Group Training Course and Workshop on Scaling-Up Apiculture and Sericulture Enterprises to Promote Rural Livelihoods

PROCEEDINGS

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

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

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icipe
African Insect Science for Food and Health

IFAD
INTERNATIONAL FUND FOR AGRICULTURAL DEVELOPMENT

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Cover photos: Silkmoths and bees provide livelihood support through their silk and honey, respectively.

CONTENTS

Foreword

Scaling-up beekeeping and other livelihood options means decreasing the challenges to rural livelihoods and threats to species diversity in Africa. It is clear that natural resource dependence has left few viable opportunities for non-exploitative additional income generation. Moreover, the often observed low horticultural, vegetable and oilseed crops production in Africa can be attributed to loss of pollinators, resulting in reduced fruit and seed set, and erratic pollination. Loss of pollinators has also caused thinning of forests and habitat reduction for forest species. Additionally, African farmers have to cope with low agricultural output caused by pests and diseases and often lack the infrastructure for value addition.

The workshop endorsed the scaling-up of technologies in beekeeping and other livelihood options and offered definitive, off-the-shelf solutions. It also illustrated how developing country governments can create a national technology infrastructure deployment that spurs effective, scaled-up and sustainable beekeeping and other income generation sources, and improve the natural resources. Through in-depth case study demonstrations, the workshop showed the trainers a number of key building blocks to scale up commercialisation of beehive products and boost crop productivity to drive down costs. While such ambitious efforts require significant human resources, time and money, the rewards are substantial.

This workshop brought together co-financers and operating partners in the participating countries and supported IFAD's strategy for poverty reduction by: (i) strengthening the capacity of the rural poor and their organisations, (ii) promoting equitable access to productive natural resources and technologies, and (iii) increasing access to financial services and markets. The workshop promoted beekeeping technologies and other natural products livelihood options and pollination services. If widely adopted, these technologies can make a significant impact in the improvement of natural resources, promote the reduction of global emissions of carbon dioxide and improve farmers' income through beekeeping, crop pollination and sustainable wild harvest.

icipe organised this workshop to provide a valuable opportunity for the representatives of IFAD projects, governments, NGOs and the private sector to interact and share experiences, and gain skills on the management and scaling-up of beekeeping and other livelihood options. The workshop aspired to design an infrastructure template for the integration of apiculture-based options with regional crop development operations in Africa. It also encouraged private investment so that the positive impacts on community livelihoods are ensured, commercial profits are maximised and biodiversity and conservation are maintained. As a result, local, national and international participants were empowered to develop long-term policies that will guarantee sound management of commercial insects and wild harvest-based micro-enterprises to meet local people's needs and support the economy and the forestry sector in Africa.

Christian Borgemeister
Director General

PREFACE

Community empowerment means building the ability of a community to carry out development actions on its own. Rural communities should be empowered and one of the effective ways is through providing necessary training for technology uptake.

The Group Training Course and Workshop on Scaling-Up Apiculture and Sericulture Enterprises to Promote Rural Livelihoods was convened by the Commercial Insects Programme (CIP) of the *icipe* in Nairobi on 21–30 October 2009. The Programme, in the Environmental Health Division, aims to create healthy environments to develop insect-based enterprises for the livelihoods of the rural communities.

Scientists, scholars, project leaders, agricultural and livestock officers and other policy makers attended this training course and workshop. The course was structured with the specific aim of disseminating technologies to rural communities through educating extension personnel and end users. The course also offered a forum to appraise national policy-making personnel on current methodologies and commercial insects issues to facilitate decision making for development planning. The ultimate aim was to enable the beneficiaries of the course to increase their technical and management skills and to assist rural communities to develop their own businesses in silk and bee products.

The course was application-oriented with replicable field components in various agroecological zones as well as hands-on demonstrations and practical training.

The course provided:

- Technical and business training on scaling-up apiculture and sericulture technologies that are central to sound and sustainable commercial production system;
- Management and organisational skills to correctly operate the appropriate infrastructure and to develop organic certification systems that provide important value addition and improved market access; and
- More expertise of the trainers in developing the correct mechanisms for forest resource utilisation, pollination services, conservation, carbon dioxide sequestration and mitigation.

The training activities were conducted at *icipe* headquarters in Nairobi and CIP project field site located in Mwingi.

Original short presentations as well as full conference papers are included in this book. We hope that it will become a useful reference tool.

Suresh K. Raina
icipe

ACRONYMS AND ABBREVIATIONS

ASFADA	Arabuko-Sokoke Forest Adjacent Dwellers Association
ATVET	Agricultural Techniques and Vocational Education Training colleges
BAM	Beekeepers Association of Malawi
BOLD	Barcode of Life Data Systems
CBO	community based organisation
CDF	Constituencies Development Fund
CFA	Community Forest Association
DGAK	Dairy Goat Association of Kenya
EIAR	Ethiopian Institute of Agricultural Research
ETB	Ethiopian birr
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FFS	Farmers' Field Schools
GHG	greenhouse gas
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
IBA	Important Bird Area
icipe	International Centre of Insect Physiology and Ecology
ICRAF	World Agroforestry Centre
ICS	internal control system
IDB	Islamic Development Bank
IFAD	International Fund for Agricultural Development
IGA	income-generating activities
IMO	Institute of Marketecology
IPCC	Intergovernmental Panel on Climate Change
KEFRI	Kenya Forestry Research Institute
KFS	Kenya Forest Service
KTBH	Kenya Top Bar Hive
MARC	Melkassa Agricultural Research Centre
MDBJSHG	Mwingi District Beekeepers Joint Self Help Group
MDG	millennium development goals
MoARD	Ministry of Agriculture and Rural Development
NAADS	National Agricultural Advisory Services
NBE	nature based enterprise
NGO	non-governmental organisation
NOP	USDA's National Organic Program
OPEC	Organization of the Petroleum Exporting Countries
PADEP	Participatory Agriculture Development Programme
PFM	Participatory Forest Management
POP	point of purchase
POS	point of sale
R&D	research and development
RLSP	Rural Livelihoods Support Programme
RMA	rapid market appraisal
SACCO	savings and credit cooperative society
TASAF	Tanzania Second Social Action Fund

SESSION 1

Resource Persons' Papers

Marketing Research and Marketplace Development

Suresh K. Raina
International Centre of Insect Physiology and Ecology (*icipe*)
P. O. Box 30772-00100, Nairobi, Kenya

Market Research

Market research is the study of markets (or groups of people) one would like to sell products to. In other words, it is learning about your customers. The pertinent questions are:

- Who are they?
- What do they want or need?
- What are their lifestyles?

When you set up your marketing plan, have a customer base in mind for the primary and secondary markets.

The information gained will help you provide an excellent product that is well received by potential customers.

The importance of marketing research for honey- and silk-based products is highlighted by its three basic uses:

a. Improving the quality of decision making;
b. Finding out what went wrong;
c. Understanding the marketplace.

Two steps are taken in conducting market research:

a. The specific nature of the problem or question to be investigated has to be defined (such as the reasons for declines in sales);
b. Kinds of opportunities that exist to expand existing markets and/or to tap new markets.

Data Collection

Three types of information are collected:

a. Geographic (Where are customers located?);
b. Demographic (What are the characteristics of potential customers including gender, age, education levels, income); and
c. Psychographic (What drives customers' buying behaviour? Are they receptive to new services or products or are they slow to accept them? What values are most important to them?

The data can be collected directly or via mail, telephone and personal interview, among other methods.

The Marketing Concept

In the silk and honey enterprises products are based upon the following three orientations:

a. Consumer Orientation—Identification of and focus on the group of people or firms most likely to buy a product, and production of goods or services;
b. Goal Orientation—A focus on the accomplishment of corporate goals;
c. Systems Orientation—Creation of systems to monitor the external environment and to deliver the marketing mix to the target market.

icipe's Value Chain Approach for Silk and Honey Products

The value chain framework is an approach for breaking down the sequence (chain) of business functions into strategically relevant activities through which utility is added to products and services (Figure 1).

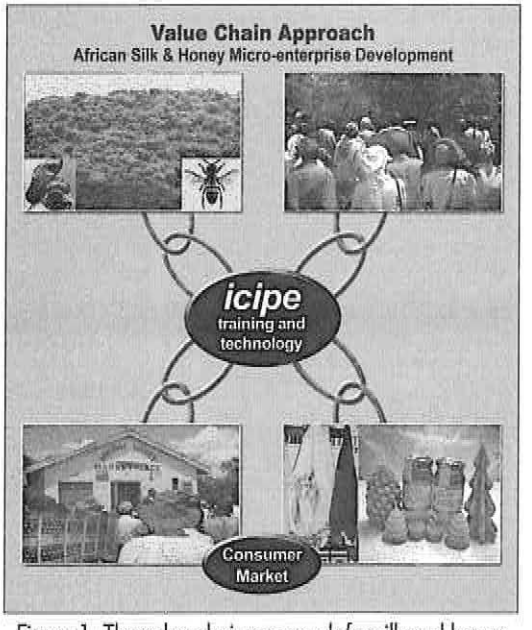


Figure 1. The value chain approach for silk and honey microenterprises

Value Chain Methodology

The methodology for constructing and using a value chain involves four steps:

a. Identifying value chain activities;
b. Determining which value chain activities are strategic;
c. Tracing costs to value chain activities;
d. Using the activity cost information to manage the strategic value chain activities.

An organisation that can do these things better than its competitors creates a sustainable competitive advantage.

Developing a Competitive Advantage

To survive in today's highly competitive business environment, any organisation must achieve, at least temporarily, a competitive advantage.

A low cost/price strategy focuses on providing goods or services at a lower cost than the competition, or superior goods or services at an equal cost. This strategy requires a tight cost-control system, benefiting from economies of scale in production, e.g. marketplaces.

The second strategy for gaining competitive advantage is differentiation. The primary focus of this strategy is to create a unique position in the market through provision of goods or services that are valued for their uniqueness (Figure 2) or fit the needs of a particular group of buyers; for example, brandings and organic certification.

A third competitive strategy is called focus. This is a strategy for targeting a specific segment of the market as defined, for example, by selling Maasai silk, and Royal Eco-honey, *Ocimum* honey or stingless bee honey types, characteristic of a geographical area.

Value Chain Analysis

Value chain analysis can help an institution determine which type of competitive advantage to pursue, and how to pursue it. There are two components of the value chain analysis:

- The industry value chain, and
- The organisation's internal value chain.

The industry value chain begins with the first step in the product development process, and ends with the completed delivery of products to the marketplace with the help of communities.

The organisation supports and monitors the system.

