de choix. Des activités de protection de certaines espèces apicoles tel que *Commiphora kerstingii*, *Vitellaria paradoxa*, *Callistemon rigidus* et bien d'autres à usages multiples sont observé tant dans les plantations que dans les habitations. Il serait donc fortement ironique de négliger le rôle indéniable que joue les abeilles dans la nature car réunissant la prouesse de récolter dans les fleurs ce dont elle a besoin pour élaborer le miel et les autres produits de la ruche dont la commercialisation améliore le revenu familial en milieu rural.

Apiculture et amélioration du revenu familial en milieu rural

De prime à bord quand on parle d'abeille on pense directement au miel, pourtant les dérivés de la ruche sont et nombreux et à usages multiples; ente autre on distingue: le miel qui est un important additif alimentaire et aussi utilisé en cosmétique; la cire utilisée

pour la fabrication des cirages et les bougies et le propolis qui regroupe plusieurs vertus thérapeutiques; L'AFH a mis au point un produit aux usages multiples qu'elle dénomme PROPAMAX-C à base de propolis. Ces différents produits sont vendus à l'état de matière première ou en produit fini sur le marché local et même importé vers les pays voisins. En terme de chiffre le litre de miel se vend sur le marché local à un prix variant de 500 à 800 FCFA et celui qui est destiné à l'importation se vend à un prix de gros donc la jerricane de 20 litres varie de 7 à 8 mille francs soit 10,75 à 12,5 Euro. Mis à part la commercialisation du miel, les autres produits de la ruche sont vendus à des meilleurs coûts ce qui fait de l'apiculture une source importante de revenus pour les familles en milieu rural car jusqu'alors cette activité est presque exclusivement artisanale, de plus l'apiculture peut être génératrice d'autres activités et de ce fait réduire le taux de chômage galopant au Cameroun grâce à la valorisation des secteurs tel que:

- La fabrication et la vente des équipements apicole et emballages, pour le bon conditionnement des produits de la ruche
- L'exploitation de la cire dans des industrie de fabrication de bougies cirages, laits de toilettes
- La création des laboratoires pour la fabrication des médicaments à base de venins d'abeilles et de propolis
- La pollinisation à grande échelle des exploitations agricoles industrielles.

Sériciculture

État général de la sériciculture au Cameroun

Sériciculture ou culture de la soie produite par des chenilles sauvages incite un intéressement de plus en plus croissant dans le domaine textile pour la fabrication de tussah (tissu à base de soie sauvage) de part les multiples qualité qu'elle offre; entre autre: son caractère doux au touché, sa souplesse, sa légèreté, sa mauvaise conductibilité de la chaleur et son potentiel d'excellent régulateur thermique. Ces chenilles sauvages produisent des fils de soie pouvant mesurer entre 1000 et 4000 m de long et cette soie jusqu'alors la variété naturelle la plus fine connue. Cependant, cette matière première est rare et son utilisation requiert une certaine délicatesse. Au Cameroun, très peu d'informations sont fournis quant à la production industrielle ou artisanale de la soie sauvage.

Sériciculture conservation de la flore et amélioration du revenu familial en milieu rural

Tout comme avec les abeilles l'on ne peut dissocier les chenilles productrices de soie sauvage des arbres sur lesquels elles se nourrissent car celles-ci sont exclusivement phyllophages. La production de soie nécessite de ce fait une double protection tant des chenilles productrices que des plantes sur lesquelles elles se nourrissent; de nombreux travaux élaborés dans d'autres pays tels que Madagascar où une espèce de vers à soie (*Borocea* sp.) a été protégé ainsi qu'une forêt de Tapia (*Uapaca bojeri*) sur lequel se nourrissent ces vers à soie a montrer des résultats satisfaisants tant dans la préservation de l'environnement que dans l'augmentation du revenu des populations locales. Non seulement la soie récoltée est vendue mais elle génère aussi d'autres formes d'activités et la forêt préservée offre d'autres produits tels que les chenilles comestibles, les champignons, les fruits et une bonne gamme de plantes médicinales; ce qui améliore significativement les conditions de vie de la population locale.

Conclusion

Apiculture et sericulture apparaissent ainsi comme étant des réponses appropriées pour résoudre en grande partie les grands enjeux et problématiques de l'environnement et du développement rural de part les revenus que ces deux filières génèrent aux populations rurales et l'action protectrice de l'environnement qu'opèrent les différents acteurs de ces filières pour la pérennisation de ces activités d'où la nécessité d'apporter un grand appui à la vulgarisation de ces filières dans le grand Nord du Cameroun.

THE ROLE OF IFAD-CBARDP IN THE NIGERIAN ECONOMY AND THE PROSPECTS OF INTRODUCING APICULTURE AND SERICULTURE IN THE COUNTRY

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Abstract: Successive governments in Nigeria have recognised that the rural sector is of critical importance to the country's development aspirations. A number of public institutions had been established with specific mandate to catalyse the delivery of integrated rural development programmes to achieve accelerated rural transformation. These initiatives, however, did not yield the desired results as the living conditions of rural communities continued to degenerate; hence the compelling need to take urgent steps to help reverse the trend.

As a long-term remedy, the Federal Government of Nigeria initiated the new Rural Development Strategy, which aims at institutionalising an integrated community driven development approach within the context of decentralised governance.

The Community Based Agricultural and Rural Development Programme (CBARDP) of Northern Nigeria was formulated against this background and strategic context.

The programme

Objective

To improve the livelihoods and living conditions of rural communities with emphasis on women and other vulnerable groups.

Components:

- i. Awareness and capacity building
 - Empowering poor rural communities
 - Making service providers more relevant and responsive to the needs of communities.
- ii. Community development component
 - Community Infrastructure
 - Services
 - Support to vulnerable groups
 - Sustainable agricultural development
 - Rural enterprise development and financial linkage support services.

Programme benefits

Primarily, the most important contribution of CBARDP will be to harness existing resources, catalysed by IFAD funding to implement a community driven development (CDD) approach capable of efficiently and effectively delivering services for rural poverty reduction.

Community level

The following are benefits derived from community development component:

- Improvements to social and economic infrastructure and skill levels in communities
- Support for sustainable agricultural development, which results in improved productivity, increased food security and increased incomes

- Support for rural enterprise development and credit linkages enabling a substantial number of micro/small scale enterprises to move from low income marginal activities to more dynamic and profitable ventures
- Wider availability of infrastructure for improved access to schools, health care services, water supply, community access and so on
- Institutional level
- Capacity building to reorient and strengthen technical skills of federal, state and local government staff for better service provision
- Empowered and more efficient institutions.

Private sector stakeholders

Partnerships developed with non-governmental and private sector service providers and consultants provide opportunities for enhanced utilisation of locally available skilled human resources. Programme patronage for contracts, training delivery as well as other forms of services promotes competition among stakeholders for better services provision.

Environmental conservation

The programme supports capacity building for the implementation of improved integrated environmental management practices for sustainable development.

Institutional arrangement

- National level Institutions (PMARDP/PCU, NPC, FMOF)-FADPEC
- State level institutions (SMOA, SMOLG, Integrated Rural Development, ARDEC, STST, others)
- Local Governments—LGDC, GLGTST
- Communities—CDA—committees, enterprise associations, vulnerable groups.

Prospects of introducing apiculture and sericulture in Nigeria

In Nigeria, 75% of beekeeping is practised using traditional methods, with about 20% being honey hunters. The remaining 5% adopt the use of either modern (Langstroth) or intermediate (Kenya top bar) methods.

The types of traditional beehives being used depend on geographical location. The most commonly use methods include the pot, the straw and log hives.

During honey harvest corn stalks are used for smoking. As a result of sparks from the corn stalks bees are killed and the honey is contaminated with ash, the brood, dead bees and impurities. In some instances bush fires also occur in devastating proportion.

Traditional beekeepers are not aware of the presence and use of six other bee by-products apart from honey for their use. They are not also aware of the practice of modern beekeeping.

Genuine attempts to promote apiculture as a viable industry began in 1996 with the first beekeeping workshop organised jointly by the state of Israel and the Federal Ministry of Agriculture. Subsequently, various state ministries of agriculture and private non-governmental organisation have conducted a series of beekeeping workshops.

International donor agencies are also supporting the development of the Nigerian beekeeping industry through financing beekeeping workshops and supply of beekeeping equipment. Such organisations include DFID, USAID, FAO, CIDA, Winrock International, Development Cooperation of Ireland, Bees Abroad, Bees for Development, IFAD and Partners for Development, among others.

Creation of awareness on the importance of beekeeping

To accelerate the adoption of modern beekeeping as well as improve on the traditional beekeeping practices, attention should be focused on the following areas:

- Collaboration with community based farmers' organisations in establishing pilot bee farms
- Creation and capacity building for local bee farmer extension groups (FEGs) who would be responsible for the transfer of beekeeping technology to other farmers as volunteers
- Adoption of on-field training methods to beekeepers
- Donor agency participation and support through non-governmental organisations
- Establishing beekeeping resource centres.

EFFECT OF RAINS IN EASTERN SUDAN (KASSALA STATE) ON COMMUNITY INCOME GENERATION CAPACITY AND IMPACT OF GASH SUSTAINABLE LIVELIHOODS REGENERATION PROJECT (IFAD) ON THEIR LIVELIHOOD

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Abstract: The Gash Sustainable Livelihoods Regeneration Project (GSLRP) is the first project prepared within the context of the new strategic framework for IFAD investments in the Sudan. The overall goal of the project will be to regenerate the livelihoods of the maximum number of poor people in and around the Gash delta, compatible with the efficient and sustainable use of its land and water resources and based upon a shared vision of development and stability of the related institutional arrangements. Rainfall is of crucial importance for all life in eastern Sudan, not only because it is a resource for humans and livestock, but also because it is the major limiting factor to plant growth, as almost all agriculture in the region is rainfed either by direct precipitation, runoff or deep percolation to recharge the groundwater aquifer, and, as a result, rainfall determines the food security and supply both for human and livestock population.

The country

The Sudan with a total land area of about 2.4 million km² is the largest and one of the most diversified countries in Africa. The country lies wholly between longitudes 4° and 24° North and latitudes 22° and 38° East and is bisected by the Nile river and its tributaries, where most of the population is concentrated. Of the total land area, 7% is agricultural, 42% range and grazing land, 33% desert and 18% is forests, mostly in the South.

The population is about 33 million and is growing at about 2.6% per year. Large movements of people have occurred in many regions due to civil strife in the south, west and east, and drought and environmental degradation. Even with the emerging oil sector, Sudan's economy is predominantly agricultural with 70% of the population deriving their livelihoods in rural areas.

Agriculture contributes about 37% of GDP. In addition, it accounts for 70% of employment and 50% of the raw materials for the manufacturing sector.

The three major farming systems are:

- Irrigated agriculture
- Rainfed semi-mechanised
- Rainfed traditional agriculture.

The three major farming systems account respectively for 28.7, 9.1 and 60% of agricultural production, Fisheries account for 1.4%.

The traditional farming systems include nomadic transhumance (moving with livestock and growing subsistence crops) and sedentary agriculture. About 60% of all crop production is irrigated; 7% comes from mechanised farming and 33% from the traditional rainfed sector.

There are high marketing margins on agricultural produce and hence low farmgate prices.

Kassala state

Kassala state is located between latitude 14° 45', 15°17' N and longitude 34°4', 37°E. It shares a border with Eritrea in the east. The total population of the State is estimated at

1,765,813 (723,002 households), with annual growth rate of 2.51% according to government statistics for 2003. The urban population is 35% and the rural population is 53%. The nomadic and semi-nomadic population is 12%. The Port Sudan–Khartoum Highway passes the state. This highway allows good access to neighbouring markets and stimulates local trade.

Agriculture is the backbone of the state's economy. It provides livelihoods for more than 80% of the state population and contributes significantly to the country's exports. The arable land is estimated to be 4,072,000 feddans (2.4 feddans = 1 hectare), which is about 40% of the total area of the state. The area under cultivation is estimated to be 1,580,000 feddans. This is about 50% of the total cropped area. This is divided into 42% for mechanised farming and 8% for subsistence farming.

Falling in the African Horn Zone, Kassala State has been severely affected by the successive drought in this zone since 1984. This drought has, however, worsened during the last two decades resulting in a sharp depletion of the rural population resources and has forced many subsistence farmers and animal herders to leave their lands and displace to urban and semi-urban centres.

The GSLRP

The Gash Sustainable Livelihood Regeneration Project is the first project prepared within the context of the new strategic framework for IFAD investments in the Sudan. The project area has been defined as small and primarily inhabited by poor households dependent on agricultural production, and it encompasses the entire locality of Gash.

The overall goal of the project will be to regenerate the livelihoods of the maximum number of poor people in and around the Gash delta, compatible with the efficient and sustainable use of its land and water resources and based upon a shared vision of development and stability of the related institutional arrangements.

The Gash delta area is ranked among the poorest areas in Kassala State due to the deterioration in the scheme management and infrastructures (e.g. siltation of the main and minor channels). As a result, the total cultivated area had fallen sharply from 80,000 feddans in the 1980s to 30,000–50,000 feddans before GSLRP. The number of claimants to farmland had increased drastically from 8000 to 45,000 in 1988 and 2002 respectively.

GSLRP started to be implemented in 2004 and is scheduled to be completed by 2012. To date, there is progress in the rehabilitation of two blocks of Gash irrigated scheme where about 16,000 farmers benefited from the rehabilitation.

It is the first time for them to cultivate 3 feddans for the last three decades; the other 4 blocks shall follow.

Rainfall pattern

Rainfall is of crucial importance for all life in eastern Sudan, not only because it is an important resource for humans and livestock, but also because it is the major limiting factor to plant growth. Almost all agriculture in the region is rainfed, either by direct precipitation, runoff or deep percolation to recharge the groundwater aquifer, and, as a result, rainfall determines the food security and supply both for the human and livestock population.

The local annual rainfall ranges from 260 mm in the southeast to less than 100 mm in the northwest. It is highly seasonal, occurring between July and October and is extremely variable in amount, intensity and distribution. Its effectiveness is severely limited by high evapotranspiration rates (>2000 mm per year) and it commonly fails to penetrate to the depth of the root zone. This means that the rainfed median effective growing season is for less than 30 days to 60 days, which presents a harsh environment for the main staples (sorghum and millet).

Droughts are frequent, and can be prolonged. They present a serious restriction on agriculture, which relies on irrigation. This means the rainfall is very poor in Kassala State but heavy in the Ethiopian highlands.

In the west of the project area, 'hafirs' and 'hods' are used for water storage. They are recharged from either outflow from irrigation canals where they are adjacent to the Gash Scheme or from rainfall runoff.

Effect of rainfall

The households in the state generate their income through various options. These options are: agriculture production—cereals/staple crop farming and cash crop farming (vegetables, sale of livestock and livestock products), trading/small business, skilled labour, seasonal labour, agricultural and non-agricultural labour, handicrafts (women), begging ('musada'), kinship, firewood collection, charcoal production, sale of fish, formal employment or salaried work, borrowing, remittances, food aid sales and grass sales.

The below average rainfall patterns have a negative impact on food security in general and these rainfall patterns that the state has witnessed have had an adverse effect on the local crop production in the agropastoral and agriculture zones and pasture condition in the pastoral zone.

A drought year is classified as a normal year. However, the secondary and primary information collected from the field showed

that after three to four years of drought, there is one good year in terms of rains.

The livelihoods of the community have been impacted negatively by the droughts and long dry spells.

The main economic seasonal activities are associated with the ecological characteristics of the locations under study. Most of host/resident community in the target study area are involved in rural economic activities connected with nature and its valuable products such as seasonal farming, herding, wood cutting and firewood collection, charcoal production, petty trade, grass selling, sale of livestock and casual labour.

In the agropastoral and agricultural zones, the seasonal activities are agriculture, sale of livestock, trade, seasonal labour and sale of charcoal and firewood. In the pastoral zone (IDPs), the seasonal activities are mainly petty trade, seasonal labour, sale of grass, charcoal production and firewood collection and to a limited extent livestock sale.

All the above-mentioned activities are related with rainfall patterns and its effect differs from one activity to another according to the amount of precipitation.

To generate income when poor rains prevail, the active household members, mainly the youth and adults, go around the main towns, to irrigated schemes and rainfed farms during the planting, sowing and harvesting seasons looking for labour opportunities. Although this activity is seasonal (November–January) and (August–September) its contribution is noticeable, particularly during the rainy seasons and stress period. Seasonal labour is agricultural labour, non-agricultural labour and casual labour.

As a result of such a harsh environment (droughts, dry spells, food deficit, poor pasture), the community or the households use many coping mechanisms. For example: The average

Table 1. Annual rainfall, Kassala State (1971–2001)

Average rainfall (mm)	Year	Average rainfall (mm)	Year
271.3	1987	245.5	1971
293.8	1988	222.7	1972
239.8	1989	285.8	1973
75.0	1990	334.0	1974
92.6	1991	296.0	1975
362.0	1992	244.7	1976
196.4	1993	212.3	1977
234.8	1994	270.1	1978
293.5	1995	280.1	1979
–	1996	194.7	1980
199.9	1997	229.8	1981
305.8	1998	217.2	1982
79.2	1999	249.4	1983
118.2	2000	98.9	1984
198.9	2001	145.9	1985
		306.9	1986

and below average households commonly reduce the quantity and number of meals, shifting to less preferred food that can be accessed at reasonable prices.

During the dry season, the households revert to looking for job opportunities in the agricultural schemes. Also, excessive sales of livestock is practised by the above average households either to acquire more income or avoid further loss due to drought.

Due to the limited rainfall, the state Ministry of Agriculture, Animal Wealth and Irrigation and its technical units have proposed and implemented many projects in water harvesting methods for agricultural purposes and rangelands improvement in cooperation with different NGOs and IFAD.

The activities above will lead to:

- Increasing the farmers and pastoralists income and avail working opportunities
- Increasing the income generation capacity
- Reduction of poverty and control of malnutrition
- Increasing the area cultivated, thus increasing the soil moisture content
- Solving erosion problems and improving the environment quality
- Rehabilitation of deteriorated rangelands
- Reseeding the rangelands
- Raising the living standards of the pastoral community in the state
- Avoiding overgrazing.

Impact of IFAD project

The project primary target group is most of the rural population encompassing some 369,000 people or 67,000 households. By the end of 2011, the project will regenerate the livelihoods of the target groups (tenants, herders and landless households). The outputs have begun to appear (now 3 years) and the project will end after the following has been accomplished:

- Rehabilitated and user/Gash agriculture scheme will co-manage flush irrigation infrastructure
- Rehabilitated and user managed rangeland
- Improved crops, mesquite/forestry and livestock husbandry
- Improved access of non-tenant households to productive and social assets
- Improved access of local communities to safe reliable domestic water supply
- Improved outreach of rural services to tenants in smaller habitations, smallscale herders, non-tenant households and women
- Vision for the development of the Gash delta elaborated in a collective and collaborative manner
- Institutional arrangements appropriate to the realisation of the shared vision are established and enforceable by law.

The above mentioned outputs will be achieved through the implementation of the proposed activities in the project components which include:

Component 1: Irrigation scheme rehabilitation

Component 2: Animal production and rangelands management

Component 3: Community development, capacity building and empowerment

Component 4: Financial services and marketing

Component 5: Institutional support.

Recommendations

- Introduction to alternative sources of basic livelihood-sustaining mechanisms (food preservation and processing, vegetables processing, beekeeping, sericulture)
- Introduction to a variety of income-generating activities, particularly for the women.

OVERVIEW AND PROSPECTS OF SERICULTURE INDUSTRY AND SILK MARKETING IN UGANDA

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Abstract: Sericulture development in Uganda is fast gaining momentum. There is need to guide investors in this sub-sector and to assure those who have been approached to finance sericulture development that there is a framework and plans to track implementation of quality assurance activities to ensure that silk products are of competitive quality, locally and internationally for sustainability of the industry. We will employ the following strategies: establish a quality inspection system for silk and grading standards for cocoons and products, train inspectors, register quality standards for cocoons and products, and establish an accredited and independent silk testing centre to provide quality certificates and licences to exporters. Farmers in Uganda have demonstrated that they can produce high quality silk cocoons. Current work and experience in silk reeling, further processing and marketing show that with appropriate equipment and skills, Uganda silk can find a niche in the world market. Timely and appropriate investments at the different levels will ensure improvement in productivity, quality and marketing.

Historical background

In Uganda, silk production dates as far back as the beginning of the twentieth century. Wild anaphe silk was one of Uganda's exports in the period 1910–1945 with annual export of about 9 tons per year. Despite the fact that *Bridelia* trees on which the anaphe silkworm feeds are found growing luxuriantly in most parts of Uganda, most of the anaphe silk was being collected from the wild trees of Mubende district in central Uganda. Attempts were made to introduce mulberry sericulture in the 1920s. Silkworm eggs were imported from Europe and Madagascar but unfortunately the eggs always hatched on the way. This problem was overcome by importing hibernating eggs. However, lack of cold storage equipment during this time affected the progress of research and development activities.

During the early 1970s, attempts were again made to introduce the sericulture industry. In 1970, the Japanese government dispatched a survey team to Uganda to undertake a feasibility study on possible cultivation of mulberry and rearing of silkworms in Uganda. The Japanese brought along with them mulberry plants, seeds, grafting twigs and cuttings. The seeds and cuttings were planted and the scions grafted onto domestic mulberry trees. The experts trained Ugandans on how to plant and maintain mulberry. In their report, the Japanese experts acknowledged that Uganda was most favoured in temperature, humidity, rainfall and sunshine for planting mulberry and for silkworm rearing. The Japanese also concluded that the most comfortable climate throughout the year would make it possible to produce more than 5 crops of cocoons in a year.

During this time, a collection of local mulberry varieties was done, multiplied and together with imported varieties mulberry plantations were established at Kawanda Agricultural Research Institute. Studies were limited to mulberry agronomic trials because of lack of silkworm eggs. These studies stopped in 1975 because of lack of silkworm eggs, trained personnel and the then political situation in the country.

During the period 1985–1995, the Indian government and Swiss Development Corporation provided training to 20 Ugandans at the International Centre for Training and Research in Tropical Sericulture, Mysore, India. Sericulture was revived at Kawanda under the Ministry of Agriculture, Animal Industry and Fisheries in 1986. Rearing trials using silkworm eggs imported from India, evaluation and multiplication of mulberry varieties

were undertaken during the period 1986 to 1989. In 1989, a team of sericulture experts from India carried out a feasibility study to identify potential areas for launching of on-farm activities. Bushenyi district in western Uganda was identified as the most promising area on account of its high population density and other factors which favour the development of sericulture.

In 1990, two private sector companies namely Uganda Silk Industries Limited and Inuula Silk Estates Limited initiated commercial cocoon production mainly for export. USIL was operating in the central and western Uganda while ISEL was operating in eastern Uganda. In September 1990, the United Nations Development Programme sponsored a study to identify problems and constraints and to improve the operations of the private companies. Reeling and silkworm-rearing experts from Japan carried out the study. Based on the findings of the study, a Japanese silkworm-rearing expert under the Japan Overseas Technical Cooperation programme was dispatched to Uganda in 1990 to train extension personnel employed by the two private companies. The companies had started with establishment of large estates of mulberry each 10 to 15 ha, central rearing facilities comprising of egg incubation, young silkworm and old silkworm rearing and construction of cocoon dryers in anticipation of undertaking their own large-scale cocoon production for export and establishment of filatures in the future. However, the production facilities and systems failed to achieve productivity levels and stabilisation of the cocoon crops that were essential for the survival, sustainability and expansion of the sector. Initially, and all along, these private companies faced problems, which were technical, environmental and financial. The companies came to learn that sericulture as opposed to other forms of agriculture in Uganda was more scientific and entailed more than just planting mulberry plantations, and asking farmers to participate as outgrowers. There were insufficient material inputs such as silkworm eggs including preservation and treatment facilities, lack of working capital for companies and rural credit schemes at farm level and extension services.

The above scenario led to a feasibility study sponsored by the United States Agency for International Development and Ministry of Finance and Economic Development conducted in 1993 with a view to improving the situation. Immediately after the study, a project was designed and funded by the European Union to bring about sustainable increase in national silk export revenues and smallholder incomes through the development and strengthening of the commercial sericulture sub-sector. The two-year project, intended to eliminate the identified constraints, was later extended to 5 years to:

- Assist private companies producing silk for export to have access to core facilities, technical assistance, and credit and stabilised supply of cocoons
- Assist 1000 smallholder families to increase cocoon production and income by developing and applying a successful and replicable complete crop-credit package and extension methodology through silk development centres
- Ensure that the pilot activities can be sustained and expanded through the strengthening of Uganda Silk Producers Association and establishment of a staff counterpart structure.

The project had six components:

- The core facility for egg preservation and treatment with laboratory cooled incubators with capacity of 15,000 boxes per annum
- Loan to private companies to provide commercial loans to silk companies that were members of Uganda Silk Producers' Association
- Material credit to farmers to enable the project to establish a revolving fund to be administered by USPA on a full cost recovery basis
- To enable the project establish 12 silk development centres to serve 240 farm families
- Strengthen USPA to ensure project activities could become sustained and extended and that USPA should take over the activities of the project
- Sericulture support services provided by or through USPA by conducting studies to support the sector as a whole.

Dry silk cocoons produced before and during the project period were exported to Japan. The quality of the silk produced from the exported cocoons was generally Grade 2A. The export accounted for 70% of total production. The rest of the production (30%) were low grade and/or un-reelable cocoons, which could not meet the Japanese cocoon import requirements. They were held in stores, buried or burnt. Cocoon exports were affected by production, which necessitated a long waiting time to fill a container of 1.6 to 1.7 tons of dry cocoons. The Japanese buyers needed bigger quantities. The situation for Uganda was made worse by the crash in the international raw silk yarn prices in the late 1990s. It became difficult for the landlocked Uganda to export the voluminous amount of cocoons to Japan, pay the freight charges and obtain a profit on the undertaking. There were no processing factories and craft processing equipment for low-grade cocoons for value addition to help mitigate the effects of the slump in the silk market prices.

The EU project ended in 1999 when export of cocoons had ceased. Lack of a sales outlet affected on-farm production, which decreased drastically. Around the time the EU project was winding up in Uganda, another sericulture project was starting at *icipe*, Nairobi, Kenya, funded by the International Fund for Agricultural Development. Silk reeling trials were undertaken by *icipe* in Uganda in collaboration with the Ministry of Agriculture, Animal Industry and Fisheries for a period of 1 year. The trials were successful. This led to signing of a Memorandum of Understanding between *icipe*, MAAIF, a local farmers group, Bushenyi Silk Farmers Association and NOBWE Silk Development Company to collaborate in a field validation trial for silk production and marketing at Bushenyi in western Uganda. Equipment for the trial and training of personnel were financed by *icipe*/IFAD. Three years of reeling, twisting, weaving and marketing of silk have shown that Uganda can become a major silk producer.

To increase raw silk production for export, African Development Foundation, USA, has assisted a local company comprising of farmers, factory workers and technical personnel working in sericulture with a high capacity silk reeling machine which was installed in Kawanda in 2003 for production of high quality raw silk.

The success of the validation trial and establishment of cocoon processing factories has encouraged farmers to expand their mulberry fields and rearing facilities. In 2003, farmers in Kanungu and Bushenyi districts in Western region have received assistance from African Development Foundation to enhance their capacity to produce more cocoons and increase their incomes. The support has been provided as a revolving loan fund intended to enable the farmers to realise full employment potential by increasing the number of rearing cycles per year from three to six or more. The assistance has been applied to establishment of cooperatives, young silkworm rearing centres, construction of individual farmer silkworm rearing houses and procurement of cocoon frames sufficient to sustain the rearing of two boxes of eggs per cycle. In mid 2005, Japan International Cooperation Agency provided an expert at the request of the Uganda government to assess the current state of the industry and to provide advice on how to expand it to economic levels, and improve cocoon production, processing and marketing. JICA has since then been assisting Uganda to build capacity for silkworm egg production including the establishment of the necessary infrastructure. Silkworm egg stocks, equipment and other technical assistance inputs for maintenance and multiplication of silkworm egg parent stocks have been received from JICA.

Experiences and lessons learned from past activities

The private sector took up sericulture in the early 1990s on a large scale. It was thought that with the government policy of liberalisation and privatisation in place, there would be sustainable increase in silk export revenues and smallholder incomes through the private sector. It was also thought that silk processing would be rapidly linked to the estates. High incomes from exporting of dry silk cocoons and reeled silk were expected. This

did not happen. To date all sericulture estates have collapsed, some with severe financial consequences. All cocoon production activities are now mainly on small land holdings. The reasons for the success of sericulture on small land holdings may be that sericulture in Uganda is mainly household farming, involving the labour of members of the family. Average family size is about seven people. The people are unskilled and the work on their household farms is the most convenient and remunerative occupation.

All sericulture projects in Uganda in the past emphasised provision of credit to farmers to set up rearing facilities. Trainers with no practical experience in sericulture were employed to train and supervise completely new farmers. One-day seminars were considered adequate for imparting skills to the new farmers who had never seen the silkworm. The design of the projects wrongly assumed that the conditions for sericulture development other than working capital for private companies and farmers were already in place. Silkworm eggs importation was always affected by lack of availability of funds. As a result, timely delivery of the eggs to synchronise farmers' rearing schedules was not possible, leading to loss of incomes by farmers. Export of only first grade cocoons and lack of appropriate equipment to process cocoons into value added products led to heavy losses to farmers and exporters.

Policy issues

From the foregoing, it can be seen that establishment of technical and economic bases for sericulture development needs a long-term approach rather than a completely commercial approach. It can also be summarised that sericulture development in Uganda has been constrained by the following factors:

- General lack of technical skills about the industry
- Inadequate supply of inputs, especially quality silkworm eggs
- Lack of specialised sericulture support infrastructure and services
- Dependence of the sericulture products on exports
- Lack of appropriate equipment.

A national policy for sericulture development has been formulated to address these issues and constraints. The purpose of the sericulture policy is to provide a basis for harmonious and sustainable development of the sericulture industry. The policy will support and guide:

- The institutional development of the sub-sector
- The efficient and effective production, processing and marketing of sericulture products, research in sericulture and related activities nationwide
- Public and private sectors in playing their roles effectively.

Eight major policy areas have been identified according to their economic importance:

- Establishing a national centre for sericulture development
- Provision of support to production and marketing of silkworm eggs
- Strengthening sericulture farmers' organisations
- Supporting cocoon production activities
- Supporting value addition to sericulture products
- Supporting marketing of sericulture products
- Supporting research to improve sericulture farm and silk industrial productivity
- Establishing regulation and quality assurance services.

The policy will be implemented through a number of strategies highlighted below.

Establishment of a national sericulture centre

The purpose of setting up a national sericulture centre is to establish an institutional framework for supporting sericulture development, develop skills and suitable technologies, and information networks. There are no sufficient infrastructures, trained technical personnel, laboratory facilities and equipment to support the sericulture sub-sector. The following strategies/activities have been planned:

- Set up infrastructure, equipment and facilities for a national sericulture centre
- Recruit, train and retain sericulture technical personnel
- Training local government personnel and private sector service providers
- Breed and maintain parent seed varieties
- Establish basic silkworm seed farms for multiplication of breeders egg stocks
- Provision of technical information to the public
- Supervision, monitoring and evaluation of delivery of sericulture technical services
- Establish information networks and international cooperation.

Production and marketing of silkworm eggs

Infrastructure for silkworm seed production and a system for silkworm seed marketing will be established. Sericulture is a new industry and inadequate silkworm egg supply is a major constraint. The following will be undertaken:

- Set up parental (P3–P1) egg multiplication centres
- Support establishment of hybrid egg production factories by public and private sector
- Establish a system of preventing and controlling diseases transmitted through silkworm eggs
- Promote involvement of private sector egg producers in sericulture extension service delivery to ensure sustainable market for eggs and increased silk production
- Establish regulations for egg production, importation and export
- Licensing of persons handling/producing silkworm eggs.

Strengthening of sericulture farmers' organisations

There is need for an organisation not directly involved in the silk business to link the industry with government and other organisations as a basis for harmonious development of the sub-sector and to promote sericulture and advocate for stakeholders interests. The following strategies have been formulated.

- Support for the establishment of an apex body for sericulture development
- Support for establishment/strengthening of a national cocoon producers' association
- Support for existing local sericulture farmers' associations in districts
- Support for small- and medium-scale silk enterprises started by farmers associations and individuals.

Cocoon production

Farmers have invested in sericulture and factories have been set up. There is demand for Uganda silk but cocoon production is too low to make farmers realise returns on their investments, and meet factory and export requirements. Therefore, there is need for sustained support to activities that will lead to increased cocoon production. Strategies being used are:

- Supporting establishment of nurseries/mother gardens for mulberry seed multiplication
- Supporting establishment of more cooperative young silkworm rearing centres

- Rehabilitating the sub-sector by mobilising all farmers who have rearing facilities and/or mulberry to start cocoon production
- Encouraging financial/credit institutions to avail credit to farmers
- Supporting establishment of a national cocoon producers' association to help stabilise supply of silk cocoons
- Supporting training of farmers
- Establish a sericulture training unit within the National Sericulture Centre
- Supporting the government institutions involved in sericulture development to train extension workers in practical skills
- Support local governments and private sector to build capacity for efficient extension service delivery and supervision
- Ensuring that all sericulture interventions are gender focused and responsive to the needs of women and youth
- Involving local leadership in sericulture promotion and development.

Value addition to sericulture products

There is need for support and guidance in activities initiated by the private sector in silk processing. The following strategies are being implemented.

- Supporting establishment of a national cocoon producers' association to help stabilise supply of silk cocoons and silk yarn
- Promoting craft silk processing technologies and small silk processing enterprises in villages in collaboration with sericulture farmers' associations
- Supporting silk technology training for yarns and dyes, and for twisting and refining raw silk yarn at national level
- Supporting training courses in villages aimed at market oriented product development
- Supporting the establishment of an organisation for silk processing and marketing
- Promoting and support establishment of suitable silk reeling and weaving mills in the private sector
- Establishing linkages with cotton spinning and weaving factories to address the issue of lack of technical skills and technology development
- Training factory workers to improve cocoon and factory productivity.

Marketing of cocoon and silk products

The industry is currently constrained by inadequate quantities of products and knowledge about markets for the different products. To improve marketing, the following strategies will be employed:

- Support/strengthen a cooperative or company that will buy/is buying cocoons from farmers for sale to yarn producers or silk reeling mills
- Support silk villages as tourist attractions and testing ground for local and export market development
- Undertake promotion of Uganda silk products locally and internationally
- Provide information on products, markets and marketing.

Research

Research facilities and a critical number of research scientists and technical staff with adequate knowledge and skills to develop sericulture technologies are needed. The medium and long term approaches to these needs are:

- Introduction, adaptability and productivity studies of different mulberry varieties in different agroecological zones and under different agronomic practices.

- Adaptability and productivity studies of different silkworm breeds in different agroecological zones and conditions
- Studies in local diseases and pests that impact on mulberry and silkworm production
- Postharvest management of cocoon and silk products
- Market research.

Regulation and quality assurance

Sericulture development in Uganda is fast gaining momentum. There is need to guide investors in this sub-sector and to assure those who have been approached to finance sericulture development that there is a framework and plans to track implementation of quality assurance activities to ensure that silk products are of competitive quality locally and internationally for sustainability of the industry. The following strategies will be employed.

- Establish a quality inspection system for silk and grading standards for cocoons and products
- Train inspectors
- Register quality standards for cocoons and products
- Establish an accredited and independent silk testing centre
- Provide quality certificate and licences to exporters.

Prospects for the future

Farmers in Uganda have demonstrated that they can produce high quality silk cocoons (Tables 1 and 2). Current work and experience in silk reeling, further processes and marketing show that with appropriate equipment and skills, Uganda silk can find a niche in the world market. Timely and appropriate investments at the different levels will ensure improvement in productivity and quality, and marketing.

Table 1. Test results of dry exported cocoons (1992–1995)

Parameter/ Year	1992	1993	1994	1995
Reelability (%)	62.0	73.0	75.0	71.0
Filament length (m)	873.0	881.0	1051.0	–
Raw silk (%)	36.22	37.17	36.22	38.42
Denier	–	–	2.67	–
Grade	B	2A	2A	2A

Table 2. Monthly results of tests for fresh cocoons produced by farmers (1995) from Kinshu x Showa eggs

Month	Cocoon weight (g)	Shell weight (g)	Shell (%)
January	2.128	0.430	20.21
February	2.050	0.530	25.85
March	1.802	0.411	22.83
April	1.592	0.385	24.18
May	1.972	0.490	24.87
June	1.906	0.449	23.56
July	1.862	0.460	24.70
August	1.689	0.392	23.21
September	1.572	0.385	24.49
October	1.882	0.453	24.06
November	1.860	0.455	24.46
December	1.865	0.406	21.77
Average	1.848	0.437	23.66

IMPLEMENTATION OF VALUE CHAIN APPROACH IN THE DEVELOPMENT, SCALE-UP PRODUCTION, BRANDING AND MARKETING OF NON-TIMBER FOREST PRODUCTS

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Abstract: Accessing value added conscientious consumer markets offers great potential for achieving livelihoods standards that are far greater than could be achieved through agriculture or livestock production in semi arid areas. Accessing value added conscientious consumer markets requires: (i) attaining ethical production, (ii) attaining sustainable production, (iii) improving quality control, (iv) improving processing, (v) improving packaging, (vi) improving market presence and (vii) selling the story behind the product.

Introduction

Thousands of NGOs are registered to assist Africans in the following areas:

- Conservation—Protect wildlife
- Development—Improve standards of living
- Humanitarian—Alleviate suffering
- Religious—Spiritually enlighten.

While the motivation to assist is different, all are based on promoting the wise and sustainable use of natural resources. Linking this sustainable use to peoples improved livelihoods is critical. Africa south of the Sahara (75%) consists of semi arid marginal land. Promoting the traditional modes of agriculture and livestock rearing has done little to improve people's standards of living in these areas. Land is marginal for agriculture with one in six harvests failing and livestock rearing requires extensive external inputs, i.e. access to artificial water or veterinary services.

Potential for harnessing the value of non-timber forest products

Naturally occurring wild species have evolved over millennia to cope and indeed thrive in such hostile environments. Sustainably harnessing the value of these wild occurring species requires less external inputs and offers greater potential for improving peoples standards of living. Non timber forest products such as gums and resins, aloes, silk, honey and wild chanterelle mushrooms offer excellent potential to create improved livelihoods. Accessing domestic, regional and international markets for the products is critical as it acts as the economic incentive to convince landholders to manage and husband the resource. Without it, poor people with little other alternative are forced to exploit short term gains such as the charcoaling of the gum arabic-producing *Acacia senegal* trees.

Many community-based natural resource management programmes (CBNRM) in the East and southern Africa region have been founded on improving livelihoods through the sustainable use of wild resources.

- Botswana CBNRM Programme
- Namibia's Living in a Finite Resource Environment
- Zimbabwe's CAMPFIRE
- Zambia's LIRD Programme.

The above CBNRM's have struggled to achieve their true potential. This is due to the lack of markets. Without markets and improved cash incomes in resident landholders pockets the incentive to sustainably rather than exploitatively use the resources is diminished. The reason is that, in general, donor-funded implementing NGOs are staffed by scientists and not business people.