Product Research

Successful new products are essential to silk- and honey-based marketplaces for growth and survival. At *icipe*, we believe that formulating 'new products' is the most important application of marketing research, but also one of the most difficult to execute in practice. New products can be *concept*-driven or *product*-driven.

Pricing Research

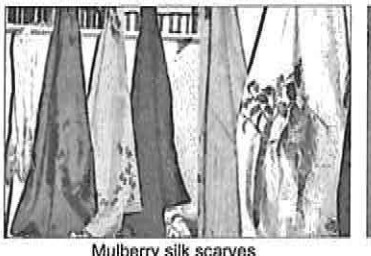
Pricing is one of the more technical areas of marketing research. However, selecting the right technique


Rainforest silk produced at Kakamega Marketplace


Coastal forest silk produced at the Arabuko-Sokoke Marketplace

Woodland forest silk produced at the Mwingi Silk Marketplace


Terry silk produced at Bushenyi Uganda Silk Marketplace


Mulberry silk scarves Kenya and Uganda


Wild silk production Madagascar

Figure 2. Different kinds of silk fabric unique to different regions of eastern Africa

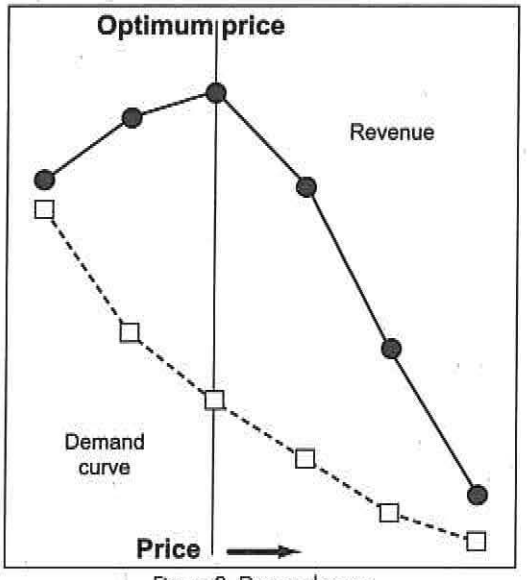


Figure 3. Demand curve

ultimately depends on what the problem is that you are trying to solve.

Market context and positioning are also extremely important in setting prices. In technology markets, prices are typically falling over time.

By taking a sample of customers we can work out what levels of demand would be expected at each price point across the market as a whole (Figure 3).

Using this estimate of demand, the price elasticity (or expected revenue) can be calculated and so the optimum price-point of the honey and silk based products in the market established.

Distribution Research

Brand Equity

In a market where products are similar, branding can have a large effect on the price that customers will pay. Brands therefore add value to a basic product or service. Brand equity is used to describe both the value of the brand and the brand's component values.

Silk and Honey Brands

Branding stimulates the growth of apiculture and sericulture products through the development and labeling of silk and honey based products. Branding also promotes brand franchise growth of enterprises.

There are three brands of Eco Honey created by the project with several eco-types based on flora and the altitude. They are:

- Eco Honey with floral types: acacia, eucalyptus, wattle, sunflower, wild forest, litchi, *Ziziphus* etc.;
- Royal Eco Honey supplemented with 2% of royal jelly powder;
- Eco Honey + propolis.

In addition, there are various eco-types based on the geographical location. A few medicinal honey types have also been branded.

There are four brands of silk created by the project. They are:

- African silk: Produced by mulberry silkworm races developed in Africa (*icipe* 1–5);
- Rainforest wild silk: Obtained from *Anaphe panda* found in rainforests such as Kakamega in Kenya and Budongo in Uganda;
- Savanna silk: Produced by *Gonometa* species feeding on acacia;
- Sea breeze silk: Produced at the coast by *Argema* and *Gonometa* species.

Promotion Research

Promotion

Promotion is the specific mix of advertising, personal selling, sales promotion and public relations a company uses to pursue its advertising and marketing objectives.

The Offer

What are you offering the target customer? What do you want the target market to do?

Measuring Response

Testing different offers, advertisements, direct mail letters, lists, and promotion techniques can tell you what method is most effective. There is a trade-off.

World Wide Web

The Web allows for a cheap way of promoting your product. It is a great tool because it allows the target customers to educate themselves about your product by reading about it, seeing a demo, and downloading information.

Direct Mail

An average response rate for direct mail is about 1%.

Classified Advertisements

This target market will read the classified ads in the magazines. They are looking for and willing to try new things.

Organic Certification

What is Certification?

Organic certification is a statutory requirement for the exportation of organic products to the EU, the USA, Australasia, Japan and many other countries.

The organic certification process for producers of organic food and other organic agricultural products involves a set of standards pertaining to production or wild harvest, storage, processing, packaging and shipping.

Standards

1. Avoidance of synthetic chemical inputs and genetically modified organisms (apart from those used for veterinary requirements and disease prevention);
2. Use of farmland that has been free from chemicals for several years (three years or more);
3. Keeping detailed written production and sales records (audit trail);
4. Maintaining strict physical separation of organic products from non-certified products;
5. Undergoing periodic on-site inspections.

Fair Trade

Fair trade is an organised social movement and market-based approach that aims to help producers in developing countries and promote sustainability.

The process of developing organic certification for smallholder/wild harvest producer groups can be successfully combined with fair-trade certification.

Price Range

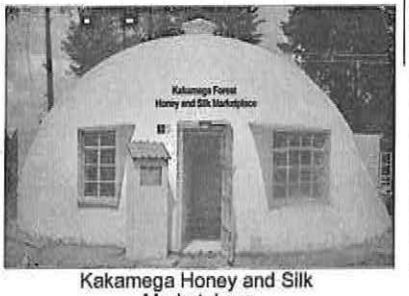
The price premium ranges from 30–300%, resulting in substantial increase in incomes for participating rural communities, in accordance to the international statutory guidelines (i.e. ISO 65 for the EU and NOP for the USA), while substantially improving their livelihoods.

Activities

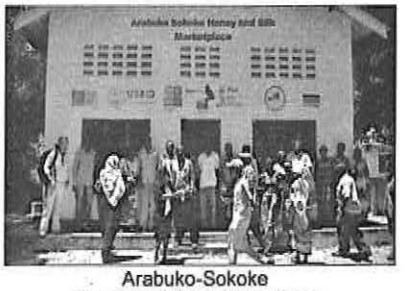
Phase 1. Certification of the land
Phase 2. Certification of the processing centre
Phase 3. Development of the ICS
Phase 4. Producer group preparation for certification.

What Organic Buyers Need from Suppliers

- Reliable quality
- Reliable quantities
- Ability to handle exportation bureaucracy and logistics
- Conformation to conditions of supply
- Effective communication
- No over-promising! Traceability
- Clear pricing structure.



Kakamega Honey and Silk Marketplace



Arabuko-Sokoke Honey and Silk Marketplace

Bushenyi Uganda Silk Marketplace

Madagascar Marketplace

Figure 4. Marketplaces in Kenya, Uganda and Madagascar

Marketplaces

The marketplace is *icipe*'s approach to formulating and managing partnership programmes for the development of a process that is equitable, participatory and sustainable, and promotes self-reliance among the community.

Thus marketplaces strengthen rural development and empower farmers to control their produce and market it without being exploited by go-betweens (Figure 4).

Outcomes/Output

1. A well equipped marketplace owned and run by community members;
2. Production of quality products for the market (hive products—honey, beeswax candles, royal jelly; silk products—scarves, shirts, mats, carpets);
3. Market outlets through private traders;
4. Farmers are economically/financially empowered through participation in nature-based enterprises.

Impact of Production Modules

Silk and Honey Technologies: Impact, Capacity Building and Marketplaces

- 15–20% income of rural households improved in all project areas;
- 35,000 farmers were trained in 24 African countries including IFAD project area (1996 to date);
- 3000 extension workers, Government and university officials from 24 African countries trained;
- 15 PhDs in eight African countries and several MSc students trained;
- 9 marketplaces for silk and honey product development in IFAD Project area and other regions (Kenya, Uganda, Madagascar, S. Sudan, Tanzania) built;
- 5 honey quality control laboratories in Libya, Tunisia, Algeria, Morocco and Kenya set up.
- The first silk quality control laboratory in Africa established at *icipe* Kenya.

Empowerment of the Community: Ownership and *icipe* Exit Strategy

Through appropriate technology and training, communities are empowered to maintain their own business activities and marketplaces reducing the role of the wholesaler and allowing silk farmers and beekeepers to improve their livelihood.

icipe feels that poverty reduction is not just about production, nor is it just about food. It is about a change in the social existence and socio-economic balance in the society.

Introduction to Beekeeping

Elliud Muli
International Centre of Insect Physiology and Ecology (*icipe*)
P. O. Box 30772-00100, Nairobi, Kenya

What is Beekeeping?

Beekeeping is the art and ability of managing bees to obtain honey, beeswax and other bee products for both food (products and pollination) and income. It involves building up colony sizes in such a way as to obtain large or maximum adult population (of workers) to coincide with the major nectar flow of a given area. A large worker population is efficient and effective in collecting nectar and pollinating crops.

Beekeeping for honey involves three things:

i) A good location
ii) Young queens bred from productive stock
iii) Good management.

Why Beekeeping?

- Source of income and food—nectar and pollen are actually wasted if bees are not kept
- Sustainable form of agriculture that helps conserve the environment
- Expensive equipment is not necessary and basic beekeeping is easy to learn
- Honeybees are efficient crop pollinators. Pollination of crops leads to higher yields, for example for fruit crops and vegetables
- Beekeeping does not take up valuable land—hives can be placed on the unproductive parts of the farm
- Beekeeping can be practised by both males and females of all age groups.

Honeybee Biology

Honeybee Structure

Basic knowledge of the important features of honeybees will improve your beekeeping.

The Exoskeleton

Like all insects, bees are covered with an outer skeleton (exoskeleton).

Functions of the exoskeleton:

- Forms a hard protective casing that offers protection against injury and predators,
- Has hairs which deter predators, and help in temperature control and to gather pollen, and also serve as sensory organs,
- The thick rigid exoskeleton plates serve as a place for muscle attachment to allow for locomotion and is waterproof enabling insects to survive on dry land.

The Head

The main structures in the head are:

a. A pair of antennae, which are sensory organs (for taste, smell, detecting movements, humidity levels, carbon dioxide presence and sound);
b. 3 simple eyes called ocelli used to monitor intensity of light and control the reaction of compound eyes to it;
c. A pair of compound eyes, which are the main organs of sight;
d. Mouthparts: Mandibles support the proboscis (sort of 'tongue') when in use, to chew pollen, manipulate wax to build the comb, collect propolis and for defence.
e. Vital glands: The mandibular glands produce a 'queen substance' in queens, 10-hydroxydecenoic acid (10-HDA) in young workers and alarm pheromone in foragers, while the hypopharyngeal glands secrete brood food in young workers and enzymes in old bees (used to convert nectar into honey).