Do markets exist for Africa's value added non timber products?

A large and growing market exists for Africa's non timber forest products—Many are based on an international market. This market is increasing due to the expanding global demand for natural and pure products. It is also keen to pay premium prices for NTFP that have been produced in an ethical and sustainable manner.

Sustainable production

Accessing such value added conscientious consumer markets offers great potential for achieving livelihoods standards that are far greater than could be achieved through agriculture or livestock production in semi arid areas.

Unfortunately, while NGOs are well suited to building communities' capacity to more sustainably harvest and produce, they are not well suited to the business aspects of ensuring that markets are accessed.

What is needed?

- Stronger public/private partnerships
- NGOs and private businesses should work together to build on their own individual strengths
- NGOs for improved ethical and sustainable production and businesses for market access.

Spearheading this approach are a number of dynamic initiatives such as

- CRIAA in Namibia
- Phytotrade in Zimbabwe
- CP Wild in South Africa
- IUCN's There is Another Way that works in southern Africa
- ASNAPP in southern Africa
- *icipe* and BridgeWorks in East Africa
- Kenya Gatsby Trust, KOAN and Wild Living in Kenya.

These initiatives are successfully building the necessary bridges between the public and private commercial sectors that is required to access value added conscientious consumer markets. Examples:

- Ewaso Nyiro Irrigation Project and Meru Herbs Ltd
- EU Baringo Aloe Project working with Land Maw Ltd.
- WWF and Oxfam working with Kenya Gatsby on Good Woods
- *icipe* working with Biop and Bridgeworks on herbal medicine
- Phyto Trade Africa working with Body Shop on essential and carrier oils.

Successful models such as these are based on value adding products within Africa. Rather than selling raw products, processing and packaging results in greater economic values being transferred to communities.

Potential products

Gum arabic

Gum arabic is still sold in raw product form for US\$ 0.40 per kg to international processors who sell for US\$ 16 per kg.

Wild chanterelle mushrooms

While the coastal and miombo areas of the region produce large quantities of this mushroom, none is currently exported to European markets where US\$ 12 per kg is paid.

Requirements

Accessing value added conscientious consumer markets requires:

- Attaining ethical production
- Attaining sustainable production
- Improving quality control
- Improving processing
- Improving packaging
- Improving market presence
- Selling the story behind the product.

Conclusions

Stepwise attainment of these improvements is required. To achieve these improvements small community based NTFP producers need to be selling and creating revenue. With a proportion of this revenue stepwise attainment of improvements can realistically be achieved. Each stepwise improvement opens the door to increased conscientious consumer markets.

STATUS OF APICULTURE IN SOUTHERN SUDAN AND STRATEGY FOR HONEY MARKETPLACE DEVELOPMENT

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Abstract: Beekeeping in Southern Sudan is traditional and needs development. There is promise of a viable beekeeping industry in Southern Sudan. Western Equatoria alone is unmatched in production in the EA region. The Peace Through Development Initiative (funded by the USAID) supported beekeeping for income generation and job creation as a priority need in most counties of Southern Sudan. Currently, *icipe* is involved in improving beekeeping in Southern Sudan through training, provision of equipment, honey marketplace development in Maridi and marketing assistance.

Beekeeping

Peace Through Development Initiative identified beekeeping development for income generation and creation of jobs as a priority need in most counties of Southern Sudan.

The USAID and partners through STAR commissioned an assessment activity to outline appropriate and sustainable development strategies for the beekeeping sector in 1999. Western Equatoria was picked for a Sector Analysis Study in 1999.

Key findings

Production

- Western Equatoria is potentially one of the most productive beekeeping areas in eastern Africa.
- The honey (50–90%) produced comes from honey hunting and traditional fixed comb hives (Figures 1 and 2).
- Honey quality is excellent but practices such as poor harvesting, handling and processing tend to spoil it.

Case study: Richard's honey production activities

Richard, a member of NSHPA is a married man with 9 kids. He relies on honey production as a cash crop. During the March–May 2004 honey season, he collected 1154 kg of grade I honey from 140 traditional bark hives (see Figure 1). The honey earned Richard over US\$ 500. This amounts to a year's wages of a worker in Southern Sudan.



Figure 1. Hives found in Southern Sudan: (a) traditional bark and (b) traditional basket type

Marketing

- Honey is a very important commodity in Southern Sudan. It is used as a cash crop, as a sweetener in coffee, tea and porridge, for medicinal purposes, for local brew and as a commodity for barter. Sugar was found to be eight times more expensive than honey/kg
- Large quantities of honey are available at US\$ 0.31–0.70/kg compared to producer prices in the following EA countries:
 - Kenya = \$1–1.5/kg
 - Somalia = \$3–10/kg
- Beeswax is discarded although valued at US\$ 3.4/kg (Kampala) and US\$ 3/kg (world market).

Key recommendations

A project be set up to:

- Develop beekeeping in S. Sudan (production and marketing)
- Work with honey hunters and beekeepers and assist them in introduction of appropriate technologies, provision of relevant skills, and establishment of demonstration apiaries using modern hives and protective gears
- Assist beekeepers develop local market, and find regional and international markets through regional partners
- Discourage beekeeping practices that are destructive to the environment (smoking, debarking). This will encourage sustainable utilisation of non-timber forest products.

Response actions

- A beekeeping commercialisation project in S. Sudan and development of local and regional products markets (USAID/CRS in 2000)
- Development of apiculture and sericulture in S. Sudan using value chain approach (*ticipe*/CIP–IFAD in 2006).

The pilot beekeeping commercialisation project

Aims

- Support local beekeepers (NSHPA now SSHPA) and SINGOs (Equatoria foods, now Organic Foods Enterprise) with equipment and training to develop beekeeping in Maridi and other potential production areas
- Market 10 metric tons of honey and 1 metric ton of wax from S. Sudan in local and regional markets by the end of 2007.

Outputs

- Between January–June 2000 NSHPA members were trained
- In June 2000 NSHPA collected 15 metric tons of comb honey; 12 metric tons were marketed by July/ August 2000 in Uganda and Kenya
- Between July 2000 and April 2001, 23.2 metric tons of honey were marketed in Uganda and Kenya
- In November 2001, an additional 10 metric tons of honey were marketed in Kenya.

IFAD Honey Marketplace, Maridi

Status

- *icipe*/CIP commitment:
 - Funds allocation (2006)
 - Visit to Southern Sudan by the CIP team in August 2006.
- GOSS/MAF commitment:
 - Allocation for transport of project materials and equipment from *icipe* to the sites.

Achievements

- MoU between CIP-*icipe* and MAF-GOSS concluded
- Project site identified in Maridi for honey marketplace
- Three MAF staff trained
- Upgrading of marketplace in progress, to be completed by early 2007
- Production of 20 tons comb honey in Southern Sudan in May 2007 (harvest March/April 2007).

Conclusion

- Beekeeping in Southern Sudan is traditional and needs development. We commend USAID/CRS and *icipe*/CIP for their initiatives
- Western Equatoria alone was unmatched in honey production in the EA region
- There is promise of a viable beekeeping industry in Southern Sudan and so we extend an invitation to come and assist.

PROSPECTS FOR THE DEVELOPMENT OF ORGANIC WILD AND MULBERRY SILK PRODUCTS

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Abstract: Sericulture (wild and mulberry silk farming) technologies promote the conservation and utilisation of natural resources, which are being depleted rapidly. Both technologies suit the African climate and are environment friendly with high potential for income and employment generation, which are the need of the hour for Africa. In an extensive survey conducted for wild silkmoth species in East Africa, 65 species were recorded which indicates the wide diversity and the likelihood of success with wild silk farming. Out of these 65, 4 species have been studied in the context of commercial silk production. *Gonometa postica* and *Argema mimosae* cocoons were processed and high quality fabric produced. New mulberry silkworm hybrid races were also evolved for high quality silk fibre and fabric. Organic products are in high demand and they add more value to the products as compared to the non-organic products. Degumming and dyeing are the major operations in silk processing. Use of various natural dyes for dyeing and fruit enzymes with sodium carbonate for organic degumming compared with synthetic dyes and conventional degumming agents add value to the silk fabric. Diverse products of wild and mulberry silk fabric were produced and their market potential assessed through an exhibition and trade fairs. The present paper deals with possible exploitation of organic silk fibre for developing high value silk fabric and by-products. The study also evaluates the feasibility of organic silk farming through eco-prescription from production to processing with creation of market for better livelihood of silk growers and conservation of wild flora and fauna in African forests.

Introduction

Organic farming is a practice that provides ecological sustainability and high diversifying farming systems that are productive. It eliminates the application of hazardous chemicals during production and processing. It emphasises on sustainable soil management, plant protection and livestock management through proper cultivation, use of vermin-compost, or livestock manure, limited use of biopesticides and prohibition of chemical pesticides and fertiliser. Application of bio- and mechanical control techniques for management of pests and weeds plays an important role in organic farming. Minimum conversion period from a conventional to an organic farm is 12 months.

Mulberry silk has been a highly valued commodity for thousands of years. The majority of silk involves the rearing of *Bombyx mori* L. on mulberry leaves. All the activities involved in pre- and post-cocoon technology are environment friendly. In East Africa, surveys have shown the existence of diverse species that can produce wild silk cocoons [1,2]. The potential for promising wild silkmoth species has been validated and is currently being studied for more value addition and prospects of introducing organic silk farming and silk products through application of organic norms in both wild and mulberry silk farming [3,4]. The organic international market is expanding continuously and maximum retailed organic certified products are sourced from developing countries. International demand for organic products is increasing every year and the returns are comparatively high compared to those of conventional products. The European market demand for eco-friendly textile products is growing. The price premium is very high and can certainly contribute to improved livelihoods in rural and semi urban areas. Therefore, to sell organic sericulture products with organic label, organic certification is important.

What is sericulture? Can silk farming fit in the organic agriculture system?

Sericulture is an agro-based cottage industry. It is eco-friendly and highly labour-intensive and much suited to the economy of developing countries like Kenya, which face the enormous problem of creating gainful employment to the growing labour force in rural and peri-urban areas. In the silk producing sector, reeling, spinning, dyeing, warping, weaving, finishing and processing of silk fabric provides employment to a large number of people. In sericulture, all activities are environment friendly. All over the world, ecological considerations are becoming important factors in the production and marketing of consumer goods, including textiles. Eco-friendly textiles require eco-prescriptions right from cultivation/production and processing of fibre and fabric. Cultivation of wild silk host plants serves in balancing environmental ecology and food for silkworms. Since the culture of wild silkworm *Gonometa* sp., *Argema* sp. and *Anaphe* sp. by and large takes place in forest areas and the use of chemical fertiliser, pesticides and hazardous chemicals is almost absent, it fits very well in the organic system. Both mulberry and non-mulberry silk can fit in the organic agriculture system.

Organic wild silk farming

Wild silk farming is an outdoor activity and is exposed to nature, which puts wild silk farming to uncertainty in respect of production. *icipe* has studied the population dynamics of wild silkworms in selected locations. *Gonometa* and *Argema* species have two generations per year and the emergence of the adult synchronises with sprouting of leaves on the host plants. The larval stages require 50–70 days to complete the life cycle. Application of net sleeves to the branches during early larval stages and sprinkling of natural pesticides (e.g. neem) has been introduced around the base of host trees to avoid attack by parasites, ants and other arthropods.

icipe's commercial insects programme has developed an innovative wild silk farming system for conservation and utilisation of natural resources and to assist the rural poor attain better livelihoods. Most of these people stay outside natural forests. This technology is based on production-oriented strategy through on-site farmer participation, training and demonstration of wild silkworms. To achieve the growth of the wild silk sector, emphasis has been given on applied and basic research based on field surveys and transfer of technology. Factors affecting production from these mechanisms have been devised to protect species and harvest cocoons. Effective innovative processing methods for fibre and fabric have been developed and introduced to the communities (see Figure 1).

Achievements of the CIP in wild silk

Over 60 species have been identified in East Africa. Out of these, 4 species, viz. *Gonometa postica* (Lasiocampidae)—host plant *Acacia* spp.; *Argema mimosae* (Saturniidae)—host plant *Sclerocarya birrea*; *Epiphora* (Saturniidae)—host plant *Zizyphus mucronata* and *Anaphe panda* (Thaumetopoeidae)—host plant *Bridelia micrantha*, showed potential for natural silk fibre and fabric production. Wild silkworm ecology and biology, food plant availability and distribution have been studied and community awareness training carried out. The most promising, *Gonometa* sp., is now being exploited commercially without damaging the environment. *Gonometa* is found mainly in Mwingi, Uasin Gishu and Malindi districts of Kenya. This species mainly survives on various *Acacia* spp. Semi-domestication activities are in progress to enhance populations by protecting them from parasitoids and predators in the field. Successful field trials have been conducted and postharvest studies carried out in *icipe's* research laboratories showed that *Gonometa* cocoons have a continuous filament like *B. mori* that can be reeled. (It produces long filaments of 900 m per cocoon.) However, to conserve these species, spun silk reeling has been introduced,



Gonomete sp.



Semi-domestication involves protecting *Gonomete* sp. cocoons from dipteran and hymenopteran parasites



Argema mimosae



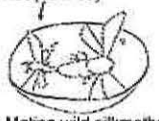
Gonomete sp. raw silk fibre



Gonomete sp. silk thread on bobbin



a. Hut (10 x 10)



b. Mating wild silkmoths in earthenware pot (Late Sep-Oct)



c. Egg laying by female (Late Sep-Oct)



d. Uniform hatching of larvae at room temperature (Oct-Nov)



e. Feeding larvae with tender *Acacia* leaves (Oct-Nov)



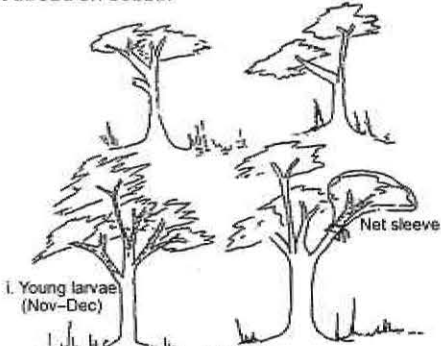
h. Covering larvae with net sleeve (Nov)



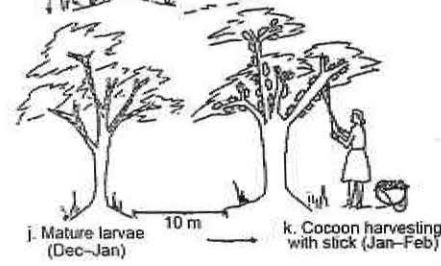
g. Tying the twig holding larvae to an *Acacia* tree (Nov)



f. Transfer of larvae to *Acacia* twig (Nov)



i. Young larvae (Nov-Dec)



j. Mature larvae (Dec-Jan)

k. Cocoon harvesting with stick (Jan-Feb)

Wild silkmoth grainage and farm release process

Wild silk farming and harvesting of cocoons

Mortality of *Gonomete* sp. during larval growth in a cage on *Acacia elatior* in Mwingi

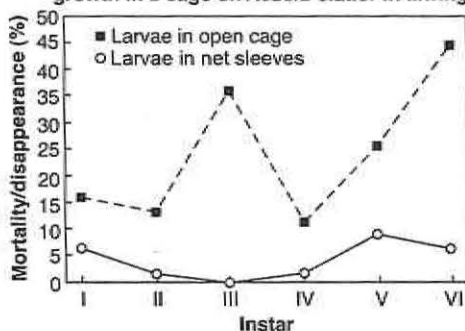


Figure 1. Forest conservation through wild silk farming

where only empty cocoon shells are utilised and moths are allowed to emerge for breeding and enhancing the population. Simple degumming techniques using fruit extracts, natural enzymes and sodium carbonate have been introduced for obtaining spun silk. The spun silk is produced through carding on locally manufactured spun reel (Figure 2). The silk thread

with uneven denier is used for spun silk cloth (Figure 2). All operations are done manually. Several self-help groups have received basic training from *icip*e. Many others are joining this new venture and are being trained at marketplaces for product development and forest conservation.



Figure 2. Spun silk cloth: (a) carding of wild silk floss, (b) spinning and (c) weaving

Organic mulberry silk farming

Mulberry silk farming is an indoor activity and rearing of silkworms is carried out in a rearing house under controlled temperature and humidity conditions. One acre (0.4 hectare) of land is recommended for mulberry silk activity. Prior to the bi-yearly rains, the land is prepared and 7 tons of manure mixed with soil. In fertile soil, mulberry is planted at a 3 x 3 feet (0.91 x 0.91 m) spacing and in soil with low fertility at 2 x 2 feet (0.61 x 0.61 m). *icip*e has screened 8 mulberry varieties and recommended Thailand, Kanva-2 and Thika for good rainfall conditions while Embu is a drought resistant variety. In 7–8 months, mulberry plants can support the rearing activity and can remain productive for 12–15 years. A mud house (25 x 20 x 10 feet [7.62 x 6.1 x 3.05 m]) with good cross ventilation to rear silkworms and appliances with locally made materials are preferred. The larval lifespan is 26–30 days. Larvae spin cocoons 2–3 days after maturation and thus one can rear 5–6 cycles in a year. In conventional silk farming, chemical fertilisers, insecticides, pesticides and fungicides are commonly used to control mulberry pests and diseases. However, the organic practices strictly prohibit this. One of the project sites in Eldoret selected organic mulberry silk farming and a 2-year-old organic farm was used for mulberry cultivation. Mulberry grows luxuriantly with manure and compost organic fertilisers as compared to chemical fertilisers and produces high quality cocoons. However, control of pests and diseases requires more emphasis on biocontrol and mechanical control techniques. The economic traits for cocoons were studied and found satisfactory (Figure 3). The conventional farms can be

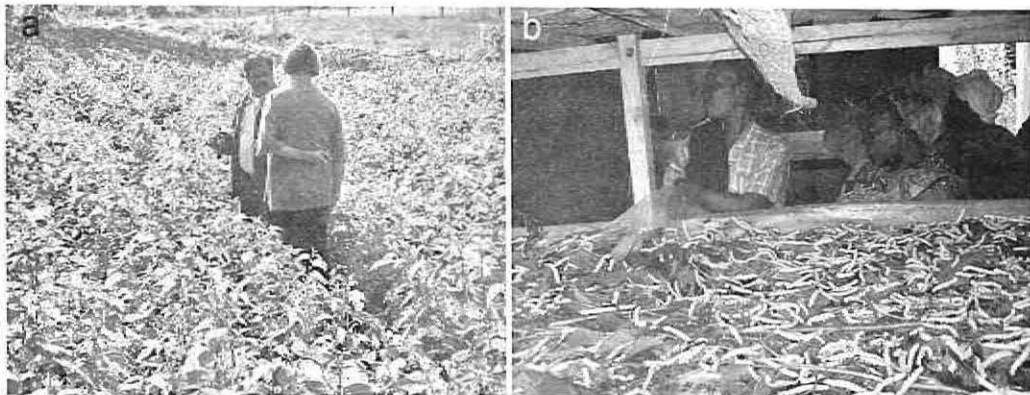


Figure 3. Mulberry silk farming: (a) mulberry farm and (b) silkworm rearing

converted into organic farms in 12 months by applying livestock manure, compost and vermicompost and avoiding chemical fertilisers. Application of biopesticides/fungicides at minimum level and adopting mechanical and biocontrol strategies are essential for control of diseases and pests in mulberry farms. Neem cake and extracts have been introduced to protect the diseases and pests in the field.

One of the major constraints facing upcoming sericulture industry in Africa is dependency on Asian partners for disease-free silkworm eggs supply. To support sericulture industries through supply of high yielding bivoltine silkworm, *B. mori* hybrid strains—ICIPE1 and ICIPE 2—have been developed for supplying silkworm eggs to the farming communities of East Africa. After screening the silkworm breeds, potential hybrids are being developed for various agroclimatic conditions. *icipe* has developed silkworm grainage (a place for facilitating the production of quality silkworm eggs). This unit is well equipped with facilities for egg production, preservation, moth examination and processing of eggs. The objectives are development of new hybrids and production of quality silkworm eggs to attain self-sufficiency.

Farmers are being trained at *icipe* and on-site for mulberry silk farming, which has enhanced the hectareage in mulberry plantation and also in production of cocoons. Simple rearing techniques like shoot rearing and cocoon drying, and storage systems have been introduced to the farming community. More emphasis is given on using a central marketplace for communities with all processing facilities. Community ownership to the marketplace brings self-confidence among the community and avoids the role of the middleman in this microenterprise. Our approach is quality product oriented as it is only quality that sells and develops confidence in consumers.

Achievements of the CIP in mulberry silk farming

Degumming agents

The Commercial Insects Programme has introduced various ecofriendly degumming agents such as fruit extracts (pineapple and papaya) and natural enzymes with sodium carbonate. The silk fibre consists of two main proteins, i.e. sericin and fibroin. The gummy protein has to be removed before spinning or reeling in wild silk as well. The percentage of sericin and fibroin has been estimated in different wild silkworm species and bivoltine silk cocoons. *Gonometa* showed the highest level of sericin (38–40%), followed by bivoltine mulberry silk (22–24%) and lowest in *Argema* sp. (18–19%).

Natural dyes for organic silk fibre and fabric production

Over 50 trees and shrubs from three project sites in Kenya were tested for dye source and their performance against bivoltine silk fibre and fabric was assessed. Our studies on natural dyes with eco-friendly mordants exhibited better performance on silk fibre in Kenya. This investigation is a step in building eco-technology in silk dyeing to avoid hazardous carcinogenic azo dyes.

Appropriate technology

To promote rural communes, paddle reeling and hand-spun, handloom technologies were introduced in field sites after successful trials in our laboratories.

Introducing various value added products through wild and mulberry silk blends

The quality tests for economic traits such as colour fastness, light fastness, abrasion and tensile strength are being studied. The samples produced have been exhibited in various trade fairs and the local market through the marketing partners, Viking Ltd, Kenya. The response

for organic silk cloth is immense and can certainly fetch a high income as compared to other fabric. This innovative approach has many advantages. The main ones are to conserve the degrading forests, flora and fauna and to generate income. It also helps in protecting the environment as all activities involved are pollution-free. All technologies introduced are very simple and easily adapted by the community and are gender sensitive and suitable for both women and men. The equipment can be operated without electricity. These products, from forest adjacent rural communes, can be branded with the geographical distribution and special characters of the fabric to gain more income (Figure 4).



Figure 4. Post-coocoon operations involved in mulberry sericulture: (a) reeling, (b) degumming, (c) weaving, (d) natural dyes, (e) finished silk, (f) fibre and thread and (g) fabrics

Economic impact

- From *icipe's* experience in Kenya and Uganda, the development of a marketplace gives farmers an opportunity to add value to their products, to bulk them and to have a strong bargaining power for their products. For example, with wild silk, a farmer receives US\$ 3 for a kg of live cocoons (about 200 cocoons). Hence 16,000 cocoons obtained by an average farmer can make 80 kg, fetching US\$ 240. There are two silkworm seasons in a year. If the 80 kg of cocoons are converted into silk, 30 kg that can make up to 200 metres of silk are obtained, which can fetch up to

US\$ 2754 at the rate of US\$ 14 per metre. If further value addition is undertaken by converting the cloth to shirts and tops, it can give 95 of them worth US\$ 4085 (at a rate of US\$ 43 per item).

- One hectare of mulberry plantation can produce 500 kg of silk cocoons in 5 rearing cycles per year and yield 70–75 kg of raw silk and generate a net income of US\$ 1600. This raw silk (70 kg) when converted into silk yarn by the throwing process (twisting, doubling, winding and warping) weave on the loom, can yield about 600 metres of silk cloth, which can generate an income of US\$ 4900 when sold at the rate of US\$ 7 per metre.

Conclusion

Sericulture is a labour-intensive rural industry and requires a low gestation period and income starts in 6–8 months after mulberry cultivation. It involves simple techniques that are easy to adopt by farmers. Sericulture by-products like mulberry twigs, silkworm litter, pierced pupae and unreelable cocoons, and reeling waste are useful and generate income. Silken pelade basin waste can be used to produce fibroin powder as a health protein food.

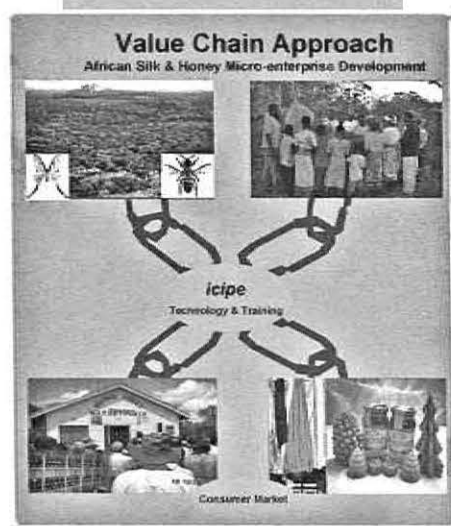
Organic silk farming is eco-friendly and has a high potential as all wild silk is grown in the forest and no chemicals are spread. The technology applied is very simple and focused on conservation and utilisation. Thus, the technology is protecting natural fauna and flora with the added boon of income generation to the communes around forests. Mulberry sericulture is an agro-based cottage industry and can also be used for wasteland management, agroforestry and, importantly for livelihood improvement in developing countries. By adapting eco-prescription from the first step, it is possible to get value added diverse organic silk products, which can certainly compete with the other products in the market. Quality products are the key for success and certification from organic bodies is mandatory to release the product with an eco-label. Silk is certainly a product with a bright future, not only for Kenya, but for other African countries as well.

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SESSION 4

Improvement of productivity
of silk- and honey-based
products through research
and development (R&D)



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COMMERCIAL INSECTS PROGRAMMES IN A FOREST BUFFER ZONE CONTEXT

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Abstract: Protected areas are essential to conserve watersheds, biodiversity and wilderness. But they create conflicts. However, buffer zones provide an arena for resolving these problems. Buffer zone management aims to maintain and enhance ecosystem services among many other reasons. Commercial insects, and the revenues they generate, provide compensation for lost access to resources, incentives for participation in joint management, opportunities for sustainable utilisation of protected areas resources, motivation for conservation, and alternatives to illegal activities.

What is a buffer zone?

A buffer zone (Figure 1) is any area, often peripheral to a protected area, inside or outside, in which activities are implemented or the area managed with the aim of enhancing the positive and reducing the negative impacts of conservation on neighbouring communities and neighbouring communities on conservation [1].

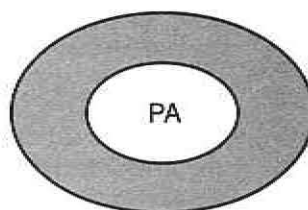


Figure 1. A protected area (PA) and the buffer zone

Why are buffer zones important?

Protected areas are essential to conserve watersheds, biodiversity and wilderness. But they create conflicts such as:

- Resource denial
- Crop raiding and injuries from wildlife
- Illegal activities, poaching
- Land hunger.

Leading to:

- Poverty in adjacent communities
- Habitat degradation
- Excision threats.

Management goals

Buffer zones provide an arena for resolving the above problems.

Buffer zone management aims to:

- Be embedded in participatory planning processes
- Maintain and enhance ecosystem services
- Support and introduce sustainable agricultural practices
- Mitigate human-wildlife conflicts
- Reduce and eliminate unsustainable resource extraction rates
- Expand, modernise and introduce alternative and non-traditional livelihoods
- Promote sustainable PA-based income-generating activities
- Facilitate financing and market linkages
- Include awareness-raising and educational activities
- Support measures to improve human and reproductive health
- Facilitate participatory monitoring and joint adaptive management.

Role of commercial insects

Commercial insects, and the revenues they generate, provide:

- Compensation for lost access to resources
- Incentives for participation in joint management
- Opportunities for sustainable utilisation of PA resources
- Motivation for conservation
- Alternatives to illegal activities.

Why commercial insects are ideal for buffer zone income generating

Activities

- Quick returns to farmers
- Sustainability
- Good fit to other livelihood options
- Little demand on land
- Opportunities to utilise wild biodiversity
- Educational activities
- Attract media attention.

Synergies

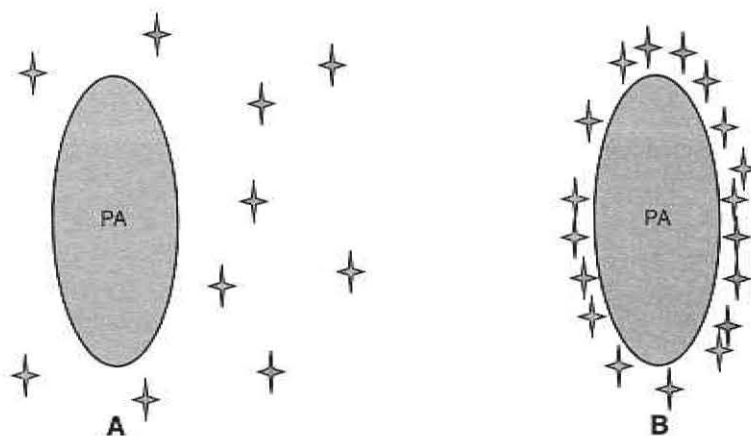


Figure 2. Commercial insects farming in buffer zones: **A**, protected area before buffer zone establishment and commercial insects farming, and **B**, the synergy achieved after commercial insects farming in the buffer zone leading to increased benefits

Take home message

If you develop your commercial insects enterprises in a buffer zone context, you multiply the benefits both locally and nationally.

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STATUS OF THE MULBERRY GERmplasm BANKS AND SILKWORM RACES IN EGYPT

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Abstract: The Governor of Egypt attempted to promote the development of the sericulture sector during the early nineteenth century by planting over three million mulberry trees in Delta region. These trees, of the local variety *Morus alba* var. *rosa*, are distributed along the canals and roadsides. They are largely used for shade and fruits in addition to feeding silkworm larvae in traditional rearing. The quality and quantity of the leaves is poor. The Sericulture Research Department (SRD) has been developing sericulture in Egypt by importing many varieties of mulberry from different countries and has established germplasm banks in two sites with 56 mulberry varieties. Also, a silkworm-breeding programme has been started to isolate pure lines of *Bombyx mori* L. However, the SRD still requires technical support to establish silkworm eggs production station (grainage).

Introduction

Egypt is located in a temperate zone and a climate with brief variable spring and autumn seasons. Winter is about 18 °C with low annual rainfall of about 25 mm. Summer is hot with low humidity because of the surrounding deserts with average temperature of 34 °C.

Mohamed Ali, the Governor of Egypt, attempted to promote the development of the sector by planting over three million mulberry trees in Delta region. These local varieties of *Morus alba* var. *rosa* are distributed along the canals and roadsides. They are kept largely for shade and fruits. They are also used in feeding the silkworm larvae in traditional rearing. The quality and quantity of the leaves is poor. In traditional rearing the leaf crop of 5–6 huge trees is sufficient for rearing one silkworm box. Local production of raw silk is not sufficient for domestic demand. So, Egypt covers its requirement from abroad. There are some new investors in sericulture adopting the recent technology.

Sericulture in Egypt

The Sericulture Research Department (SRD) is the organisation responsible for promoting and supporting sericulture in Egypt. It is dedicated to promotion of silk production and scientific research. The SRD is a division of the Plant Protection Research Institute of the Agricultural Research Centre of the Ministry of Agriculture and Land Reclamation. The SRD is based in Giza Governorate and has four small branches in Alexandria, Sharqiyah, Kafer Elshykh and Dakahlyia Governorates and a small experimental station of 4 feddan (1 hectare = 2.4 feddans).

Mulberry germplasm banks

Egypt has mulberry germplasm banks in two sites, at the Sericulture Research Department (with 56 mulberry varieties), and also at the Genetic Engineering Institute of the Agriculture Research Centre.

Silkworm breeding

The Sericulture Research Department started a silkworm breeding programme to select pure lines from some varieties available at the SRD. Some of them are monovoltine varieties which were imported from Italy a few years ago. Also, some bivoltine hybrids were imported from South Korea. Cocoon shape, cocoon weights, shell and shell ratio were taken into consideration.

This programme has faced many problems including the following:

- SRD has no postharvest laboratory
- This programme must be extended to include isolation and selection of pure lines resistant to diseases, high temperature and climate fluctuations. We thus need technical and financial support
- Also, SRD has a very simple and old diseases laboratory, so it must be reinstalled.
- A small grainage must be set up to produce silkworm eggs suitable for spring, summer and autumn. They must also be suitable for Delta Region, Upper Egypt and reclaimed land areas which exhibit different climate conditions.

Conclusion and recommendations

- A modern laboratory of postharvest and diseases control must be installed.
- The breeding programme must extend to create varieties suitable for each season, and varieties suitable for Delta, Upper Egypt and reclaimed land areas.
- Isolate varieties resistant to diseases and bad conditions and with high productivity.
- Establish germplasm bank of different silkworm races.

HARNESSING WILD SILKMOTH BIODIVERSITY FOR ENVIRONMENTAL CONSERVATION AND INCOME GENERATION

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Abstract: Africa is increasingly seen as a real centre of globally significant biodiversity. The biodiversity of Africa supports the livelihoods of nations and rural and urban households alike. Biodiversity is the foundation of national and local economies. It provides resilience to cope with frequent environmental perturbation and stress and can be used to strengthen livelihoods. African wild silkmoth species diversity has been documented and the potential of these species to give quality silk has been reported. These species offer an opportunity for diversifying the sources of income for rural communities living adjacent to fragile ecosystems. Wild silk farming requires minimal expenses when compared with other agricultural endeavours yet encourages sustainable utilisation of natural resources. Some of the basic requirements for setting up wild silkmoth farming are discussed in this paper with reference to species recorded in East Africa.

Introduction

Sustainable management and development of fragile ecosystems lies in the rational use of the existing biodiversity. Support should be given to enhance conservation responsibilities of the local communities. National governments and international agencies can help to provide technical guidance while giving the authority and benefits for conservation to local communities and institutions. Most communities across Africa have organised structures that can be used as entry points for conservation efforts. To save the declining biodiversity, there is need to provide economic incentives to the rural communities for conservation. Some studies suggest that the economic incentives for biodiversity conservation carry an additional advantage of leading to voluntary changes in behaviour rather than forced changes [1]. Wild silk farming is eco-friendly, provides quick and significant rewards, uses forest resources in a sustainable way and provides other services and products [2,3,4].

How to determine the species diversity in a country

Natural history collections

Natural history insect collections can be useful in getting records of wild silkmoth species. These can be found in museums, national forest and agriculture research institutions, universities and other national or private insect collections.

Field surveys

This involves field surveys for the different types of cocoons found in an area. Once the cocoons are collected, the live ones can be kept in well-ventilated containers to await the emergence of the moths. The moths can be pinned and identified at museums. Once the species is identified, the details on food plants can be obtained from the literature or even from further field observations. Table 1 shows some of the records from various parts of Kenya [5,6].

Fifty-eight species of silkmoths were recorded in a survey done in Kenya, Uganda and Tanzania [5]. Of these, the family Lasiocampidae had the majority of species (Table 2).

Table 1. Some cocoon forming species of moths recorded during field surveys in Kenya

Silkmoth species	Family	Locality	Host plant
<i>Gonometa postica</i>	Lasiocampidae	Nguni, Mwingi; Sultan Hamud, Makueni	Silkworms feeding on <i>Acacia elatior</i> , <i>A. senegal</i> , <i>A. mellifera</i> , <i>A. nilotica</i>
<i>Gonometa postica</i>	Lasiocampidae	Kamaguti, Uasin Gishu	Silkworms feeding on <i>A. hockii</i> , <i>A. mearnsii</i>
<i>Eucraera</i> sp.	Lasiocampidae	Kamaguti, Uasin Gishu	Cocoons collected on <i>Carissa edulis</i>
<i>Epiphora</i> sp.	Saturniidae	Kakamega forest; Kilifi; West Pokot	<i>Ziziphus</i> sp.
<i>Anaphe panda</i>	Thaumetopoeidae	Kakamega forest	<i>Bridelia micrantha</i>
<i>Lechriolepsis pulchra</i>	Lasiocampidae	Kakamega forest	Unidentified shrubs
<i>Argema mimosae</i>	Saturniidae	Makueni; Malindi	<i>Sclerocarya birrea</i> , <i>Spirostachys venenifera</i> , <i>Lannea schweinfurthii</i>

Understanding the life cycle of wild silkmoth species

To develop wild silkmoth farming, life cycle information is very important (Plate 1). By understanding the life cycle, the species and its food plants can be conserved and the community helped to utilise it for income generation. The duration of each stage and factors affecting the development can be understood by undertaking field studies. Table 3 shows the life stages of *Gonometa postica* in Nguni, Mwingi and Table 4 some of the cocoon parameters. These are important in understanding the silk production of the species [7,8].

Table 3. Mean development period for the different *Gonometa postica* life stages on *Acacia elatior* in Nguni, Mwingi

Life stage	Mean development period in days \pm SE
Egg	11.3 \pm 0.1
Larva	53.5 \pm 6.2
Pupa	95.9 \pm 16.5
Adult moth	6.4 \pm 3.2

Table 2. Diversity of wild silkmoth species recorded in three families in East Africa

Family	Genera	Species
Lasiocampidae	17	33
Saturniidae	6	19
Thaumetopoeidae	1	6

Table 4. Mean weight and size of female and male *Gonometa postica* cocoons in Nguni, Mwingi

Variable	Females	Males
Weight (g)	8.83 \pm 2.77 a	3.44 \pm 0.91 b
Length (cm)	5.38 \pm 0.63 a	4.16 \pm 0.37 b
Width (cm)	2.26 \pm 0.30 b	1.67 \pm 0.20 b

Means \pm SE followed by a different letter in the same row are significantly different (t-test $P < 0.05$).

Capacity building for sustainable wild silkmoth farming and production

Sericulture is relatively new in most African countries. As such, training is key for sustainable development. Training at the research, extension, community trainers and the community based organisations levels is needed. The training should go beyond production and engulf postharvest technologies, processing, product development and marketing so that at the end of the process, the local communities are able to reap benefits from the enterprise.

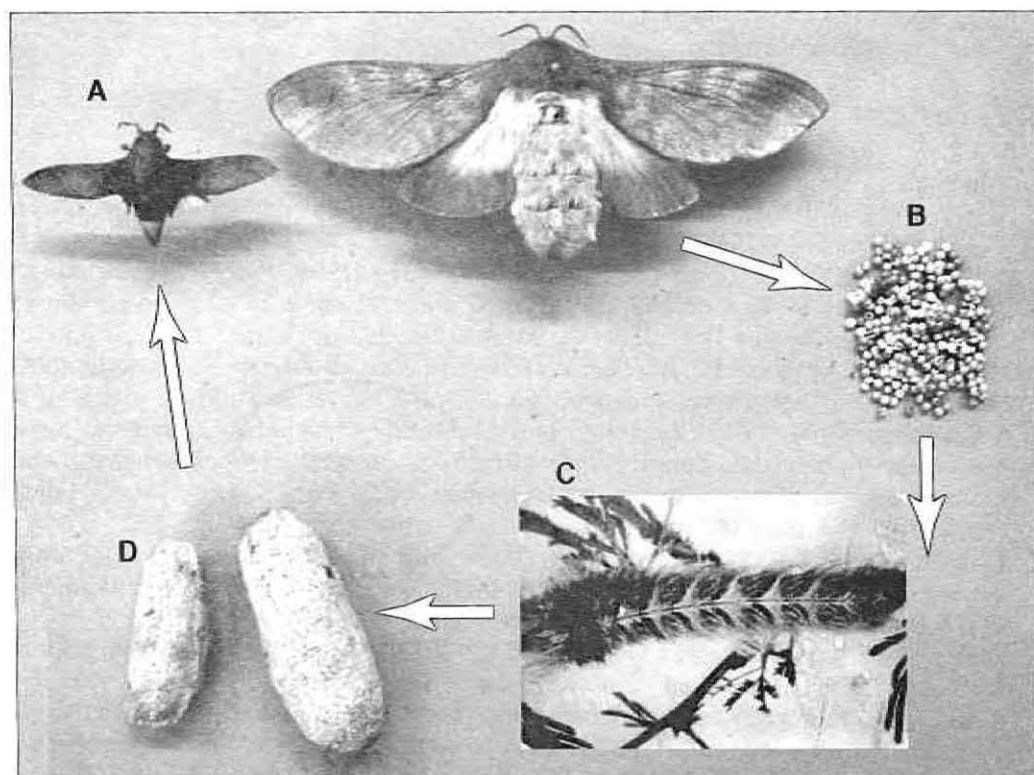


Plate 1. Wild silkmoth life stages: (A) Male and female moths; (B), eggs; (c) 5th instar silkworm on acacia; and (D) female and male cocoons

The conservation link

Wild silkmoths require food plants and the planting of these should be a key component in the farming activity. Other than providing food for the wild silkworms, the trees will have other benefits such as soil erosion control, protection of water catchment areas and improved biodiversity conservation in general.

It should be noted that for wild silk farming to be sustainable, farming as opposed to wild harvesting is encouraged. Care of the silkworms (using net sleeves at early stages) and preservation of seed will ensure a continued population as opposed to depletion of the populations in the wild.

The Mwingi district experience

Research on the insect, *Gonometa postica*, is still ongoing. *icip*e collaborates with the Forest Department and the Ministry of Livestock production among other stakeholders to enhance wild silkmoth conservation and utilisation in the district.

The way forward for wild silkmoth farming

Each country in Africa can do the following:

- Explore the existing diversity of wild silkmoths and collect baseline data on the population levels and availability of food plants
- Establish the current state of ecosystems that can be utilised for conservation and utilisation of wild silkworm species.
- Determine the major challenges such as natural enemies.

- Establish links with other countries for collaboration in capacity building, branding and marketing linkages.

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QUALITY ANALYSIS OF SILK FIBRE AND FABRIC

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Abstract: The finest quality raw silk and the highest fibre production come from the commonly domesticated silkworm, *Bombyx mori* L. The steadily growing demand for silk in the silk consuming countries indicates excellent opportunities for any country to increase its silk production. To secure this opportunity, it is important for production of silk products to be of highest quality. In addition, for the success of this initiative there is need to focus on the silk production process and the product quality. The production of raw silk fibre from cocoons is a crucial middle stage in the silk industry. In this regard, analysis and testing of raw silk is essential for the production of quality silk fibre. Not only does the industry and government require testing of materials in ways that are accepted as reliable and standardised, but researchers also require a body of accepted tests for use in comparing data. To assure accuracy and replicability, textile testing should be carried out under carefully controlled conditions. Testing equipment must conform to specifications established in testing methodology and fabric specimens must be of uniform size.

Why test silk?

Quality control is not just to make judgment concerning the quality of product, but also to enable the producer to take the necessary steps to improve the product quality throughout the manufacturing process.

The rationale of testing silk and classification is to:

- Test quality of raw silk
- Determine the grade by the results of the quality tests.

From the above, testing silk and classification aids in establishing a standard for facilitating a fair and equitable transaction of silk and providing a standard to induce reelers to eliminate poor reelings and enable weavers to select appropriate lots. Testing of raw silk is essential for the production of quality yarn and fabric. It ensures efficiency and harmony in the production process and a final product of high quality. The properties of any fibre determine the performance of the fabric produced from it [1].

Silk fibre and fabric analysis

To illustrate silk fibre and fabric analysis, the quality of raw silk and fabric produced by three strains of the domesticated silkworm *Bombyx mori* L. (ICIPE I, ICIPE II and Chun Lei x Zen Zhu (C x Z) were evaluated.

Winding breaks

- The sample skeins were fitted onto the winding frame/reel and the end attached to a bobbin.
- Winding was carried out at an average speed of 110 metres/min.
- The number of breaks that occurred were counted.

Tenacity and elongation

- A sizing reel of 1.125 m in circumference (400 revolutions equal to 450 m) and a constant speed of 300 revolutions per minute is used to prepare the test sample
- A serigraph with a constant rate of extension (CRE)-speed (15 cm per min) was used to test the tenacity and elongation of the raw silk.

Cleanliness and neatness testing

- Cleanliness imperfections are classified as super major defects, major defects and minor defects. Each defect carries penalty points and the difference of the total penalty points from 100 gives the test results. The kind and class to which each defect belongs was determined by comparing it with the standard photographs for cleanliness defects.
- Neatness value was estimated in percentages. From 100 to 50 percent the estimate was made to the nearest 5 percent, while below 50 percent the estimate was made to the nearest 10 percent.
- Inspection for both tests was done in a dark room, from a position of 0.5 metres (2 feet) directly in front of the inspection panels.

Breaking load and elongation

- Fabric samples (350 x 60 mm) were prepared. (Five samples with warp yarns running in the direction of stress and the others with the stress in the filling direction.)
- The serigraph tension was equal to $1 \pm 0.25\%$ of the probable breaking load. The average breaking time should be 20 ± 3 seconds [2].
- Breaking strength in each direction was calculated by dividing the sum of observed values of breaking load in newton (N) by the number of observations.

Tear resistance

- Five samples warp-wise and the other five weft-wise were prepared. A sample was clamped onto an Elmendorf tearing tester and the pendulum raised to the starting point and the pointer set against its stop.
- A slit approximately 20 mm was started on the sample specimen leaving 43.0 ± 0.15 mm of fabric to be torn.
- The pendulum stop was depressed, releasing the pendulum. The stop was held until the tear was completed and the pendulum caught on its return wing by the hand without disturbing the position of the pointer.
- Average force in N was thus calculated as follows:

$$N = kg f \times 9.81$$

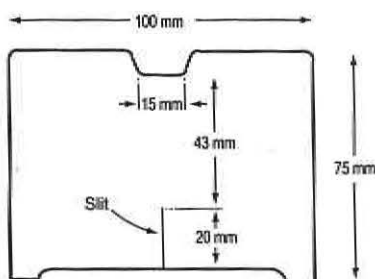


Figure 1. Silk sample for tear resistance test using the Elmendorf apparatus

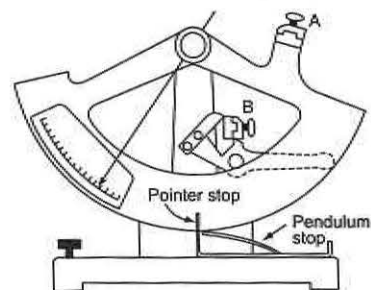


Figure 2. An Elmendorf tearing tester. A, pendulum; B, stationary member

Results

Winding break counts

Raw silk winding breaks varied among the different strains (Figure 3). Research shows that silkworm strains have varying characteristics in their spinning of silk thread.

Reeling errors become evident during this test.

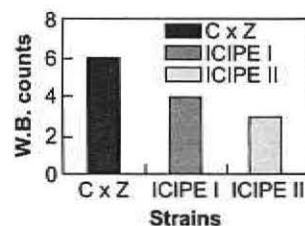


Figure 3. Winding breaks

Tenacity and elongation percentage

Tenacity of the three strains was within the ISA standards (Table 1). The elongation percentages compare with Lee [3]. The worker states that raw silk has an elongation of 18–23% of its original length. It was observed that silkworm strains having the highest elongation count had the least winding breaks and vice versa (Figure 4).

Table 1. Tenacity comparison

Strain	Tenacity (g/denier)
C x Z	3.78
ICIPE I	3.71
ICIPE II	3.75

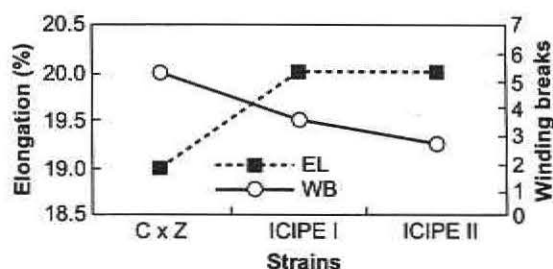


Figure 4. Elongation and winding breaks comparison (EL, elongation; WB, winding breaks)

Table 2. Mean cleanliness and neatness (%)

Strain	Mean cleanliness	Mean neatness
C x Z	94.4 ± 0.363 b	88.9 ± 0.194 b
ICIPE I	96.2 ± 0.359 a	92.9 ± 0.180 a
ICIPE II	97.0 ± 0.333 a	93.0 ± 0.184 a

Means followed by the same letter in the same column are not significantly different ($P < 0.05$).

Table 3. Breaking load per strain

Strain	Warp		Weft	
	Force (N)	El (cm)	Force (N)	El (cm)
C x Z	124.08	7.7	256.26	4.2
ICIPE I	124.18	8.1	256.43	4.3
ICIPE II	124.21	8.0	256.21	4.3

N, Newton; El, elongation.

Cleanliness and neatness percentages

ICIPE I and ICIPE II had no significant differences in their cleanliness and neatness means; however, C x Z had a significant difference in the two parameters (Table 2).

Research shows that a characteristic of the silkworm race may give rise to cleanliness and neatness defects. Aruga [4] attributes this kind of occurrence (neatness and cleanliness defects) to the technique applied in the cooking and reeling of cocoons.

Fabric breaking load and elongation

In this study, the average breaking load for warp yarns, of denier 20/22 ranged between 124.08 and 124.21N and the average breaking load for weft yarns of the same denier was between 256.21 and 256.43N (Table 3).

The strength of fibres and fibre structures is commonly regarded as the criterion of quality. One cannot overlook the production processes that silk undergoes. Damage may have occurred during the manufacturing process and hence have an effect on the strength results either by weakening or strengthening the fibres and fabric. Eyre [5] suggests that the production process is a factor that affects textile strength.

Tearing strength

There was no significant difference in the warp tearing strength among the strains; however, ICIPE II differed in the weft tearing strength (Table 4). The chemicals used for the degumming process may affect the strength of the silk fibres and consequently the fabric tearing strength. A change in any physical property and chemical composition of a textile material will nearly always result in a change in strength.

Conclusion

Silk is a natural fabric and for this reason, some irregularities do occur. During this study, it was established that there was a significant difference in the tearing strength among the silkworm strains. This may have been caused by the individual characteristics of the silkworms. Table 5 shows the classification of the raw silk tested.

In this study, it is significant to note that results of tests carried out were within the international standards.

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Table 4. Comparative tearing strength per strain

Strain	Mean tearing strength (\pm SE)	
	Warp	Weft
C x Z	393.89 \pm 7.325 a	313.97 \pm 4.677 b
ICIPE I	394.07 \pm 7.005 a	316.87 \pm 5.466 b
ICIPE II	395.30 \pm 7.022 a	320.13 \pm 7.006 a

Means followed by the same letter in the same column are not significantly different ($P < 0.05$).

Table 5. Classification of raw silk (19-33 denier)

Major Item	Strain		
	C x Z	ICIPE I	ICIPE II
Winding (breaks)	Class 2	Class I	Class I
Average neatness (%)	2 A	3 A	4 A
Cleanliness (%)	3 A	4 A	4 A
Elongation (%)	Class I	Class I	Class I
Tenacity (g)	Class I	Class I	Class I

MOLECULAR TOOLS FOR THE CHARACTERISATION OF HONEYBEE AND SILKMOTH POPULATIONS IN AFRICA

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Abstract: Molecular tools have a role in genetic studies of the population biology of honeybee and silkmoth populations. This paper covers the available molecular tools, why they are used and what can and has been accomplished through their use.

Introduction

These studies utilise the hereditary information in biology macromolecules; that is, proteins and nucleic acids to address questions such as organismal behaviour, kinship and phylogeny. Molecular tools rely on the variation within and among populations of a species and they are powerful tools to differentiate genome-wide and locus-specific effects. They are used to test for associations between phenotypic variation and genetic function in natural populations. Genetic markers detect much greater diversity of genetic polymorphism in a genus than phenotypic markers; they continue from where Mendel's experiments ended.

There exists a large number of distinct geographical races and inbred lines that represent variation for a number of quantitative and qualitative traits of basic biological and economic interest including silk quality, fecundity and pathogen resistance in both honeybee and silkworm to mention just a few.

Genetic marker technology methods used to identify genetic variation in natural populations include morphological mutants using recessive genes, and allozyme markers, which are variant forms of proteins. DNA markers, which are the more recent methods, include restriction fragment length polymorphism (RFLP), and those methods using polymerase chain reaction technology such as random amplified polymorphic DNAs (RAPD), amplified fragment-length polymorphisms [1], microsatellite or short tandem repeat markers and single nucleotide polymorphisms (SNP).

Honeybee and silkmoth population studies

What has been achieved?

In the silkworm *Bombyx mori*, which has been domesticated for silk production, molecular maps have been constructed in standard strains using RFLPs, RAPDs, STSs and microsatellites. A draft sequence of its genome has been sequenced [2]. The potential applications of molecular markers include stock identification, marker assisted selection (MAS), identification of quantitative trait loci (QTL), i.e. traits under polygenic control and positional cloning of both visible mutations and QTL.

The Honeybee Genome Sequencing Consortium has sequenced the honeybee *Apis mellifera* genome, which was completed in 2006 [3]. Molecular maps have also been constructed using RAPDs and microsatellite markers. These provide new insights into the origins of the honeybees and their spread throughout the world. SNPs have been developed and will be important for MAS and positional cloning of important genes such as those involved in economically important traits.

Technologies that have been instrumental in the collection of molecular data have been the PCR and RFLP recombinant technology. The PCR is a technology by which a gene sequence is quickly amplified, and it has applications in several fields such as genome

mapping, population genetics, gene expression studies, taxonomy and forensics among others.

The RFLP recombinant technology involves cutting (restricting) DNA with one or more endonucleases, separating the resulting fragments according to molecular weight by gel electrophoresis and visualising the size-sorted fragments. Variations produce characteristic banding patterns, which translate to the relatedness of species in a given population. AFLP selectively amplifies a subset of restriction fragments generated by the digestion of genomic DNA with two restriction nucleases. The PCR products are separated on polyacrylamide gel whereby the fragment lengths are proportional to the rate of their mobility in the polyacrylamide gel. Polymorphisms are then scored as differences in lengths of amplified fragments.

What can be accomplished through the use of these molecular tools in Africa?

In Africa, these molecular tools can be used to find the genetic diversity in wild silkmoth species that have shown potential in silk production such as the ones that are being used by the *icipe*, from the *Anaphe* and *Gonometa* species. Molecular markers can be used to tag genes affecting factors such as growth rate, yield, fibre quality and virus resistance for faster construction of genetically improved strains of economically viable wild silkmoths. The same markers can be used to measure the genetic diversity within and between wild silkmoth populations in Africa and fingerprint the economically viable strains, and for breeding and marker assisted selection.

Likewise in the honeybee, MAS can be used to produce improved strains or lines for traits that are important; for example, virus resistance and defensive behaviour.

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CHINESE ACADEMY OF AGRICULTURAL SCIENCES SUPPORT FOR ENHANCING SILK, HONEY AND HIVE PRODUCTS IN AFRICA

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Abstract: During the Beijing Summit and Third Ministerial Conference of Forum on China–Africa Cooperation, the need for economic cooperation between China and Africa was discussed. The two sides stressed the importance of agriculture in their respective economies and noted with pleasure the progress made in China–Africa agricultural cooperation. They resolved to intensify their exchanges and cooperation. Cooperation with the Chinese Academy of Agricultural Sciences can assist Africa in achieving better silk, honey and hive products.

Beijing Summit and Third Ministerial Conference of Forum on China-Africa Cooperation

Economic Cooperation

China and Africa stressed the importance of agriculture in their respective economies. Enhanced agricultural cooperation will play a positive role in eliminating poverty, promoting development and ensuring food security for both sides.

The two sides noted with pleasure the major progress made in China–Africa agricultural cooperation and resolved to intensify their exchanges and cooperation in farming, animal husbandry, irrigation, fishery, agricultural machinery, processing of agricultural produce, sanitary and phytosanitary measures, and food safety and epidemic control. They agreed to actively explore new forms and ways of agricultural cooperation.

The Chinese side decided to do the following:

- Send 100 senior experts on agricultural technologies to Africa and set up 10 demonstration centres of agricultural technology in Africa
- Give encouragement and support to Chinese enterprises in expanding their investment in agriculture in Africa and getting more involved in agricultural infrastructure development, production of agricultural machinery and processing of agricultural produce in Africa
- Step up cooperation with Africa in extending applicable technologies and human resources training in agriculture
- Strengthen cooperation with African countries within the framework of the Special Programme for Food Security of the Food and Agriculture Organization of the United Nations.

Chinese Academy of Agricultural Sciences

- There are 39 institutes or research centres, and one graduate and postgraduate school in CAAS
- Fifteen institutes are located in Beijing
- Twenty-four institutes are in the other provinces of China
- The Academy has 9342 employees, with 5975 scientists
- The Academy also has one crop seeds bank, 11 crop resources gardens and 26 research farms.

The Bee Institute of CAAS

The Bee Institute was established in 1958. It has 92 employees, with 65 scientists.

It has 5 departments:

- Bee conservation, genetics and breeding
- Bee pathology
- Bee pollination
- Bee products
- Quality control.

Department of Bee Conservation, Genetics and Breeding

The Department of Bee Conservation, Genetics and Breeding is involved in:

- Conservation of *Apis cerana* and bred *Apis mellifera*
- Population genetics of *Apis cerana* and behaviour genetics
- Breeding for high production of honey, royal jelly, propolis and varroa-tolerance strains of *Apis mellifera*.

There are 7 million colonies in China (*Apis mellifera* and *Apis cerana*), about 1/8 of the colonies in the world; with annual productions of:

- 200,000 tons of honey
- 2000 tons of royal jelly
- 3000 tons of pollen
- 300 tons of propolis.

Conservation network—Nature resource bank action (2003)

- Animals → honey bees
- Plants
- Humans
- Racks
- Microorganisms
- Total: 9 research areas and more than 100 projects.

Honeybee resources bank

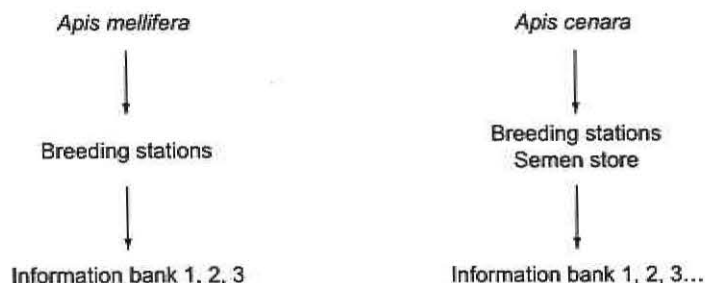


Figure 1. *Apis mellifera* and *A. cerana* resources banks at the Bee Institute of CAAS

Department of Bee Pathology

The Department of Bee Pathology is involved in:

- Pathology
- Treatment
- Standards and regulations set up.

Department of Bee Pollination

The Department of Bee Pollination is concentrating on the following bees:

- Bumble bee
- Honeybee.

Department of Bee Products

The Department of Bee Products is concentrating on the following bee products:

- Honey
- Royal jelly
- Propolis
- Pollen

Department of Quality Control

The Department of Quality Control (Bee Institute and Ministry of Agriculture) is involved in the following activities:

- Sampling and investigating the quality of all bee products in China
- Setting up standards and regulations for bee products.

Apicultural Science Association of China

The Apicultural Science Association was established in 1979 and has 200 member organisations and 1100 individual members (scientists, beekeeping organisations, bee companies, beekeepers). It is based in Beijing, in the Bee Institute.

Conclusion

Africa stands to gain from China's experiences in apiculture through exchange and cooperation programmes.

RELATIVE ABUNDANCE OF THE WILD SILKMOTH, *ARGEMA MIMOSAE* AND HOST SELECTION BEHAVIOUR OF ITS PARASITOIDS

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Abstract: This study sets out to explore *Argema mimosae* (Lepidoptera: Saturniidae) wild silkmoth relative abundance in different indigenous food plants at Arabuko-Sokoke forest, Kenya. Food plant distribution pattern will be determined and its effects on the moth's relative abundance in Arabuko-Sokoke buffer zones explored. The *A. mimosae* phenology, including all developmental stages, will be studied. The developmental stages performance will be related to the quality of leaves from the different food plants. Cocoon characteristics and silk quality in relation to host preference will be examined to evaluate economic potential of the wild silkmoth.

The study will also explore for *A. mimosae* parasitoids and study their host preference attack on the different food plants. To develop push and pull parasitoid control methods, volatiles released by developmental stages of *A. mimosae* and food plant leaves will be trapped through adsorbents and the electrophysiologically active components identified by electroantennogram detector linked to gas chromatography.

The study will further evaluate wild silk production potential of the moth and link it to community livelihood development and conservation of the Arabuko-Sokoke forest, which is the largest (420 km²) and biologically most important coastal forest in East Africa. The conservation of this forest is also enhanced through community participation supported by the Kipepeo project based at the Gede Ruins.

About the Arabuko-Sokoke forest, Kenya

The Arabuko-Sokoke forest, covering a total area of 420 km², is the largest remaining block of natural forest on the East African coast. The natural vegetation cover is classified into three types: *Brachystegia* woodland, *Cynometra* thicket and *Azelia* mixed forest.

The vegetation provides a habitat for a number of endemic and endangered plant and animal species which make this forest one of the most important biodiversity areas in Africa.

Wild silkmoth *Argema mimosae* food plants in Arabuko-Sokoke forest

In Arabuko-Sokoke forest, the false manila *Lannea schweinfurthii* (Engl.) Engl. (Anacardiaceae), the African marula *Sclerocarya birrea* (A. Rich.) Hochst. (Anacardiaceae), the broad leaved resin tree *Ozoroa obovata* (Anacardiaceae) and the African sandalwood *Spirostachys venenifera* (Pax) Pax (Euphorbiaceae) have been observed as food plants for *A. mimosae*.

Wild silkmoth *A. mimosae* population in Arabuko-Sokoke forest

Argema mimosae (Boisduval), commonly known as the African lunar or moon moth, is a saturnid. It was described by Jean Boisduval in 1847 as *Saturnia mimosae* from the specimens collected by French explorer, Adulphe Delegorge in Natal, South Africa. The wild silkmoth population in Arabuko-Sokoke has been increasing since its introduction and awareness in 2005 (Figure 1). Due to biotic and abiotic factors, harvesting healthy

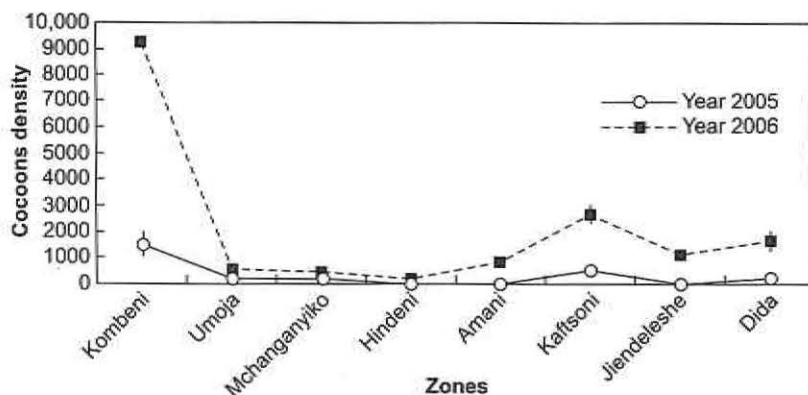


Figure 1. Wild silkmoth cocoons density in Arabuko-Sokoke forest, Kenya (2005–2006)

Minor host plant

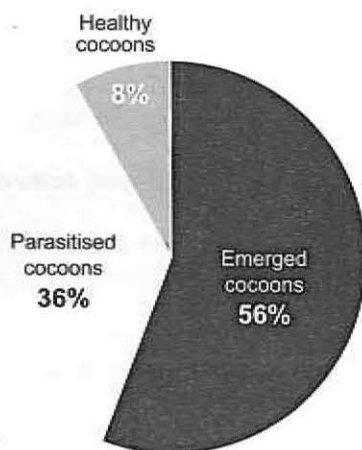


Figure 2. Wild silkmoth cocoon population on minor host plants in Arabuko-Sokoke forest, Kenya (2005–2006)

Major host plant

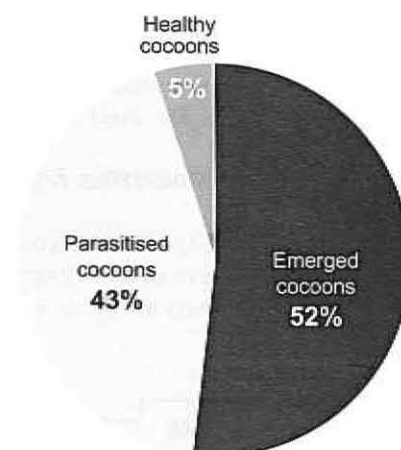


Figure 3. Wild silkmoth cocoon population on major host plants in Arabuko-Sokoke forest, Kenya (2005–2006)

cocoons remains a challenge to increased cocoon production in the field (Figures 2 and 3). Eight groups are participating in wild silkmoth farming in Arabuko-Sokoke Forest.

Challenges facing *A. mimosae* cocoon production in the field

Lack of community awareness

A community based butterfly farming, the Kipepeo project, developed in the early 1990s for the community adjacent to Arabuko-Sokoke forest, has been exporting *A. mimosae* pupae but its silk production potentiality has not been exploited. Introducing wild silkmoth production would provide additional income for the community living adjacent to the forest.

Low wild population

There is a low wild population due to natural enemies, viz. predators, parasites and parasitoids, e.g. *Mesocomys pulchriceps* Cameron (Eupelmidae) and *Pediobius anastati*

(Crawford). *Telenomus* sp. (Scelionidae) are egg parasitoids of *A. mimosae*.

Main objectives of the proposed study

The main objectives of the ongoing study are to:

- Determine larval development and survival in different food plants in relation to host preference
- Identify volatiles responsible for parasitism of developmental stages of *A. mimosae*
- Develop control measures of *A. mimosae* parasitism to increase the wild population.

Adsorbent preparation and collection of volatiles

Step I: Preparation of adsorbents

Volatiles collection will be done on adsorbents (on activated charcoal [mesh 80–100]), octadecyl-bonded silica gel (C_{18}), octyl-bonded silica gel (C_8) 40 μ m or super Q. Each adsorbent (30–50 g) will be packed in a cylindrical glass tube (6 cm long x 8 mm i.d.) held between two glass wool plugs. The adsorbents will be soxhlet-cleaned using dichloromethane or hexane, then activated in high purity nitrogen in an oven at 250 °C.

Step II: Trapping volatiles from eggs, larvae and food plant leaves

Samples of egg clusters, larvae and leaves of food plants will be placed in a quick-fit glass tube (12 cm long x 2.5 cm d) and connected to the air supply and adsorbent system of the air tight chamber as shown in Figure 4.

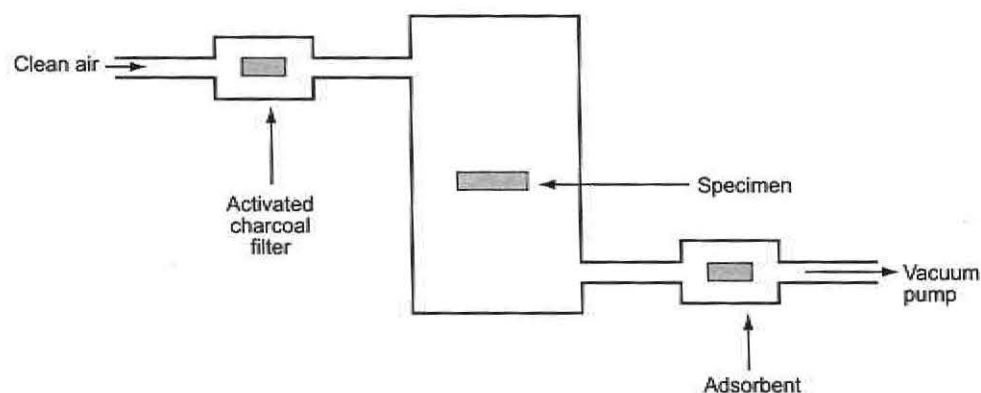


Figure 4. Apparatus for trapping *Argema mimosae* eggs, larvae and food plant leaves volatiles

Step III: Elution of volatiles from the adsorbents

A tube will be clamped and the adsorbent eluted with 2 ml dichloromethane (99.9% HPLC grade, Aldrich Chem. Co., UK) and the eluent collected in clean 4 ml vials under ice salt mixture at -4 °C.

The dichloromethane extracts will be concentrated under ice mixture (-40 °C) using a gentle stream of high purity nitrogen and stored in the freezer until required for bioassays and chromatographic analysis.

Step IV. Identification of electroantennography-active (EAG) components

Identification of the EAG volatile components will be done by gas chromatography linked to mass spectrometer (GC-MS) and GC co-injection with authentic standards.

Step V. Coupled GC-electroantennographic detector (GC-EAD) analysis

The electrophysiologically active components of the trapped volatiles will be identified by coupled GC-electroantennographic detector (GC-EAD) analysis using the insect antennae (parasitoid).

Both FID (flame ionisation detector) and EAD signals will be acquired on a PC equipped with an EAD card (Syntech). The behavioural assay of the EAD-active components will be done to help identify the EAD-active compounds as either kairomones or allomones.

Step VI. Bioassays

Subtractive olfactometric (or wind tunnel) assays will be done with various compound blends of the EAG-active components to determine both the kairomonal and/or allomonal effects (if any) for the parasitoids.

Expected outputs

The ongoing research would be expected to develop methods to protect and increase the wild population of silkmoths. This would enhance wild silkmoth farming, community livelihoods and forest conservation.

DIVERSITY OF STINGLESS BEES IN UGANDA AND THEIR POTENTIAL FOR INCOME GENERATION

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Abstract: Uganda has a range of environments that harbour stingless bees, e.g., forest and savanna. Three genera have been confirmed. There are viable populations of stingless bees in forests especially those under Uganda Wildlife Authority unlike National Forest Authority because of management regimes. However, several factors threaten their existence. Stingless bees are known to be good pollinators, sources of food, e.g. brood, honey, pollen stores. As a result, studies to ascertain abundance and distribution in Bwindi forest, domestication at all pygmy resettlement centres and analysis of the active ingredients in the Bwindi stingless bees honey has been initiated.

Background

Uganda is a landlocked country neighbouring Kenya, Tanzania, Rwanda, Democratic Republic of Congo and the Sudan). Her land area is 241,500 km² and 15% of the area is open water (lakes and rivers). Uganda has a population estimated at 27.3 million people. Vegetation is forest, savanna, woodlands, swamps and scrub in the northeast. Climate is wet and dry but micro-climate influence in the montane areas is conducive for agriculture and other activities.

It has a range of environments that harbour stingless bees, for example forest and savanna. Stingless bees range is from the Cape of Good Hope to Tunisia. Needless to say they are cosmopolitan. Stingless bees are little known organisms but essential in their own way to wild ecosystems and agroecosystems and have been found to be important pollinators worldwide (CA, SEA, and recently Uganda—Bwindi, Kenya—Mt Kenya and Tanzania—Usambara).

Inventory in rangeland (Queen Elizabeth National Park, Lake Mburo National Park) is on the Albertine rift forests (Afro-montane ecosystem), which has sufficient populations for honey harvests as Kabarole beekeepers harvest honey. The major agroecological zones favour growing of coffee and banana.

Few studies have been done in Africa. In East Africa, studies have been done on the ecology and biology of stingless bees at MSc and PhD levels: Ug 1 MSc and 1 PhD; Kenya 1 MSc and 1 PhD and Tanzania 1 MSc. Scanty information exists here and there in conservation and pollination reports.

World records

Central America (Costa Rica, Mexico, Brazil, Paraguay) and South East Asia (Malaysia, Taiwan, Indonesia, Philippines, China, Singapore, Vietnam) have done extensive research on the biology, ecology and applied aspects of stingless bees. The main constraint like any natural science is taxonomy.

Stingless bees in Bwindi forest

Stingless bees are found in this forest. They build their nests inside living or dead tree cavities caused by heart rot. Some stingless bees are ground-nesting and others colonise abandoned ant nests. All grassland species are known to be ground-nesting, in termite mounds and also

and also in rock crevices. In homesteads, they nest in areas such as door locks and walls (mainly *Hypotrigona gribodoi*). Some nest in banana pseudostems and underground stems by taking the oval structure of the stem. They also nest in abandoned boats/canoes. Workers have cited the occurrence of stingless bees nests on animal carcasses and on civet cat dung.

Uganda has three confirmed stingless bees genera:

- *Meliponula (bocandei, nebulata, lendliana, erythra)*
- *Hypotrigona gribodoi*
- *Trigona carbonaria*.

Identification was done at the Institute of Entomology, University of Kansas by Dr Robert Brooks.

Status of stingless bees in Uganda

There are viable populations of stingless bees in forests especially those under Uganda Wildlife Authority unlike National Forest Authority because of management regimes. Stingless bees are non-aggressive unlike *Apis mellifera*. Rangeland populations are threatened by the following:

- Pasture land management and constant fires
- Nesting sites destruction for fuel wood (i.e. heart rot-affected trees)
- Pesticide usage in agroecological zones
- Habitat alteration (termite mound destruction)
- Invasion of alien plant species that are not good as forage/pollen/nectar sources
- Loss of woodpecker bird species (Cavities created by woodpeckers are reused by stingless bees)
- Hunter-gatherer community (pygmies) look for honey, brood and pollen stores as a delicacy
- Other predators are chimpanzees, gorillas, jackals, aardvarks, baboons, birds and moths.

Stingless bees potential

- Known to be good forest canopy pollinators
- They pollinate herbs, shrubs and trees, e.g. mahogany species (*Entandaphragum excelsa*), which is a preferred timber species
- Source of food-brood, honey, pollen stores
- Source of medicine especially *Meliponula erythra* honey with anti-fungal and anti-bacterial properties
- Stingless bees visit particular plant species with medicinal ingredients (e.g. *Senecio*, *Bersama*, *Rytigynia*, *Phytolacca*)
- Known to harbour pollen stores of major canopy tree species like *Syzigium*, *Maesopsis*, *Teclea*, *Myrica*, *Celtis*, *Illex mitis*, *Entandaphragum utili*
- Crop pollination (potatoes, beans, peas, melon, pumpkins, mango, avocado and apples)
- Potential for commercial pollination colony packs
- To purify honey in pots, and to keep it uncontaminated
- Good blend for herbal medicine concoctions
- *Meliponula bocandei* is the same size as a honeybee and can be manipulated for better production to produce 0.5–1.5 litres of honey
- Ornamental (e.g. in Costa Rica)
- Source of wax, gum, cerumen concentrate (used in making honey pots)
- Environmental indicator (environmental monitoring programmes)
- Wax and gum concentrates of key forest tree species like *Allambrackia*, *Symphonia*, *Landolphia*, *Zanthoxylem*, *Musa* and *Harungana madascarensis*.

Key characteristics of stingless bees

- In Uganda stingless bees nest on east and west facing slopes in hilly areas of Bwindi
- Have an activity pattern peak at 12 noon in Bwindi, Mgahinga, Rwenzori and Budongo forests because of size and temperature fluctuations in montane zones
- Are attracted to sugary substances
- Different species have different entrance shapes
- Diameter size of nest entrance of *M. bocandaii*—1.6 cm; *M. erythra*—1.25 cm; *M. lendliana*—1.1 cm; *H. gribodoi*—0.5 cm.

The way forward

- Inventory: Biology Department commissioned inventory in Lake Mburo, Queen Elizabeth National Park and Kibale forest
- Studies: Have initiated on-site monitoring of the Bwindi species under the Ecological Monitoring Programme of the forest health to ascertain abundance and distribution
- Domestication: Domesticated stingless bees at all pygmy resettlement centres (Mpungu, Kisoro Bee Keepers Associations collect stingless bee honey, wild honey and home hive honey)
- Biology: Pharmacy and Pharmacology Departments are in a joint venture to analyse the active ingredients in the Bwindi stingless bees honey
- Collaboration: We look forward to more cooperation with *icipe*.

CHEMICAL COMPOSITION AND APPLICATION OF BEE PRODUCTS

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Abstract: Mankind has used hive products as medicine since time immemorial. Products like honey, propolis, royal jelly, beeswax and bee venom have found different applications for treatment of various diseases in humans and animals. Due to their healing properties, various attempts have been carried out to understand their chemical composition and how the active ingredients aid in healing.

Introduction

Honeybees are master chemists and chemical engineers. Their success in the animal kingdom is largely because of the chemistry and application of their products. Three are chemically synthesised by the bees themselves; these are beeswax, venom and royal jelly. The other three are derived from plants and are modified by the bees for their own use, i.e. honey, pollen and propolis.

Bee products go through a highly complex manufacturing process. To produce one jar of honey, a colony of bees has to travel a distance of thousands of kilometres.

The transformation of nectar into honey requires that between 30 and 80% of the water content must be removed by evaporation. Beeswax is used as pliable, stable and moisture-proof material with which to construct their nests, to rear honeybees safely and to rear their brood, in addition to being an excellent material for moulding, burns, cleaning, lighting and in medicine.

Royal jelly is a balanced food source that does not spoil readily and is used to feed bee larvae. Bee venom gives honeybees the advantage of a formidable defence that is capable of stopping or deterring all but the most determined and capable of predators. It is useful because it causes pain and possesses a host of pharmacological activities. Pollen is a nutrient-rich food that, like honey, can be stored in the hive indefinitely to serve as a reserve during times or seasons of shortages. Propolis is a sticky substance that bees collect on their hind legs—just as they do with pollen—and use it in sealing the nest cavities. It is also one of the best anti-microbial agents known toward bacteria, viruses, fungi and moulds.

The goal of this study is to examine the chemistry of honeybee products, to use this information to explain the application of the products and to predict their usefulness.

Pollen

Bee pollen contains approximately 30% protein, 55% carbohydrates, 1–2% fat, 3% minerals and trace vitamins. It is rich in carotenoids, flavonoids and phytosterols. Pollen can be collected in two ways. The usual method is for beekeepers to fit a pollen trap at the entrance of the hive to capture the clumps of pollen attached to the bees hind legs. The compact mass formed by the pollen grains offers some protection against oxidation caused by atmospheric oxygen. The second method consists in collecting what is known as bee bread. This pollen is stored in the comb and is better provided with animal ferments. It is first chewed by young bees, then fermenting agents are added and then it is mixed with honey and stirred around the brood area on the comb.