The Thorax

The thorax is the hard body part next to the head. Important structures include wings and legs.

2 pairs of wings (four in total). The forewings are larger in size compared with the hind pair of wings. To increase the efficiency of the wings during flight the two pairs of wings are hooked together by special structures called hamuli, which enable them to flap as one.

Three pairs of legs (six in total) located as a pair per thoracic segment. Legs next to the head have a 'pollen comb', used to remove bits of pollen from the

antennae. The second pair aids in pollen collection while the third pair has adaptive structures called 'pollen baskets' or (corbicula) for storage of pollen in the field. Legs also have Arnhart glands at the tips whose function is to produce the 'footprint substance' a chemical for orientation at the hive entrance and on flowers.

The Abdomen

This is the last segment on the posterior end of the insect's body and is devoid of appendages. The abdomen is covered by hairs that serve a sensory function and in addition, the terga (dorsal) and sterna (ventral) plates of the exoskeleton in the abdomen are simple in construction: The terga is wrapped around to overlap the sterna. Between the segments is a loose intersegmental membrane that allows for lengthening and contraction of the abdomen during breathing movements, and to accommodate the queen's ovaries during egg production.

Glands of importance in the abdomen include:

i) Wax glands in worker bees for secretion of wax for comb building.
ii) Nasanov glands found beneath the tergite of the last abdominal segment secrete a chemical substance used for orientation at the nest entrance, and to attract bees of the same nest (e.g. to swarm and at water or food collection sites).
iii) Sting apparatus at the posterior end (tip) of the abdomen used for defence, comprising the sting and poison gland. The poison gland cells secrete venom into the poison/venom sac, which is surrounded by muscles that pump the venom through the sting.
iv) Parts of the digestive, excretory, reproductive and circulatory systems are also found in the abdomen.

Honeybee Nest

Bees carefully choose their nest sites, and factors considered include:

- Cavity volume—too small cavities are not enough for resource storage, while bees have difficulty in maintaining the temperature in too big cavities;
- Protection from excessive exposure to rain, wind and sunlight;
- Small and few entrances to facilitate defence.

Honeybee Colony

Colony is the term used to denote a number of insects living in a common nest, which they have constructed, working together to supply each other's needs and cooperating to raise offspring. A normal honeybee colony should ideally have:

- One queen,
- Several thousands of worker bees of various ages,
- A few hundred male bees (drones) during peak population periods,
- Adequate stores of honey and pollen,
- Eggs, a brood of all ages, and
- No signs of disease.

Colony size is extremely variable, but a population of less than 200 workers is not viable, and more often than not dies off, since the individuals do not cluster well and normal division of labour cannot take place.

Members of the Honeybee Family

Queen

The queen has a long and slender abdomen, with wings covering about ¼ of the entire abdomen. In addition, it has two large ovaries and the spermatheca (a sac-like structure for sperm storage), housed in the abdomen.

The queen performs no colony maintenance work and hence lacks work-related structures like pollen baskets.

The queen's function is to:

- Mate, and lay eggs for the rest of her life,
- Produce chemical substances called pheromones that keep the colony cohesive, e.g. the queen substance inhibits queen rearing and worker ovary development,
- Control the sex of eggs she lays— 1500 eggs/day, and can live for up to 4–7 years.

Workers

These are the smallest in size and are the majority in the colony. They have shrunken reproductive systems and rudimentary spermatheca, and as such cannot mate or store semen.

The following activities form their daily duties:

- Cleaning vacated brood cells,
- Feeding honey and pollen mixture to older worker larvae,
- Secreting brood food (5 – 10-day-old bees),
- Wax-making (10 – 15-day-old bees)

- Colony defence/guarding,
- Conversion of nectar/honeydew to honey (secreting invertase and glucose oxidase enzymes),
- Hive ventilation (to maintain correct humidity and temperature levels),
- Attending to the queen,
- Comb building,
- Collecting nectar, pollen, water and propolis.

They have the instincts, bodily structures and glands to provide for all colony needs except to supply eggs. The average lifespan of the worker is 6–8 weeks but is usually related to pollen consumption and intensity of brood rearing.

Drones

Drones are the male honeybees and develop from unfertilised eggs. They are larger than worker bees, with large eyes that practically cover the whole head, have a blunt abdomen covered with a tuft of small hairs, and fly with a loud buzzing sound. This coupled with their large size makes them scary; however, they lack the sting and thus do not sting. They lack work-related structures and their sole function is to fertilise the queens. Drones are usually run out of the colony during the dearth period when resources are scarce and usually die, as they cannot fend for themselves. They die minutes after mating the queen as they lose 'vital parts' of the abdomen in the process.

The Young (Brood)

Laid eggs look like grains of rice, at the bottom of comb cells. To see the eggs, hold combs from the centre of the brood nest (at the centre of the hive) up to the light.

Table 1. Life cycle of the honeybee (days)

Bee Caste	Egg–Larva	Larva–Pupa	Pupa–Adult	Egg–Adult
Queen	3	6	7	16
Worker	3	6	12	21
Drone	3	7	14	24

Biology of the Domesticated Silkworm and Spillover Benefits of Sericulture Industry for Rural Income and Nature Conservation

Everlyn Nguku
International Centre of Insect Physiology and Ecology (*icipe*)
P. O. Box 30772-00100, Nairobi, Kenya

Scientific Classification

The silkworm is the larva or caterpillar of the domesticated silkmoth, *Bombyx*. The domestic mulberry silkworm is grouped in the phylum Arthropoda, which has a complete metamorphosis. It is a member of the family Bombycidae of about 300 moth species under the order Lepidoptera.

Taxonomic classification of mulberry silkworm is as follows:
Phylum: Arthropoda
Class: Insecta
Order: Lepidoptera
Family: Bombycidae
Genus: *Bombyx*
Species: *mori*.

Classification Based on Native Regions

Silkworms are classified into Japanese, Chinese and European races. The Japanese race has univoltine and bivoltine silkworms, and the cocoons are white and barrel shaped. The Chinese race has univoltine, bivoltine and polyvoltine silkworms, and the cocoons are elliptical (almost round). The European race has only a polyvoltine silkworm. The polyvoltine cocoons are spindle shaped.

Classification Based on Voltinism

The number of life cycles (generations, termed as voltinism) per year depends on the silkworm strain and it varies with the environmental conditions, particularly temperature.

Univoltine/Monovoltine (One Generation Per Year)

Under natural conditions, silkworm strains undergo only one generation in a year. This is an adaptation to overcome harsh winters in temperate countries (usually found in Europe). The silkworms have a long life cycle and the larvae and cocoons are large.

Bivoltine (Two Generations Per Year

The life cycle of the breed starts twice within the same year, due to the suitable climate (normally found in Japan, China and Korea). The silkworms are stronger and healthy compared to univoltine silkworms.

Polyvoltine/Multivoltine

The eggs hatch in 9 to 12 days. Silkworms have a short life cycle and go through multiple generations (5–6) in a year. These strains do not undergo egg diapause, which is an adaptation to tropical conditions in which there is no severe winter. Cocoons are of inferior quality.

Classification Based on Moulting

Among existing varieties, there are silkworms with three, four or five larval moults. It has been noted that silkworms with three larval moults have shorter life cycles and produce thin fibre, whereas silkworms with five larval moults have longer life cycle and their cocoons have a thicker fibre.

Classification Based on Cocoon Colour

Cocoons can be classified as white or coloured. The white are either superior white or inferior white while the coloured are either yellow or green.

Classification Based on Larval Markings

Silkworms that appear plain are referred to as plain silkworms, while silkworms that show a pattern are referred to as patterned or marked silkworms. Larval markings include stripes, zebra bands, and dark colour, among other types.

Life Cycle of the Domesticated Silkworm

The life cycle of *Bombyx mori* silkworm represents

the most advanced form of metamorphosis. Termed holometabolous, the silkworm completes its life cycle through serial progression of four distinct stages of development: egg, larva, pupa and adult.

Stage 1: Egg

The silkworm egg is about the size of a pinhead and resembles a poppy seed, and the eggshell provides a protective covering for embryonic development. When first laid, an egg is light yellow. The fertile ovum darkens to a blue-grey within a few days.

Stage 2: Larva

The larva is a caterpillar, and is the only feeding stage in the life cycle of the silkworm (Figures 1 and 2). It is monophagous and feeds only on mulberry (*Morus alba*). During the larval stage, the larva sheds its skin (moult) 4 times to accommodate growth. The period between successive moults is called an instar. Before ecdysis (moulting) the larvae remains dormant without feeding. This temporary starving period is referred to as period of rest. The commonly reared strains undergo 4 rest periods (tetramoulting silkworms).

Stage 3: Pupa

At the end of the 5th instar, the larva spins a silk cocoon of one continuous fibre within which it undergoes pupation (Figure 3). After a final moult inside the cocoon, the larva develops into a brown, chitin-covered structure called the pupa. The silk cocoon serves as protection for the pupa.

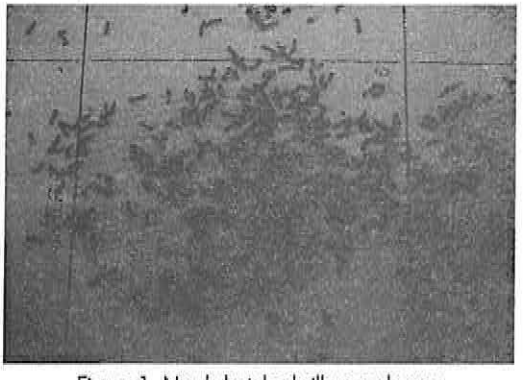


Figure 1. Newly hatched silkworm larvae

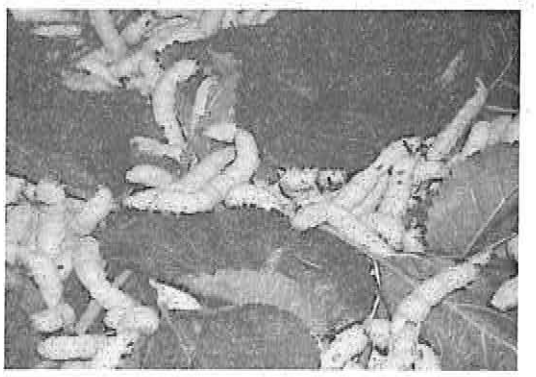


Figure 2. Fifth instar silkworm larvae

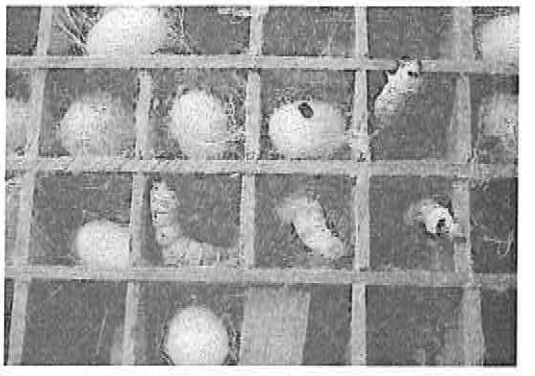


Figure 3. Silkworm larvae spinning cocoons

Stage 4: Adult

Metamorphosis of the pupa within the cocoon results in an emerging moth or adult. The forewing has a hooked tip, which is a characteristic feature of this family; however it is flightless. The wings and body are usually white, but may vary in shades of light brown. Wingspan is 1.5 to 2.5 inches (4–6 cm). The moth is covered with heavy, round, furry scales and lacks functional mouthparts, thus is unable to consume food. It is the reproductive stage; adults mate and females lay eggs.