This feature enhances the nutritional balance of the pollen, but also means that bee pollen is not a uniform product; rather it varies somewhat from sample to sample [1]. The variability complicates the analysis of pollen chemistry [2]. All chemical and nutritional analyses here will be given as means derived from large numbers of literature: reports,

journals and research that appears reliable. Table 1 is a listing of the chemical composition of pollen and a comparison of pollen nutrient density with that established for recommended daily allowance (RDA) or estimated daily intake (EDI) for human dietary needs [3]. In general, compared to many standard human foods, pollen is rich in protein, low in fat and possesses a wealth of minerals and vitamins. No obvious human nutritional deficiencies are present in pollen with the possible exceptions of vitamin B₁₂ and the fat soluble vitamins D and K. In the case of B₁₂, the vitamin is not usually in shortage because the body usually retains a multi-year reserve. Shortage only occurs in cases of defective body recycling (anaemia), needed for pregnant women who have metabolic deficiencies or are strict vegetarians.

Vitamin D is somewhat of a misnomer, as it is not truly a vitamin. Humans can synthesise the vitamin from 7-dehydrocholesterol if they are exposed to sunlight. Vitamin K is a minor vitamin whose sole role is to aid in blood clotting and which is produced naturally by intestinal bacteria. The organism uses provitamin A and carotene to synthesise vitamin A. The following vitamins are present in pollen: B₁ (thiamine); B₅ (pantothenic acid), which promotes growth, skin care, strengthens the nerves, improves breathing, regulates the digestion and improves the blood; B₃ (niacin also known as nicotinic acid) is a well known substance which protects against pellagra, a disease which counteracts disorders in balance, is important for the skin, metabolism and the nerves; B₆ (pyridoxine) which stimulates growth and combats anaemia; vitamin C; folic acid 2 complex, important for the renewal of blood cells; vitamin E (tocopherol) which improves fertility and conception by its effect on the production of sperm and ova; vitamin H (biotin), a growth stimulant which is also effective against skin infections and rutin, which strengthens the capillaries thus preventing undesirable internal bleeding and also strengthens the heart muscle [4].

Pollen has been used to treat a variety of health problems. It appears to improve symptoms of prostatic hyperplasia, alleviate allergies and protect the liver from certain toxins. Pollen is also claimed to lower cholesterol, reduce the effects of arteriosclerosis and improve the metabolism. In one study, mice treated with pollen extracts for lung cancer survived twice as long as mice in untreated control groups [5].

Pollen has not been analysed in detail for some of the trace elements such as boron, chromium, molybdenum, iodine, fluoride and selenium, but it would not be surprising if it also contains adequate quantities of these elements.

Table 1. Average chemical composition and nutritional value of bee pollen

Chemical	Composition	% of RDA/EDI
Energy	2.46 K cal/ g	
Protein	23.7%	420
Carbohydrates	27%	83
Lipids	4.8%	59
Cholesterol	0	0
Phosphorus	0.53%	590
Potassium	0.58%	190
Calcium	0.225 %	250
Magnesium	0.148 %	470
Sodium	0.044 %	27
Iron	140 ppm	830
Manganese	100 ppm	2500
Zinc	78 ppm	580
Copper	14 ppm	560
Nickel	4.5 ppm	?
Boron	trace	?
Chromium	?	?
Molybdenum	?	?
Iodine	?	?
Fluoride	?	?
Selenium	?	?
Thiamin	9.4 ppm	760
Niacin	157 ppm	940
Riboflavin	18.6 ppm	1300
Pyridoxine	9 ppm	500
Pantothenate	28 ppm	450
Folic acid	5.2 ppm	2600
Biotin	0.32 ppm	440
Vit.B ₁₂	0	0
Vitamin C	350 ppm	520
Vitamin A	0	0
Carotenes	95 ppm	900
Vitamin D	0	0
Vitamin E	14 ppm	160
Vitamin K	0	0

Ref: Recommended Dietary Allowances, (1989) [32]. RDA, recommended dietary allowances, EDI, estimated daily intake.

Table 2. Nutritional composition of pollen and typical nutrients of foods

Food	Protein (g)	Fat (g)	Potassium (g)	Calcium (mg)	Sodium (mg)	Iron (mg)	Vit. A (Int. U)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	Vit. C (mg)
Pollen	96.3	19.5	2.4	915	129	57.0	14500	3.82	7.56	63.8	142
Tomato	50.0	8.8	11.0	588	138	22.0	41000	2.75	1.88	31.2	1050
Cabbage	54.1	8.3	2.4	2037	835	16.0	5410	2.11	2.75	12.8	1950
Chicken	152.8	35.9	2.0	60	484	8.9	484	0.28	1.29	57.7	0
Beans	40.1	6.5	1.7	443	3800	15.0	1070	0.65	0.25	4.9	16
Apple	3.4	10.3	1.9	122	19	5.3	1560	0.53	0.34	1.9	68
Bread	43.2	12.3	1.1	407	2200	12.0	Trace	1.06	0.49	11.5	Trace
Beef	59.4	82.7	0.7	26	145	7.5	143	0.17	0.46	12.2	0

Ref: Liebelt R. A., Lyle D. and Walker J. (1994) [5].

To evaluate the nutritional content of pollen is to compare the levels of dietary nutrients in good wholesome food to those in pollen. In Table 2, the quantities of 11 well-established and measured nutrients for two vegetables, one fruit, two meats and two staples are compared to pollen. Pollen ranks number 1 in quantity for four of the nutrients, number 2 for another four and ranked lower only for vitamin C, sodium and fat. Overall, pollen has a higher ranking than any of the compared foods, even tomatoes and cabbage, which are considered to be classic examples of the most nutritious foods available. In terms of protein, pollen ranked number 2 and above beef. The overall conclusion is that pollen is a food source par excellence that is probably not exceeded by any other food. But, consumption of large quantities can cause adverse effects [5]. Pollen has been shown to have several beneficial applications for human use. Pollen has been successfully used for treatment of some cases of benign prostatitis [6-9] and for oral desensitisation of children who have pollen allergy [10,11].

Honey

Honey has multifarious utility. As well, honey has an honoured place in most religions. The Holy Quran describes honey as a remedy for diseases. Christians prepare mead from honey for similar purpose. Ancient Egyptian medical texts dating from 2600 to 2200 BC mention honey in at least 900 remedies [12]. Honey is extremely hygroscopic and can be stored for long periods if it contains less than 17% water and is stored in an airtight container [13,14]. Honey is a supersaturated solution of sugars, mainly fructose, glucose and maltose, and with traces of sucrose, oxidases, hydrogen peroxide, phenolics, flavonoids and terpenes [15]. The sugars make honey hygroscopic and viscous and the sugar concentration plus other factors, including low pH, hydrogen peroxide and the flavonoids,

phenolics and terpenes make honey antimicrobial or prevent microbial growth [3]. Honey contains minerals such as potassium, phosphorous, calcium, magnesium, sulphur, iron, manganese, silica, sodium, copper, zinc, molybdenum and cobalt [16]. Human beings require daily amounts of these minerals, which can be found in 100 g of honey.

Honey contains enzymes such as invertase, diastase, amylase and oxidase. Acetylcholine is also found in honey and can stimulate the heart which enables the body to take up more fuel in the form of glucose; it also improves the metabolism and regulates the blood circulation and stimulates the digestive organs [17] and the kidneys. There are substances which inhibit the growth of bacteria [16].

Many types of acids are present in honey as agents producing aroma and taste. They stimulate the appetite and the digestion. There are 50 types of aromatic substances, mainly aliphatics, alcohols, aldehydes and ketones. Vitamins found in honey are mainly due to the presence of pollen [4].

The main use of honey is as sweetener. Secondary but important uses of honey are for the promotion of health and well being (includes aiding in the healing of wounds, serious skin burns and gastric ulcers) [17]. Subrachmanyam [18] conducted a study comparing a conventional method of burns treatment (silver sulfadiazine) with topical application of honey. Burns of patients of a variety of ages were divided into two treatment groups (Table 3). The burns of patients in group

1 were cleaned with saline solution and pure, undiluted, unprocessed honey was applied daily. Burns of group 2 (control) were cleaned and covered with gauze that was soaked in 5% silver sulfadiazine which was changed daily. Results showed that within 7 days, 91% of the

infected wounds treated with honey were free of infection compared to less than 7% of the silver sulfadiazine-treated burns. Within 15 days, 87% of the honey-treated wounds were healed whereas only 10% of the control group wounds were healed. Patients treated with honey experienced less irritation, more relief of pain and no allergic reactions or side effects. He suggests that honey is effective for treatment of burn wounds because it: (1) prevents infection because of its antibacterial or bacteriostatic properties (inhibits the growth of both gram-negative and gram-positive bacteria), (2) provides a viscous barrier to fluid loss and wound invasion by bacteria thus preventing infection, (3) contains enzymes which may aid the healing process by promoting tissue formation, (4) absorbs oedema fluid (pus) thereby cleaning the wound and (5) reduces pain and irritation and eliminates offensive smell [18,19]. The marked differences in the curative properties of honey were studied. Margoran honey indicated a remedial effect for many cases (sputum, eczema, sore throat and wounds), but fennel flower honey exhibited a best medicine for diarrhoea and sore throat. While banana honey showed marked effect for cured anaemia, and sweet basil honey for common cold, cotton honey was the best for those having high cholesterol level [10].

Honey in the natural state is generally used to guard against illness and to improve bodily functions. Here are a few examples:

Pregnancy

In cases of toxemia of pregnancy, intravenous doses of honey can be administered. It prevents vomiting and improves the appetite. Honey protects the liver tissue during bouts of toxemia.

Infants and children

In cases of malnutrition, honey can be given. It is a supplementary food when breastfeeding is insufficient for the child's needs. Intake of honey causes calcium and magnesium binding in the body and the teeth develop better. Honey helps in cases of bed-wetting, to calm children down and improves their sleep pattern [16]. But infants younger than 1 year should not be fed honey as they do not have sufficient stomach acid.

Table 3. Honey and silver sulfadiazine (Std) treatments for burns

Treatment (n = 52)	% sterile in 7 days	Mean days for granulation	Healing in 15 days (%)
Honey	91	7.4	87
Silver sulfadiazine	7	13.4	10

Ref: Subrachmanyam M., 1991 [18].

Wounds, oedema, bacteria

Honey has a healing influence on suppurating wounds and on infected tonsils. It promotes rapid epithelialisation and absorption of oedema from around ulcer margins. It inhibits the growth of bacteria responsible for bowel infections and is also effective in the treatment of typhoid, paratyphoid, peritonitis, dysentery and cholera.

The liver

The liver is the principal organ in the metabolism of sugars, fats and proteins. Honey assists the liver in three ways: by promoting the formation of glycogen, by removing toxins from the liver and by stimulating improvement in liver diseases and thus in all types of jaundice.

The heart

Honey can prove useful in cases such as bad cardiac circulation and for patients taking digitalis, to reinforce the effect of the drug. Honey can also prove useful in inflammation of the heart muscle and especially in arrhythmia, damage to the heart muscle after infectious illnesses, and for all types of high blood pressure and cardiac and circulatory problems. There are never any side effects except in diabetics.

Allergy

Honey leads to improvement in 90% of allergy cases. It is usually best to use local honey since this contains the types of pollen causing the hay fever. Ingestion leads to immunity.

Antimicrobial, wound healing

There are many references for the successes of honey as an antimicrobial [3,16,18,20,21].

Our experiences in this field by observations of honey on wound healing are 60 patients with wounds and ulcers, most of which (90%) had failed to heal with conventional treatment were treated with pure honey. Fifty-nine cases showed remarkable improvement following topical application of honey. One case later diagnosed as Buruli ulcer, failed to respond. Wounds that were sterile at the outset remained sterile until healed, while infected wounds and ulcers became sterile within one week of topical application of honey, with sloughs being replaced with granulation tissue. It also promoted rapid epithelialisation and absorption of oedema from around the ulcer margins [17].

Royal jelly

Royal jelly is a creamy product secreted by young nurse worker bees for feeding to the queen larvae and other young larvae. It is totally synthesised by the bees in the hypo pharyngeal and mandibular glands and is derived from the proteins and nutrients in the pollen ingested by the secreting bees. Royal jelly consists of an emulsion of proteins, sugars and lipids in a water base (Table 4). The proteins have no particularly unusual properties [19] and have the main presumed function of providing the growing larva or the queen a readily digested source of protein. The remainder of the composition except the lipids, also appears to be oriented toward providing a balance of nutrients for the consuming individuals. The lipids are unusual because they lack the normal triglycerides and diglycerides that are composed of fatty acids having carbon chains of even numbers from 14 to 20 that are typical of insect fats. These compounds have active functionalities at both ends of the molecule, are more soluble in water than usual fatty acids, are highly acidic and act as good detergents and

Table 4. Chemistry of royal jelly

Component	Quantity	Comments
Water	67.0%	
Proteins with digestibility greater than beef	12.5%	8+ major peptides/proteins of 14–94 kd
Sugars	11.0%	
Fructose	6.0%	
Glucose	4.2%	
Others	0.8%	
Fats	5.0%	Mostly hydroxy fatty acids with short chains
E-10-dehydroxydec-2-enoic acids	31.8% of fat	
10-hydroxydecanoic acids	21.6% of fat	
Other hydroxy fatty acids	9.5% of fat	
Dicarboxylic acids	4.5% of fat	
Gluconic acid	24% of fat	
Others	8.6% of fat	
Minerals	< 1.0%	K, Mg, Na, Ca, Zn, Fe, Cu, Mn
Vitamins	< 0.1%	Thiamin, riboflavin, pyridoxine
Niacin, pantothenic acid, inositol, biotin, folic acid, vitamin C		
Sterols	< .01%	24-methylene cholestro, β -stigasterol, etc.
Undetermined	3.5%	
PH	3.8%	

Ref: 1. Schmidt J. O. and Btichmann S. L. (1992) [22]. 2. Thien F. C. K., Leung R., Adlido B. A., Weiner J. A., Plomley R. and Czamy D. (1996) [34].

antimicrobial agents. It is this latter property that appears to be the main function of the lipids in royal jelly.

Some studies

Townsend et al. (2006) [36] did extensive investigation on 10-hydroxydecanoic acid in royal jelly on antitumor activity in mice. Euphoria and strength after royal jelly consumption may be related to neurostimulating substance.

Different medical specialists have carried out tests. Research has focused mainly on the effect of this natural product on neurasthenia, stress, convalescence, combatting the symptoms of aging, growth problems and pregnancy. Royal jelly is also a super ointment for the skin. It feeds and regenerates tissue and is extremely helpful in removing uncomfortable or itching scars. When used in face creams, it produces truly miraculous results.

Beeswax

Beeswax is synthesised by honeybees in four pairs of glands located on the ventral side of the abdomen. Bees use the wax as their primary building material for making combs for rearing their brood and for storage of honey and pollen. Beeswax is composed of a variety of monoesters, diesters, hydroxylated esters, hydrocarbons and free fatty acids (Table 5). This composition distinguishes the material as a wax rather than a fat because it is composed mostly of esters and long chained hydrocarbons, the classic wax components. Triglycerides and diglycerides, typical of fats, are missing. The chemistry of the beeswax

components is ideal for use by both bees and man. The strength, flexibility and water-proofing qualities of beeswax have made it an excellent material for polishes, varnishes and waxes that preserve, add shine and generally enhance products coated with it. Beeswax was an excellent material for making moulds for casting [22].

Propolis

Propolis is a plant resin collected by bees for use in and around the hive. It serves to protect them from the elements of the weather plus attack by bacteria, fungi, moulds and viruses. Much work has been conducted on the chemistry and properties

of propolis. Hundreds of chemical compounds have been identified from propolis. The main chemical classes present in propolis are flavonoids, phenolics and various aromatic compounds [4]. These compounds are poorly soluble in water, usually are soluble in alcohols and are often poorly soluble in hydrocarbon solvents. Propolis also contains some volatile oils, terpenes and beeswax. Propolis has the capacity to destroy or halt the multiplication of numerous types of bacteria such as *Staphylococcus*, *Streptococcus* and *Salmonella*; *Bacillus subtilis*; *Proteus bulgaris* and *Escherichia coli*.

Propolis stimulates the functions of a number of different organs and thus induces the body to show even more resistance to the causative agents of disease. The effects can probably be attributed to such substances as benzoic acid, ferulic acid, galangin and pinocembrin [23].

Perhaps the most broadly investigated and widely accepted attribute of bee propolis is its immune-boosting activity. It is a natural, broad-spectrum antibiotic that activates the thymus gland. Bee propolis not only prevents infectious diseases, but clears them from the system as well. As demonstrated in numerous experiments, propolis has the ability to destroy bacteria, viruses and fungi, even penicillin-resistant *Staphylococcus*. Another benefit of propolis is its inhibitory effect on certain prostaglandins, which it accomplishes by blocking the enzymes that form specific prostaglandins. This can be of immense benefit to those suffering from aches and fever which are caused by prostaglandins. Bee propolis acts in nearly the identical way that aspirin does, by blocking the same enzymes, yet without the negative side effects you can get with aspirin.

This enzyme-blocking prostaglandin-inhibitory effect is also beneficial to the mouth and throat. For instance, a leading cause of dental problems is the erosion of the gums and tissues that line the tooth sockets. Inflammation and infectious bleeding can cause a weakening of the bone structure and tooth loss. Flavonoids are well known plant compounds that have antioxidant, antibacterial, antiviral, antifungal and anti-inflammatory properties. Other properties of propolis include acting as a local anaesthetic, reducing spasms, healing gastric ulcers and strengthening capillaries. Compounds responsible for these activities are listed in Table 6.

Table 5. Gross chemical composition of beeswax

Chemical class	Quantity (%)
Monoesters	35
Diesters	14
Triesters	3
Hydroxy esters and polyesters	12
Acid esters and polyesters	3
Long-chained hydrocarbons	14
Long-chained fatty acids	12

Ref: Tulloch A. P. (1980) [35].

Table 6. Compounds in propolis that possess known pharmacological activities

Compounds	Chemical activities
Quercetin	Antiviral Antihistamine Ulcer healing Capillary strengthening
Pinocembrin	Antibacterial Antifungal Antimould Local anaesthesia
Caffeic acid	Antibacterial Antifungal Antiviral Antiinflammatory
Phenethyl ester	Tumor cytotoxicity
Acacetin	Anti-inflammatory
Pinostrobin	Local anaesthesia

Ref: Schmidt. J. O. (1996) [21].

Bee venom

Venom is synthesised by honeybees for only one purpose: as a defensive agent against predators, primarily large mammalian and other vertebrate predators. To be of defensive value the venom must induce pain, cause damage, or have some other pharmacological or sensory activity in the potential predators [24].

Bee venom is composed of a diversity of proteins, peptides, active amines and other compounds which possess a variety of activities [25]. The major chemical components and their primary activities are listed in Table 7. The main pain-inducing and lethal component appears to be melittin [26] and this component might be responsible for much of the activity of bee venom in apitherapy use. Bee venom has been particularly successful with individuals suffering from rheumatoid arthritis, gout and multiple sclerosis, but a variety other immune disorders including scleroderma and asthma have been treated. The benefit of apitherapy for treatment of arthritis has received some research attention by the medical establishment [27]. Cohen et al. [27] demonstrated in controlled experiments that bee venom and local pain-inducing agents significantly improved the symptoms of a rheumatoid arthritis patient. Steigerwoldt et al. [28] reported moderate improvement in 66 of bee venom treated patients versus only 27% improvement in the controls [29]. Using severely arthritic dogs, they reported significant improvement in mobility and activity in the cages of bee venom-treated animals compared with controls. Some of the problems in demonstrating efficacy of bee venom treatments for immune diseases stem from the very nature of immune disorders, which are characterised by 'flare ups' and remissions that occur unpredictably. In addition, immune disorders are particularly susceptible to treatment placebo effects. These two factors combine to make clinical research trials on immune diseases very difficult and often inconclusive. In the cases of arthritis and multiple

Table 7. Components in honeybee venom and some of their activities

Component (% venom)	Activity/ pharmacology	Chemical nature
Melittin (30–50)	Small, highly basic 26 amino acid polypeptide of 2840 Mol. Wt.	Pain, cardiotoxin, haemolysin, membrane activity
Phospholipase A2	Basic, stable protein of disrupt, toxic, lungs are target (10–20) 15,800 Mol. Wt.	Membrane and phospholipid
Apamin (3)	Highly basic 18 amino acid polypeptide	Neurotoxin, causes tremors
Hyaluronidase (2)	Protein of 35,000 Mol. Wt. components, no other activities	Promotes spreading of other venom components
Mast cell degranulating peptide (2)	Highly basic 22 amino. Releases histamine, etc. from mast cells. Acid polypeptide	Pain, anti-inflammatory, Burn-itch redness, immediate
Histamine (<1)	Small, unstable biogenic amine of 111 Mol. Wt	Local skin effects

Ref. 1. Banks B. E. C. and Shipolini R. A. (1986) [25] and 2. Schumacher M. J., Schmidt J. O., Egen N. B. and Lowry J. E. (1980) [33].

sclerosis, modern medicine has no cures; it simply treats to suppress symptoms [30]. The established treatments include use of steroids—strong anti-inflammatory drugs, antibiotics, antimalarials and gold salts. These drugs have serious side effects and often fail to deliver relief. This frustrating situation led one researcher to comment that “rheumatoid arthritis rarely kills the patient corticosteroids often do” [31].

The question arises: How does bee venom work? The answer is not clear, but we have some hints. Bee venom has anti-inflammatory effects. It might well shock the immune system, which somehow might correct imbalances. It causes pain and it might stimulate the nervous system which in turn can exert influence on the immune system.

Bee venom possesses chemical components responsible for the following: anti-inflammatory actions—mast cell degranulating peptide, apamin; ‘shocks’ immune system—phospholipase A2, hyaluronidase, melittin; stimulates nervous system—melittin, apamin, mast cell degranulating peptide. Overall, bee venom appears to have the chemical properties to affect the immune system and immune disorders, and apitherapy has been shown to work in many cases. So all that is needed is a clearer understanding of how apitherapy works and to convince mainstream practitioners to use apitherapy.

Conclusions

Although honeybees and humans are dramatically different, they share two fundamental features: both are social animals and both live in highly complex societies. These features cause both species to maintain more or less permanent residences, to have developed specialised behaviours, to engage in a diversity of activities, and to need a multitude of materials. Material properties and uses are governed by their chemistry and vice versa. Honeybees need a stable food supply for long term energy and growth; people likewise need a stable food supply. Honeybees need structural materials such as beeswax and propolis to construct their nest; people have housing needs. Honeybees need materials such as propolis and venom to defend against diseases and predators; people have similar needs.

Human beings have gone to honeybees as a chemical warehouse of materials and foods. Honey and pollen are the foods that promote health and well-being in honeybees. They have served the same function for people. Bees use wax to build their combs and people have taken advantage of the wonderful chemical properties of beeswax to make objects for their homes and daily lives and to coat and preserve materials. Bees use propolis and venom to defend against microorganisms and enemies. People also use propolis, sometimes in conjunction with honey, for its antimicrobial properties. People use the same properties in bee venom that drive off bee predators to enhance human autoimmune diseases. Overall, much of the human application of bee products can be explained on the basis of the bee products chemistry. This is not to say that bee products should not be used for purposes for which we have no chemical understanding. Indeed, the process has usually operated in reverse first: People discovered uses for bee products, then later came the chemical understanding of how and why the bee products were useful. Perhaps the message from this is that we should look to traditional uses of bee products to guide us in our investigations and to use research to discover how best to use bee products and their components to improve human life. But for this process to operate, individuals concerned with bee products must be fair and honest in representing the legitimate uses and benefits of the bee products.

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ANTIBACTERIAL PROPERTIES OF PROPOLIS FROM THREE REGIONS IN KENYA

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Abstract: This study aimed at investigating the susceptibility of the microorganisms *Pseudomonas aeruginosa*, *Salmonella typhi*, *Escherichia coli*, *Staphylococcus aureus* and *Bacillus subtilis* to ethanolic extracts of propolis (EEP) from three regions in Kenya. The propolis was extracted using four ethanol concentrations: pure ethanol, 70, 50 and 30%. Seventy percent pure ethanol and streptomycin were used as controls. The agar diffusion method using filter paper discs was used. Antibacterial activity was determined as an equivalent of the diameter of the inhibition zone (in mm) after 24 h incubation at 37 °C. Results indicate that antibacterial activity varies according to the test microbes and the procedure used to extract propolis. *Bacillus subtilis* and *Staphylococcus aureus* were the most susceptible bacteria while 70% EEP had the highest antibacterial effect.

Introduction

Aristotle probably coined the word 'propolis' and its Greek meaning is *pro* (before) *polis* (city)—'before the city' or 'defender of the city'. It is the sticky substance found on hive parts, and is commonly referred to as 'bee glue' or 'bee gum'. The colour of propolis varies enormously, from light yellow, brown to a dark brown or even green. Propolis has been used as a medicine since ancient Egyptian times, but in common with other natural medicine, was forgotten for over 100 years. However, in recent times, a renewed interest in propolis has been witnessed mainly due to an increase in awareness and interest in all natural ways of staying well and combating disease, increasing concern on the side effects of chemical medicine (especially antibiotics) and the realisation that antibiotics are not the 'magic bullet' we once thought they were. As a result, medical researchers are now questioning their search for a single active ingredient, and it seems we are going back to where medicine started: The use of the whole plant.

Propolis is a complex resinous mixture collected by bees from plant exudates and which is mixed with hypo-pharyngeal secretions, beeswax and pollen [1,2,3]. In the hive, propolis is used for comb construction and polishing, to maintain aseptic hive environment and for protection and adaptation of bees nests. Propolis has a complex chemical composition, depending on the diversity of plants and geographic locations from which bees collect it⁴. The biological activities of propolis (antibacterial, antiviral and antifungal) vary according to its source [1,5].

There are no studies on the antibacterial activity and chemical composition of Kenyan propolis. This study aimed at determining the antibacterial activity of propolis from three regions in Kenya.

Experimental protocol

Preparation of ethanolic extracts of propolis (EEP)

Propolis samples were collected from 5 colonies in each region (Taita, Tana and Samburu). The samples were separately ground into powder, weighed into batches of 30 g and extracted with pure absolute ethanol, 70, 50 and 30% ethanol: water (v/v). Extraction was done at room temperature, in the absence of light for 20 days, then filtered.

Bacterial cultures

Five (5) bacterial strains were used: *Pseudomonas aeruginosa* (ATCC 27853); *Salmonella typhi* (ATCC 2202); *Escherichia coli* (STD 25922); *Staphylococcus aureus* (ATCC 20591) and *Bacillus subtilis* (ATCC 6633). The bacterial strains were obtained from Inocline International, Nairobi Kenya.

Antibacterial activity

The agar disc diffusion method [6] was used to test antibacterial activity of EEP. The inoculum was prepared with fresh bacterial strains and cultured on nutrient agar. A loopful of bacteria culture was inoculated into nutrient broth medium, size adjusted to 0.5 McFarland standard turbidity, approx. 10^8 CFU/ml. Paper discs of 6 mm diameter were impregnated with 25 μ l of each EEP concentration and control. Impregnated paper discs were then placed on inoculated agar plates, and the plates incubated under aerobic conditions at 37 °C for 24 hours. The size of inhibition zones around the discs (diameter) was measured after 24 hours, and recorded in millimetres.

Results

Table 1. Antibacterial effect of EEP of propolis obtained from three regions in Kenya

Region	Ethanol conc. (%)	Inhibition zones (mm)				
		<i>Bacillus subtilis</i> ATCC 6633	<i>Staphylococcus aureus</i> ATCC 20591	<i>Pseudomonas aeruginosa</i> ATCC 27853	<i>Escherichia coli</i> STD 25922	<i>Salmonella typhi</i> ATCC 2202
Taita	100	ND a x	ND a x	ND a y	ND a y	ND a x y
Tana	100	8.5 b x	10.0 b x	10.0 b y	ND b y	8.5 b x y
Samburu	100	8.5 b x	9.5 b x	ND b y	9.0 b y	ND b x y
Taita	70	9.0 c x	8.0 c x	10.5 c y	9.0 c y	11.0 c x y
Tana	70	11.5 c x	8.0 c x	10.5 c y	10.0 c y	8.5 c x y
Samburu	70	10.5 c x	9.5 c x	ND c y	9.0 b y	8.0 c x y
Taita	50	8.5 b x	9.0 b x	ND b y	ND b y	9.5 b x y
Tana	50	ND b x	9.5 b x	9.0 c y	7.0 b y	9.5 b x y
Samburu	50	8.0 b x	7.5 b x	ND b y	ND a y	ND b x y
Taita	30	10.5 abc x	8.5 abc x	7.0 b y	ND abc y	11.0 bc x y
Tana	30	7.5 abc x	10.5 abc x	ND abc y	10.0 abc y	9.5 bc x y
Samburu	30	11.5 abc x	7.0 abc x	7.0 abc y	ND abc y	ND bc y
	Ethanol (70%)	7.0 b x	7.0 b x	ND a y	ND a y	ND a
	Streptomycin (50%)	10.5 c x	11.0 d x	22.5 d y	18.0 d y	23.5 d y

Different letters within columns (a–d) and within rows (x–y) indicate significant differences ($P < 0.05$).

ND = Not detected.

The gram positive bacteria (e.g. *B. subtilis* and *S. aureus*) were noted to be the most susceptible to EEP, agreeing with earlier observations by Keskin et al.; Ivan et al.; Park et al. and Funari [7–10]. The gram negative (e.g. *E. coli* and *P. aeruginosa*) were noted to be the least susceptible to EEP, as also reported by Ivan et al [8]. Other workers report EEP to be ineffective against *E. coli* [8,10,11] or have complete or minimal susceptibility to EEP (Fernandes et al.; Ahmed et al. and Sato [12–14]).

Similarly varying inhibition zones for EEP on similar target strains have been reported depending on propolis origin: Argentine propolis [15]; Brazilian propolis [16] and Croatian propolis [17].

Conclusion

This study has demonstrated the antibacterial properties of Kenyan propolis and the effect of extraction procedures on antibacterial activity of EEP. Investigations on chemical composition of Kenyan propolis are underway to confirm this.

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DISTRIBUTION OF STINGLESS BEES IN SELECTED KENYAN FORESTS: POTENTIAL FOR MELIPONICULTURE ENTERPRISES

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Abstract: All African stingless bees (Meliponini) are eusocial. There are about 600 species in 56 named genera in tropical and subtropical areas of the world. There are about 12 species of stingless bees in Kenya. Six species have been identified in Kakamega forest, three species in Mwingi and three in Arabuko-Sokoke forest. Stingless beekeeping (meliponiculture) is an income generating enterprise with the potential of achieving forest conservation.

Introduction

Like the honeybees, stingless bees are eusocial. The stingless bees are the most abundant bees on earth. Meliponini is one of the older groups of bees originated in Africa and has distributed in all major continents probably through the mechanism of continental drift. The size of the stingless bees ranges from 2 to 16 mm. They have reduced wing venation and sting, which is compensated by the stout mandibles supported by strong muscles. Though they are stingless, they protect the nest very effectively: They get into the hairs and the skin of the intruder with the mandibles. But defence behaviour of stingless bees is much less harmful to the beekeeper than honeybees.

The species vary widely in their physiology, behaviour, social organisation and ecology. They have a long history in human culture both as providers of honey and wax (or cerumen) and as pollinators of crops [1].

With the growing pressure on the environment and the associated loss of honeybees, there is a need for additional pollinator species to be used in agriculture to maintain resilience in food production and improvement of yield, especially in hot, dry areas where honeybees are less abundant [2]. Many Meliponini could be utilised as surrogates for honeybees. Replacing destructive harvesting of stingless bees with meliponiculture would provide honey for food and medicine, and enhance pollination of both commercial crops and indigenous plants.

Distribution

A major description on the distribution of stingless bees was done by Kerr and Maule [3]. The bees occur in tropical and subtropical regions of the world. Most stingless bees are in tropical South and Central America—260 species in Brazil and 20 to 40 each in the tropics of Africa, Asia and Australia [4]. There are about 600 species in 56 named genera in tropical and subtropical areas of the world [5] of the tribe Meliponinae, which can be divided into two tribes: the Meliponini with the single genus *Melipona* and the Trigonini with a large number of genera and sub-genera [6]. Some differences between the two tribes are shown in Table 1.

In Africa, 6 genera of stingless bees comprising of 19 species are known to occur. They are all social. In five of the genera (*Dactylurina* Cockerell, *Meliponula* Cockerell, *Plebeina* Moure, *Hypotrigona* Cockerell and *Liotrigona* Moure), workers collect pollen and nectar from flowers, and in one genus (*Cleptotrigona* Moure) they rob pollen and nectar from the nests of other stingless bees) [2].

Table 1. Some differences between Trigonini and Meliponini tribes of the stingless bees of the tropical and subtropical areas of the world

Trigonini	Meliponini
Specialised queen cells	No specialised queen cells
Queen cells usually found near periphery of combs	Queen cells intermingled in the combs
Ovaries of newly emerged queens well developed	Ovaries underdeveloped
Queens rarely produced	Queens frequently produced

Nesting

The nest is the central place from which stingless bees mate, forage and pass through life stages. Nests are immobile fixtures and potentially long-lived. Most stingless bees depend on trees to make nests whereas a minority nest in the ground or make exposed nests. The nest is usually made up of five parts: brood cells, storage pots, involucrum, batumen and an entrance. The nest is built using a special building material called cerumen that is a mixture of wax secreted from the wax glands on the abdomen and resin which is collected from plants. Brood comb may be either multi layered or made up of brood cells arranged in a cluster. Cluster type nests can take advantage of small irregular spaces.

A small crack or hole serves as the entrance hole. Each species constructs an entrance tunnel, made of wax, at the outside often provided with special structure in which much other building material is present. This entrance protects the nest. The entrance hole is connected to the nest components by an internal tube. Two types of envelopes protect the nest; involucrum and batumen plate. Brood cells are wrapped by loose wax sheet called cerumen. Batumen plates, usually made of cerumen and mud, seal the extra space present inside the tree cavity. Pillars and the connectives formed of criss cross strands of cerumen are found in clusters inside the nest to support it. Pollen pots are usually found closer to the entrance. Honey pots are usually found in separate clusters. The honey pots are closed after the completion of honey ripening process. Waste and resin are stored inside the nest in waste dump and resin dump respectively, which are found only in stingless bees nests. Stingless bees are not efficient in controlling nest temperature. They are inefficient in raising the temperature when it is low. Hence, they are limited to tropical and subtropical areas.

Colony reproduction

Brood cells of the stingless bees are either spherical or oval in shape. In each brood cell a bee is reared and it is used only once. The queen brood cells are few and are both larger and taller than worker brood cells in *Trigona* (African species). But in *Melipona* (Neotropical species) both the worker cells and queen cells are similar. Eggs are laid singly in the cells. The developing grub inside each brood cell is nourished by mass provisioning. The cell is closed immediately after oviposition. This process is characterised by highly developed social interaction among members. Stingless bees provide their brood cells with food all at once and then close the cell just after the queen has laid an egg. Queens are reared in special large cells at the margin of the comb and the cells are filled with more larval food cells. The production of a queen depends on the amount of food provided during the larval stage, and any fertilised egg can become a queen or worker.

Caste differentiation

Like honeybees, stingless bees have a queen, workers and drones. The queen can be identified by longer scape, shorter lapping tongue, smaller mandibles, less distinct glabrous streaks on mesonotum, absence of corbicular and wings partially covering the inflated abdomen. The worker is characterised by smaller mesonotum, presence of corbicular and

wings projecting well beyond the pointed abdomen. The drone is characterised by straight arranged ocelli, enlarged compound eyes, smallest scape, longest antennae, smallest mandibles and less distinct glabrous streaks on mesonotum, rudimentary corbicular wings projecting slightly beyond the blunt abdomen and genitalia.

Distribution in Kenya

There are about 12 species of stingless bees in Kenya. Six species have been identified in Kakamega forest, three species in Mwingi and four in Arabuko-Sokoke forest in Kenya (Table 2).

Table 2. Stingless bees found in three selected Kenyan forests

Kakamega	Mwingi	Arabuko
<i>Meliponula bocandei</i>	<i>Hypotrigona gribodoi</i>	<i>Dactylurina schmidtii</i>
<i>Meliponula (Trigona) ferruginea</i>	<i>Meliponula (Trigona) ferruginea</i>	<i>Hypotrigona gribodoi</i>
<i>Meliponula (Meliplebeina) becarii</i>	<i>Hypotrigona araujo</i>	<i>Meliponula (Trigona) ferruginea</i>
<i>Meliponula lendliana</i>		<i>Hypotrigona araujo</i>
<i>Pleibeina hildebrandti</i>		
<i>Hypotrigona araujo</i>		

The distribution of the various species varied depending on the availability of nesting cavities. *Hypotrigona* species preferred nesting on house walls although some were found on trees. *Meliponula bocandei* preferred the trees in the forests. Both *Meliponula ferruginea* and *Meliponula lendliana* preferred nesting on trees and house walls.

Meliponiculture

Meliponiculture is the science of keeping stingless bees. It is growing fast in some countries like Mexico and Australia, with an estimate of 250 stingless beekeepers with more than 400 colonies in Australia. Some of the reasons for this growth include the realisation that stingless bees can be propagated and kept in hives, and the rising need of conserving and protecting native bees species from threats such as environmental degradation and competition from honeybees [7].

The perennial nature, human safety and absence of absconding trait are the important desirable attributes of stingless bees, which induce anyone to keep them. Hence, meliponiculture can be a viable sideline occupation for both men and women. Meliponiculture is a low cost technology that rural people who are living below the poverty line can take up. There is a very good scope to introduce and expand meliponiculture in Kakamega, Mwingi and the coastal area in Kenya.

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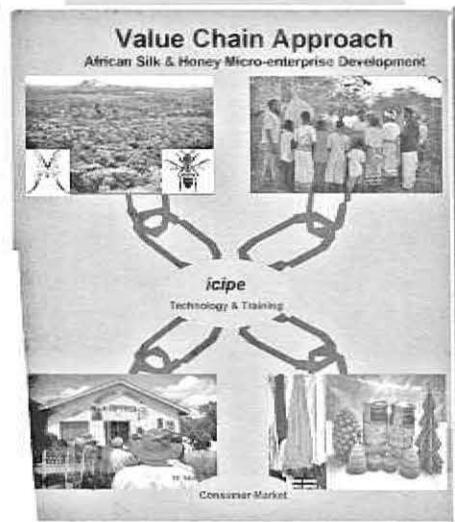
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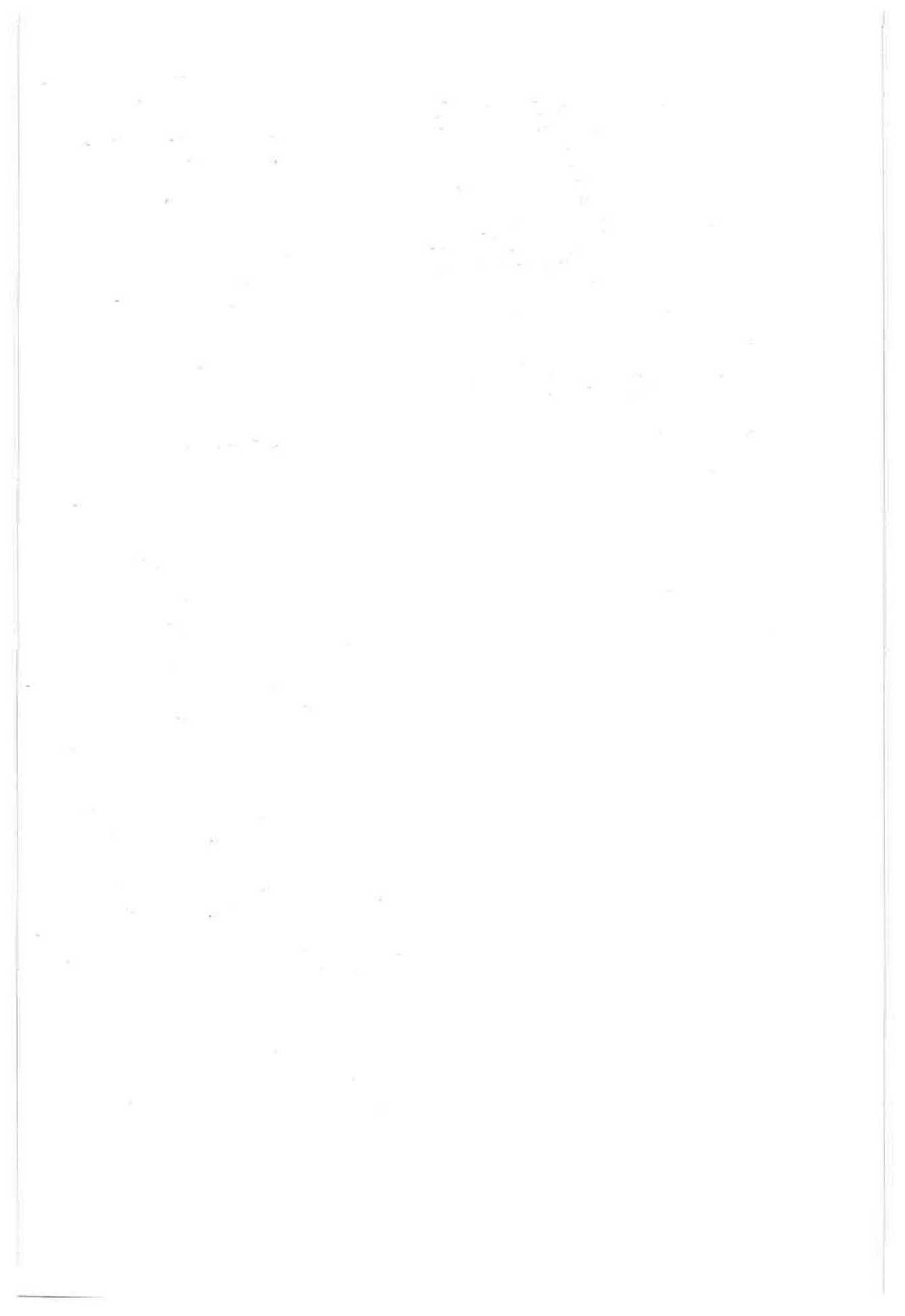
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SESSION 5

Improvement of managerial and technical capabilities of beekeepers and silk farmers through adaptation and dissemination of appropriate technologies





STRATEGY FOR AGRICULTURAL DEVELOPMENT WITH SPECIAL REFERENCE TO MICROENTERPRISE DEVELOPMENT IN SOUTHERN SUDAN

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Abstract: The Sudan is the largest country in Africa (1 million sq miles, bordering 9 countries and the Red Sea). It has been at war with itself for 40 of its 50 years of independence. In Southern Sudan, agriculture is largely subsistence (640,000 km², 70% arable), rainfed and more than 95% of the population earn livelihoods from agriculture. Poverty levels are high, with more than 80% living on less than US\$ 1 a day. The Ministry of Agriculture and Forestry is tasked with the challenge on how to revitalise and transform traditional subsistence farming to a sustainable modern one to achieve food self-sufficiency, alleviate poverty and attain economic growth. To do this, the Ministry is implementing agricultural policies, agricultural inputs and credit facilities, research and extension services, rural/ village infrastructure development, conservation and management of natural resources and human resource development.

Facts about the Sudan

It is the largest country in Africa (1 million sq miles, bordering 9 countries and the Red Sea). It has been at war with itself for 40 of its 50 years of independence. CPA was signed on 9th January 2005 resulting in one country but two systems (GONU and GOSS). GOSS was formed in October 2005, marking re-birth of the Ministry of Agriculture and Forestry (MAF).

Southern Sudan

Agricultural sector

Agriculture is largely subsistence (640,000 km², 70% arable). It is mainly rainfed with limited irrigated farming being practised. Rainfall ranges from 500 to 2000 mm/year (4–10 months of rains). The population is 8–10 million. Livelihood of > 95% of the population is agriculture, >80% of the population depend on < US\$ 1/day. The Sudan has diverse natural resources, e.g. forest, pasture, rivers, lakes, swamps, plains, plateaus, mountains and a range of soil types. There are a variety of crops. It is a potential bread basket of the Sudan.

War-time initiatives

The SPLM strategy on 'Peace Through Development' in the opposition held areas in 1998 was the first ever step in self planning.

This multi-faceted strategy targeted six key components:

- Physical infrastructure (e.g. roads, airstrips, communication)
- Financial institutions (Nile Commercial Bank and others)
- Agriculture and natural resources
- Microenterprise development
- Human capital development; and
- Macroeconomic policy framework.

USAID/OFDA supported agriculture and microenterprises through Transition to Development Assistance (STAR) Programme from 1998.

STAR and agricultural rehabilitation

CDRF (1998), benefited project groups in 9 counties in S. Sudan
SSARP (2001) formed six training centres:

- Food Crops
- Agriculture
- Technology
- Livestock
- Forestry
- Wildlife Management.

The centres are currently partially funded by GOSS.

STAR and microenterprises

STAR funded microenterprises in the following key areas of economic rehabilitation:

- Transport (e.g. trucks)
- Agriculture (e.g. farmers association)
- Trade (e.g. wholesale shops)
- Small-scale manufacturing (e.g. grinding mills, oil pressing, soap making)
- Beekeeping and honey harvesting to create jobs and income
- Hides and skins processing (6 million cattle, hides sold in Arua, Uganda valued at > US\$ 100,000 in 1998).

Post-war initiatives

GOSS Development Strategy on agriculture and microenterprise.

Ministry of Agriculture and Forestry (MAF) goals

- Microenterprises (to build on war-time gains)
- STAR-CDRF
- SSARP training centres
- Microenterprises funded projects
- Gum arabic
- Agriculture and forestry, i.e. how to revitalise and transform traditional subsistence farming to a sustainable modern one to:
 - (i) achieve food self-sufficiency,
 - (ii) alleviate poverty, and
 - (iii) attain economic growth.

Constraints to agricultural development

- Security issues
- Land issues (ownership, leases, sub-division, taxes)
- Weak institutional and human capacity
- Poor and inadequate rural infrastructure
- Weak research and extension systems
- Lack of inputs and input supply channels
- Lack of processing technology and marketing facilities

- Inadequate natural resources and environmental conservation practices
- Lack of agricultural data and information flow.

MAF strategic interventions

- Agricultural policies
- Agricultural inputs and credit facility
- Research and extension services provision
- Rural/ village infrastructure
- Natural resources and environment conservation and management
- Institutions and human resources.

Agricultural policies: (Effective planning and programming strategies)

1. Collect, compile and analyse agricultural data;
2. Diagnostic and baseline surveys by State, Counties, Payams and Bomas;
3. Develop effective information flow using IT and M&E system at all levels of MAF;
4. Train and equip staff of Planning and Programming Directorate;
5. Generate agricultural policy framework.

Agricultural inputs and credit facility: (Plan, determine and supply inputs)

1. Improved seeds, seedlings, tissue culture;
2. Agrochemicals and organic fertiliser;
3. Labour saving farm implements;
4. Mechanised equipment and facilities for the large-scale irrigated fields;
5. Credit facility establishment.

Research and extension services provision

1. New and improved agricultural technologies and cropping practices;
2. Efficient agricultural research and extension, and information services;
3. Market information and linkages;
4. Facilitate agricultural loans.

Rural/village infrastructure

1. Rehabilitate and expand feeder roads;
2. Rehabilitate and expand rural markets and postharvest facilities;
3. Design, develop and construct irrigation schemes;
4. Identify and develop swamplands for commercial agriculture.

Natural resources and environment: Conservation and management

1. Mapping and documentation of land uses;
2. Advocate for enactment of land use policy;
3. Mitigate environmental degradation through best management and damage control practices;
4. Improve techniques in land, soil and water conservation, and range management;
5. Introduce sustainable agroforestry/ forestry techniques and management.

Institutions and human resources: (Develop and strengthen human resources)

1. Take inventory on current staffing and availability;
2. Determine staffing requirements (GOSS and States);
3. Match demand with supply and develop internal and external training programmes;
5. Strengthen institutions and departments with the required facilities and needs;
6. Empower training and skills development department within MAF.

Opportunities

- There is a favourable macroeconomic environment (the CPA)
- GOSS/MAF commitment to agriculture and forestry development (policy and budgetary allocation)
- Abundant arable land and natural resources
- Donor goodwill and support
- Regional collaboration: Institutions waiting for official invitations to participate (IFAD project in SS).

Conclusions

- Agriculture is largely traditional. Harnessing the opportunities outlined above may prime its development to attain self-sufficiency and surplus
- Potential of becoming one of the largest organic farming countries in the world exists
- War time small pilot projects experiences undertaken by individuals/groups so far guarantee a viable microenterprise sector which could develop to meet the local demand.

MANAGERIAL AND TECHNICAL APPROACHES IN ENHANCING PRODUCTION, PROCESSING AND MARKETING OF WILD SILK BY SMALLSCALE FARMERS IN AFRICA

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Abstract: It must be accepted that to many African farmers most insects are seen as pests, which need to be eradicated. Their actual or potential benefits are often overlooked. This was very much the case in Namibia. The Kalahari Wild Silk Company is harvesting or purchasing cocoons from which the *Gonometa postica* moths have emerged for processing. Although farmers in the Kalahari would like to see these moth species eradicated, we in the silk industry are striving to protect and sustainably manage the resource. To develop a sustainable wild silk industry, new partnerships need to be developed among different stakeholders, e.g. researchers, conservation groups, government, NGOs, entrepreneurs and community groups, since no single organisation has the ability to single-handedly achieve this. Silk farming as a business must be integrated at the local level and must be taken as far up the value chain as possible.

Introduction

For the past six and a half years, this author has been responsible for the establishment of a smallscale wild silk industry in Namibia. This has involved everything from research and surveying of the resource base to setting up the degumming plant, training of the spinners and weavers and the production of a range of Kalahari Wild Silk products.

The Namibian project is unique in many ways. What we are doing in Namibia will certainly not apply to most wild silk projects that are initiated elsewhere in Africa. This paper discusses what we have done and are doing in Namibia and why it is being done in this way.

To many African farmers, insects are seen as pests, which need to be eradicated. Their actual or potential benefits are often overlooked. This was very much the case in Namibia. Also, where people are poor, hungry and in need of firewood (and surrounded by seemingly endless forests), conservation of these forests is not a priority. Communities, therefore, need to be educated as to the value of what they have in natural resources and the urgent need for forest management.

Our situation in Namibia is somewhat different. Cocoons occur in a semi-desert environment, but it still is important to preserve this. The silk we are producing comes from the wild silkworm *Gonometa postica* that is from the moth family Lasiocampidae. These moths are endemic to the Kalahari region of Namibia, Botswana and South Africa. The cocoons of these moths are extremely hard and difficult to degum.

There are approximately 17 different species of *Gonometa* occurring on the African continent. In East Africa, there are reportedly 56 different silk producing moth species. There are 11 species in the family Lasiocampidae, 8 species in the family Saturniidae and one in the family Thaumetopoeidae that have been positively identified. These all produce silk of equal or even greater commercial value than some of the wild silks currently being produced. We will not speculate on what exciting new silks are potentially available in the rest of Africa.

Cocoons

Where wild harvesting of cocoons in an area is unable to provide enough cocoons for local processing, it may, in some instances, be possible to semi-domesticate or rear some of these moth species in semi controlled conditions or create population increases through seeding of eggs and cocoons containing live pupae. In wild harvesting of cocoons, the most important factor is to ensure that your regeneration exceeds your take off.

In Namibia, as a matter of strict principal, we only harvest or purchase cocoons from which the moths have emerged for processing. Although farmers in the Kalahari would like to see this moth species eradicated, we in the silk industry are striving to protect and sustainably manage this resource. By using only spent cocoons, we have no impact on the regeneration of the moths. And as a result of using only spent cocoons, we have no other choice but to degum the cocoons and hand spin the yarn directly from the cocoon. For us, this gives us our own unique yarn and products.

Partnerships

No single organisation has the resources, training and local knowledge to support all of the activities associated with the sometimes complex and sustainable process of establishing all the linkages in such a project. For example, silk production requires basic field research to determine what species are present in different sites and how to rear them, teaching of local farmers and artisans, providing financial and business services to communities, and identifying new markets. Therefore, you need to work to organise new partnerships among existing conservation, government, NGO, entrepreneurs and community groups.

Once the opportunity for an area to harvest or produce wild silk has been identified there is a lot of work to be done. There is the research needed to determine the life history biology of the species in question.

This includes the life cycle of the particular moth species:

- Population dynamics (The biotic and abiotic causes of mortality)
- Parasitoids, on eggs and larvae
- Predators, on larvae and cocoons
- Attempts at artificial production of cocoons using various seeding methods.

The value chain

Then there is the preparation and training in the different activities in the value chain. This will mean the organising of the entire production process from beginning to end and the development of the institutional set up. Members of the community will need to be recruited and trained for this.

A system that will provide a market for individual farmers who can produce only a limited number of cocoons as well as a market for communities that combine their efforts to produce finished fabrics and wild silk products will be needed.

Appropriate technology for the processing of the cocoons to finished product is readily available. In a country like India, which has produced silk for centuries and where four different kinds of silk are produced, they have developed the necessary technology and this is readily available to us.

Certain cultures in Africa already have a culture of textile production. Let us adapt or learn from this where possible. Decision on which method of processing, reeling vs degumming, will need to be determined during the early stages of a project.

Silk farming as a businesses must be integrated at the local level. It must be taken as far up the value chain as possible (i.e., from farming/wild harvesting, to fibre processing, spinning, weaving/textile production and finished products), to ensure that enough income is generated to substantially alleviate poverty among the rural poor.

Silk will not replace current income streams but will enhance them. Because the production of wild silk is of necessity a smallscale labour-intensive activity that normally takes place in regions remote from the most profitable markets, it is difficult for rural communities to access these markets and marketing is the most vital process in the whole chain of success.

Wherever wild silk is produced, it is only in relatively small quantities, and as a result is unique in its own right. We must also accept that we will never be able to compete with silk originating in Asia; therefore, we need to produce products that are uniquely African, with new ideas and designs and immediately distinctive from Asian silks.

What do we need to do in Africa to give our silk a competitive edge?

African creations

We have an advantage of being able to introduce new types of silk to the world market. We have an incredible pool of art, craft, history and culture that we can draw from and work into African creations. Let us use this to our advantage. Africa has the exciting opportunity of being able to introduce completely new forms of wild silk and products to the world market. We need to develop new customers and explore new avenues where silk can be utilised.

An essential factor in marketing a new product like this is the need to spin a story around the silk, the product, the process and/or the community. An interesting story helps enormously in getting customers interested in your product and making the product visible. The story needs to tug on the emotions of the buyer, as buying of silk is often an emotional thing. In Namibia, we are fortunate that we had the ideal vehicle available to be able to do this. The name Kalahari is a name that many people in the consumer world are aware of. It conjures up visions of dry desert, wildlife and the San or Bushmen communities that live in a hostile environment. We could have called it Gonometa silk or Acacia silk but neither of these two names would have the same impact as Kalahari Wild Silk.

Just the name is a strong selling point. Added to this was the story of all the animal losses that farmers had experienced and were attributed to the animals having eaten cocoons and succumbed to rumen impaction. So, not only is the product from the Kalahari Desert but also on converting a serious pest into a valuable job creation opportunity and beautiful products. It is natural, organic, ecofriendly and a luxury product. So one needs also to promote this and its other unique properties (organic, hypoallergenic, comfort, look, and with new silks, uniqueness). Brand your product, make it identifiable. As a brand name with the story behind it, Kalahari Wild Silk touches all the right buttons of the consumer.

Take your product as far up the value chain as possible

To benefit to the fullest extent from the value of your product, it needs to have as much local value addition as is possible.

Designers around the world are always looking for new and interesting fabrics. Wild silk offers them the opportunity to be able to experiment with new and interesting natural materials. We are all aware of the ever-growing move in the developed world towards 'organic' products and natural fibres. We need to capitalise on this. We need to educate the designers and consumer as to the benefits that come with using or wearing silk.

Maybe Africa needs to take note of the silk mark idea in India. We should combine production under one regional banner and market cooperatively. Silk, like many other high value agricultural products, can benefit from co-op marketing.

Let us look at a value chain analysis, the greatest profit in the silk market, using an illustrative profit made from a consumer purchasing an article valued at \$100:

- Harvesting or farming (5–10% or US\$ 2)
- Fibre production (25–50% or US\$ 5)

- Weaving (50% or US\$ 9)
- Finished products (50% or US\$ 16)
- Wholesaler (45–50% or US\$ 18)
- Retailer (50–800% or US\$ 50).

Understand who your consumers are and what they want

Production of wild silk is necessarily a smallscale, labour-intensive activity that takes place in regions remote from the most profitable markets. Maximise profits by forming marketing co-ops.

The case of the Rainforest Silk Cooperative

Prof. Catherine Craig of Harvard and Tufts University and IPALI in Madagascar has put together a silk marketing cooperative that is currently establishing markets for wild silks from Madagascar, India, Indonesia and Namibia mainly in the USA but will later expand to other markets.

The benefits of belonging to a cooperative such as this are:

- Reduced marketing costs
- Reduced risk to individual farmers, spinners and weavers
- Product recognition through a common brand that affords larger volume, consumer perception and customer loyalty
- New channels to market
- Partnerships with designers, etc.
- Pricing leverage
- Opportunities to share best practices to improve production and product quality.

There are also the fair trade organisations around the world who are always looking for new products to market for communities in developing countries.

Conclusion

Apart from fabrics and textiles, a number of other products can be manufactured from either the cocoons themselves or the woven fabric. In Indonesia, cocoons of *Cricula trifenestrata*, which are small golden cocoons, are used for decorative uses like the covering of wooden trinket and jewellery boxes, handbag flaps and other articles for the tourist trade. In one of the top boutiques in Madagascar I have seen handbags and shoes covered in hand woven wild silk. Lastly, produce brochures and get them to all the tourist spots.

CONSTRAINTS IN THE POSTHARVEST SERICULTURE IN EGYPT

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Abstract: Egypt government policy is to expand sericulture activities in the villages to provide employment and generate more income for the poor rural people. This expansion is limited because of non-introduction of modern sericulture technology in the villages. The mulberry cultivation is found only in the Government and private farms but not in the villages. The raising of silkworm crops by the farmers is very primitive. Thus, the production of cocoons is neither assured nor taken up in different seasons. Therefore, training of the farmers for raising high-grade cocoons suitable for modern reeling machines must take place. The local raw silk is mainly produced by the manual reeling machines, using cheap and simple locally manufactured appliances. These appliances are either foot-powered or hand-driven. So the produced raw silk is used for weaving carpets and handmade fabrics on hand looms. It has irregular thickness (50–70 denier) and high percentage of sericine.

Introduction

For achieving sustainable economic development in Africa, it is necessary to alleviate human condition and preserve the environment on which all lives depend. In Egypt, there was a depletion in the natural resources due to the surrounding desert. Activities are restricted only around the Nile riverbed both in the Lower and Upper Egypt regions. The total area for cultivation is very limited for the life process to continue, yet the population has increased stupendously in the recent past. Unemployment in rural areas has surmounted and agriculture unpaid. Hence, creation of new jobs for the youth in the villages especially for graduates and undergraduates is essential at present.

The Government of Egypt has already started distributing the land areas to smallscale farmers and graduates to overcome this situation. Among the sustainable commercial activities of the farmers, sericulture being an agro-based industry, provides employment to a large number of rural people and arrests their migration. Thus sericulture provides the opportunity of increasing rural income in Egypt.

Development of sericulture in Egypt, therefore, promises a new opportunity for the rural masses to get employment and increase their income to improve their living conditions. Sericulture requires minimum inputs and has a short gestation period, but the returns are periodical and are highly remunerative. The mulberry silkworm *Bombyx mori* culture produces good quality silk yarn, which is used for producing highly priced fabrics, tyre lining, electrical insulation, artificial food vessels and surgical sutures. The farmers can produce the cocoons by raising mulberry gardens and earning money if the cocoons are properly reeled and fabric produced from the quality raw silk.

Cocoons

Presently, reeling cocoons have to be subjected to a process of stifling with the object of killing the pupae inside without in any way interfering with the structure of the silk shell around the cocoons.

Drying of cocoons

The popular method in Egypt is mainly sun drying by prolonged exposure of fresh harvested cocoons to the scorching hot sun. Immediately after the harvest of cocoons, they are spread

out on mats and kept in the hot sun from sunrise to sunset for several days till the pupae are killed and the cocoons completely dried. Sun-dried cocoons are very light and when shaken make a rattling sound.

Silk reeling

Although sun drying is simple and cheap, it is not suitable for modern reeling. Silk is very sensitive to sunlight and when cocoons are exposed to bright and hot sunlight for a prolonged period as in the sun drying process, the original bave strength is affected, thus impairing reelability of the cocoons and lowering the quality besides increasing wastage of silk in reeling. Therefore, the Sericulture Research Department researchers and extensionists advice the farmers to cover the cocoons while drying by a black cloth to prevent the harmful effect of the sun's rays.

In advanced countries, stifling and drying of the cocoons is carried out by the hot air conditioning method. This should be practised in Egypt.

The local raw silk is mainly produced by the manual reeling machines, using cheap and simple appliances that are locally produced. These appliances are either foot-powered or hand-driven. As a result, the produced raw silk is used for weaving carpets and handmade silk fabrics on hand looms. It has irregular thickness (50–70 denier) and high percentage of sericine.

In Egypt, there are a few hand looms in Delta area. Besides, there are some traditional power looms in Upper Egypt for producing silk fabric distributed among six Governorates in the Delta (in the north): Qalyoubeya, Gharbeya, Menoufeya, Dakahleya, Beheira and Sharqkeya and also, two Governorates in Upper Egypt (in the south): Fayoum and Souhag. A total of 100 families, distributed over 40 villages of average of 40 to 200 workers are working in the postharvest industry.

Manual spinners are also used to produce spun silk. One kg of spun silk is produced from 4.5 kg of waste silk.

At present, the annual output of raw silk is limited to about 3–4 metric tons and it does little to match the consumption needs in Egypt. Therefore, Egypt imports raw silk from China for the silk industry.

Conclusion

The following activities should be carried out to achieve and develop sericulture in Egypt:

- Increase number of well-trained rearers to produce high quantity cocoons
- Create professional reelers who would be able to reel 20–22 denier or less, which has a good demand in the international market
- Distribution of modern silk reeling machines in different Governorates to replace manual reeling machines
- Raise the quality and quantity of cocoon production produced from one silkworm egg box
- Use power looms instead of handlooms.

According to these activities, we will be able to introduce modern sericulture enterprises in the villages and urban areas for generating both employment and sufficient income to improve the economy of rural Egypt.

DÉVELOPPER L'ÉCONOMIE RURALE DU CONGO EN UTILISANT L'APICULTURE COMME SOURCE DE REVENU

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République Démocratique du Congo

Résumé: La République Démocratique du Congo à l'instar de plusieurs pays africain est à la recherche des voies et moyens susceptibles à développer l'économie de ses milieux ruraux; afin de réduire la pauvreté qui y sévit. Pour ce faire, l'une des approches serait de promouvoir aux paysans du milieu rural d'autres compléments d'activité en plus de leur activité de base déjà existant. Cependant, le choix de cette activité devra d'une part contribuer à augmenter le revenu du paysan et d'autre part sauvegarder son environnement. Par ailleurs, l'activité complémentaire devra aussi être d'un apprentissage facile, d'un investissement moins coûteux et le moins laborieux possible pour ne pas empiéter l'activité de base des paysans découlant de leur héritage traditionnel. C'est dans ce contexte que nous envisageons qu'une attention particulière soit prêtée à l'apiculture pour la production du miel pour comme complément d'activité en milieu rural. Le miel est très apprécié par la population congolaise; il est consommé au petit déjeuner et bon nombre l'apprécie pur-ses vertus médicinales. Sur le marché congolais, le miel provient de l'importation, du petit élevage local et de la récolte dans les ruches sauvage. Malheureusement, faute de statistiques en la matière, il nous est difficile de ressortir la contribution d'un chacun dans l'approvisionnement du marché en RD Congo. Toute fois, la part attribuable à l'apiculture local n'est pas significative et serait surtout pratiqué en milieu rural de la RDC. Des données recueillies par certains auteurs dans le territoire de Kasangulu dans la province du Bas Congo à quelques 15 km de la capitale (Kinshasa) révèle que; bien que du type traditionnel, cet apiculture ouvre des nouveaux horizons au paysan de cette contrée. Le revenu saisonnier d'un apiculteur disposant en moyenne de 3 ruches est encourageant, soit 150.000 FC équivalent à 300\$ pour 2 périodes de récolte par an. Ce revenu se rapporte à une production moyenne de 10 litres de miel pur par période de récolte et par ruche. Le coût d'investissement d'une ruche étant évalué à 10\$. Cependant, une amélioration des rendements à la production et une organisation du circuit de commercialisation du miel et des ses sous produits s'avère indispensable. Elles permettront à nos apiculteurs de zones rurales de tirer d'avantage profit de cette activité et de voir ainsi le nombre de personne y intéresser augmenter sensiblement.

Introduction

Le revenu du paysan dans le milieu rural en République Démocratique du Congo est faible, ne pouvant pas lui permettre d'aspirer à une vie mondaine. La vie économique du paysan dans le milieu rural du pays est bâtie soit sur l'agriculture traditionnelle, la pêche artisanale, l'exploitation de la forêt pour la production du bois de chauffage et/ou charbon de bois. Ces activités sont en générales jusqu'à ce jour la seule ressource de revenus du paysan avec comme corollaires la destruction de la forêt ainsi que du réservoir aquatique, et la disparition de la faune sauvage. Il s'impose donc une nécessité de chercher des solutions palliatives pour relancer le secteur économique en milieu rural et réduire l'exploitation abusive de la forêt et des zones aquatiques par les paysans. Pour ce faire, bon nombre d'auteur stipule que l'une des approches serait de promouvoir pour les paysans en milieu rural des compléments d'activité en plus de celle de base déjà existante. Le choix de cette activité devra d'une part contribuer à augmenter le revenu du paysan et d'autre part sauvegarder son environnement. Par ailleurs, l'activité complémentaire devra être d'un apprentissage facile, d'un investissement moins coûteux et le moins laborieux

possible pour ne pas empiéter l'activité de base des paysans découlant de leur héritage traditionnel.

C'est dans ce contexte que nous envisageons qu'une attention particulière soit prêtée à l'apiculture pour la production du miel pur comme complément d'activité en milieu rural. Le miel est très apprécié par la population congolaise; il est consommé au petit déjeuner et bon nombre l'apprécie pour ses vertus médicinales.

Sur le marché congolais, le miel provient de l'importation, du petit élevage local et de la récolte dans les ruches sauvage. Malheureusement, faute de statistiques en la matière, il nous est difficile de ressortir la contribution d'un chacun dans l'approvisionnement du marché en RD Congo. Toute fois, la part attribuable à l'apiculture locale, n'est pas significative et serait surtout pratiqué en milieu rural de la RDC.

C'est à ce juste titre, que vu l'accessibilité facile par voie routière et ferroviaire qu'offre la province du Bas-Congo et sa proximité de la ville de Kinshasa, capitale de la R.D. Congo. Notre choix a porté sur celle ci en vue de présenter l'impact socio-économique de l'apiculture en milieu rural de la dite province.

Brève présentation de la Province du Bas Congo

Situation géographique

La province du Bas-Congo [1] s'étend entre le 4° et 6° latitude sud et 12° et 16° longitude Est. Il couvre une superficie totale de 53.947 km² soit 2,3% de la superficie du pays.

Situation administrative et démographique

Sur le plan administratif, la province du Bas-Congo est divisée en deux villes (Boma et Matadi) et trois districts (Bas fleuve, Cataracte et la Lukaya). Chacun de ces districts est subdivisé en trois territoires qui à leur tour sont divisés en secteurs, soit 55 secteurs pour l'ensemble des trois districts. On compte au total 6000 villages répartis dans les trois districts.

La densité de la population de cette province est relativement élevée en comparaison avec celle des autres provinces du pays. Elle était de 50 habitants au kilomètre carré en 1994; actuellement elle est augmentée durant cette dernière décennie.

Le Tableau 1 nous donne la répartition de la population rurale et des villages par districts.

Tableau 1. Répartition de la population rurale et des villages par districts

Districts	Population rurale	Nombre de village
Lukaya	345.000	1.455
Cataracte	590.000	1.550
Bas fleuve	515.000	2.995
Total	1.450.000	6.000

Source: Division provinciale de l'Urbanisation et Habitat (1995).

Climat

La province du Bas-Congo est caractérisée par un climat tropical soudanien qui selon le système de classification de Koppen appartient au type Aw1. Il s'agit d'un climat tropical humide dont la saison sèche, bien marquée s'étend sur un peu plus de quatre mois (du 15 mai au 25 septembre). De plus, la longue saison des pluies est souvent interrompue par une petite saison sèche entre mi-janvier et février. Les moyennes annuelles des précipitations varient de 900 à 1500 mm, alors que la température moyenne annuelle, assez uniforme, oscille au tour de 25 °C en saison de pluie et de 22 °C en saison sèche.

Végétation et relief

La province du Bas-Congo est dominée par un relief des collines entrecoupées. Sa végétation comprend trois types de formations naturelles bien distinct répartis dans le district:

- Les districts de la Lukaya et de Cataracte sont malgré les fortes pluviosités, le domaine d'une savane arbustive entrecoupée par des lambeaux de forêt.
- Le district du Bas fleuve est recouvert d'une part par la forêt sur presque toute l'étendue et d'autre part par une formation herbeuse.
- L'hinterland côtier est caractérisé par une végétation de mangroves dans les terrains inondés et/ou marécageux de l'embouchure du fleuve Congo et de steppes dans les plateaux dominant la côte de Moanda.

Activités socio-économiques

La province du Bas-Congo est une zone agro-pastorale. Les activités paysannes sont essentiellement basées sur l'agriculture vivrière et arbres fruitiers, le maraîchage, l'exploitation du bois pour le chauffage et le charbon de bois. On y cultive l'haricot, l'arachide, le manioc, la patate douce, l'aubergine, les choux, la tomate, la banane, la ciboule, l'oignon, le taro, agrumes, etc. Du point de vue pastoral, l'élevage bovin, porcine est pratiqué par des investisseurs privés.

Impact socio-économique de l'apiculture en milieu rural du bas-Congo

En milieu rural du Bas-Congo le miel disponible sur le marché proviendrait de deux sources à savoir:

- Le prélèvement dans des ruches naturelles
- Les pratiques apicoles.

Miel provenant des ruches naturelles

L'impact socio-économique en milieu rural de la commercialisation du miel provenant des ruches naturelles a été réalisé par NSITU (2005) [2]. Pour cet auteur, la quantité moyenne du miel qu'un paysan obtiendrait dans une ruche naturelle en recourant aux méthodes traditionnelles s'élèverait à 3,3 litres par ruche. La qualité du miel obtenu est de mauvaise qualité (odeur de la fumé, beaucoup d'impureté et une teneur élevée en eau) d'où le prix de vente de ce type de miel est trop faible, soit 1 \$US le litre. Le même auteur souligne que, le coût d'investissement engagé par les paysans pour toutes les opérations traditionnelles déployées pour recueillir le miel peu s'estimer à 7 \$US. Bref, cette pratique est moins rentable pour le paysan et se limite qu'à une seule récolte car la colonie des abeilles étant détruite par le feu, ce qui est à la base de la destruction de l'écosystème.

Miel provenant des pratiques apicoles

Dans la province du Bas-Congo, l'apiculture au sens strict est très peu répandue. A ce jour, celle-ci est focalisée dans deux cités rurales dans le district de la Lukaya à savoir:

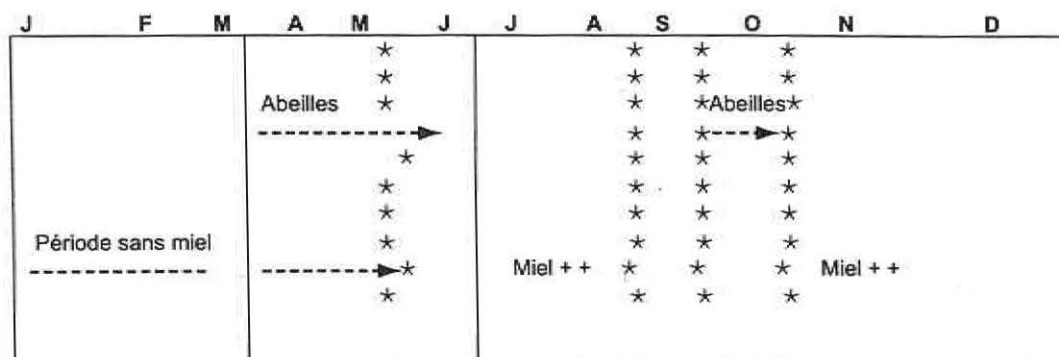
- Kavwaya situé à 110 km de la capitale et
- Kasangulu situé à 15 km de la capitale.

La vulgarisation de l'apiculture dans ces deux contrées est initiée par un projet local de l'église Armée du Salut. Il a pour objectif d'augmenter le revenu des paysans fidèles de l'église qui ne dispose que de l'agriculture comme source de survie.

Au stade actuel, l'apiculture paysanne dans ces deux cités rurales est du type artisanal amélioré. Il est pratique dans des ruches à barrettes nommées «la grande» d'une dimension moyenne de 75 cm x 50 cm x 25 cm et dont le coût de construction s'évalue à 10 \$US. Les abeilles qui y sont élevés sont généralement obtenues par capture des colonies sauvages.

Calendrier apicole

Le calendrier apicole dans ces deux cités rurales se présente Figure 1.



Source: MASUDI (2002) [3]

Figure 1. Calendrier apicole dans le territoire de Kasangulu et Kawwaya

Il en ressort de ce figure que la période allant du mois de janvier au mois de mai se caractérise par une absence de la production du miel. C'est à partir du mois de juin jusqu'en décembre que le miel est disponible sur le marché local. Au cours de cette période, deux récoltes du miel sont réalisées par les apiculteurs paysans. Il s'agit du mois de juin en août et octobre en décembre.

Production en miel et recettes

Les présentes données sont des moyennes enregistrées par MASUDI (2002) et NSITU (2005). Pour ces auteurs, le nombre moyen des ruches exploiter par paysan apiculteur dans ces deux cités est de 3.

La production moyenne en miel par ruche par période de récolte s'élève à 5 litres pour les apiculteurs non-encadrés et 10 litres pour les apiculteurs encadrés par le projet de l'Armée du Salut. Le prix à la vente d'un litre de miel est fixé à 5 \$US.

Le Tableau 2 fait ressortir le coût d'investissement engagé par les paysans de ces deux cités pour la production et la récolte du miel.

Il ressort de ce Tableau 3 que le coût d'investissement moyen pour un paysan désireux construire une ruche et se doter des matériels connexes à

Tableau 2. Coût d'investissement engagé par les paysans pour l'apiculture

Matériels	Quantité	Coût unitaire (\$US)
Ruche	1	10
Tenue complète	1	15
Enfumeur	1	6
Matériels de récolte et d'extraction		
Toile d'extraction	1	5
Couteau	1	1
Bassin	2	3
Brosse	1	3
Sceau	2	2
Total	10	45

Source: NSITU (2005).

l'apiculture artisanale améliorer s'élevé à 45 \$US.

De ce Tableau 4, il en ressort que la production moyenne en miel pour un apiculteur disposant en moyenne 3 ruches et effectuant 2 récoltes par an est de 60 litres. Les recettes qu'il tire de cette production s'évaluent à 300 \$US.

De cette analyse il se dégage que l'apiculture ouvre des nouveaux horizons aux paysans de ces deux cités du Bas-Congo. Le bénéfice annuel qu'un paysan peut tirer de la pratique d'une apiculture artisanale améliorée tel que réaliser dans les conditions décrites ci haut est de 255 \$US.

Tableau 3. Bénéfice annuel pour 2 récoltes équivalentes à 60 litres de miel pur

Produit	Coût		Bénéfice (\$)
	annuelles (\$US)	d'investissement (\$)	
Miel pur	300 \$	45 \$	255 \$

Tableau 4. Production et revenus du miel en apiculture paysanne du Bas-Congo

Produits	Production moyenne par ruche par période	Nombre moyen de ruche par paysan	Production totale par période de récolte	Prix de vente (\$/litre)	Recette par période de récolte	Nombre des récoltes par an	Recette annuelle (\$)
Miel pur	10 litres	3	30 litres	5 \$	150 \$	2	300 \$

Conclusion et suggestions

La recherche des voies et moyens pour améliorer le revenu du paysan en milieu rural constitue à ces jours le cheval de bataille des Organisations non gouvernementales et du Ministère de développement rural. Dans cette optique, l'apiculture en tant qu'art d'élever les abeilles pour la production du miel pur et ses autres sous produits mérite une attention particulière. Du point de vue socio-économique, l'analyse effectuée dans 2 cités rurales de la province du Bas-Congo en République Démocratique du Congo; révèle que l'apiculture ouvre des nouveaux horizons aux paysans de cette contrée. Sur le plan social, les productions de l'apiculture servent l'homme sous multiples façons (alimentation, apithérapie, art plastique, etc.). Du point de vue écologique, l'abeille est importante pour la pollinisation des plantes faisant ainsi de l'apiculture un complément à l'agriculture dont elle augmente le rendement en qualité et en quantité.

Sur le plan économique, la valeur du miel issu de l'apiculture artisanale améliorée est estimée supérieure; soit 5\$ US le litre contre 1\$ US pour un litre de miel provenant des ruches naturelles.

Par ailleurs toutes les dépenses relatives aux coûts d'investissement (45\$ US en moyenne) engagées par un paysan apiculteur disposant de 3 ruches et pratiquant une apiculture artisanale améliorée sont couvertes dès la première récolte. Cette étude relève que la production moyenne en miel dans ce type d'apiculture s'estime à 10 litres de miel pur par ruche/récolte. Le revenu saisonnier moyen de ces apiculteurs serait encourageant et équivalent à 300\$; avec un bénéfice de 255\$ US en 2 périodes de récolte par an produisant 60 litres de miel pur. La période de récolte s'échelonne de juin en décembre.

Cependant, une amélioration des rendements à la production et une organisation du circuit de commercialisation du miel et de ses sous produits s'avèrent indispensables. Elles permettront à nos apiculteurs de zones rurales de tirer d'avantage profit de cette activité et de voir ainsi le nombre de personnes y intéressées augmenter sensiblement.