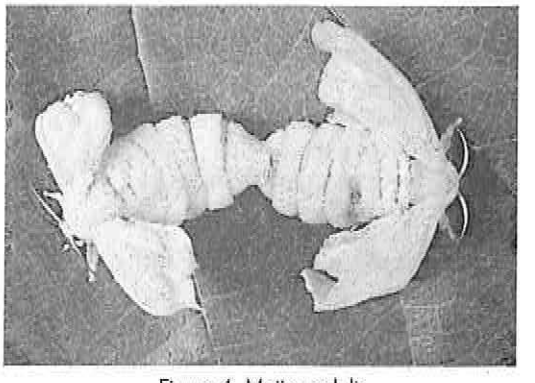


Figure 4. Mating adults

Table 1. Silkworm diseases

Disease	Symptoms/ Etiologies/ Remedies	Description/Actions
1. Pébrine	Symptoms	Pébrine is a disease caused by microsporidian parasites, mainly Nosema bombycis (Naegeli) • Diseased larvae show slow growth, undersized body and poor appetite. • Diseased larvae reveal pale and flaccid body. Tiny black/brown spots appear on larval integument. • Dead larvae remain rubbery and do not decompose shortly after death.
	Causes of pébrine	• The pathogen comes from infected eggs laid by infected mother moths. • May exist in rearing facilities or mulberry gardens as spores. • Comes from wild insects naturally infected with Nosema bombycis.
	Precautions	• Disinfect the rearing room and appliances before the rearing starts. • Purchase silkworm eggs certified as free of pébrine. • If the hatching is poor and many dead eggs remain, identify the hatched larvae. • Reject the crop when spores of *Nosema bombycis* are detected from larvae. • Destroy diseased silkworms by burning. • Disinfect completely the rearing rooms and equipment.
	Remedy	• Examine larvae before larvae cross preferably the 2nd moult. • If the crop is diseased, stop further rearing, collect all the larvae and silkworm waste and burn them. • Disinfect facilities and equipment completely. • Disinfect the silkworm waste pit by dusting 5% bleaching powder along with lime. • Get a new batch of larvae/eggs.
2. Grasserie	Symptoms	The grasserie disease is caused by a nucleopolyhedrosis virus (BmNPV). • The larvae will be sluggish with swollen inter-segmental region. • The integument of diseased larvae will be fragile and break easily. • On piercing, a milky fluid containing many polyhedral inclusion bodies oozes out from the larval body. • The diseased larvae do not settle for moult. • The larvae appear to be restless. • The dead larvae hang by hind legs head downward.
	Causes of grasserie (Young age larvae)	• If grasserie is observed in young age rearing stage, then the larvae must have been infected while hatching or during rearing. • Young age larvae may get infected if the silkworm egg surface is not disinfected. • The larvae also get infected when the silkworm rearing house is not disinfected and hygiene is not practiced effectively during young age rearing. • The disease development in early instar rearing is faster as the early instar silkworms are reared at high temperature. As the larvae are also smaller in early instars than the later instars, the virus spreads to all tissues in a short period.
	Causes of grasserie (Late age larvae)	• It depends on the instar/time the silkworm got infected by the pathogen. • If the silkworm gets infected during the 4th or early 5th instars, the symptoms of the disease will be observed prior to spinning or pre-pupal stage. • In the silkworm is infected with the high dose of virus, the ecdysone hormone required for moulting and maturation will be destroyed. The larval period will be simply continued due to lack of ecdysone till the larvae develop the disease. Thus we see the disease associated with worms that fail to moult/spin cocoons. • If the infection is low, larva pupate but die in pre-pupal or pupal stage resulting in melting.
	Precautions	• Disinfect silkworm rearing house, its surrounding and appliances before brushing. • Conduct additional disinfection with 0.3% lime solution. • Rear young age silkworm as well as late age silkworm under strict hygienic conditions. • Avoid high (28–35 °C), low rearing temperature (10–20 °C) and rearing humidity (<70%). • Dust lime uniformly when larvae settle for moult at 3 g/sq. ft for 1st and 2nd moults and 5 g/sq. ft for 3rd and 4th moults.

Disease	Symptoms/ Etiologies/ Remedies	Description/Actions
		• Dust the bed every time the larvae come out of moult and on the 4th day of the final instar as per the quantity cited above. • Feed quality mulberry.
3. Flacherie	Symptoms	Bacteria and virus infections cause the disease individually or in combination. Fluctuating temperature and humidity and poor quality mulberry predispose the disease development. • The diseased larvae will be stunted in growth, dull, lethargic, soft and appear flaccid. • The cephalothoracic region may be translucent. • The larvae vomit gut juice, develop dysentery and excrete chain type faeces. • The larvae on dying rot and emit a foul smell.
	Causes	• It is caused by bacterial pathogens such as *Streptococcus* sp. and/or *Staphylococcus* sp. in association with infectious (viral) flacherie infections. • These pathogens are released into the rearing tray/bed by diseased larvae along with faeces and vomit. • The released pathogens contaminate the rearing tray, bed and the mulberry leaves in the bed. They survive in the rearing tray/bed for a long time and cause the disease if they are not disinfected effectively. (The rate of disease development depends on the temperature and humidity in that particular tray.). • The temperature and humidity will be high in the tray/bed in which there is accumulation of faeces, waste leaves and poor air circulation. Such conditions are suitable for the bacteria to multiply in the larvae and rearing bed. • If the there are diseased larvae reared in high temperature condition, the disease development will be faster. • As the infection takes place in the particular contaminated tray and develops based on the environmental conditions in that particular tray, the disease later spreads to other trays through secondary contaminations.
	Precautions	• Disinfect the rearing tray by dipping in disinfectant for 10 minutes. • Rear silkworm on good quality mulberry. • Practice rearing and personal hygiene during rearing. • Avoid accumulation and consequent fermentation of faeces and uneaten leaves in the rearing bed. • Provide good cross ventilation in period of high humidity. • Dust dry lime.
4. Muscardine	Symptoms	White muscardine is caused by the fungal pathogen *Beauveria bassiana* and green muscardine is caused by the fungus *Spicaria prasina*. • The diseased larvae prior to death will be lethargic and on death are flaccid. • Oil specks may be seen on the surface of larvae. • They gradually become hard, dry and mummify into a white or green coloured structure. • The diseased pupae will be hard, lighter and mummified.
	Precautions	• Disinfect rearing house and appliances. • Reduce silkworm bed humidity by dusting lime powder after bed cleaning. • Collect all the diseased larvae and burn them. • Practice rearing and personal hygiene during rearing. • Practice pest control measure against mulberry pests. • Adopt all anti-muscardine measures at village level.
5. Aspergillosis	Symptoms	Aspergillosis is caused by infection with moulds (*Aspergillus*) and is common in young silkworms. • The infected larvae will become shiny and die. • Dark green (*Aspergillus flavus*) or rusty brown (*Aspergillus tamari*) mycelial clusters are seen on the cadavers.
	Precautions	• Disinfect rearing house and appliances. • Sun-dry rearing equipments. • The faeces and bed refuse should be disposed of properly.

Spillover Benefits of the Sericulture Industry

In agriculture, sericulture waste has many uses. This waste can be recycled and has high potential for use in livestock, grain and fish production.

Waste generated from silkworm rearing includes:

- Stems
- Small branches
- Undigested leaves
- Silkworm litter
- Skin shed during moulting.

Mulberry Plant By-products

The primary use of the plant is for raising silkworms, which utilise the leaves as their main food source. It also serves as fruit, and for animal feed and making crafts, among other uses.

Fruit

Mulberry can be consumed as a fruit, juice (commercially produced as a health beverage in China) or syrup. Without adding preservatives, the original juice of mulberry fruit remains fresh under cold storage for 3 months, while the bottled beverage remains fresh at room temperature for 12 months. Mulberry syrup is also used as a medicine to protect against diseases of the liver, gall bladder, and heart (Oktay et al., 2004).

The main content of fresh, ripe mulberry fruit includes:

- Water: 85–88%
- Carbohydrates: 7.8–9.2% (Sugars, mainly glucose and fructose, producing the sweet taste)
- Protein: 0.4–1.5%
- Fat: 0.4–0.5% (Mainly fatty acids, such as linoleic, stearic and oleic acids in the seeds)
- Free acids: 1.1–1.9% (Mainly malic acid, producing the sour taste)
- Fibre: 0.9–1.4%
- Minerals: 0.7–0.9%.

Mulberry fruit is classified in the modern Chinese Materia Medica as a blood tonic. Traditionally, mulberry fruit has been used as a medicinal agent to nourish the blood, benefit the kidneys, treat weakness (fatigue), anaemia and premature greying of hair. It is also utilised to treat urinary incontinence, dizziness and constipation in the elderly.

Animal Feed

Mulberry leaves are high in crude protein and low in crude fibre. This combination makes it a perfect feed supplement for livestock. It has been reported that mulberry leaves are a good source of energy and protein for ruminant animals. They can be used as supplements for lower-quality forages.

Benefits include increased body weight gain in growing lambs and goats, and milk production in goats.

Crafts

Mulberry branches are used as raw material for paper production, while the stems (after pruning) can be used for basketry and handicrafts.

Silkworm Waste

Silkworm waste includes silkworm litter, pupae and defective cocoons.

Silkworm litter can be processed for various uses:

- Raw material (preferably fresh) for biogas production when combined with cow manure.
- Dried silkworm waste is used as manure. It contains 3.06% nitrogen.

Silkworm pupae can be used for the following:

- Compost and fish feed: Silkworm pupae, are discarded when reeling, and are rich in protein and fat and make an excellent nutritious feed forfish, chickens, and cattle.
- The pupa yields oil that is dark brown in colour with fishy smell. Sterol can be separated from this oil, which is a very good hair tonic.
- The white fat obtained after hydrogenation is an excellent raw material for manufacture of soap and candles.

Defective cocoons can be used for the following:

- Defective cocoons, which are unreelable, can be used as raw material for silk hand spinning after degumming. Handspun silk yarns may b e used to produce various items including cloths, sweaters and bags, among others.
- Wastes generated from reeling, re-reeling, winding and throwing can be utilised for the production of spun silk yarns. These are high-grade wastes.

With all the uses and the products that can be made out of sericulture wastes, these wastes can actually be considered as wealth. They could generate a livelihood in the community engaging in sericulture.

Reference

Oktay, A., Erzengin M., Sinan S. and Ozensoy O. (2004) Purification of mulberry (*Morus alba* L.) polyphenol oxidase by affinity chromatography and investigation of its kinetic and electrophoretic properties. *Food Chemistry* 88, 479–484.

Monitoring Forest Connectivity using GIS and GPS

Klaus Mithöfer
International Centre of Insect Physiology and Ecology (*icipe*)
P. O. Box 30772-00100, Nairobi, Kenya

Forest Management

Forest management plan involves:

- Vegetation coverage (forest types)
- Soil, geology
- Rivers, drainage network
- Climate data (e.g. precipitation)
- Administrative districts
- Land ownership.

Data required:

- Topographic data
- Land administration data
- Digital terrain data
- Soil map
- Remotely sensed images.

What is GIS (Geographic Information system)?

GIS Philosophy

Geography is the study of the Earth and its lands, features, inhabitants and phenomena. It is an integrative science.
Techniques:

- Analysis
- Spatial analysis, geo-statistics.

Visualising Space

- Understanding space/environment
- Orientation, navigation
- Visualise and communicate environment
- Language of mapping (symbols, colours)
- Thematic maps / topographic maps
- Based on spatial science > Geography.

GIS Data Model

A vector raster is:

- Layer based concept
- Vector and raster based data
- Combining data of different content
- Data from different resources.

What Does GIS Do?

A geographic information system (GIS) integrates hardware, software, and data for capturing, managing, analysing, and displaying all forms of geographically referenced information.

GIS Data: Geo-Referenced Data

- To georeference / to geocode / to geolocate: Tagging records with geographic locations
- A georeference must be unique, e.g. pointing to one house.

How to Georeference?

- Place name: Nairobi is unique, Makutano in Kenya is not
- Mailing address? Does not work with box numbers
- Metric georeferences are more useful because they allow maps to be made and distances to be calculated.

Measuring the Earth

Longitude and latitude is the most comprehensive system.

Degree (°), minute (′), second (″)
1 Degree = 60 Minutes
1 Minute = 60 Seconds
At the Equator:
1° ~ 111 km
1′ ~ 1.8 km
1″ ~ 30 meters.

What is GPS (Global Positioning System)

The global positioning system:

- Was developed by the United States Department of Defense;
- A full constellation of 24 satellites was achieved in 1994;
- Each satellite is built to last about 10 years;
- It is just one global navigation satellite system (GNSS);

- Other navigation satellite systems are GLONASS, Galileo positioning system, Chinese Compass Navigation System, and Indian Regional Navigational Satellite System;
- There are usually at least 5 satellites visible, above a 15-degree elevation angle, often 6 or 7 satellites visible.

How Does It Work?

- Receive a signal from 4 to 7 satellites.
- Receiver calculates distance from signal speed.
- You need at least 3 satellites to triangulate your position.
- The distance is measured based on the time the signal takes from between satellite and receiver.
- Time is tricky! A fourth satellite is required to adjust time between the receiver and satellites.

GPS Accuracy?

How accurate is the measurement?

- Handheld GPS without reference signal: 5 – 20 meters.
- A higher quality signal (meter or sub-meter) requires a signal from a differential global positioning system (DGPS) ground base station.

What is Remote Sensing (RS)?

Remote sensing is the small or large-scale acquisition of information of an object or phenomenon without getting in contact with it.

How Are These Technologies Related and How Can I Use Them for My Project?

Use RS, GPS and GIS for:

- Tree planting projects
- Field work
- Geo-reference locations/images
- Ground truthing for RS
  -Land cover
  -Tracks
  -Tree density.

RS: Image Interpretation

Computer + RS software + ground truthing

- Digital image classification
- Uses the spectral information represented by the digital numbers
- Spectral pattern recognition
- Information classes and spectral classes.

GIS: Get the Data Together

- Get your data together in a database
- Analyse data (e.g. land cover change)
- Produce maps or web based GIS applications (Google Earth).

Summary

- GIS, GPS and remote sensing are complementary technologies based on geo-referenced data.
- GPS assists our fieldwork to produce geo-referenced data.
- Remote sensing helps us to analyse land cover and changes in a faster and (often) cheaper computer based approach.
- GIS is able to combine these resources due to its ability to integrate different data in one system.

Organic Certification of Silk and Honey Products — Mwingi Case Study

Esther N. Kioko[1], Jack Juma[2], Susie Wren[3]
[1]National Museums of Kenya, P. O. Box 40658-00100, Nairobi, Kenya
[2]Kenya Organic Agriculture Network (KOAN), P. O. Box 72461, 00200, Nairobi, Kenya
[3]Bio-enterprise Development Programme, P. O. Box 708 - 10400, Nanyuki, Kenya

"If the honeybees disappeared from the earth, man would only have four years left to live. No bees, no pollination, no plants, no animals, no people."—Albert Einstein

Organic Farming (or Ecological or Bio-Organic Farming)

Organic farming embodies the agroecosystem approach. Using natural resources, it reduces build up of harmful substances in the environment and is economically sustainable. It uses biological methods and natural compounds instead of synthetic chemical pesticides to control pests and diseases.

Organic Certification

Organic certification is a system of regulation for ensuring that organic producers comply with set standards. The standards give guidelines on the principles to be followed in organic production and processing. The important standardisation marks in Kenya are shown in Figure 1.

Is Organic Certification Important?

Consumers are requesting for healthy and environmentally sound products and are ready to pay higher prices for them.

Organic certification creates trust as production and processing are done according to defined organic standards and products can be sold at a premium price.

Figure 1. The important standardisation marks in Kenya

Organic farming is one of the fastest growing segments of agriculture in many parts of the world since the 1990s, increasing by 20 to 25% per year.

Organic certification is important for conservation and survival of all.

The Mwingi Case Study

Study Area: The Larger Mwingi District

- Mwingi lies in the eastern part of Kenya, 200 km east of Nairobi
- It is situated in a semi-arid region with limited modern agricultural systems
- The landscape is characterised by flat rocky hills, with hilltop forests
- It is one of the high biodiversity areas, home to endemic, endangered birds, reptiles and plant species
- The National Liaison Committee in March 2008 recognised the Mwingi hills and valleys as an Important Bird Area (IBA).

Farmer Profile

The Akamba people, who are traditionally known for beekeeping, inhabit Mwingi. Since 1995, *icipe* has worked with the beekeepers resulting in the formation of the Mwingi District Beekeepers Joint Self Help Group. In 2007, when the organic certification process started, 45 groups had registered with the district beekeepers organisation. To-date 51 groups have registered with over 2000 members. The groups run two marketplaces for purchasing, processing and selling apiculture and sericulture products (Figure 2).

Achievements of the Organic Certification Process

- Site evaluation with an organic farming expert
- Awareness creation for all stakeholders
- Workshop with district government departments

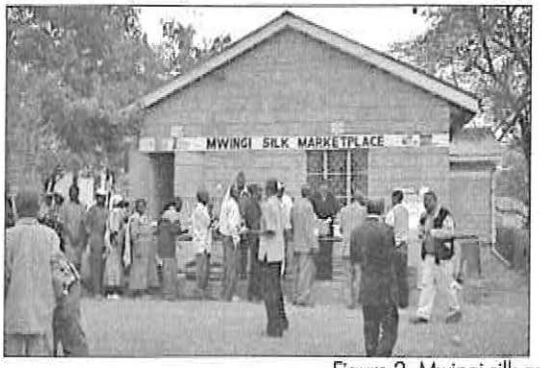


Figure 2. Mwingi silk and honey marketplaces

Figure 3. Capacity building on-site

- ICS manual produced
- Training of 45 group secretaries
- Community nomination of field officers
- Training of field officers
- Follow up on capacity building at community level (Figure 3).

Internal Control System (ICS)

The internal control system is a documented quality assurance system.

Field Officers' Undertakings on the Ground

- *Farm Entrance Form*:
  - Name of field (Figure 4 a and b)
  - Acreage
  - Vegetation
  - Number of hives
  - Date acquired
  - Estimated yield
  - Date of commencing organic management
  - Others—crops, animals, any other comment.

- *Internal Inspection Form:*
  - Name of field
  - Acreage
  - Vegetation
  - Number of hives, this year, last year
  - General assessment (crops, animals, environment), management, pest control, bee feeding, harvesting procedures, storage, source of hives
  - Records, management, harvests, delivery.
- *Beekeepers' Contract:*
  - Name of harvester
  - Grower's address
  - Group name
  - I accept to become a member of MDBJSHG organic project certified by IMO and will not use non allowed procedures during managing, harvesting, storage and handling of honey

Figure 4 (a and b). Organically certified fields

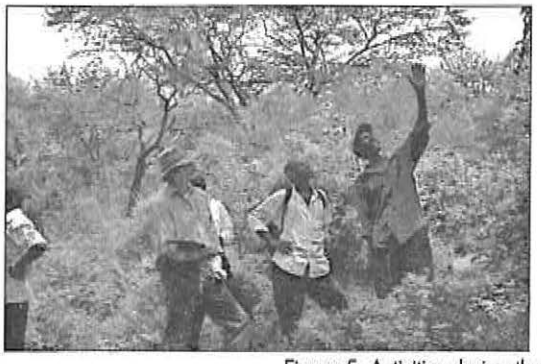


Figure 5. Activities during the external inspection of 2007

CERTIFICATE

Nr. 27925

ICIPE

MWINGI DISTRICT BEEKEEPERS JOINT SELF HELP GROUP

P. O. Box 507, Mwingi, Kenya

The Institute for Marktoekology (IMO) hereby confirms that the above mentioned operation was inspected and certified according to the control procedures as outlined in Regulation (EEC) N° 2092/91 and that the below listed activities and products were found to be in compliance with the production rules defined in said Regulation. It is the certificate holder who is responsible for permanent compliance with the applicable requirements.