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THE ROLE OF UNDP PROGRAMMATIC OVERSIGHT IN PROJECTS

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Abstract: The oversight role of UNDP in its implemented projects follows set out guiding principles and norms. These norms subscribe to the need to be independent, transparent and impartial and maintain quality while remaining relevant to all stakeholders. At the project levels, the role of UNDP is well captured in the project document and this includes and is not limited to: monitoring for results in the context of results-based management, tools and criteria to be used in monitoring and evaluating processes, outputs and outcomes realisations and impacts of the interventions of the project. The methods deployed take root from the provision of RMG such as project tracking sheets, term sheets for due diligence purposes, use of corporate databases (ATLAS and MPN), field visits, appraisals and use of management structures in-built into the project document.

The M&E framework, which forms an integral part of the project document, details the roles of partners in the provision of oversight functions. In addition, it charts out the frequency, depth and nature of financial and technical reporting needed to capture project effectiveness, efficiency, degree of change, sustainability and relevancy of the project to UNDP mandates, national priorities and to beneficiaries needs. In conclusion, the project assurance role remains the key function of UNDP where resources are externally sourced and channelled through UNDP or from own resources. The oversight role should provide indications for refocusing, guiding future activities and re-defining strategies of the project. The scope of the oversight functions must of necessity cover sets of activities and strategies to bring a certain outcome, clarify underlying factors affecting progress and make appropriate recommendations aimed at improving performance and generating lessons learned to inform the design of future projects.

Interventions

Programmed interventions include:

- Inception meetings (PRODOC is evaluated)
- Mid term review (project objectives evaluated)
- End of project evaluation (capture realised outputs, impacts and lessons learned).

Methodology

- The methodology is sufficiently rigorous and follows the prescribed generic norms for the UN, to assess the planned interventions and ensure a complete, fair and unbiased assessment with very clear indications on the cost effectiveness
- It is characterised by mutual respect and trust of all stakeholders
- Peer reviewers (Technical Advisory Committee) are useful during design of the methodology for appraisal or evaluation.

Tools used for programming, monitoring and evaluation

The tools used for programming, monitoring and evaluation are based on some tested parameters over the years.

- Programmatic Evaluation—>\$1 million or more and or direct support in an institution for over 10 years
- Evaluation Plan—Serves as a basis for evaluation compliance (sent to evaluation office)

- Project evaluation information sheet (PEIS)—Rating of performance as an integral part of evaluation reports (e.g. HS, S, MS, US—Common with GEF projects)
- Tripartite Review (TPR)—Periodic stakeholder consultations including beneficiaries (held annually)
- Terminal Report (TR)—Similar to APR/PIR for final year
- Field visits—Regular project field visits are encouraged. Visits have a flexible format but are more results oriented
- Annual reviews—A strengthened management dialogue at CO is required to assess progress towards results (outcomes and outputs). Requires strong stakeholder participation and serves as a basis for ROAR. It is the key for generating lessons learned for new programming as CPAP progresses
- Inception reports—New projects must begin with inception meeting to validate project planning matrix (PPM) and Plan of Operations (POP) and set realistic benchmarks and baseline conditions
- Consolidated delivery reports (CDR)/Project delivery reports (PDR)—Used for budgeting and estimating expenditures
- Project work plans—Used to plan for resource use, implementation and review strategies.

Technical reporting

- Technical reports are detailed documents covering specific areas of analysis or specialisations within the overall project
- Project log frame is the basis for reporting and is broken down to quarterly or half yearly work plans
- Progress and or quarterly reports—Used to present progress and problems
- Substantive project documentation—Prepared as part of work plan. Used to share achievements and or new thinking. May also be used for policy dialogue
- Bilateral/tripartite meeting reports—Used to solve problems and discuss strategy for future reference
- Stakeholder meeting reports—Used to adapt strategy based on feedback
- Steering Committee Minutes—Take action on decisions and adapt strategy.

The role of partners in M&E

- Government Coordinating Authority/Ministries—Coordinate design and support for M&E activities especially during annual review
- UN agencies—Provide basic socio-economic information, share common objective through Common Country Assessment and UNDAF. Provide technical support
- Executing agents—Provide information on effective implementation strategy and how outputs are being delivered
- Target beneficiaries—Provide information about relevance and quality of outputs or services through stakeholder meetings/consultations
- Universities/research centres/consulting firms—Supply M&E skills and capacity to offer training in skills and evaluation techniques
- Civil society—Uses M&E materials to inform public debates on public policies. Provides useful perceptions regarding outcomes
- Development assistance agencies—They exercise policy influence, technical advice, expertise and training.

Implications to beekeepers and silk farmers

- Interest in project participation ensured through participation in the field visits and meetings
- Exchanging of views from farmer to farmer during participatory farmer innovations learning (Farmer Field Initiatives)
- Global sharing of working methodologies and concepts through a number of UNDP web based networks, publications and knowledge management systems.

Conclusion

- The project assurance role is key function of UNDP
- The oversight role should provide indications for refocusing, guiding future activities and redefining strategies of the project
- Scope must cover sets of activities and strategies to bring a certain outcome, clarify underlying factors affecting progress and make appropriate recommendations aimed at improving performance and generating lessons learned to inform the design of future projects.

THE ROLE OF KENYA BUREAU OF STANDARDS IN PRODUCT QUALITY CONTROL

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Abstract: In the implementation of its core functions, KEBS focuses on facilitating fair national, regional and international trade by development of standards that are responsive to the needs for economic development, industrialisation and environmental sustainability, promoting industry, service and product competitiveness by providing internationally recognised conformity assessment systems, ensuring traceability in measurements for the worldwide recognition of test and measurement results performed by KEBS laboratories or its accredited laboratories, protecting consumers by enhancing awareness and facilitating provision of quality products and ensuring efficiency and effectiveness in the provision of services.

KEBS overview

The Kenya Bureau of Standards (KEBS) commenced its operations on 12 July 1974 following the enactment of the Standards Act, Chapter 496 of the Laws of Kenya. The Act has undergone several amendments aimed at ensuring that the functions of KEBS are responsive to the prevailing circumstances. In establishing the Bureau, parliament set out its functions as follows:

- To promote standardisation in industry and commerce
- To make arrangements to provide facilities for the testing and calibration of precision instruments
- To make arrangements or provide facilities for the examination and testing of commodities and any material or substance
- To control, in accordance with the provisions of this Act, the use of standardisation marks and distinctive marks
- To prepare, frame, modify or amend specifications and codes of practice
- To encourage or undertake educational work in connection with standardisation.

Through the implementation of its core functions, KEBS focuses on the following key objectives:

- Facilitating fair national, regional and international trade by development of standards that are responsive to the needs for economic development, industrialisation and environmental sustainability
- Promoting industry, service and product competitiveness by providing internationally recognised conformity assessment systems
- Ensuring traceability in measurements for the worldwide recognition of test and measurement results performed by KEBS laboratories or its accredited laboratories
- Protecting consumers by enhancing awareness and facilitating provision of quality products
- Ensuring efficiency and effectiveness in the provision of services.

Activities to promote quality of products

- Market surveillance
- Quality inspection of imports
- Pre-export Verification of Conformity (PVoC)
- Industrial visits
- Handling of consumer complaints
- Testing services.

Insect products currently covered by Kenya Standard

- Honey—KS 05-344
- Natural beeswax—KS 05-1279

Parameters stipulated in Kenya standards KS 05-344 and KS 05-1279 are shown in Tables 1 and 2. Table 3 details the main parameters to be tested on silk fibres.

Table 1. Parameters stipulated in KS 05-344

SN	Parameter
1	Relative density
2	Moisture content
3	Total reducing sugars
4	Total ash
5	Fieche's test
6	Pollen
7	Diastase activity and HMF
8	Pesticide residues
9	Acidity

Table 2. Parameters stipulated in KS 05-1279

SN	Parameter
1	Melting point ± 1 (0 °C)
2	Specific gravity at 25 °C
3	Refractive index at 75 °C
4	Saponification cloud point (°C)
5	Acid value
6	Ester-value
7	Ester-acid ratio
8	Hydrocarbons content
9	Fats, fatty acid

Table 3. Main parameters to be tested on silk fibres

SN	Parameter
1	Tenacity and elongation
2	Specific gravity
3	Filament length
4	Defects, e.g. loops, split ends, hairiness, nibs, etc.
5	Electrical properties—static charge
6	Grading
7	Boil-off test
8	Exfoliation test
9	Yarn count of spun silk

Challenges

- Lack of capacity to test some key parameters such as pesticide residues
- Lack of standards for some products already marketed e.g. royal jelly, propolis, silk fibre etc.
- Lack of awareness on the part of consumers
- Lack of collaboration between the stakeholders
- Lack of equipment to test silk fibres and by-products.

For more information about KEBS, visit www.kebs.org.

THE ROLE OF NATIONAL AGRICULTURAL ADVISORY SERVICES IN PROMOTING APICULTURE AND SERICULTURE ACTIVITIES IN HOIMA, THROUGH IFAD PROJECTS

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Abstract: The Plan for Modernisation of Agriculture (PMA) in Uganda envisions that the National Agricultural Advisory Services (NAADS) will be a decentralised, farmer-owned and private sector serviced extension system with a fundamental aim to develop a demand-driven, client-oriented and farmer-led agricultural service delivery system, in particular targeting the poor, the youth and women. The justification for NAADS is the failure of the traditional extension approach to bring about greater productivity and expansion of agriculture, despite costly government interventions.

As a part of its national expansion and resource rationalisation strategy, the NAADS programme focuses on harmonisation and integration of projects/programmes with agricultural extension related components. In Hoima district, the NAADS harmonisation process involves, among others, integration of the apicultural and sericulture enterprise development activities of the agricultural component within the District Development Support Programme (DSSP) supported by IFAD/BSF in collaboration with *icipe*.

Introduction

According to the PMA annual report, 2003/2004 [1], the Agricultural Advisory Services aims at assisting organised groups to access information, knowledge and technology. It realigns itself and harmonises with the existing resources and on-going extension programmes and projects. In Hoima, the harmonisation process has, among others, integrated the IFAD/*icipe* supported activities of the agricultural component of District Development Support Programme (DDSP) like apiculture and sericulture development into NAADS implementation structures.

The Poverty Eradication Action Plan (PEAP)

The Poverty Eradication Action Plan (PEAP) is Uganda Government's framework to guide action to eradicate poverty [2]. It was first drafted in 1997 and was revised in 2000. It was prepared through consultative process involving central and local governments, parliament, donors and civil society. It aims at transforming Uganda into a middle-income country. The PEAP has 5 pillars:

- Economic management
- Security, conflict-resolution and disaster management
- Good governance
- Human development
- Production, competitiveness and incomes.

Plan for Modernisation of Agriculture (PMA)

Under the PEAP [2], a policy framework known as Plan for Modernisation of Agriculture (PMA) guides actions that promote production, competitiveness and incomes. PMA provides guidelines for the transformation of agriculture. It is envisaged that modernising agriculture will contribute to increasing incomes of the poor by raising farm productivity, increasing the share of agricultural production that is marketed, and creating on-farm and

off-farm employment. The PMA mission is to eradicate poverty by transforming subsistence agriculture to commercial agriculture. PMA has seven components:

- Rural financial services
- Agroprocessing and marketing
- Agricultural education
- Sustainable use and management of natural resources
- Supportive infrastructure
- Agricultural research and technology development
- Agricultural advisory services (NAADS).

National Agricultural Advisory Services (NAADS)

The National Agricultural Advisory Services (NAADS) is one of the seven core components under the PMA. It was established by an act of parliament in 2001 [3]. The PMA envisions that NAADS will be a decentralised, farmer-owned and private sector serviced extension system contribution to the realisation of the agricultural sector objectives [1]. The mission of NAADS is increased farmer access to information, knowledge and technology through effective, efficient, sustainable and decentralised extension with increasing private sector involvement in line with government policy [4,5,6].

NAADS justification

The justification for NAADS is the failure of the traditional extension approach to bring about greater productivity and expansion of agriculture, despite costly government interventions. NAADS is a new approach aimed at overcoming institutional undermining of farmers' access to knowledge and productivity enhancing technologies. These constraints include weak research–extension–farmer linkages; uncoordinated and non-participatory extension services; high level of bureaucracy during service provision; low responsiveness to farmers' needs and lack of financial and performance accountability.

The fundamental aim of NAADS, therefore, is to develop a demand-driven, client-oriented and farmer-led agricultural service delivery system, in particular targeting the poor, the youth and women. The strategic elements of NAADS are as follows:

- Shift from public to private delivery of advisory services
- Empower subsistence farmers to access private extension services and market information
- Develop private sector capacity and professional capability to supply agricultural services
- Create options for financing and delivery of appropriate advisory and technical services for different farmer types
- Gradually reduce the share of public financing of farm advisory costs such that, by the end of 25 years of NAADS, public finance accounts for not more than 50% of farm advisory costs.

NAADS principles

Implementation of NAADS is in accordance with the following principles:

- Empowerment of farmers and building their capacity to demand appropriate technologies and agricultural advisory services
- Targeting agricultural advisory services to the poor farmers especially women who constitute the major farming population
- Mainstreaming of gender issues into the policy framework and integration of gender concerns into implementation plans

- Deepening decentralisation to enable farmers to own and control agricultural services
- Increased commercialisation, including intensification of productivity and specialisation
- Use of participatory processes in planning, contracting, monitoring and evaluation
- Sustainable management of natural resource productivity
- Increasing institution efficiency in providing agricultural advisory services through contracting out of services
- Creation of better linkages between research, advisors and farmers
- Harmonisation of externally supported projects with PMA principles.

Private extension services

Under NAADS approach, extension services are delivered by private providers who are awarded short term contracts to promote specific enterprises. There is a coordinator at the sub county level who works with the Local Council and the local community to identify priorities and manage the allocation of contracts.

Target

The programme is working principally with the economically-active poor; those with limited physical and financial assets, like skills, and knowledge, rather than with the destitute or large-scale farmers. A poverty and gender strategy is in place to provide clear guidelines to be used by staff working under the NAADS programme, in both its design and implementation.

The role of NAADS in apiculture and sericulture development through collaboration of IFAD/*icipe* in Hoima local government

As a part of its national expansion and resource rationalisation strategy, the NAADS programme has continued with the harmonisation of ongoing projects/programmes with agricultural extension related components in conformity with NAADS principles. In Hoima district, these include District Development Support Programme (DDSP) supported by IFAD in collaboration with Belgian Survival Fund (BSF) and *icipe*.

DDSP became effective in May 2000 as a follow on phase of Hoima Kibaale District Integrated Community Development Project (H-KICDP). General focus was on community mobilisation for development (using all avenues, local FM radios, drama), farmer empowerment, participatory planning, production and technology development support to farmers aimed at increased productivity, income generation and improved food security. DDSP laid a firm foundation on which NAADS programme was started in the district.

In Hoima, NAADS began in July 2003, piloting the DDSP/NAADS harmonisation strategy in two sub counties. The two sub counties performed so well that by 2005/2006, NAADS had rolled onto all the 11 sub counties of Hoima District.

The harmonisation process involved integration of the IFAD/*icipe* supported activities of the agricultural component of District Development Support Programme (DDSP), like apiculture and sericulture into NAADS implementation structures.

Beekeeping as a priority enterprise in the NAADS programme

Enterprises supported under NAADS are selected through a participatory exercise by farmers at parish level. Farmers are facilitated using a given criteria to select enterprises which are profitable, marketable and with low production risks. Food security is also a major consideration. Three enterprises are selected per sub county and farmers are supported in advisory services, enterprise development and market information and linkage.

The enterprises which have been selected by farmers in different sub counties are beekeeping, upland rice, cassava, local poultry, goats, horticultural crops and local cattle development.

Beekeeping is also supported by *icipe* especially in technology development and capacity building of extension staff.

NAADS implementation components

NAADS is implemented through six components. Each component ensures harmonisation of other related programmes and projects of other development partners operating within the district and sub counties. This is aimed at creation of better linkages, synergies and to avoid duplication at household level.

Component 1: Farmer institutional development

This component supports strengthening and capacity development of farmer institutions in the NAADS farmer structures. It supports farmer fora and parish coordination committees, procurement committees and community-based facilitators.

Component 2: Advisory and information services to farmers

This component supports initiatives by men and women farmers, working together in groups with their sub county government, to contract agricultural advisors to deliver identified priority services. Matching grants are channelled from the national level of Government through the Districts for farmers (through farmer fora and their sub county governments) to use in financing such contracts. Services contracted under this mechanism include programme orientation and group mobilisation for farmers, participatory planning, farm advisory services and information communications.

Component 3: Enterprise development and linkage with markets

This component fosters strong linkages among farmers, advisors and researchers and between farmers and markets by making funding available to farmers and their farm advisors. Funds are available at the district and sub county levels with which to contract the services of researchers and others with relevant expertise to work with farmers and farm advisors in farmers' fields on specific technology, market development and adaptation.

Component 4: Service provider capacity development

This component assists in capacity building of individual service providers, firms and NGOs to become eligible for award of contracts to provide services to farmers with NAADS financing. Specific activities to be funded include local service provider development and national representative organisations/institution support.

Component 5: Planning, monitoring and quality assurance

This component supports planning activities, semi annual and annual review activities, baseline studies, impact assessments and management information system (MIS). It also supports process monitoring, participatory (farmer) monitoring and service provider technical audits.

Component 6: Programme management and coordination

This component establishes and supports entities at both the national and district levels of government, which coordinate and administer NAADS. At national level this includes establishment and maintenance of NAADS Board and Secretariat. At the local government level, NAADS supports district and sub county NAADS Coordinators to facilitate the bottom up planning process, and liaise with other stakeholders. It supports the facilitation, coordination, financial management and reporting, financial auditing of the programme's financial flows and oversight of service contracts. In addition, the component supports establishment of a management information system for monitoring of the NAADS, as well as baseline surveys and data gathering procedures for impact evaluation.

Achievements in apiculture development through collaboration of IFAD, *icipe* and NAADS in Hoima

- Through support from *icipe* and IFAD loan projects, in close collaboration with NAADS, most of the challenges in apiculture, like inadequate trained staff involved in apiculture development, declining swarms due to deforestation, indiscriminate use of pesticides, poor practices, lack of organised marketing system and unavailability of improved technologies for modern beekeeping have reduced in magnitude.
- The *icipe* has built capacity of 5 technical officers in specialised areas of queen rearing, royal jelly production, candle making, handling, processing and packaging of hive products.
- The trained team has been mobilising and popularising these techniques by training beekeepers.
- A more organised beekeepers association (Hoima Beekeepers Association) with over 300 members is in place.
- Re-orientation of beekeeping from subsistence to commercial enterprise beekeeping is ongoing. There is a gradual shift from the traditional/local low yielding hive (8–15 kg/hive/year) to the improved KTB and Langstroth hives. The harvest from Langstroth hives is 20–30 kg and with good management the harvest can be two times a year. Currently, there are a total of over 500 Langstroth hives (200 provided by DDSP, 100 by *icipe*, 60 by other organisations, and over 155 procured by individual beekeepers). There has been increased productivity and incomes at beekeepers level.
- Beekeepers sell honey at Uganda shillings 1000/kg comb honey; therefore, income from Langstroth honey is Ushs 40,000–80,000 (US\$20–US\$40) per hive per year (two harvests). With diversification of production to royal jelly production, queen rearing and other hive products, the beekeeper will realise more income.
- Income from the local hive is Ushs 8000 to 15,000 (US\$2–US\$7.5) per hive per year (one harvest).
- Training of local artisans has been done; two carpenters were trained on how to make Langstroth and KTB hives using templates from *icipe*. In 3 years, they have made over 1000 hives for organisations and individuals in the programme area.
- Bulindi Marketing Centre was constructed with support from IFAD/BSF, Hoima Local government and Hoima Beekeepers Association. The *icipe* provided the honey

processing machines. The marketing centre has become the honey production hub of Uganda. It is a link between producers and consumers.

- Technology development and technology development sites have been established at Bulindi, Kikonoka and Wambabya where different apiculture technologies such as pollination services, royal jelly production, queen rearing and candle making, are demonstrated and disseminated.

Challenge

One important challenge to NAADS is failure to implement all the seven pillars of PMA at the same rate. NAADS would perform best if it was implemented alongside the PMA pillars of microfinance, infrastructure development, marketing and agroprocessing.

Conclusion

- NAADS focuses mainly on enterprises that can be developed into marketable ventures and yet NAADS alone cannot guarantee a market for any product. Close links between NAADS and the marketing and agroprocessing strategy are needed to minimise marketing risks. As for apiculture, this challenge has been addressed by the development of the marketing centre at Bulindi with support from IFAD/*icipe*.
- Apiculture has been fully integrated into the mainstream NAADS programme implementation. However, Hoima District Local Government still requires the close collaboration and support from *icipe* and IFAD particularly in apiculture and sericulture technology packages that have not been established, up-scaling the developed technologies and in farmer institutional development.
- There is also the need to establish and develop the sericulture enterprise, which is not yet as developed as the apiculture enterprise.

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PRESENTATION DE NY TANINTSIKA MADAGASCAR

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Résumé: L'ONG Ny Tanintsika intervient depuis l'année 2001, à la relance de la «filière soie» dans les hautes terres centrales de Madagascar, notamment dans la région de l'Amoron'i Mania.

La filière soie à Madagascar se base sur deux espèces d'insectes séricigènes: le *Bombyx mori*, ou vers du mûrier, introduit dans l'île au début du XIX siècle par les européens, et qui fait l'objet d'un élevage familial très répandu dans la zone des hautes terres, et le *Borocera madagascariensis*, insecte endémique dont les cocons sont collectés dans la forêt (soie sauvage). Ces deux variétés de soie, qui ont coexistés depuis longtemps, deviennent de plus en plus complémentaires ces dernières années tant du point de vue économique que du point de vue environnemental.

La sériciculture est une activité traditionnelle dans cette région, pratiquée par des petites exploitations familiales. Elle a été presque abandonnée jusqu'à l'année 2000. Les paysans ne produisaient que des linceuls à cette époque, et à cause de la concurrence des fibres synthétiques, l'écoulement des leurs produits était devenu très difficile. Depuis quelques années, la sériciculture est devenue un secteur porteur, car les consommateurs apprécient les produits naturels, et elle constitue comme une activité génératrice de revenu pour améliorer le niveau de vie des ménages.

Introduction

Ny Tanintsika est une association malgache créée en 2002. Ny Tanintsika a pour objectifs de:

- Améliorer la gestion des ressources naturelles et conserver l'environnement
- Augmenter la capacité des communautés locales par le biais d'une offre des solutions adaptées afin de promouvoir le développement durable à Madagascar
- Promouvoir le développement socio-économique, culturel et de l'éducation environnementale
- Elaborer des actions visant à l'auto responsabilité des populations locales en favorisant les initiatives locales
- Le siège de Ny Tanintsika se trouve au LOT IB 65 BIS Isoraka Antananarivo, Madagascar.

Intervention dans le domaine de la sériculture

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Activités

1. Appuis aux 13 groupements, regroupant 73 familles par:
 - Introduction des techniques améliorées pour toutes les étapes des activités à l'amont de la filière
 - Formation aux techniques modernes de filature et de tissage, ainsi qu'à la confection des produits artisanaux de bonne qualité
 - Appui aux groupes de producteurs et artisans pour l'amélioration des matériels de filature et de tissage
 - Formation des groupes de producteurs à l'organisation, la gestion et la commercialisation des produits.
2. Mise en place de la gestion communautaire des forêts de tapia et de repeuplement des vers à soie sauvage *Borocera madagascariensis* axée sur:
 - Transfert de gestion de la forêt de tapia aux communautés et aménagement de la forêt de tapia
 - Une recherche sur la multiplication des vers à soie sauvage *Borocera madagascariensis*, la réintroduction et l'intensification de leur présence dans la forêt
 - Valorisation des produits de la forêt (fruits, cocons, plantes médicinales)

Quelques résultats

- Deux magnaneries modèles mises en place au niveau des villageois
- Des nouveaux équipements améliorés de transformation de la soie introduits: bassine de filature, moulin, assembleur, rouets de filature, métier à grande largeur
- Une augmentation de volume de vente en 2005 (\$16,000 pour 50 femmes)
- 3453,5 ha de forêt de tapia à gérer par 6 communautés de base.

Perspectives

- Introduction de l'activité de grainage au milieu paysan
- Une nouvelle stratégie adoptée pour une meilleure exploitation de la soie sauvage
- Labellisation de la soie malgache
- Renforcement du marketing.

Intervention dans le cadre de l'apiculture

L'apiculture est une nouvelle activité de Ny Tanintsika depuis le début de l'année 2006. On intervient dans les zones de corridor forestier du Sud Est de Madagascar, dont l'un des objectifs c'est de fournir des sources de revenus respectueuses de l'environnement à la population riveraine des ressources naturelles.

Actuellement, la population se rend compte des conséquences dans le long terme de ses activités en ce qui concerne la protection de la biodiversité, mais elle ne peut rien faire car il faut d'abord assurer la survie de chaque ménage. D'où l'importance de l'accompagnement des initiatives visant à réduire les pressions en offrant des alternatives durables entre autre l'apiculture.

L'apiculture est une activité économique qui a son importance dans la zone d'intervention. Cependant, actuellement sa pratique n'est pas durable. Nous avons ainsi

relancé l'activité en profitant de l'existence de la forêt naturelle pour produire du miel de qualité mais en appliquant des techniques modernes et durables.

Collecteurs (50) de miel sauvage seront formés pour devenir des apiculteurs et seront appuyés matériellement et au niveau organisationnel pour constituer une association des producteurs et assurer la production de miel typique et de qualité.

Un objectif de 500 ruches améliorées fabriquées et fonctionnelles à la fin de l'année 2007.

SITUATION DU PROJET PPRR DU FIDA ET LE DÉVELOPPEMENT DE L'APICULTURE AU SEIN DES GROUPEMENTS APICULTEURS

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Résumé: La filière «miel» est la deuxième filière développée par le programme dans la région Analanjirifo. En 2005, treize (13) groupements composés de 130 apiculteurs sont subventionnés sous forme des microprojets pour valoriser la forêt de Tampolo à Fénériver Est. Et en Septembre 2006, 02 groupements (25 apiculteurs) sont nouvellement appuyés à Soanierana qui est dans la partie nord de la zone d'intervention. Des matériels apicoles tels que des ruches modernes du type Langstroth, des ruchettes, des brosses à abeilles, des lèves cadres, des voiles protecteurs, des combinaisons et des enfumoirs ont été distribués aux bénéficiaires. Une formation et appui technique ont été donnés aux paysans apiculteurs. Un contrat a été signé avec un opérateur économique pour la vente du miel. Des miels monofloraux de litchis et de Niaouli ainsi qu'un miel polyfloral de la forêt naturelle de la région seront produits.

Contexte

- Zone d'intervention du PPRR: Littoral de la province de Toamasina, Madagascar
- Durée: 8 ans (2004–2007 et 2008–2012).

Financement

- Gouvernement Malagasy
- FIDA (Fonds International pour le Développement Agricole)
- OPEP (Organisation des pays exportateurs de Pétrole).

But et objectifs spécifiques

- Améliorer l'accès des producteurs aux marchés et la valorisation des produits
- Intensifier, accroître et diversifier la base productive, notamment des populations les plus vulnérables.

Axes stratégiques

- Appui au développement des pôles et aux partenariats commerciaux
- Appui à la structuration du monde rural et à l'amélioration de la base productive
- Appui aux services financiers de proximité
- Appui aux institutions, à la politique et à la gestion du programme.

Activités/filières

- Activités AGR
- Huiles essentielles
- Collecte des paddy
- Miel
- Piment
- Pêche maritime apiculture.

Production nationale de miel: 225 T en 1998, 290 T en 2003. 50% cueillette, 35% apiculture traditionnelle, 15% apiculture moderne.

Produits et utilisation

Produits et sous-produits

- Le miel
- La cire
- La gelée royale
- Le pollen
- La propolis
- Le venin d'abeille

Utilisation:

- L'alimentation (le miel et la gelée royale),
- Le traitement de la maladie et le culte païen

Actions en apiculture

Appui technique pour les organisations de producteurs partenaires (formation). Appui financier, sous forme de subvention, aux micro-projets (matériels et équipements).

Résultats

- Début de financement: octobre 2005
- 15 groupements composés de 155 apiculteurs appuyés
- Des formations et appui technique ont été donnés aux paysans apiculteurs
- Des matériels apicoles tels que des ruches modernes du type Langstroth, des ruchettes, des brosses à abeilles, des lèves cadres, des voiles protecteurs, des combinaisons et des enfumoirs ont été distribués aux bénéficiaires.

Types de miels produits

- Des miels monofloraux de litchis et de Niaouli
- UN miel polyfloral de la forêt naturelle de la région.

Commercialisation

- Production au niveau des apiculteurs
- Collecte des produits au niveau de CAM
- Convention de partenariat avec l'opérateur économique.

Défis

- Amélioration des techniques d'élevages
- Augmentation de la production.

Perspectives

- Production de 12 tonnes de miels en 2007
- Diversification des produits (cire, gelée royale, propolis, venin)
- Élevage de reines maîtrisés par les apiculteurs.

STATUS OF BEEKEEPING AND SERICULTURE IN MADAGASCAR

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Abstract: Since the disengagement of the Ministry of Agriculture and Livestock to the direct production of honey, beekeeping was shelved for some time. But during the last three years, different projects were initiated and financed to promote apiculture in Madagascar. Different workshops were organised to identify the problems and to define suitable solutions. Modern apiculture was then developed through the funding of farmers group projects since 2004. Beekeeping equipment, training and follow-up were given to farmers' groups. Honey standards were officially established as well as honey exportation legislation. Farmers were trained on mulberry plantation, silkworm rearing and on postharvest technologies. Mulberry plantations have increased by more than 300% during the last three years. Postharvest machines have been provided to farmers' groups through different projects and programmes, and market for products developed.

Introduction

In 2000, the Ministry of Agriculture, Livestock and Fisheries announced its disengagement to direct honey and silk production, but remains responsible for the legislation, certification and exportation of hive products through the Animal Production Directorate and the Animal and Plant Health Directorate (DSAPS) and for the supplying of funds for apiculture projects. The Ministry also supervises international funds. To revitalise beekeeping and sericulture enterprises, different workshops were organised in collaboration with NGOs, international organisations, project leaders and farmers groups to assess the different problems of beekeeping and honey production and to define the new strategies to beekeeping and sericulture development in Madagascar. Different institutions, programmes and projects took over together with farmers' associations and private beekeepers in developing modern beekeeping. For sericulture, UNIDO supported the local carpenters for the construction of the postharvest equipment such as reeling, doubling, twisting and hand weaving machines. During the last three years, many farmers' groups have been supplied with apiculture facilities and others have been supplied with mulberry cuttings and postharvest machines. Training in modern beekeeping and sericulture was given to different farmers' groups or associations.

Beekeeping

Methodology

In 2002, different workshops, meetings and conferences were organised with all the stakeholders (technicians, farmers, businessmen, NGOs, international organisations). All the beekeeping problems were looked over and classified in the order of their importance and priority. Actions were then undertaken according to the donors decisions.

Outputs

Among the problems enumerated during the workshops, the following were defined as the main factors affecting the honey production enterprises:

- Attachment of farmers to traditional beekeeping
- Honey hunting as the major honey production practice
- Lack of knowledge on modern beekeeping

- Lack of knowledge on quality control and international standards
- Lack of qualified trainers
- Lack of funds to purchase hives to start projects
- Lack of markets.

Actions undertaken

Priority was given to the following:

- Capacity building: Training of trainers, monitoring and evaluation
- Training of farmers' groups, implementation, monitoring and evaluation of the projects
- Funding farmers' projects and assisting them to undertake the projects for at least two years
- Supplying beekeepers with notes and booklet on beekeeping, quality control of honey
- Improvement and management of the natural resources (plantation of melliferous trees and control of bush fires)
- Improvement of honey potential by plantation of melliferous trees and reduction of bush fires
- Improvement and management of the natural resources.

Partners and donors in beekeeping development

The main farmers partners in developing modern beekeeping are:

- Rural Development Support Programme (PSDR), Ministry of Agriculture and Livestock/World Bank
- Suisse Intercooperation Programme (SAHA)
- Provincial and regional national programmes
- National and international NGOs
- International organisations: FAO, GTZ, Conservation Society, CRS, UNIDO.

Achievements in beekeeping

The following are among the achievements during the last four years in collaboration with the different partners:

- With PSDR programme (Ministry of Agriculture/World Bank)
 - More than 150 farmers' associations' projects were financially and technically supported and their projects implemented. Owners of Langstroth hives were supplied with beekeeping equipment such as smokers, wax foundations, swarm attractants and extractors
 - Under the Suisse Intercooperation SAHA programme
 - 35 beekeeping technicians were trained
 - About 100 farmers groups were trained and assisted to implement their projects. The beekeepers were able to construct their own hives after training and to undertake colony development by swarm trapping or by colony division (Figure 1)
- A booklet on honey quality control was written and distributed to the farmers.



Figure 1. Queen rearing training

- With ANGAP project: Five technicians and 7 farmers' group leaders were trained.
- Ny Tanintsika NGO project: Four beekeeping technicians trained more than 20 beekeepers' groups
 - Projects were supported financially and technically
- Some private beekeepers and organisations engaged also in beekeeping
- Opening of honey exportation to European markets was affected.

Other achievements include:

- Modern beekeeping adopted by farmers
- Honey production increased and quality improved
- Honey hunting, tavy system (planting on slopes), and bush and forest fires reduced
- Honey floral calendar understood by farmers and followed to produce monofloral honey.

Problems encountered

- Natural hazards such as cyclones
- Beekeeping equipment not available in the market or very expensive in the local markets (e.g. extractor, queen excluder)
- Unorganised local marketing system.

Impact of the actions

- Adoption of modern beekeeping
- Improvement of production (quantity and quality)
- Development of monofloral honey production
- Increase in number of modern hives
- Increase in number of beekeepers
- Conservation of forests, reduction of honey hunting practices and bush fires
- Improvement of the rural households' income.

Prospects

- Continuation of training, monitoring and evaluation
- Grouping of beekeepers under a union or a cooperative
- Development of marketplaces.

Sericulture

The development of sericulture was undertaken during the last three years. Different organisations and institutions such as the Province of Antananarivo, the PSDR projects, the Suisse Intercooperation Programme and other NGOs contributed to the funding of mulberry plantation, silk production and postharvest equipment and technologies.

Objectives

- Cocoon and silk production in the High Plateau regions through farmers' groups
- Development of wild silkworm production in Tapia forest regions
- Technical empowerment of farmers through training
- Improvement of silk materials and products' quality
- Investigation of the wild silkworm *Anaphe* sp.

Methodology

- Increase of mulberry plantation
- Supplying postharvest equipment to farmers' groups
- Training and backstopping of farmers' groups to implement projects
- Setting up of grainage facility for wild silkworm
- Habitat and host plants investigation for *Anaphe* sp.
- Assistance in marketing of silk products.

Source of funds

- PSDR programme (Ministry of Agriculture)
- Suisse Intercooperation SAHA Programme
- Funds from the provincial and regional budgets
- NGOs and international organisations.

Achievements in sericulture

- More than 50 farmers' associations trained and assisted
- Mulberry plantation increased (for example 1 ha per farmers' group in Itasy region)
- Cocoon and silk production increased
- Silkworm population re-established in the Tapia forest
- *Anaphe* sp. habitat, host plant and development period identified
- Mulberry plantations established in different regions
- Rearing houses built (Figure 2)
- Grainage techniques for wild silkworm set up in Tapia forest
- Production of cocoon and silk products increased and improved.

Recommendations

- *Anaphe* sp. silk production will be undertaken
- To sustain the development of sericulture enterprise in Madagascar and to satisfy the demands of farmers on quality eggs, grainage units must be set up in the major silk production regions.

Prospects

- Setting up of grainage units
- Marketplaces development in the buffer regions on silk production
- Improvement of the silk materials design.



Figure 2. Silkworm rearing house in Miarinarivo

SERICULTURE: AN EMERGING ENTERPRISE IN KENYA

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Abstract: Sericulture enterprise in Kenya started in 1972. Research and surveys focusing on the suitability of local conditions for sericulture were done and it was established that sericulture was viable with good returns. In 1992, *icipe* Innovation Trust, an autonomous non-profit organisation, was mandated to initiate sericulture pilot project in Kenya. The principal objective was to establish and promote a community-based sericulture industry through demonstrations and training. There has been a rising demand for sericulture for the last 3 years, evidenced by farmers' demand for mulberry planting materials. Currently mulberry acreage stands at 100 acres (40.5 ha). Several constraints face the industry, namely lack of capital for construction of rearing houses, cocoon market and lack of postharvest processing facilities. The potential for the development of sericulture in the country is high, and farmers are willing to take it up so long as the above constraints are sorted out.

History and background

Sericulture enterprise was started in 1972 as a project by Japanese International Cooperation Agency in collaboration with Ministry of Agriculture. The project assisted in the establishment of eight rural silk centres in the country, which became dormant with the winding up of the project in 1982.

However, in 1992, *icipe* through its now disbanded Innovation Trust, that was an autonomous non-profit organisation, was mandated to initiate sericulture pilot project in Kenya. The principal objective was to establish and promote a community-based sericulture industry in the country through demonstrations and training. To date, this sericulture project has continued in collaboration with the Ministry of Agriculture providing the necessary extension and technical back-up to the farmers.

Suitability of sericulture in Kenya

Research and surveys focusing on the suitability of local conditions for sericulture were done and it was established that sericulture was viable with good returns. Kenya has potential since the climate is ideal for mulberry cultivation and equally suitable for rearing of silkworm throughout the year. Up to 30 tons per hectare per year has been recorded in Thika centre.

Other reasons include:

- No natural disasters e.g. severe frosts
- Silkworm can be reared in simple structures and equipment
- Cheap labour is available
- Quality of cocoons is good with average cocoon filament of 1200 metres.

Present situation of sericulture

There has been a rising demand for sericulture for the last 3 years. Farmers have started demanding for mulberry planting material and currently the acreage stands at 100 acres (40.5 ha). Through trials done, sericulture has been found suitable for arid and semi arid areas, and for this reason it can be a food security interventional measure in these areas, where hunger and poverty are prevalent. The enterprise is also adaptable for cottage industries and job creation. Sericulture, being an agro-based industry, is labour intensive

and can provide employment for up to 13 persons per acre of mulberry garden and is, therefore, well suited as a tool for rural employment and poverty alleviation.

Constraints

Despite the advantages of this enterprise, development has been hampered by the following constraints.

- Rearing houses: A number of farmers in various arid areas of the country are growing mulberry but are financially incapacitated since they do not have funds to construct rearing houses.
- Marketing: This is the most important aspect that determines the profitability of an enterprise. Marketing of cocoons, at the moment, is being done by the collaborative work of both the Government (Sericulture Station) and *icipe*.
- Postharvest processing: Sericulture station is involved in training in postharvest processing but the technology being used is obsolete as the machines are of:
 - Low capacity
 - Low efficiency
 - Manual mode of operation.

This has resulted in low quality processed raw silk.

Recommendations/suggested solutions

- Credit: Access to loans or grants should be made available so as to facilitate the farmers to build rearing houses and buy the rearing accessories.
- Silk marketplaces: Marketing should be opened by bringing in the private sector rather than relying on *icipe* and GOK. The communities should be assisted to develop and organise silk marketplaces.
- Machinery: There is need for acquisition of modern machines.