Das Institut für Marktökologie (IMO) bestätigt hiermit, dass der obengenannte Betrieb gemäss dem Kontrollverfahren der Verordnung (EWG) 2092/91 kontrolliert und zertifiziert wurde und die nachgenannten Tätigkeiten und Produkte den Produktionsvorschriften dieser Verordnung entsprechen. Verantwortlich für die kontinuierliche Einhaltung der genannten Anforderungen ist der Zertifikatinhaber

Certified Activity: Organic Agricultural Production
Processing and Marketing of Organic Products

Validity: 2008/2009 (until inspection 2009)

Quality & Product: Organic
Honey

Institut für Marktökologie (IMO)

Weinfelden, 17.02.09

Figure 6. The certificate

- I will endeavour to maintain organic principles
- I will report violation to internal inspector.

External Inspection

Requirements:

- Farmers list
- Summary of trainings done
- ICS staff, qualifications and responsibilities
- Filled internal inspection forms
- Updated farm maps
- Record on product flow—Traceability from field to final product
- Inspection of apiaries
- Inspection of processing facility
- Taking of samples.

Results of the 2007 Inspection

- Report on areas to improve on
- All tests on samples taken passed
- Given conversion status—A period between farmer registration and time of selling organic product.

Results of the 2008 Inspection

- Inspection of apiaries
- Inspection of processing facility
- Comparison on areas of concern from previous external inspection
- Report on areas to improve on
- Given organic certified status (Figure 6).

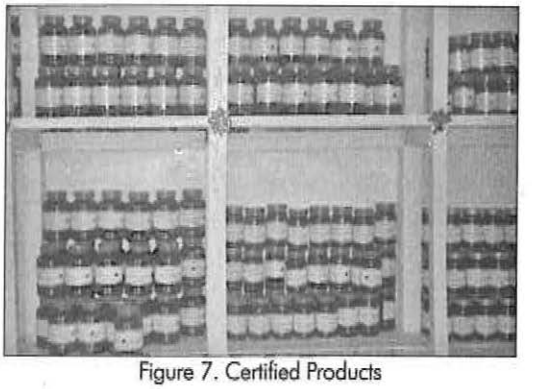


Figure 7. Certified Products

Figure 8. Exposure, business networks: The invitation to Biofach 2009

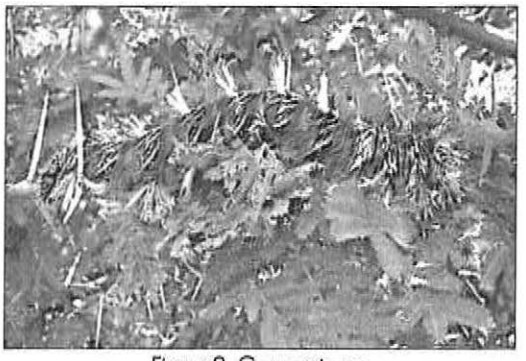


Figure 9. *Gonometa* sp.

Other Results of Inspection

Improved Human and Environmental Health

From questionnaire data, there were on average two benefits mentioned by each beneficiary as follows: knowledge on use of pesticides (74.7%), improvement of environment (67.1%), received training (59.5%), improvement of food security (54.4%), improvement in health (51.9%) and additional income (44.3%—Median Kshs 3800).

Boost to Initiate Other Organic Enterprises

- Wild sericulture
- Dryland crops
- Wild products—Tamarind, baobab, gum arabic, and others.

Other benefits included exchange programmes, networking and receiving beehives.

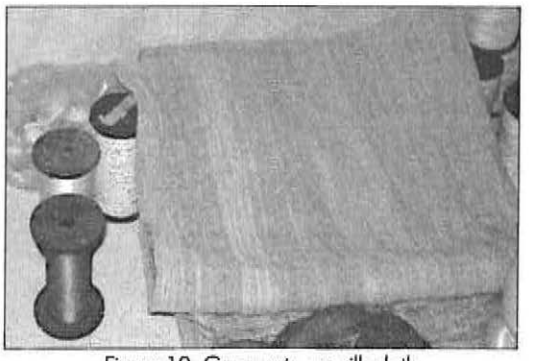


Figure 10. *Gonometa* sp. silk cloth

Planning for Organic Certification

- Ensure sufficient funding to support the project
- All stakeholders involved in the capacity building
- All should understand the process and if possible communicate in the farmers' language
- Put in place, qualified personnel
- Select a certifier, e.g. Institute of Marketecology (IMO)
- Develop suitable ICS forms and procedures meeting the certifier's specific requirements (EU, USA etc.)
- Select minimum requirements for improvement before the first inspection
- Gradually improve the ICS document.

At the end of the organic certification process, the community should benefit, own the project and sustain it.

Branding and Marketing Natural Based Products

Brian Odwori

MilbaBrands Associates Limited
P.O. Box 53651-00200, Nairobi, Kenya

Business Objective

The business objective should be to achieve commercial sustainability of nature-based enterprises (NBEs).

Partnership Approach

Applying a value chain perspective shows whether a marketing consultant has a role to play in supporting nature based enterprises' (NBEs) sustainability by:

- Reinforcing market orientation;
- Providing business analysis;
- Offering business services.

Value Chain Perspective

The value chain perspective considers all of the factors that are linked together, and forms the basis for creating value in a market.

(Input Suppliers > *Producers* > Processors/Packagers > *Marketers/Retailers* > Consumers)

Value Chain Perspective—Application

Using value chain perspective provides the means to better understand the challenges and opportunities facing the NBE.

Links can be examined both individually and collectively to see where value can be created by:

- Eliminating obstacles, e.g. lack of expertise for better modes of processing;
- Reducing constraints, e.g. inadequate and inexperienced sales force;
- Pursuing other opportunities, e.g. other product formats.

Value Chain Perspective—Benefits

- Helps to promote market driven orientation
- Shifts focus from solely production (supply)
- Helps focus on other links in the chain.

MilbaBrands Associates

MilbaBrands Associates is a marketing and communications group

The services include:

- Milba Advertising
  - Advertising and Design Services
    - Creative Services
    - Production Services.
- Milba Retail Solutions
  - Retail Marketing Services
    - Sales Management
    - Merchandising Management
    - Promotions Management and Experiential Marketing.
- SouthBell
  - Media Management Services
    - Media Planning and Buying
    - Media Development and Management.
- Milba Corporate Communications
  - Corporate Communications Services
    - PR and Publicity
    - Sponsorship Management
    - Event Marketing.
- Milba Consulting
  - Marketing Management Services
    - Research, Strategy and Planning
    - Brand Management
    - Capacity Building and Training.
- NatureBrands
  - Supply Chain Management Services
    - Distribution Services
    - Procurement/Materials Management
    - Technical Product Management.

NatureBrands

Introduction

NatureBrands is positioned to offer business, commercial and marketing consultancy to nature-based enterprises (NBEs).

Vision

To be the base of expertise in the marketing of nature based products in Africa.

Mission

To build great brand value for our clients by offering the most comprehensive marketing and communication solutions that deliver on nature-based products opportunities by clear understanding of the special challenges they face.

Services Offered

- Brand Management Services
  - Market Surveys
  - Strategy Development
  - Creative Development
  - Advertising and Design.
- Retail Marketing Services
  - Sales Management
  - Merchandising Management
  - Promotion Management.
- Supply Chain Management Services
  - Distribution Services
  - Procurement/Materials Management
  - Technical/Production Management.

The Team Experience

- Executive Director: Pinnacle Management Centre
  - Key Clients: Celtel, Barclays Bank, Uganda Telecom, UML
- Managing Director: CenturyGrey Advertising EA
  - Key Clients: GSK, BAT, EABL, Barclays Bank, Nokia, Visa
- Deputy Managing Director: Ogilvy & Mather EA
  - Key Clients: Unilever, British American Insurance, Welcome, Bata
- Marketing Manager: The Boots Company EA
  - Category: Toiletries (Lady Gay brand), Medicines (Strepsils, Good Morning Lung Tonic, Salimia, Brufen)
- Brand Manager: EAI/Unilever EA
  - Category: Toilet soaps (Lux, Lifebuoy and Rexona).

Branding and Marketing of Nature Based Products: The Five Important Questions

Question 1: Is There a Market? (Can We Create One?)

THE FIRST TASK

- To answer this, there is need to evaluate the market and consumer needs by gathering market intelligence and conducting surveys to facilitate better understanding of the market.

Case Study 1

Naturub®—The Brand (Figure 1):

- Naturub balm and ointment are products that use extracts from *Ocimum kilimandscharicum*;
- They are used for alleviation of flu, colds, chest congestion, muscular aches, pain and insect bites;
- The ointment is available in tubes of 15 and 30 g, while the balm is available in a 25 g jar, and 4 and 7 g tins packaging.

Figure 1. Naturub brand

The Market:

- Ointments and balm market in Kenya is estimated at KShs 100 m per annum (ex-factory prices);
- Urban/rural split—20:80;
- Sales in rural areas driven by small size (4 g) due to lower disposable income;
- Rural usage is mostly of balms for colds and flu, nasal congestion and aches;
- Urban usage includes ointments for muscular aches;
- Western Kenya (Nyanza, Western and North Rift) is the leading sales region driven by the 4 g size.

Competition (Figure 2):

- Over 15 brands in the market;
- Over 80% of them imported;
- The leading brands market share:
  - Robb by PZ Cussons 70%.

Figure 2. The competitive brands found in the market in Kenya

- Deep Heat imported by Harleys Pharmacy 10%
- The rest 20%.

Brand Positioning

Naturub is the proven natural based relief for colds and flu, congestion, muscular aches, pain and insect bites for all the family. Its safe natural ingredients act speedily and provide fast and lasting relief.

Case Study 2

Eco Honey—The Brand:

- Eco Honey is a honey product packaged as part of *icipe*'s programmes to help fight poverty by economically empowering local communities while conserving the environment and biodiversity;
- The product is available in only one size, a 500 g glass jar with a metal top and sells at Kshs 150 from the community market in Mwingi and KShs 160 from the shop at *icipe*;
- Initially the product was available in some outlets in Nairobi but currently it is only available at the above places.

Competition:

- In a survey conducted between 8–12 September 2008 in 80 outlets in Nairobi, 42 different brands of packaged honey were identified;
- Market intelligence indicates the following shares:
  - Winnie's Pure Health.....20%
  - Green Forest.....20%
  - Real Honey.....10%
  - Others.....50%

Brand Opportunity:

There is opportunity for Eco Honey as it is the only honey brand with the organic certification in the market.

Question 2: Is Our Product Formulated/ Packaged to Fulfill the Market and Consumer Needs?

THE SECOND TASK

- Participate in product and packaging development to match consumer needs:
  - Fulfill regulatory requirements;
  - Offer packaging meeting competitive requirements.

Product:

Covers:

- Product variety
- Quality
- Design
- Features
- Brand name
- Packaging sizes
- Services
- Warranties
- Returns.

Case Study: Naturub

Packaging Development:

- Brand name "Naturub" coined to send brand cues
- Package design developed to stand out in crowded field
- Developed different sizes to fulfill different market segment needs.

The Market:

Uchumi Ngong Hypermarket

- Naturub display is consistent
- Naturub Balm placed next to Robb brand
- Point of sale (POS)/point of purchase (POP) material placed.

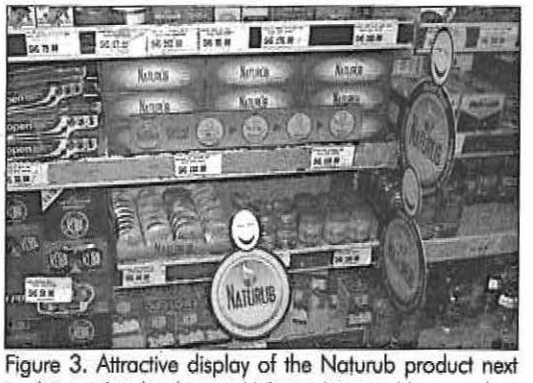


Figure 3. Attractive display of the Naturub product next to the market leaders at Uchumi Ngong Hypermarket, Nairobi

Question 3: Is Our Product Priced Appropriately?

THE THIRD TASK

- Provide market intelligence to enable proper costing and price strategy.

Price:
Entails decisions on:

- List price
- Discounts
- Allowances
- Credit terms
- Payment period.

Case Study: Eco Honey

Pricing Decisions:

- Pricing decisions are based on how consumers perceive prices and what they consider to be the current actual price and not the marketer's stated price.
- They may have a lower price threshold below which prices may signal inferior or unacceptable quality and an upper price threshold above which prices are seen as prohibitive and not worth the money.
- It is believed that for a 500 g jar of honey, the lower threshold is Kshs 150 and the upper threshold is Kshs 300.

Pricing—Factors to Consider:

1. Pricing Objectives
   - Survival—Good when there is overcapacity, short term
   - Maximise current profit—Short term
   - Maximise market share—Where low prices stimulate market growth
   - Maximum market skimming—Where there is high demand
   - Product/quality leadership—Price high enough but not out of consumer's reach. Product/quality leadership approach recommended for Eco Honey.
2. Determining Demand
   - Price sensitivity—Consider elastic v. inelastic
   - Honey is in short supply at the moment, demand is inelastic, therefore a price change may not cause a big change in demand.
3. Establishing Costs
   - Costs set the price floor that can be charged
   - Target costing—Sometimes, a target cost is set to enable the product to sell at certain retail price. This may entail re-looking at all the costing parameters, e.g. packaging, transport etc.
4. Competitor Prices Analysis
   - Analysis of competitive brands gives the price *orienting* point
   - If the brand contains features not offered by others, its worth to consumers is evaluated and a premium added to the competitor's price
   - Competitive price analysis has been done and the average price is Kshs 180. Eco Honey's competitive feature 'organic' means a premium can be charged.

Customer's Assessment of Unique Features:
From our market surveys it is clear that there is appreciation of organic products in the market with most consumers interpreting it to mean natural, healthy, no harmful effect, has medicinal properties, boosts immunity, free from artificial chemicals and additives, nutritious and safe. Thus we believe we can charge a premium for this.

Determining Price:
Three bits of information are required to determine price:

1. Costs— To set floor to the price;
2. Competitor's price—To provide orienting point;
3. Customer's assessment of unique features—To establish price ceiling.

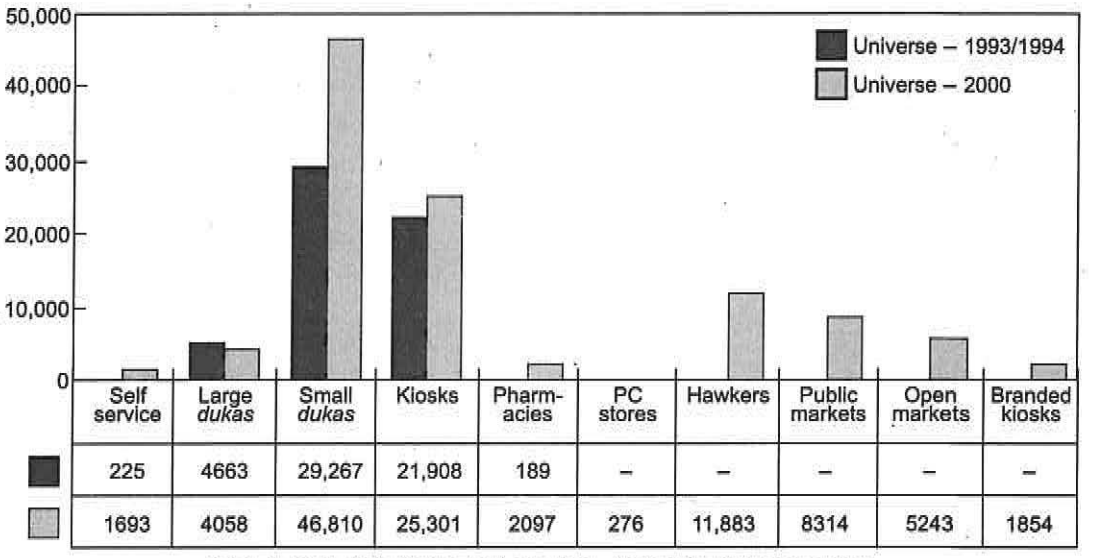
Question 4: Is Our Product Adequately Available Where the Consumers Can Conveniently Get It?

THE FOURTH TASK

- Set up and run an efficient sales and distribution structure
- This was found to be one of the biggest challenges for NBEs because they rarely start from the consumer end of the value chain.

Place:
Involves decisions on:

- Channels
- Coverage
- Assortments
- Inventory
- Transport
- Location.



	Self service	Large *dukas*	Small *dukas*	Kiosks	Pharm-acies	PC stores	Hawkers	Public markets	Open markets	Branded kiosks
	225	4663	29,267	21,908	189	–	–	–	–	–
	1693	4058	46,810	25,301	2097	276	11,883	8314	5243	1854

Figure 4. Case study: Kenya retail mapping—National outlet segmentation

Table 1. National retail mapping (estimated—2008)

Self Service	Large *dukas*/ Wholesalers	Small *dukas*	Kiosks	Branded kiosks	Pharmacies	Convenience stores	Open mkt stalls	Public mkt stalls	Hawkers
3000	5000	40,000	20,000	2000	3000	500	5000	8000	15,000

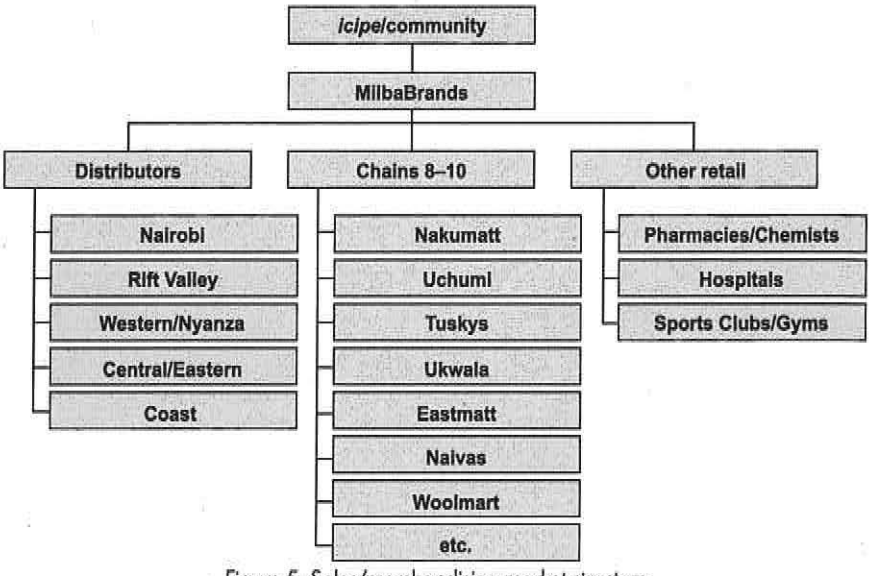


Figure 5. Sales/merchandising market structure

Question 5: Do Consumers Know About Our Product?

THE FIFTH TASK

- Develop and execute appropriate promotional and advertising programmes

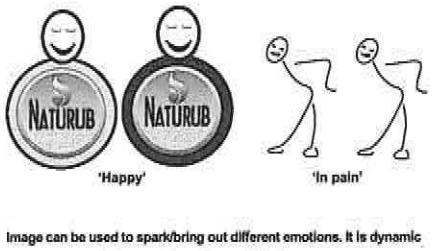
Promotion
Covers:

- Sales promotion
- Advertising
- Sales force
- Direct marketing
- Public relations

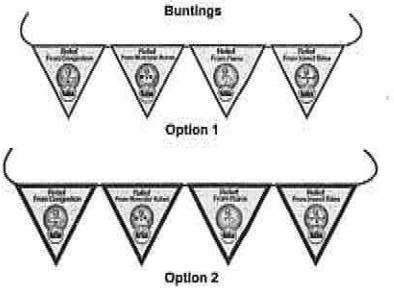
Case Study: Naturub

Advertising and Design

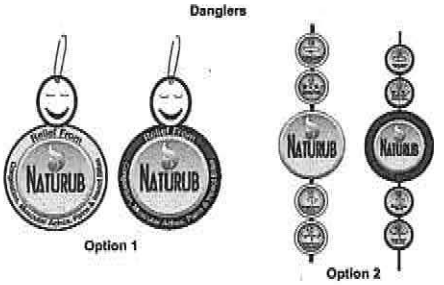
- Designed and produced point of sale (PoS) materials
- Creative development for thematic material including radio, television and print ongoing.