Future outlook

The potential for the development of sericulture in the country is high, and farmers are willing to take it up so long as the above constraints are sorted out. There is a big potential for incorporation of silk fibre in our textile industries, hence the need to produce enough silk for these industries.

Investment potential

Kenya has a bimodal pattern of rainfall and mulberry can be grown throughout the year. It is possible to have 4–5 crops of silkworms per year since it takes only 28–30 days to form cocoons. Calculated gross margins have shown that, from $\frac{1}{4}$ acre (0.1 ha) of well established mulberry, it is possible to rear 1 case (20,000) silkworms 4–5 times a year, which yields up to 100 kg of cocoons in a year. A kg of cocoons is priced locally at an average of Kshs 250. Consequently, from a quarter acre piece of land, one can get up to Ksh 25,000 per year, including labour costs (This translates into Kshs 100,000 per acre). Furthermore, raw silk retails at Kshs 3000 per kg and the farmers can do it as a cottage industry within the long value chain, hence increasing their benefits.

GENERIC MEDICINES AND HEALTHCARE PRODUCTS: SCIENTIFIC EXCELLENCE WITH THE HUMAN TOUCH

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Abstract: Universal Corporation Ltd (UCL) came into being in 1997 when the visionary directors of small distribution units decided on entering the manufacturing of generic medicines and healthcare products. A small dream transpired into a wholehearted commitment to provide better healthcare services and medicines to the masses at affordable price. Initially, the Universal Corporation produced only cough syrups and healthcare products. However, in 2002, UCL commissioned a C-GMP accredited manufacturing unit at Kikuyu Town, just 25 km outside Nairobi. Today, UCL is a team of 300 professionally qualified people with a common vision: To be Africa's leading name in generic medicines and healthcare products. Equipped with the latest machinery and knowhow, we are manufacturing high quality medicines such as syrups, suspensions, tablets/capsules and ointments for not only common diseases but also anti-retroviral, anti-malarial and anti-TB drugs. This is complemented with our technologically advanced research and development laboratory for new innovations. Currently, our professionally managed marketing team is increasing its activities in the Kenyan market. In addition, we are exporting these medicines to nine countries in East and Central Africa.

The recent achievement for UCL's Kikuyu plant was the agreement signed with the multibillion dollar Switzerland-based pharmaceutical giant, Roche, for the technology transfer to manufacture the generic version of its latest anti-retroviral (anti-AIDS) saquinavir. We shall be allowed to provide this to the entire African continent at a reasonably low and affordable price. This will enable UCL to succeed in providing almost all WHO listed drugs to the local and regional market and shall enable us to advance the Government's healthcare policy and vision. In addition, UCL plans to manufacture honey-based products. It gives us immense pride to be a part of the team at UCL, which gives 'Scientific Excellence with the Human Touch'.

Scientific excellence

Universal Corporation Limited is based in Nairobi, Kenya. It specialises in human and veterinary healthcare. Its product base includes syrups, tablets, capsules and ointments/creams (anti-hypertensive, antibiotics, anti-malarials and anti-retrovirals).

The company has many clients (doctors) and exports to nine African countries (Figure 1). Universal Corporation has a strong team of 300 employees (both technical and commercial) and is still creating more job opportunities, with a very strong commitment to enter the European Market.

Highlights of UCL's competence

- CHMP—The largest NGO in Kenya has inspected and approved the factory.
- Approval from NDA Uganda
- Awaiting approval from Malawi
- NGOs like PSF and MEDS have inspected and applauded the plant facility
- ICRC has recently inspected the factory and are positive on approval
- Applied for FDA-Tanzania approval.

Latest achievement

Technology transfer agreement with Roche, Switzerland, for the generic manufacturing of Saquinavir, which shall enable us to provide the ARV at a reasonable price to the masses on the African continent.

Countries that we export to

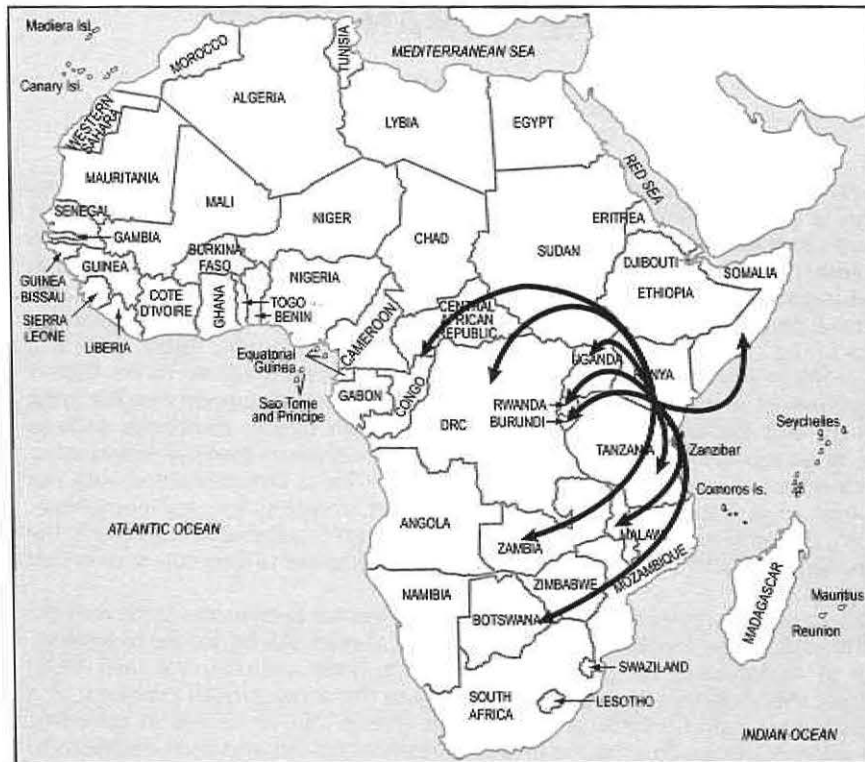


Figure 1. Universal Corporation Ltd exports to African countries include many of the WHO listed drugs

Box 1: *The New York Times*, Date: 22 September 2006 African Companies to Make Anti-HIV Drug

Roche Holding AG said Friday it will help three African companies to produce one of its anti-HIV drugs. Roche will provide the companies—Aspen Pharmacare in South Africa, Cosmos Ltd. and Universal Corp. Ltd in Kenya—with the technical assistance necessary to produce saquinavir, the active ingredient in the Swiss-based pharmaceutical's Invirase treatment.

The three companies will produce the drug in Africa and will be allowed to export it to other developing countries around the world. "It is both encouraging and heartening that local African manufacturers are taking steps to increase their capacity to produce and provide HIV medicines locally," said Lembit Rago, a medicine expert at the World Health Organization.

Future plans

- UCL is setting up a state-of-the-art I.V. Injection Unit to be commissioned in early 2007.
- Production of herbal products like mint-based antacids—'puhin hara'.
- Production of honey and herbs-based cough syrup—'honitus'.
- Awaiting *icipe's* approval to allow UCL to commercially manufacture royal jelly and promote it to clinicians across the continent.

RULES AND REGULATIONS OF ORGANIC BEEKEEPING

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Abstract: The production of organic products is regulated by Council Regulation 2092/91/EEC. This regulation specifies the definition of organic, ecological, and biological and the rules regarding organic production, inspection systems and importation from third countries. The same rules apply for organic beekeeping as for any other form of animal husbandry. Considerations for organic beekeeping are discussed herein. The production of organic honey in Europe is limited, due to the presence of the varroa mite, lack of unpolluted areas and cold winters. The varroa mite is most effectively treated with veterinary medicines, which are not allowed in organic production. The varroa mite is not yet widespread across Africa, which is a big advantage for organic honey production in Africa.

Introduction

The same rules apply for organic bee keeping as for any other form of animal husbandry. Most of the legislation concerns the use of veterinary medicines, determining maximum residue levels (MRLs) in the final product. Important laws regarding MRLs are the following:

- Council Regulation 1990/2377/EEC [1], specifying the maximum residue level of veterinary medicines in products of animal origin.
- Council Directive 86/363/EEC [2], on the fixing of maximum levels for pesticide residues in and on foodstuffs of animal origin.

Both of these laws have been amended numerous times [3]. Honey may only be exported to the European Union if it comes from an establishment approved by the European Commission to export.

In summary, honey imports into the EU market need to:

- Come from a country approved to export honey to the European Union
- Come from an establishment registered by the competent authority of the exporting country and approved by the European Commission
- Be accompanied by a commercial document
- Enter the European Union through a border inspection post, where veterinary checks must be carried out.

Organic production

The production of organic products is regulated by Council Regulation 2092/91/EEC [4]. This regulation specifies the definition of organic, ecological, and biological and the rules regarding organic production, inspection systems, and importation from third countries.

Location of the colonies

Uncultivated or organically farmed land is to be chosen when installing the bees. The location must be such that a guarantee can be given that no significant deterioration of the bee products by contamination from agricultural and non-agricultural sources of pollution can be expected within a radius of 3 km of the hive.

Hives

With the exception of connecting sections, small elements, roof covering, mesh flooring, feeding equipment and roof insulation, the hives are to be constructed of natural materials such as wood, straw or clay.

Treatment of the hives

External treatment of the hives is permissible if natural, not synthetic, means are used. Pesticide-free paint on the basis of natural matter (e.g. linseed oil or wood oil) as well as glues as free as possible of harmful substances are permissible for external treatment. Internal treatment of the hives is prohibited, except with beeswax, propolis and vegetable oils.

Hives which already exist and which have been painted with harmless materials can be re-used after approval by the certifier.

Cleaning and disinfection

Cleaning and disinfection can be performed with heat (flaming out, hot water) or mechanically. In the case of acute infection, NaOH-solutions are permissible to disinfect the hive and to clean it out, if they are then neutralised by organic acids. The use of other chemicals is not permitted.

Wax and honeycombs

In natural beekeeping, the continual renewal of the wax by the bees' own means, is to be aimed at. The colonies should be given the opportunity to construct natural honeycombs on several supers. Septums, starter strips and other wax products may only be made from wax originating from beekeeping which is certified organic or complies with any certification accepted as equivalent. Plastic septums are prohibited.

Feeding

It is permissible to feed the bees, provided this is necessary for the healthy development of the colonies. The bees should be fed with honey from its own apiaries. It is only permissible to feed sugar or sugar syrup to tide the colonies over the dry period and to stimulate brood rearing. The sugar must be of organic origin. To guarantee that the sugar is sufficiently inverted, at least 10% of the winter feed must be in the form of honey left in the combs or supplemented to this level. To avoid adulteration of the honey by remains of the winter feed, it must be removed before the start of the next honey flow. In time of need or interruption in the availability of forage, then it is permissible to feed only honey which is from own apiary and certified organic. Records must be kept to substantiate any claims. It is forbidden to feed pollen substitutes.

Beekeeping practice, breeding, increasing stocks

It is a principle tenet of organic beekeeping that the bees be treated as gently as possible. The use of synthetic chemical means to pacify or expel the bees is prohibited. The use of smoke should be reduced to a minimum. Natural materials (e.g. wood, dried cow or donkey dung) are to be preferred as smoking materials. It is forbidden to mutilate the bees e.g. by clipping their wings.

It is permissible to remove part of the brood of drones to control swarming and to keep the varroa mite under control. The hives of each of the bee colonies have to be marked distinctively and the colonies listed in an inventory.

The aim of breeding is to produce bees, which are adapted to the local organic situation, of a robust constitution and tolerant of varroa. Preference should be given to the local bee type and their locally occurring varieties. Genetic engineering and the use of genetically manipulated bees is prohibited. Preference should be given to natural breeding and reproduction methods. The swarming instinct is to be taken into account. Stocks should be increased by taking advantage of the bees' swarming habits. It is possible both to anticipate swarming by creating an artificial swarm and dividing the remaining colony to increase stocks further, as well as to re-unite anticipated swarms. Artificial insemination may only be performed in breeding operations and with the approval of the certifier. Care must be taken not to injure the bees when gathering pollen. The holes in the pollen comb should be preferably round.

Health of the bees

A bee colony should be reared in such a way that it is capable of correcting any imbalances by itself. The measures employed in organic beekeeping are designed to retain and promote the natural curative powers and the vitality of the bee colonies. The use of synthetic chemical medication is prohibited.

In cases where they are allowed under EC Regulation No. 2092/91, the following methods and substances may be employed to combat the varroa mite:

- Lactic acid
- Formic acid
- Acetic acid
- Oxide acid
- Herbal teas
- Essential oils
- Biological, technical and physical methods (e.g. use of heat).

Any treatment of commercial colonies is only permitted during the period after the last major honey flow and until up to 6 weeks before the next nectar flow begins.

The certification body must be informed of any treatment prescribed by the authorities with substances not listed above. Products from colonies thus treated may not be marketed under the organic label. When the treatment has been concluded, the colonies are subject to the conversion period. All treatment measures have to be recorded in a treatment book.

Brought-in bees

It is only permissible to buy colonies or queens from sources which are certified organic. Purchased colonies may not be contaminated with substances forbidden under organic standards. It is permissible to capture foreign swarms provided they do not make up more than 10% per year of the existing stock. This regulation also applies to the purchase of queens from conventional origins. Where severe losses have been sustained, the certifier may make an exception to this rule. If colonies from conventional sources are added to the farm, they are subject to the conversion procedure.

Extraction of honey, storage

In organic beekeeping, attention must be paid to all aspects known to ensure the best quality, according to the principles of carefully applied and well-established practices (maturity of the honey, no brood in the combs, working with materials approved in foodstuffs) when extracting the honey. The honey's valuable ingredients should be altered as little as possible during the processes of extraction and storage.

Removal of the honeycombs

The bees must be removed from the honey as gently as possible (e.g. using vibrators, escape boards, brushes or fans). The use of chemical repellents and killing the bees to facilitate honey harvesting is forbidden.

Extraction of honey

The equipment and vessels used in the extraction of honey by spinning or pressing have to be such that the honey only comes into contact with materials approved for use in the processing of foodstuffs (e.g. stainless steel, glass, non-contaminating plastics).

The measures employed and the relevant data on the honey harvest (when the combs were removed, date of spinning, amount harvested, pasture) have to be recorded.

During spinning, straining, filtering and conservation, or if the honey crystallises, it may not be heated to more than 38 °C. Heating is only to be applied indirectly. The temperature has to be measured regularly. Filtering under pressure is prohibited in all forms. Low pressures such as those which occur in normal operation (e.g. when pumping) are permissible.

Storage and conservation

Only vessels of non-contaminating materials (e.g. stainless steel, glass) may be used. The honey must be stored in a dark, cool and dry place.

Whenever possible, the honey should be filled into jars before it becomes solid. Recycling jars must be used. The addition of mixtures of raw materials not produced according to these standards must be excluded.

Measurable quality of the honey

In addition to the legal stipulations, the following criteria must be fulfilled:

- Water content, measured by the AOAC method, max. 18% (with exceptions, e.g. heather honey 21.5%)
- HMF (= Hydroxymethylfurfural) content, measured according to Winkler, max. 10 mg/kg invertase index, min. 10 (Hadorn-/Gontarski unit). In the case of honey from acacia, lime trees and *Phacelia*, min. 7 (analyses according to AOAC = Association of Official Agricultural Chemists).

As a general rule, these criteria will be met if the honey has been produced according to these standards and the honey extracted only from sufficiently capped combs or parts of combs. It may be necessary to have the honey analysed. In borderline cases, the HMF and invertase have to be examined concurrently.

Honey which does not meet the quality criteria with regard to its content of HMF, enzymes and water, may only be sold as in conversion as honey suitable for industrial processing.

No traces of chemotherapeutic drugs should be found in the honey indicating forbidden methods of treatment.

Labelling

The organic logo of the certifier may be applied to bee products if the colonies have been reared for at least a year according to organic standards and the production of wax/construction of the honeycombs corresponded to organic standards before the first time nectar was foraged. All the colonies and their products are to be labelled distinctively.

Previous rearing methods, e.g. treatment of the colonies exclusively with substances permitted in organic standards can be recognised by the certifier upon consultation. In addition to the legal requirements, it must be possible to identify the farmer, the bottler and the forage plant from a lot number on the label. In the interests of clear labelling, notice to the effect that the bees' extensive flight radius means that they may also forage beyond the borders of the organic or equivalently farmed land should appear on the jars. Ultimately the definition of organic quality rests on the beekeepers' method of working.

Conclusion

Although conventional honey production is similar to organic production, there are additional rules for organic honey production. In the European Union, some of these rules are the following:

- Crops on which the bees feed may not have been chemically treated
- Bees should be able to survive harsh times (winter) on self-produced honey and therefore may not be fed sugar to increase honey production
- There may not be any airports or main roads near the beehives
- Diseases may not be treated with veterinary medicines but only with a limited number of organic substances
- Bees may not be stupefied during the harvest of the honey.

The production of organic honey in Europe is limited. The main reasons are the presence of the varroa mite, the lack of unpolluted areas and cold winters. The varroa mite is most effectively treated with veterinary medicines, which are not allowed in organic production.

In Europe, a honey reserve to last through the winter can be achieved only when the honey is not (fully) harvested in the summer. This seriously limits the production volume of organic honey.

In tropical regions, four to five times more honey can be produced. Feed crops are amply available, and the bees can produce year round. Because of the lack of a clear winter period for which honey reserves are needed, more honey can be harvested.

Only a limited number of chemicals may be used for the treatment of bee diseases and beehives. The varroa mite is not yet widespread across Africa, a big advantage for organic honey production in Africa.

Biodynamic production, distinguished with the Demeter label, is a type of organic production. Organically certified honey can easily be biodynamic certified, since the production standards are very similar. In Germany, there is a small market for this type of honey. The supply of biodynamic honey is small.

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SILK PRODUCTION IN ETHIOPIA: EFFORTS, CHALLENGES AND FUTURE DIRECTIONS

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Abstract: Sericulture (silk production) is a recently introduced agro-based technology to Ethiopia. Silk production has a number of processes that entail cultivation of feed plants, silkworm rearing and silk fibre processing. Eri silkworm *Philosamia ricini* is the major type of silkworm currently found in the country followed by mulberry silkworm *Bombyx mori*. Even though silk production is at the infant stage, it has become one of the priorities in the development agenda of the country due to its wide range of benefits. It enables the country to generate income and create employment to various social classes of people involved in the production, particularly the smallscale farmers. Its low cost-benefit ratio, minimum investment and land requirement make the production of silk more attractive. Existence of favourable weather, availability of adequate feed plants in diverse locations, familiarity of Ethiopians with spinning of other fabrics and commitment of the government to promote the technology gave and is believed to give an added advantage for scaling up and out of the technology.

Melkassa Agricultural Research Centre (MARC) is the focal point for research and most of the development activities undertaken in the field of sericulture. Successive evaluation was carried to identify better performing silkworm races. As a result, four eri silkworm races, obtained from Japan and India, were found adaptive to Ethiopian agroecologic conditions. Moreover, among several mulberry silkworms introduced from abroad (Poland, India, Vietnam), two bivoltine and two multivoltine races showed promising results. Encouraging results were also recorded in response to efforts made to popularise silk production techniques to users at various levels. Even though the silk production venture is progressing positively, it is confronted by a number of obstacles. These include lack of adequate awareness (training), shortage of silkworm supply, limited market and its poor linkage to producers and lack of improved postharvest processing technologies.

Introduction

Agriculture is the mainstay of 80% of the population accounting for 41% gross domestic product (GDP) and 80% of exports. Many other economic activities depend on agriculture, including marketing, processing and export of agricultural products. Production is of a subsistence nature. Principal crops include coffee, cereals, pulses (e.g. beans), oilseeds, potatoes, sugarcane and vegetables.

Silk farming is a new dimension added to the country's agroindustry for diversification of agriculture and amelioration of rural poverty [1]. Even though silk farming is at its infant stage it is progressing well due to its benefits [2]. It plays an important role in income generation and creates job opportunities for different age groups and social classes: women, men, youth, the old and disabled [3]. It reduces migration of people from rural to urban areas and serves as an alternative cash crop contributing to export earnings and raw material for local industry.

The history of sericulture in Ethiopia dates back to the 1930s. Italians realised the suitable agroclimatic condition for growing feed plants and rearing of silkworms. They established mulberry plantations in 30 locations in altitudes ranging from 1300–2200 masl and silkworm rearing at 11 sites. As a result, they demonstrated the possibility of silk production at various locations in the country. However, the attempt of silk production by Italians was interrupted due to the Second World War. Later on, sericulture got the attention by IAR, (now EIAR) in the early 1980s. The research institute was looking for alternative crops for export earning due to the devastation of the major export crop (coffee) by CBD. Visits paid

by expatriate professionals at different times also confirmed the immense potential of the country for silk production. As a result, activities were initiated. But research endeavours were discontinued after a few years due to rearrangements in project priorities.

Since 2000, sericulture got much attention by the government and research system due to its wide benefits, particularly to rural farmers. Currently, sericulture stands as an independent project in the research system where encouraging research and development activities are underway. This paper gives a brief account on major achievements, challenges facing silk production in the country and points future directions.

Major achievements

- Among six eri silkworm races introduced from abroad, four races were found to adapt to Ethiopian conditions upon successive evaluation
- Mulberry silkworm races/breeds introduced from abroad (Japan, India and Vietnam) are at the final stage of evaluation and promising results have been observed
- Based on modest agronomic research results, better agronomic practices for mulberry cultivation were recommended (spacing, fertilisation, pruning)
- Available silk production techniques³ were demonstrated and popularised via various means: theoretical and practical training, the mass media (radio, TV), workshops and exhibitions
- Three production manuals and a leaflet were published in the local language (Amharic) and distributed to the users
- Several silkworm seeds and planting materials were distributed to stakeholders in different parts of the country.

Partners in sericulture R&D

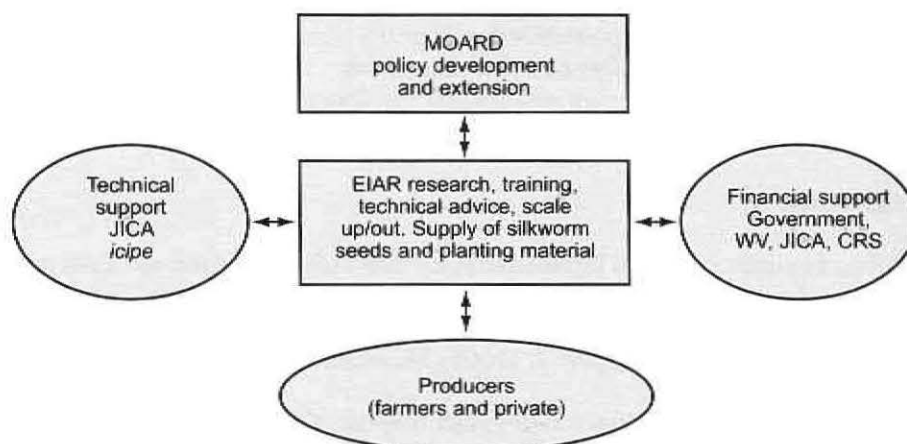


Figure 1. Ethiopia's R&D partners (in sericulture)

What needs to be done

- Supporting the establishment of sericulture research at a regional research centre, e.g. Adet, Awassa
- Curriculum development for vocational colleges in collaboration with JICA and MOARD
- Preparation of silk production business plan for the country and southern regional state in collaboration with MOARD
- Effort to establish eri silk producers association that links producers with the market.

Challenges facing silk production

- Shortage of skilled manpower
- Lack of adequate knowledge on silk production by different actors, i.e. researchers, extensionists and farmers, as this is a new technology
- Weak linkage with reliable and continuous seed source (silkworms and feed plant)
- Absence of laboratory facility and grainage
- Lack of post cocoon processing technology
- Limited market and its poor linkage with producers.

Advantages for disseminating silk production in Ethiopia

- Favourable agroclimatic condition for silkworm rearing and feed plant growing
- Availability of feed plant in diverse agroecologies
- Existence of suitable government policy to scale up/out silk production
- Familiarity of Ethiopians with spinning of other fabric, e.g. cotton
- Easy adoptability of silk production technology
- Commitment of researchers and extension workers to work with stakeholders.

The way forward

- Further promotion of silk production (especially mulberry silk) and widening market opportunities
- Support the technology promotion with strong research back-up
- Build the capacity of actors at various levels (R, E and P) in terms of human and physical resources
- Strengthen linkage among researchers, producers and market
- Establish grainages and postharvest processing plants/technologies
- Carry out studies on indigenous wild silkworms
- Strengthen linkages and partnerships among different stakeholders and international institutions working in the area.

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APICULTURE DEVELOPMENT IN KENYA

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Abstract: In general, 80% of Kenya is suitable for beekeeping, particularly in arid and semi-arid areas. Kenya's honey production potential is estimated at 80–100,000 metric tons with an equivalent of 10,000 metric tons beeswax. However, only about 20% of these products are realised because most of the highly productive areas are unexploited. Traditional hives contribute over 75% of honey production in Kenya. The main products are honey and beeswax. Honey and beeswax export and support figures show higher honey importation and lower amount of exports. Challenges facing the beekeeping industry include dissemination of information, formulation of a comprehensive apiculture policy, upgrading the capacity of the relevant institutions to provide the necessary assistance and services, setting up a mechanism for dynamic coordination, collaboration and networking among all the stakeholders, setting up the requisite inspection and certification process, strengthening the capacity of the quality and testing facilities and attracting domestic and foreign investment resources.

Status and history

In general, 80% of Kenya is suitable for beekeeping. This is particularly so in arid and semi-arid areas. It is important to note that in these areas other agricultural activities like raising of crops are minimally carried out. We find more of *Acacia* spp. kind of vegetation in abundance. There are also substantial apicultural activities in agriculturally high potential areas where you may find good quality products and improved production facilities employed.

Kenya's honey production potential is estimated at 80–100,000 metric tons with an equivalent of 10,000 metric tons beeswax. However, only about 20% of these products are realised because most of the highly productive areas are unexploited. The production of these products mostly comes from traditional hives (1.5 million) Kenya top-bar hives (156,000), Langstroth hives (35,000) and others like box hives and mud block hives (5000). It is, therefore, right to say that most of bee products from Kenya come from traditional beekeeping. Other products like royal jelly, pollen, propolis and bee venom are insignificantly produced due to lack of awareness, knowledge on production techniques and undeveloped marketing system. The major constraints, however, in traditional beekeeping are low productivity per hive, minimal managerial practices, as well as lower quality products compared to use of top bar or frame hives.

Honey and beeswax export and support figures show higher honey importation and lower amount of exports. Utilisation of honey is mostly through nutrition, fermented drink, preservation, pharmaceuticals and herbal medicine. Beeswax is mostly used in candle making, cosmetics, the medical field and textile industry as well as equipment production.

Development of beekeeping heightened during 1971–1984 where various studies and programmes were carried out. This was when CIDA came in with a national project on beekeeping (Table 1). The project had components of training, research extension and establishment of centres.

General information

Kenya is an East African country and is divided into two by the Equator. The population is about 33 million. Her total land area is 225 sq. miles (582.75 km²). Kenya is an agricultural country with coffee, tea and horticultural crops as the main export crops. Of the total area, 80% is ASALs (arid and semi arid land) with livestock production as the main activity,

e.g. beef, sheep and goats production and apiculture. Dairy production is also practised within the high agricultural potential areas of Kenya, occupying 20% of total land. These ASAL areas support around 10 million people. Kenya is also a tourism destination due to its wildlife, marine parks and the geographical landscape.

Table 1. Stages in apiculture development in Kenya

Oxfam	1967–1969	Feasibility study
CIDA	1971	Training
		Research
		Extension
		Investment
	1984	Extension
	1993 todate	Liberalisation

Overview of the beekeeping industry in Kenya

Beekeeping in Kenya is a traditional art. Honey was customarily important for socio-cultural purposes. Three-quarters of Kenya's land supports beekeeping. Only 20% of Kenya's potential is exploited. Traditional hives contribute over 75% of honey production in Kenya. The main products are honey and beeswax.

Constraints

- Bee farming performance is low despite annual honey production estimate of 100,000 tonnes.
- Adoption of appropriate technology is low due to socio-economic factors.
- There is noted environmental degradation and unchecked pesticide use.
- Lack of credit provisioning, low apicultural research and unfavourable land tenure systems have contributed to the above low production performance.

Policy environment

- Encourage sustainable beekeeping and management of resources
- Involve stakeholders in all aspects
- Strive to develop modern beekeeping and provide additional income to rural households
- Embark on promotion of other hive products
- Support associations and groups.

Honeybee races in Kenya

- *Apis mellifera littoria* (in the coastal lowlands)
- *Apis mellifera scutellata* (in the plains/grasslands)
- *Apis mellifera monticola* (at higher altitudes)
- *Apis mellifera nubica* (in the arid Northern Kenya).

Estimated hive population

- Log hive, 1.56 million;
- Kenya top-bar hive, 0.16 million;
- Langstroth, 0.035 million;
- Others, 0.005 million.

Honey and beeswax production

Honey and beeswax production for 2000–2005 is shown in Table 2.

Table 2. Honey and beeswax production for 2000–2005

Year	2000	2001	2002	2003	2004	2005
Honey (MT)	24,940	24,940	22,000	22,500	24,000	25,000
Beeswax (MT)	74	325	401	350	290	465

MT, metric tons.

Extension methods

Extension methods include:

- Field visits
- Farmer field days
- Media
- Shows
- Training
- Print outs
- Symposia.

Honey and beeswax processing methods

Honey extraction

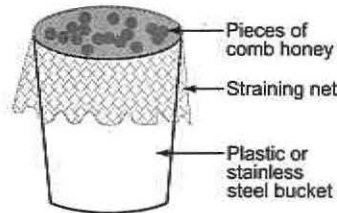
- Comb honey is uncapped using a warm knife in readiness for extraction
- Wax cappings are collected and then strained to remove honey—The wax cappings are melted to provide good quality light coloured beeswax
- Honey from top-bar hives and traditional hives can also be extracted using this method by placing the combs in special comb holders
- The frames are then placed in an extractor and the honey is extracted by centrifugal force.

Honey press

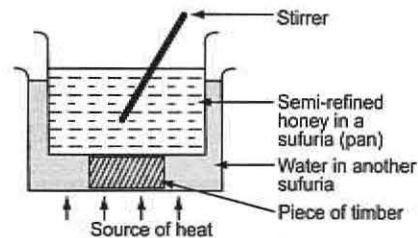
Beeswax processing methods:

- Wax press/squeezing method
- Solar wax melter
- Steam wax extractor.

Simple straining method



The water bath method



Bulk processing using OAC strainers

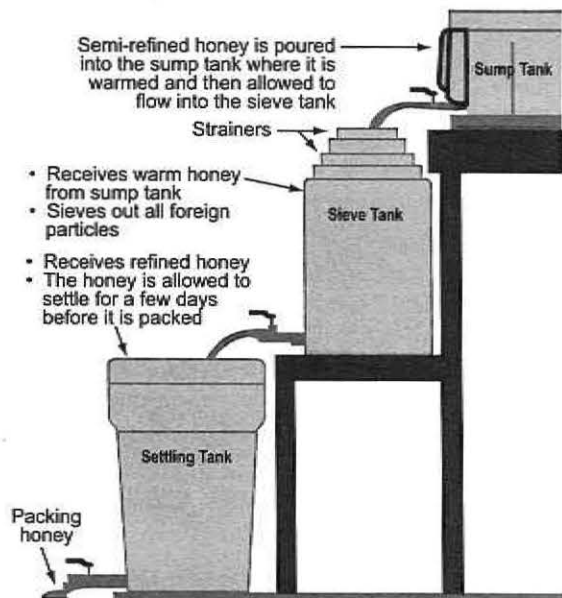




Figure 1. A honey press

Production and processing technologies

Table 3. Current hive product production and processing technologies

Production technology	Hive product obtained	Processing technology used	Equipment used	Final product	Quality of product	Cost of processing
Traditional or log hive (fixed combs)	• Raw honey	• Straining	• Simple straining	• Honey	• Good	• High
	• Comb honey (pieces)	• Extraction	• Extraction	• Honey	• Medium	• High
	• Semi-refined honey	• Continuous processing (refining)	• Strainers	• Honey	• Good	• Low
	• Combs	• Beeswax	• Steam wax, wax	• Beeswax	• Good	• Low
Kenya Top-Bar hive	• Comb honey (whole)	• Packaging	• Extraction	• Comb honey	• Good	• Low
	• Comb honey (pieces)	• Straining or extraction	• As above	• Honey	• Good	• Low
	• Raw honey	• Straining	• As above	• Honey	• Good	• High
	• Semi-refined honey	• Continuous processing	• As above	• Honey	• Medium	• High
Langstroth hive	• Honey in frame	• Extraction	• Extraction	• Honey	• Good	• High

Quality determination of honey

Basic parameters

Table 4. Basic parameters of quality honey

Parameter	Recommended content (% or mg/kg)
Moisture content	≤ 20%
Total reducing sugars	≥ 65%
Apparent sucrose	≤ 5%
Acidity	≤ 40 mg/kg
HMF	≤ 40 mg/kg
Diastase activity	≥ 8 S unit
Invertase activity	≥ 50 U/kg
Ash	0.02–1.0%

S, schade units; HMF, hydroxymethyl furfural.

Honey residues

- Antibiotics
- Pyrethroids and carbomates
- Chlorinated hydrocarbons
- Organophosphorous compounds
- Chemical elements:
 - Cadmium
 - Lead
 - Zinc
 - Arsenic
 - Copper.

Honey marketing outlets

Major outlets for Kenyan honey include:

- Supermarkets
- Health shops
- Retail shops
- Hotels
- Roadside kiosks
- Hawking
- Traditional breweries
- Confectioneries
- Open air markets
- Pharmaceutical industries.

Beeswax marketing outlets

- 'Jua kali' shoe makers/menders
- Wood and leather industry
- Horticultural industry and forestry (used in plant grafting)
- Beekeeping equipment manufacturers (foundation sheets and top-bars)
- Cosmetic industry
- Pharmaceutical industry.
- Confectionery industry.

Export and import levels of honey and beeswax

The honey and beeswax export and support figures show a higher honey importation and lower amounts of exports (Tables 5–8).

Table 5. Export of honey and beeswax (2000–2003)

Year	2000	2001	2002	2003
Honey (MT)	0.35	0.32	0	0.5
Beeswax (MT)	16	24	15	0

Table 6. Import of honey and beeswax (2000–2003)

Year	2000	2001	2002	2003
Honey (MT)	63	38	84	10
Beeswax (MT)	0.37	2.5	0.3	1.2

Table 7. Value of exports and imports of honey (1999–2005) (Kshs in millions)

Year	Exports	Imports	Deficit
1999	0.6	5.2	4.6
2000	0.05	9.8	9.795
2001	0.05	5.4	5.4
2002	0.07	7.1	7.0
2003	0.1	2.1	2.0
2004	0.9	5.2	4.3
2005	0.3	10.0	9.7

Table 8. Value of beeswax exports and imports (1999–2004) (Kshs in millions)

Year	Exports	Imports	Balance
1999	1.7	0.4	1.3
2000	3.3	0.3	3.0
2001	4.4	0.6	3.8
2002	–	0.1	0.1
2003	–	0.35	0.35
2004	1.5	0.3	1.2

Destination of Kenya's honey products

- Uganda
- Tanzania
- Sudan
- Ethiopia
- Somalia
- UK
- Ireland
- USA
- Canada
- United Arab Emirates.

Destination of Kenya's beeswax products

- UK
- Netherlands, the
- USA
- Uganda.

Challenges of the beekeeping industry in Kenya

- Dissemination of information among the rural population on the benefits of beekeeping and where to acquire the necessary training, knowledge, equipment, support services or credit

- Formulation of a comprehensive apiculture policy—Upgrading the capacity of the relevant institutions to provide the necessary assistance and services
- Setting up a mechanism for dynamic coordination, collaboration and networking among all the stakeholders
- Setting up the requisite inspection and certification process and strengthening the capacity of the quality and testing facilities
- Attracting domestic and foreign investment resources to the apiculture industry.

Opportunities and prospects of the beekeeping industry in Kenya

- Favourable policy environment for private investors
- Production of organic honey
- Value added products
- Environmental conservation
- The unexploited potential.

IDENTIFICATION PROCESS OF IMPORTANT BEE TAXA FOR INCOME GENERATION IN EAST AFRICA

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Abstract: Bees play an important role in pollination and regeneration of vegetation. They are also indicators of habitat quality and support economic enterprises for income generation. Recently, there has been a decline in bee populations. However, data on bee diversity is scarce. Several challenges face bee identification such as lack of enough taxonomists, lack of reference collections, poor documentation of bee ecology, behaviour and species distribution, poor understanding of races, hybrids and genetic variability, limited expertise and laboratory facilities. A need therefore arises for evaluation of existing genetic material (gene bank), a review on the current state of bee breeding and mapping of gene pools.

Introduction

Following the observed pollinator decline, bees have been considered a priority group in regard to management and conservation [1]. Bees are the main pollinators of angiosperms [2,3,4] and solitary bees constitute 85% of the 25,000 known species of bees. They pollinate nearly 60–70% of flowering plants [5] while about 15% of the world's crops are pollinated by domesticated bees (honeybees, bumble bees), and 80% by solitary bees [6]. Recent reports have pointed out that most pollinator populations have declined to levels which cannot sustain their pollination services in both agroecosystems and natural habitats. In agroecosystems, agricultural intensification has been reported as the key threat to bees especially wild bees [7,8].

Unfortunately, very little is known about bee biology, taxonomy as well as their economic value in most parts of Africa. Such data are missing in East Africa and very little knowledge on solitary bees exists. Hence the need for identification of important bee species and races in East Africa for increased income generation and biodiversity conservation. Identification of bee species is not only important in beekeeping industry but also in smallscale and largescale horticultural farming due to their role in pollination. Each plant requires an efficient pollinator without which seed set would not be ensured. Due to reduction of bee populations, many farmers have resorted to commercial breeding of solitary bees and use of domesticated bees (honeybees and stingless bees). For instance, in the United States of America, the alfalfa pollinators *Megachile rotunda* (the alfalfa leafcutting bee) and *Nomia melanderi* (the solitary alkali bee) have been successfully reared. Other solitary bees that have been reared in other countries such as Brazil include carpenter bees for passion fruits pollination.

Honeybees and their distribution

Honeybees *Apis mellifera* are the most well known bees. They are known to have evolved in Africa and spread to Europe [9]. There are about 25 races of *Apis mellifera* that have been documented worldwide, of which 11 are found in Africa. However, there are other honey making bees in the tropics and Neotropics although highly underutilised. About 500 species of stingless bees have been documented worldwide and the centre of their diversity is in South America. The recent report by Eardley [10] indicates that there are 18 species in Africa of which 14 species represented in six genera are found in East Africa. According to the current data, there is little variation in stingless bee diversity in the three East African countries (Figure 1). Unfortunately, the stingless bees do not produce much honey; but the honey they produce is highly medicinal. There are six stingless bees genera in East Africa

which include the following: *Meliponula*, *Hypotrigona*, *Liotrigona*, *Pleibena*, *Dactylurina* and *Cleptotrigona*. The genus *Cleptotrigona* is parasitic on both *Hypotrigona* and *Liotrigona* genera.

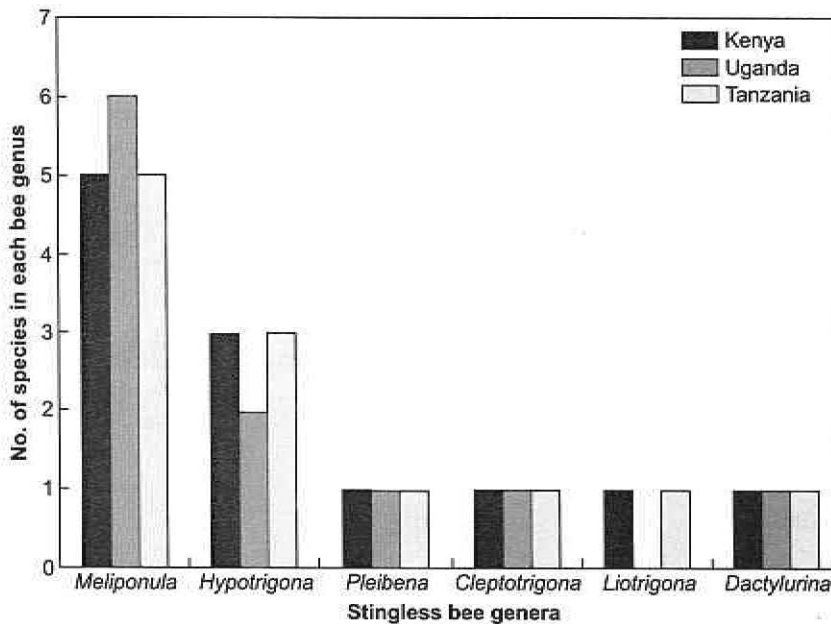


Figure 1. Distribution of stingless bees in East Africa

Apis mellifera races recognition

The honeybees *Apis mellifera* were initially regarded as one taxon in sub-Saharan Africa due to their uniform yellow pigmentation [11]. Recent studies have shown that *Apis mellifera* has distinct races in terms of morphology and behaviour and each race is adapted to a particular environment; that is, climate and geography. Understanding *Apis mellifera* races variation is, therefore, very important in beekeeping. Unfortunately *Apis mellifera* variation is poorly studied. To avoid weakening of bee populations, beekeepers and commercial breeders need to understand the dangers of 'bee mixing' or social parasitism. Some races are known to be more resistant to certain diseases than others and translocating bees from their adapted zones makes them less resistant. A good example of social parasitism is the invasion of *Apis mellifera capensis* into colonies of *Apis mellifera scutellata* as a result migratory beekeeping and promotion of pollination service (Eardley pers. commun.). To differentiate the races, a number of techniques have been used, e.g. use of morphometrics, mtDNA, nDNA and alloenzymes. Other characters that have been found to be of great importance include hairiness, colour, size, defensiveness, comb placement, the ability to sting and honey quality. However, *Apis mellifera* races characterisation in East Africa is still unresolved and hence the need for a review. The well known East African races include *Apis mellifera monticola*, *Apis mellifera scutellata*, *Apis mellifera litorrea* and *Apis mellifera yemenitica* [12]. For the stingless bees, their identification is mainly based on morphological features and nesting behaviour.

Challenges in bee identification

- Very few taxonomists
- Lack of reference collections

- Little bee ecology, behaviour and species distribution knowledge
- Races, hybrids and genetic variability poorly understood
- Limited expertise and laboratory facilities.

The way forward

To conserve and sustainably use the existing genetic material (gene bank) of honey making bees in East Africa, there is need for the following:

- A review of the current state of bee breeding programme to plan for important future research programmes
- Mapping of local gene pools
- Assessment of hybridisation levels among the local races
- Need for race certification centres
- Training on breeding and race identification
- Established mating control stations
- Need for more registered queen breeders
- Controlled colony translocation (in support of increased pollination services and migratory beekeeping)
- Capacity building at all levels, e.g. NMK-BIOTA bee taxonomy and pollination course for graduate students.

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STATUS ET PERSPECTIVE DU PROJET IFAD DANS LE REGION MONTAGNEUSE DU CENTRE DU MAROC ET INTEGRATION DE L'APICULTURE DANS LE PROJET

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Résumé: Un projet de développement des zones montagneuses de la région centrale du Maroc (Haouz Marrakech) était concrétisé en 2002/2003 entre l'IFAD et le ministère de l'agriculture marocain. L'objectif principale du projet est de réduire le niveau de pauvreté des populations de cette région, en gérant d'une manière rationnelle les ressources naturelles tout en tenant comptes des attentes spécifiques de chaque catégorie de populations bénéficiaires. Le montant global du financement du projet est de 32 millions de dollars américain. 60 pour cent est financé par l'IFAD, 36 pour cent par le gouvernement marocain et 4 pour cent par les bénéficiaires et les ONG. L'amélioration de la productivité de toutes les composantes de production, agricole, l'élevage, la valorisation des produits, constituent l'un des objectifs spécifiques du projet. L'apiculture constitue l'une des activités la plus importantes en tant que génératrice de revenue. Cependant la production est destiné à la consommation domestique ou vendu localement non conditionné. L'encadrement sanitaire constitue presque l'unique intervention du projet, l'intégration total du secteur au sein du projet IFAD serait d'une grande importance.

Données sur la zone du projet

- Nombre de cercles: 2 (Asni et Amizmiz)
- Nombre de communes rurales: 17
- Nombre de douars: 456
- Populations: 111.774
- Nombre de ménages: 18,459
- Superficie totale: 239.200 ha.

Zones agro-écologiques

Piemont: 800 m d'altitude

- 8 CR
- 250 mm
- Agro-pastorale
- Céréales, olivier.

Moyenne vallée: 800-1200 m

- 5 CR
- 500 mm (+ Neige)
- Pastorale
- Arbres fruitiers: Pommier, Amandier.

Haute vallée: 1200 m

- 4 CR
- 700 mm (+ Neige)
- Sylvo-pastorale
- Arbres fruitiers: Noyer et cerisie.

Les composantes retenues par le projet sont

Renforcement des capacités locales

- Formation
- Organisation
- Alphabétisation
- Participation.

Amélioration de l'infrastructure socio-économique de base

- Pistes rurales
- Actions facilitatrices
- Traitement des ravins, etc.

Amélioration de productivité

- Production végétale et animale
- Commercialisation
- Valorisation.

Aménagement des ressources naturelles

- Irrigation
- Eau potable
- Parcours, foncier.

Etat d'avancement du projet: Jusqu'au 31 Mai, 2006

Approche participative

- Élaboration de 217/210 PDD soit (104%)
- Mise en oeuvre des actions du projet dans le cadre d'un contrat signé entre la Direction du Projet et les représentants des bénéficiaires (association locale, CR, autorité locale)
- Organisation d'une session de formation en approche participative au profit des partenaires du projet (100%)
- Organisation d'une session de Formation approfondie et pratique en approche participative (9 semaines) au profit de l'équipe du projet (100%)
- Organisation de 21/21 sessions de formation en législation et gestion administrative et comptable au profit des membres de CA des associations locales soit (81%).

Promotion de la femme

- Organisation des ateliers de diagnostic participatif au profit des femmes lors de l'élaboration des 217/210 PDD soit (104%)
- Équipement de 62/210 classes d'alphabetisation soit (30%)
- Équipement de 5/50 foyers féminins soit (10%).

Actions facilitatrices

- Financement de 48/210 actions facilitatrices soit 23% dont:

- + 25 AEP
- + 6 PMH
- + 17 AGR
- Bénéficiaires:
 - Douars: 46
 - Habitants: 15.000.

Rehabilitation des périmètres PMH

- Aménagement hydro agricole:
 - + Etudes: 2776/4000 ha (69%)
 - + Travaux: 2390/4000 ha (59%).
- Nombre de bénéf.: 25.000
 - Formation des membres des AUEA: 37/70 sessions (53%)
 - Visite d'échange: 6/5 (120%).

Adduction en eau potable

Aménagement ou équipement de 65/64 points d'eau soit (102%).

Pistes rurales

- Études sur 145 km de pistes soit (94%)
- Ouverture et stabilisation de 55 km pistes (35%)
- Travaux en cours sur 40 km
 - Bénéficiaires: 37.000 habitant.

Appui conseil à la production

Appui conseil en production végétale

- Distribution de 148.000/550.000 plants fruitiers soit (27%)
- Acquisition d'une unité mobile de trituration (100%)
- Distribution de 14 pulvérisateurs
- Réalisation de 53/280 essais de démonstration (19%)
- Organisation de 5/10 sessions de formation au profit des agriculteurs (50%) et 6/6 pour les techniciens du projet (100%)
- Organisation de 148/300 journées de sensibilisation (49%)
- Surveillance phytosanitaire et avertissement agricole.

Appui conseil en élevage

- Réalisation de 6/64 essais d'engraissement (9,38%)
- Organisation de 3/5 sessions de formation sur la conduite d'élevage (60%).

Recherche développement

- Signature d'une convention avec CRRA.

Santé animale

- Éparasitage interne de 690.000 têtes petits ruminants (138%)
- Déparasitage interne de 17.000 têtes bovines (71%)

- Vaccination contre l'enterotoxémie de 300.000 têtes (60%)
- Traitement de 21.000 ruches contre la varoase (101%).

Amélioration pastorale et sylvo-pastoral

Amélioration pastorale

- Etude agro-pastorale
- Travaux de plantation d'*Atriplex numularia* sur 720 ha de parcours collectif de piémont (72%)
- Plantation de *Médicago arboria* sur 100 ha en parcours collectifs de montagne (10%)
- Organisation de visite d'échange au profit des usagers de parcours
- Formation des usagers des parcours (100%).

Amélioration sylvo-pastorale

- Etude des forêts de Guadmoua et Aghbar
- Formation des usagers de la forêt (50%).

Conservation des eaux et des terres et aménagement foncier

- DRS—fruitière sur 420 ha (21%)
- Construction des murettes sur 200 ha (20%)
- Correction des ravins: 25.700 m³ (256%)
- Traitement du Jujubier sur 1125 ha (38%)
- Bénéficiaires: 41 douars.

Promotion des micro-entreprises et des AGR

- Financement de 17 AGR (apiculture, cuniculture, moulin à grain)
- Réalisation des journées sur l'appui à l'investissement et au financement bio
- Signature de 2 conventions de partenariat avec l'ADS et le FREPE pour le financement des micro-projets
- Lancement d'une étude sur l'écotourisme.

Appui aux services financiers

- Ouverture de 2 ONG de microcrédit à Amizmiz et Asni avec un montant total octroyé de 8.020.480,00 Dhs
- Réalisation des journées de sensibilisation sur l'appui à l'investissement et au financement.

Intégration de l'apiculture au sein du projet

Pour le secteur de l'apiculture, l'action retenue par le projet reste très limitée. Il s'agit des traitements des ruches contre la varoase, comme la zone du projet a une flore très diversifiée, l'opportunité d'intégrer cette activité au sein du projet en tant qu'activité génératrice de revenu reste très profitable. En effet, la formation des apiculteurs sur les méthodes d'élevage des reines, leur organisation en associations, la création d'unité de conditionnement rendront le secteur plus productif.

DEVELOPPEMENT DE L'APICULTURE MODERNE SUR LE LITTORAL EST DU PROVINCE DE TAMATAVE, MADAGASCAR

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Résumé: L'étude de la filière apiculture a été faite pour discerner les goulots d'étranglement du développement de l'apiculture dans la région. Une trentaine de projets des associations de paysans apiculteurs ont été financés par le projet PSDR. Une formation technique, organisationnelle et un encadrement ont été donnés aux associations bénéficiaires. Des matériels et équipements apicoles (ruches modernes, extracteurs) ont été distribués à chaque association. Le nombre de cheptel apicole a considérablement augmenté dans la région ainsi que la production du miel. La notion de la qualité et des normes de miel a été initiée au niveau des producteurs.

Introduction

La sous région Sud-Est de la province de Tamatave est une zone à haute potentialité apicole. Elle est caractérisée par la présence d'une forêt naturelle qui couvre plus de 60% de la superficie totale. C'est une zone caractérisée par la présence de plusieurs essences mellifères telles que l'*Eucalyptus*, le *Grevillea*, le niaouli et les différents arbres fruitiers tels que le litchi, avocatiers et les bananiers. L'apiculture est une pratique traditionnelle dans la région Atsinanana et en particulier dans les districts de Mahanoro, Vatomandry et Tanambao. Presque chaque famille possède une ruche au minimum. Différentes formes de ruches sont utilisées selon les ressources naturelles locales et généralement les ruches sont installées dans la forêt. La chasse au miel est aussi une pratique ancestrale dans cette zone de Madagascar.

Néanmoins, la production de miel était toujours très bas et l'apiculture ne constituait pas encore une activité génératrice de revenu pour la population locale. De l'autre côté la qualité du miel restait à désirer. Il a fallu attendre l'intervention du Ministère de l'Agriculture et de l'Élevage en 2004, par le biais du financement PSDR pour développer l'apiculture moderne dans la région.

Objectifs

L'objectif principal du programme est de lutter contre la pauvreté au sein de cette communauté rurale caractérisée comme les plus démunies et de faire de l'apiculture moderne la première activité génératrice de revenu (AGR) durable des paysans.

Les autres objectifs sont:

- De connaître les pratiques paysannes sur l'apiculture
- De définir les boulots d'étranglement du développement du secteur apicole dans la zone
- De sensibiliser les apiculteurs sur l'inconvénient de la chasse au miel et d'éradiquer progressivement cette pratique
- De former les paysans bénéficiaires sur les techniques d'élevage moderne des abeilles
- De former les apiculteurs sur la gestion des ressources naturelles par lutte contre le feu de brousse et la culture des plantes mellifères
- De sensibiliser les apiculteurs sur la traçabilité, la qualité et les normes du miel
- De former les paysans sur la gestion d'un projet communautaire

- D'établir une structure fiable au sein de la communauté rurale afin de pérenniser le développement de l'apiculture.

Méthodologie

Des enquêtes ont été menées au niveau de chaque groupement apiculteur pour:

- Analyser la structure de leurs associations
- Pour connaître leur savoir-faire sur l'apiculture
- Pour analyser le potentiel mellifère de chaque zone d'intervention
- Pour définir d'une façon participative les thèmes de formation à dispenser

Après la confirmation de l'éligibilité du groupe demandeur, le budget de chaque projet a été établi avec les membres de chaque association et les équipements et matériels apicoles ont été achetés après approbation du PSDR.

Des séances des formations techniques et socio-organisationnelles ont été données à chaque association suivant l'état d'avancement du projet.

De même un suivi-encadrement est accordé à chaque association bénéficiaire pendant au moins un an.

Pendant chaque rencontre aux apiculteurs, les techniciens font toujours une sensibilisation sur l'importance de la qualité et des normes du miel.

Résultats obtenus

- 31 associations d'apiculteurs ont été encadrées
- 500 apiculteurs ont été formés sur la technique de l'apiculture moderne, sur la gestion d'un projet communautaire et sur la conservation des ressources naturelles
- 3100 ruches Langstroth ont été distribuées
- 31 extracteurs et autres matériels (enfumoirs, combinaisons, levè-cadres, attire-essaims, etc.) distribués
- Plus de 15.000 pieds de plantes mellifères ont été plantées (agrumes, *Grevillea*, litchi, etc.)
- Augmentation des ruches peuplées ainsi que de la production du miel
- Amélioration de la qualité du miel.

Conclusions

Après avoir acquis les connaissances sur l'apiculture moderne, les équipements et matériels y afférents, on a observé un enthousiasme et une volonté au niveau des apiculteurs sur le développement de la filière apicole.

Le cheptel apicole a sensiblement augmenté dans la région ainsi que la qualité du miel sur les marchés locaux.

Une diminution considérable du feu de brousse et de la chasse au miel (liée aux abattages des arbres) a été observée dans la zone d'intervention. L'apiculture devient une activité génératrice de revenu pour les paysans.

Perspectives

Former une Union ou une Coopérative des apiculteurs pour faciliter la vente du miel et l'accès aux institutions de microcrédit. Mise en place d'un centre ou point de vente des produits apicoles.

COMMERCIAL INSECTS AS INCENTIVES FOR COMMUNITY PARTICIPATION IN ARABUKO-SOKOKE FOREST MANAGEMENT

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Abstract: Insects were valued mainly as sources of nutrition and income through the sale of the surplus at Arabuko-Sokoke Forest before 1993. The main products were larvae of moths and honey from bees. In 1993, farming of butterflies for export to live invertebrate exhibits in Europe and US ushered in the use of insects purely as a commodity for trade. The commercial insect enterprises now number five: butterfly farming, sericulture, beekeeping, mantis and stick insect farming. Capacity building of the commercial insect institutions (enterprises) and improved networking and marketplace, have given the community an advantage on negotiating their roles and benefits from their inclusion in the management of natural resources of the Arabuko-Sokoke forest. The commercial insect lobby now totals more than 3000 forest-adjacent residents. There are both ecological and social challenges that have prevented the realisation of the full potential of the commercial insect enterprises.

Arabuko-Sokoke forest and its importance

Arabuko-Sokoke forest in coastal Kenya, is an important resource for subsistence of the adjacent community. It is the largest (420 km²) and most intact remnant of East Africa's coastal dry forests and is ranked second for conservation of birds in Africa. It is also among the 25 global biodiversity hotspots for endemism.

The value of the Arabuko-Sokoke forest to the community before commercial insects enterprises

The attitude of 85% of the community members living adjacent to the forest was that the forest was of no value to them. Below is a sampling of their comments:

- "Those who live near the forest endure a lot but this is unknown to the authorities"
- "... You cannot get inside, if you are caught even with a twig you are arrested."
- "We don't plant here because of elephants"
- "It (the forest) is a saving for farm land".

Why commercial insects enterprises?

Commercial insects farming would change local attitudes by enabling forest-adjacent communities to get cash incomes from the forest. The benefits to the community would not be short term (e.g. tree products and non-consumptive [destructive] use of forest resources).

After commercial insects introduction

- We have established
 - Butterfly farming
 - Beekeeping
 - Mantis farming.
- We have also initiated
 - Sericulture.

Incomes earned and other achievements

- US\$ 800,000 from butterfly, moth and mantis farming since 1994
- US\$ 30,000 from beekeeping since 2000
- 800 butterfly farmers in 27 groups
- Four other household residents support a registered farmer
- 1997 beekeepers in 112 groups.

Impacts of commercial insects

- Added forest value, i.e. more than 80% of revenue is realised; this cannot be compared to licensed trade in forest products and ecotourism
- Attitudes of more than 85% of adjacent community members for the forest's conservation changed
- Individual annual cash income per capita more than doubled
- Super farmers earn about US\$ 2000 per annum, but average income is US\$ 100.
- There is a network of nature-based enterprises
- Marketplace—Interactive participation.

Challenges

- Non-traditional livelihood options
- Wait and see culture
- Linkages with the private sector
- Mainstreaming conservation action.

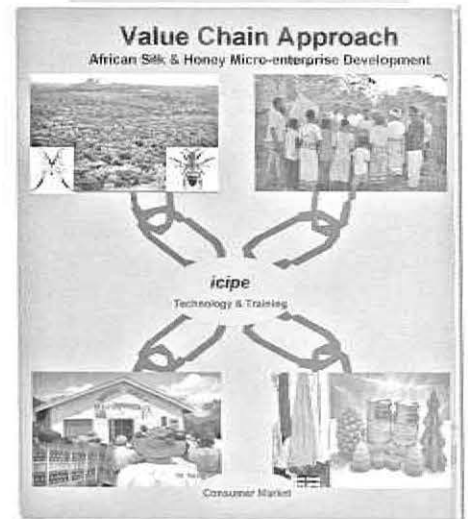
Conclusion

Commercial insects enterprises are:

- Compatible with forest conservation
- New livelihood opportunities
- Reducing land-use conflicts
- Increasing value of forest to locals
- Reasons for locals to participate in the forest's management.

SESSION 6

Recommendations for future biological and marketing research and development activities to solve local and regional problems





RECOMMENDATIONS

Cameroon

- Training in apiculture.
- Introduction of sericulture.

China (support)

- Technical training.
- Market for products.

Democratic Republic of Congo

- Training in apiculture and sericulture.
- Beekeeping equipment.
- Silk and honey marketplace.
- Grainage unit.
- Silk postharvest technologies.

Egypt

- Grainage.
- Pathology laboratory.
- Quality control laboratory.

Ethiopia

- Capacity building.
- Grainage.
- Postharvest technology.
- Marketplace for silk.

Ghana

- Grainage.
- Mulberry germplasm.
- Training of trainers.

India

- Training and technical advice.
- Supply of silkworm seed.
- Equipment.

Kenya

- Promotion of strong collaboration with key stakeholders.
- Equipments.
- Marketing of products.

Madagascar

- Sericulture grainage.
- Marketplace for honey and silk.
- Equipment for sericulture.
- Training on queen rearing.

Morocco

- Training in apiculture.
- Development of a honey processing unit and marketplace.

Mozambique

- Training in apiculture.
- Marketplace for honey.
- Beekeeping equipment.

Namibia

- Promotion of eri-culture.
- Registration of silk production in Africa.
- Support from resource countries.

Nigeria

- Training of trainers in apiculture and sericulture.
- Marketplace for honey and silk.

Rwanda

- Sericulture and apiculture support.
- Study tours to successful countries.
- Rehabilitation of buffer zones.

Southern Sudan

- Training in apiculture and sericulture.
- Training of trainers.
- Apiculture and sericulture equipment.
- Mulberry cuttings.
- Honey marketplace.

Sudan

- Marketplace for honey and silk.
- Training centre for beekeeping.
- Equipment.

Tunisia

- Integration of IFAD projects and api/sericulture.
- Improved pollination in green houses.

Uganda

- Institutional support and capacity building.
- Marketplace (for honey) in other areas.

UK (support)

- Promotion of pollinator and stingless bees networking.
- Technical insight into pollinator monitoring tools.

United Republic of Tanzania

- Capacity development in apiculture to support relevant institutions and communities.
- Technical support on establishment and up-scaling of apiculture.
- Establishment of integration processes (processing and marketing)—establishment of honey and silk market centres.
- Technical support in establishment of sericulture into the country.
- Capacity development (training of trainers) in silk production.
- Linkage to relevant institutions and markets.

Yemen

- Quality control laboratory.
- Queen rearing training.
- Langstroth hives.

Other suggestions**General**

- Establishment of another apiculture and sericulture training centre south of the Sahara, e.g. in Ghana
- Formation of apiculture and sericulture networks
- *icipe* proposed as secretariat
- Country or organisation membership proposed, not individuals
- Need to include the NGOs in the network.

Interim committee

The following volunteered to form the interim committee for the network:

- Esther Kioko (Kenya: East Africa)
- Paul Ntaanu (Ghana: West Africa)
- Jean Joseph Randriamananoro (Madagascar: French-speaking)
- Usama Ghazy (Egypt: North Africa)
- Mohamed Sir-Elkhatim (The Sudan)
- Faiza Saleh Abdilla (Yemen: NENA Region)
- Arop Leek Deng (Southern Sudan/East Africa).

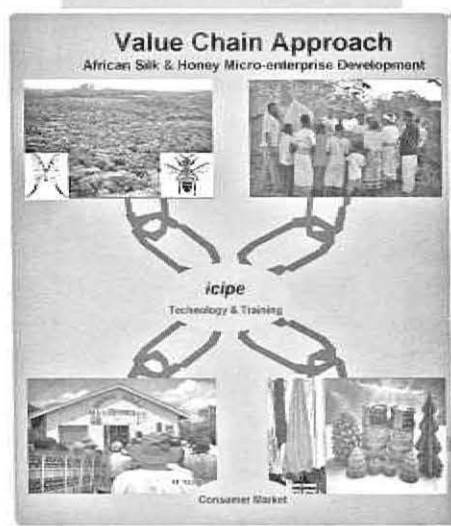
Tasks

The immediate tasks are:

- Draft constitution;
- Proposal for funding;
- Registration of membership (website);
- Identification of areas for sub-committees.

Workshop Programme

List of Participants





PROGRAMME

Venue: Thomas Odhiambo Conference Hall

5th December 2006 (Tuesday)

0800–0830 Registration: R. Onyango, E. Nguku and G. Mose

OPENING SESSION:

Chair: J. P. R. Ochieng-Odero

Rapporteur: Rose Onyango

- 0830–0850 Opening remarks: *icipe's* capacity building and institutional development
(*J. P. R. Ochieng-Odero, Head CBIDP*)
- 0850–0910 Workshop theme and objectives
(*S. K. Raina, Programme Leader, Commercial Insects Programme*)
- 0910–0930 Welcome address
(*Roger Finan, Director, Finance and Administration*)
- 0930–1000 Keynote address (*Alan Rodgers, UNDP-GEF Regional Coordinator*)
- 1000–1030 TEA/COFFEE BREAK
- 1030–1130 Visit to Commercial Insects Programme laboratories by the delegates
(*E. Kioko, V. Adolkar, E. Muli, E. Nguku, CIP staff and students*)

SESSION 1: **Natural resource assessment and strength of networking African partners in the management and implementation of sericulture and apiculture technologies**

Chair: Alan Rodgers

Rapporteur: Esther Kioko

- 1140–1155 Crossborder biodiversity conservation, cases on ground and possible interventions (*John Salehe, E. Africa*)
- 1155–1210 Prospects of introducing beekeeping and sericulture in the IFAD Mount Kenya East Pilot Project for conserving the natural resources
(*Muthoni Livingstone, Kenya*)
- 1210–1225 Wildlife conservation for livelihoods by the local community
(*Richard Bagine, Kenya*)
- 1225–1240 Status and prospects of using stingless bees for pollination services
(*Koos J.C. Biesmeijer, United Kingdom*)
- 1240–1255 Spatial distribution of *Anaphe panda* in Kakamega forest and its significance in monitoring the forest biodiversity
(*Mbahin Norber, Cameroon*)
- 1255–1400 LUNCH BREAK
- 1400–1415 Natural resource management with special reference to nature based products in East Africa (*Paul Matiku, Kenya*)
- 1415–1430 Integration of apiculture and sericulture to support forest biodiversity in Nigeria (*Oyelade Oyewumi Oyesola, Nigeria*)
- 1430–1445 Participatory forest management in Kenya with special reference to Commercial Insects Programme (*D. K. Mbugua, Kenya*)

- 1445–1500 Income generation options for improving rural economy and their integration with IFAD projects in the Sudan: Apiculture and sericulture status and constraints (*Magzoub Bashir, Sudan*)
- 1500–1515 Forest biodiversity conservation in fragile ecosystems through value chain insect-based enterprises among resource limited farming communities (*Suresh K. Raina, Kenya*)
- 1515–1530 General discussion
- SESSION 2: Identification of markets for silk and honey based products to facilitate farmers' access to the market**
- Chair: Beera Saratchandra**
- Rapporteur: Vijay Adolkar**
- 1530–1545 Current global silk markets and the prospects of African silk enterprises (*Beera Saratchandra, India*)
- 1545–1600 IFAD's and Government of Sudan (GoS) strategic and proposed thrusts for livelihood improvement (*Mohammed Sir ElKhatim, Sudan*)
- 1600–1630 TEA/COFFEE BREAK
- 1630–1645 Bridgeworks and marketing of *icipes* research products (*Milton Lore, Kenya*)
- 1645–1700 History of kente cloth and its value addition through design integration with African wild silk for export market in Ghana (*Ken Fening, Ghana*)
- 1700–1715 Impact of CRDA IFAD Project in Tunisia (*Naceur Chariag, Tunisia*)
- 1715–1730 Developing marketing infrastructure: A case study of IFAD AMSD Project in Tanzania (*Vincon Nyimbo, Tanzania*)
- 1730–1745 Introducing apiculture and sericulture in IFAD PDCRE cash crop project for income generation in Rwanda (*Sixte Rutayisire, Rwanda*)
- 1745–1800 General discussion

6th December 2006 (Wednesday)

- SESSION 3: Implementation of value chain approach in the development, scale-up, production, branding and marketing of sericulture and apiculture products**
- Chair: Souad M. Mohamoud**
- Rapporteur: Elliud Muli**
- 0830–0850 Implementation of sericulture in Sohag IFAD project in Egypt (*Souad M. Mohamoud, Egypt*)
- 0850–0905 Marketing of silk: Value addition through textile design in Africa (*Janice Knausenberger, Kenya*)
- 0905–0920 Present status of sericulture in Ghana and its prospects for integration in IFAD project (*Paul Ntaanu, Ghana*)
- 0920–0935 Impact of IFAD projects in South Kordofan on income generation activities including beekeeping (*Mohamed Gibriel Abdalla Gibriel, Sudan*)
- 0935–0950 Prospects of introducing sericulture in Rwanda (*Mukase Francoise, Rwanda*)

0950–1005 Impact of IFAD AAP support programme in rural livelihoods with special reference to micro enterprises in Uganda (*Mugume Amos, Uganda*)

1005–1030 TEA/COFFEE BREAK

SESSION 3 continued

Chair: Susie Wren

Rapporteur: Everlyn Nguku

1030–1050: Premium market access through organic certification
(*Susie Wren, Kenya*)

1050–1105 Integrating beekeeping and wild silk farming for forest conservation and rural development in Northern Cameroon
(*Soulemanou Abba, Cameroon*)

1105–1120 Impact of IFAD Projects in CBARDP on the economy of Nigeria and prospects of introducing apiculture and sericulture
(*Ibrahim Mohamed Bello, Nigeria*)

1120–1135 Effect of heavy rains in Eastern Sudan Kassala State on community income generation capacity and impact of IFAD project on their livelihoods (*Abdel Gadir Hag Ali Khalid Ali, Sudan*)

1135–1150 Overview and prospects of sericulture industry and silk marketing in Uganda (*Gershom Mugenyi, Uganda*)

1150–1205 Marketing of non-timber forest products (*Rob Barnett, Kenya*)

1205–1220 Status of apiculture in Southern Sudan and strategy for honey marketplace development (*Jacob Mogga, S. Sudan*)

1220–1235 Prospects of development of organic wild and mulberry silk products
(*Vijay Adolkar, Kenya*)

1235–1300 General discussion

1300–1400 LUNCH BREAK

SESSION 4: **Improvement of productivity of silk and honey based products through R&D**

Chair: Ian Gordon

Rapporteur: Joseph Macharia

1400–1420 Commercial insects programmes in a forest buffer zone context
(*Ian Gordon, Kenya*)

1420–1435 Present status of mulberry germplasm and silkworm races in Egypt
(*Usama Ghazy, Egypt*)

1435–1450 Harnessing wild silk biodiversity for environmental conservation and income generation (*Esther Kioko, Kenya*)

1450–1505 Quality analysis of *Bombyx mori* (L) silk fibre and fabric
(*Everlyn Nguku, Kenya*)

1505–1520 Molecular tools for characterisation of potential honeybees and silkworms population in Africa (*Pamela Seda, Kenya*)

1520–1535 CAAS China support for enhancing silk, honey and hive products in Africa (*Shi Wei, China*)

- 1535–1550 Relative abundance of the wild silkworm, *Argema mimosae* and host-selection behaviour of its parasitoids (*Boniface Ngoka, Kenya*)
- 1550–1605 Diversity of stingless bees in Uganda and their potential for income generation (*Dominic Byarugaba, Uganda*)
- 1605–1630 TEA/COFFEE BREAK

SESSION 4 continued

Chair: Faiza Saleh

Rapporteur: Boniface Ngoka

- 1630–1650 Hive products as medicine with special reference to *Ziziphus* sp. honey in Yemen (*Faiza Saleh, Yemen*)
- 1650–1705 Antibacterial properties of propolis (*Elliud Muli, Kenya*)
- 1705–1720 Distribution of stingless bees species of three Kenyan forests (*Joseph Macharia, Kenya*)
- 1720–1740 General discussion

7th December (Thursday) 2006

SESSION 5: Improvement of managerial and technical capabilities of beekeepers and silk farmers through adaptation and dissemination of appropriate technologies

Chair: Arop Deng

Rapporteur: Susan Sande

- 0830–0850 Strategy for agricultural development with special reference to micro enterprise development in Southern Sudan (*Arop Deng, Southern Sudan*)
- 0850–0905 Managerial and technical approaches in enhancing production, processing and marketing of wild silk by small scale farmers in Africa (*Ian Cumming, Namibia*)
- 0905–0920 Constraints in post harvest sericulture in Egypt (*Mona Maher Hassan, Egypt*)
- 0920–0935 Building up of the rural economy through beekeeping as an income generating option in Congo (*Nkoba Kiatoko, Congo*)
- 0935–0950 UNDP country office oversight roles in project management (*Jane Chemweno, UNDP/GEF*)
- 0950–1005 Role of Kenya Bureau of Standards in product quality control, with special reference to honey, silk and nature based products (*Kimetto, Kenya*)
- 1005–1030 TEA/COFFEE BREAK

SESSION 5 continued

Chair: Scola Bwali

Rapporteur: Ken Okwae

- 1030–1050 Role of NAAD in promoting apiculture and sericulture activities in Hoima Uganda, through IFAD project (*Scola Bwali, Uganda*)
- 1050–1105 Natural resource enterprise development in Africa (*Kamni Mehta, Kenya*)

- 1105–1120 Status of IFAD PPRS and prospects of integrating beekeeping and silk farming in Madagascar
(*Adeline Razoelarisoa and Eugenie Raharisoa, Madagascar*)
- 1120–1135 Role of Kenya Bureau of Standards in product quality control, with special reference to honey, silk and nature based products
(*Enoch Kattam, Kenya*)
- 1135–1150 Sericulture and apiculture activities in Madagascar
(*Jean Joseph Randriamananoro, Madagascar*)
- 1150–1205 Sericulture as an emerging enterprise in Kenya
(*Marion Gathumbi, Kenya*)
- 1205–1220 Universal Corporation Ltd—Scientific excellence with human touch
(*Sanjay Purang, Kenya*)
- 1220–1235 Organic certification and marketing strategy (*Tom Deiters, Kenya*)
- 1235–1250 Sericulture research development in Ethiopia: Achievements, challenges and opportunities (*Ammanuel Tamiru, Ethiopia*)
- 1250–1305 Overview and prospects of beekeeping in Kenya (*Robinson Mbae, Kenya*)
- 1305–1400 LUNCH BREAK

SESSION 5 continued**Chairperson: Mary Gikungu****Rapporteur: Vijay Adolkar**

- 1400–1420 Identification process of important bee taxa for income generation in East Africa (*Mary Gikungu, Kenya*)
- 1420–1435 Status and prospects of IFAD project in the central mountainous region of Morocco and integration of apiculture in the project
(*Latifa Bousaad, Morocco*)
- 1435–1450 Development of modern apiculture in Tamatave province, Madagascar
(*Jean Aubin H. B. Herimamilalaina, Madagascar*)
- 1450–1505 Participatory forest management in Arabuko-Sokoke
(*Washington Ayiemba, Kenya*)
- 1505–1520 General discussion

SESSION 6 Recommendations for future biological and marketing research and development activities to solve local and regional problems**Chairpersons: Ian Gordon and J. P. R. Ochieng-Odero****Rapporteur: Esther Kioko**

- 1520–1600 General discussions and recommendations
- 1600–1630 TEA/COFFEE BREAK
- 1630–1700 Submission of reports and closing remarks
(*Ian Gordon and J. P. R. Ochieng-Odero, Kenya*)

9th December (Saturday)

- 0900–1400 Farmers' Day

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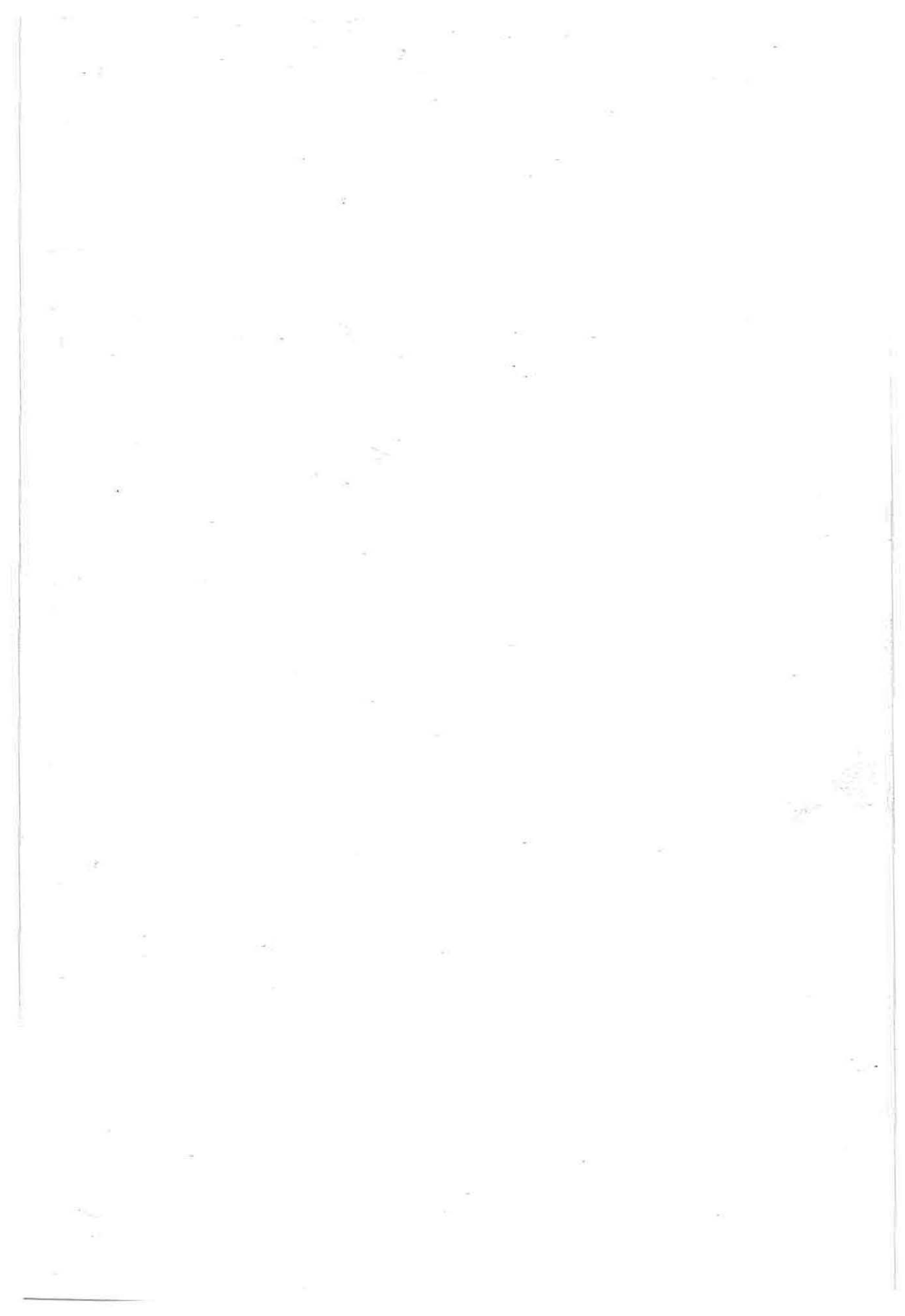
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