Naturub – Brand Mascot

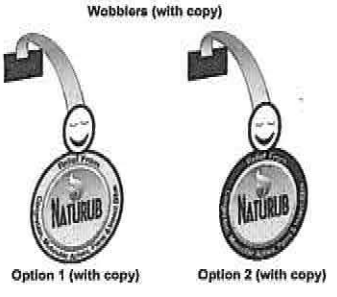


Naturub PoS – Buntings



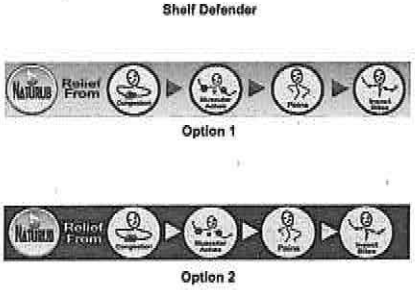
Naturub PoS – Buntings and Danglers

Naturub PoS – Roll-up Banners



Naturub PoS – Wobblers

Naturub PoS – Shelf Dividers



Naturub PoS – Shelf Defenders

Wheel Cover

Naturub Promotional Materials : Aprons and T-Shirts

Naturub – Promotion Poster

Naturub – Available Here Poster

The Market

Uchumi Supermarket, Koinange Street:

- Naturub display consistent and attractive
- Naturub products strategically placed next to competition
- PoS/PoP material in place.

Uchumi Supermarket, Adams Arcade:

- Naturub display consistent and attractive
- Naturub placed at a more prominent shelf than competition
- PoS/PoP material in place.

PR and Publicity

The objective is to build the 'naturalness' credentials of Naturub® and create interest around the brand through PR.

Table 2. Naturub Sales History

Year	Kshs
2005/6	315,000
2006/7	350,000
2007/8	180,000
2008/9	1,200,000*
2009/10	2,000,000*

*Involvement of Milba/NatureBrands begins August 2008.

Wild herb turns green gold for local farmers

Participatory Forest Management in Kenya

Esther Wang'ombe

Kenya Forestry Service, Karura Forest
P.O. Box 30513-00100 Nairobi, Kenya

Introduction

Community involvement in forestry dates back to the pre-colonial era. During this era, the communities managed the forests. There were community structures as well as beliefs that promoted conservation. For example, there were beliefs that some trees were sacred while others harboured evil spirits. This helped in conservation. Alienation of communities from forest management started during the colonial era through enactment of various legislation and policies that had inadequate provisions for community participation in forest management. These laid emphasis on protection through command and control system with minimal participation of other stakeholders. Consequently, communities have been alienated from the forest resources and participation in decision-making. Over time, this has created animosity between forest managers and communities neighbouring the resources. The result was that communities started viewing forests as state forests.

From 1910 there was formal involvement of communities through the *shamba* system, which was used in establishment of forest plantations through informal arrangements with farmers to grow crops and remove weeds around the tree seedlings. The *shamba* system has undergone many changes since its inception. In 1987/88 there was a ban and all forest villages were destroyed.

In 1994, the system was re-introduced as Non-Resident Cultivation (NRC). The community was expected to be residing outside forest areas and only go in to cultivate.

Definition of Participatory Forest Management (PFM)

PFM is broadly defined as the involvement of local people in decision in some or all aspects of forest management.

PFM can be defined as an arrangement where key stakeholders enter into mutually enforceable agreements that define their respective roles, responsibilities, benefits and authority in the management of defined forest resources within a framework that contributes to the community's livelihoods. PFM is carried out through stages that are interdependent and as such, this is a process.

Why Participatory Forest Management (PFM)?

In the past, there has been a significant reduction of the forest cover, unsustainable utilisation of the forest resource and skewed distribution of benefits (Figure 1).

To address this situation, the government has now adopted PFM (Figure 2) as a strategy to involve the wider stakeholders in the management of Kenya's forest and woodland areas so as to significantly contribute towards sustainable management of

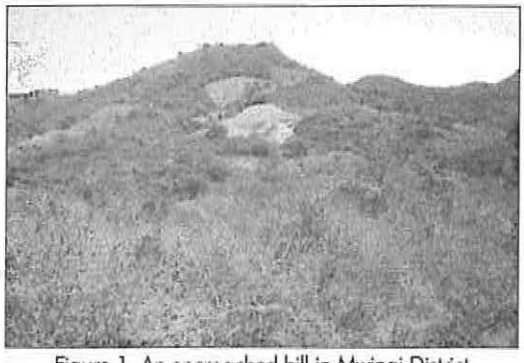


Figure 1. An encroached hill in Mwingi District

Figure 2. A PFM planning meeting in Mwingi District

forests. The Government even gave the authority to pilot PFM implementation in some parts of the country even in the absence of an enabling legislative framework. With the enactment of the Forests Act 2005, other stakeholders' participation has now been provided for. The Act provides a clear legal basis for communities across Kenya to manage and utilise forests under a wide range of conditions.

Development of PFM in Kenya between 1996 and 2008

Majority of PFM sites were started in areas characterised by low rainfall, limited means of livelihood, low income and high dependence on forest and forest products. The distribution of these PFM sites in the country is unevenly spread spatially, even in dry ecological areas. This spatial distribution is due to several factors, among them location of donor projects and civil society programmes.

From 1996 to 1997 civil society became particularly active because of excisions of gazetted forests. This threat helped to bring communities and conservation organisations together to fight for forest conservation. It was the same period that communities around Arabuko-Sokoke forest came together to resist proposed excisions. This culminated in formation of a community group, Arabuko-Sokoke Forest Adjacent Dwellers Association (ASFADA). In 1997, authority was granted to the Arabuko-Sokoke Forest Management Team to pilot PFM.

The launch of the millennium development goals (MDGs) created a paradigm shift in forestry management, necessitating policy and legislative reforms. MDGs aim at enhancing livelihood security. Eradication of extreme poverty and hunger is one of the MDG goals. The majority of Kenyans are rural based, so they depend on the environment and natural resources for their livelihood.

Figure 3. Planning for PFM activities in Kakamega Forest

Figure 4. CFA-owned beehives in Kakamega Forest

Progress in Initiating PFM Process in the Country

The first PFM pilot initiative in Kenya was started at Arabuko-Sokoke forest in 1997. Permission was granted by the then Ministry of Environment and Natural Resources.

Other initiatives followed all over the country and included Upper Imenti forest in Meru, and others in Loitokitok, Kakamega (Figures 3 and 4), and parts of Mt Kenya and Aberdares forests.

Objectives of PFM

The main objectives of PFM are:

(i) **Conservation and sustainable forest management:** This was the motivation for all the early PFM cases. It is still the motivation of Kenya Forest Service, which has recognised its own limited capacity to manage large areas of forest effectively. It is hoped that involvement of local people will assist in carrying out this task, and conserve biodiversity while at the same time enhance people's livelihoods, and ensure the sustainable use of forests so that present and future generations benefit.

(ii) **Improving livelihoods:** Governments as well as donors have become more concerned with achieving poverty reduction. Poverty is often

Figure 5. A typical family in the study zone

concentrated in forest areas and PFM is seen as a route for achieving poverty reduction.

Tenure Arrangements under PFM in Kenya

- Limited set of user rights and other conditions are given to the communities through the Forest Act, 2005
- The community members must be part of a registered CFA, registered under Societies Act (Cap 108) of the laws of Kenya
- The CFA must apply to the Director, Kenya Forest Service to be allowed to participate in forestry activities within the forest
- The CFA then enters into a management agreement with the Director, KFS, and this agreement must indicate terms and conditions of involvement, and how and when an agreement can be terminated.

Drivers of PFM

There are many drivers of PFM in the country with varying expectations and varying objectives.

- Government institutions (KFS, KEFRI)
- Communities
- Private sector.

As a partnership arrangement, there is need to synchronise the various interests with the aim of meeting a common goal.

PFM and Livelihoods

Early interest in PFM centered on its ability to improve forest conservation, but the current poverty reduction focus of the global development agenda has raised interest in the livelihood impact of PFM.

Contribution to Improving Livelihoods

Financial—Income Generation from PFM

Income generation from PFM includes subsistence activities such as fuelwood collection and commercial activities such as apiculture and sericulture. In addition to forest-based activities, other non-forest income-generating activities include woodlots on private farms. All these impact on people's financial wellbeing.

icipe, in collaboration with other institutions, has contributed a lot towards improvement of livelihoods of local communities under PFM. During the period 2005 to 2007, this organisation started apiculture and sericulture activities with Community Forest Associations in Arabuko-Sokoke and Kakamega forests, and CFAs based in Mwingi and Mumoni hill forests in Mwingi District. A marketplace was built in each of these areas to ensure market for the products. Today, these communities are earning an income from these initiatives although the project has ended.

Improvement of Forest Condition

This can have a direct impact on livelihoods by ensuring the provision of a more sustainable flow of benefits (fuelwood, timber, water) or ecotourism, which can create employment for local people.

Again *icipe* has prepared a project proposal, which, if implemented, will go a long way towards improvement of forest conditions on farms in two forest corridors in Kenya. The first corridor will be connecting Nandi North and Kakamega forests. The project targets to plant, together with the farmers, two million seedlings of assorted tree species. The second corridor will be connecting Mutaitho and Nuu hills, and Nuu and Imba hills in Mwingi District. Here, another two million seedlings will be planted with the farmers. Apart from improving forest conditions on the farms, the trees will act as corridors for migration of bees, provide flowers/nectar for the bees, and farmers will be able to place more beehives on these corridors and of course some tree species will be suitable for wild silk farming.

The PFM Process

Social and Political Aspects

Being involved in PFM often has a positive impact on the capacity of communities to speak out for their rights, speak out against forest excisions and engage with other development actors to improve their livelihoods.

Figure 6. CFA-owned tree nursery in Malindi District

Negative Effects of PFM

- Exclusion of groups of people from the process, e.g. pastoralists and landless people who rely on the forests for livelihoods
- The poorest people in a community may not have time to attend all the meetings under PFM or contribute to, e.g. forest patrols, as they rely on wage labour to earn their living (Figure 7).
- In some areas, local people may have been involved in forest management over the years, e.g. the Ogiek community in Kenya. Introduction of a formal PFM agreement may undermine or even destroy such traditional systems by introducing new institutions and changing management practices.

Positive Effects of PFM

If well implemented, PFM can lead to:

- Fewer conflicts and improved relations among major stakeholders;
- Increased social acceptability;
- Empowerment of marginalised groups through recognition of rights and responsibilities;
- Stronger alliances against external conservation threats;
- Mechanisms of working together that can be used to address other issues;
- A win-win situation vis-à-vis poverty alleviation and natural resource conservation.

Figure 7. Youth involved in forest patrols in Arabuko-Sokoke forest

Figure 8. Commercial plantation in Kakamega forest

Challenges

The Forests Act 2005, as well as the interest among stakeholders to engage in PFM, are good opportunities for PFM. However, there are several issues that need to be addressed in PFM. These include:

- Gender. Most of the emerging Community Forest Association (CFA) committees are male dominated;
- Feasibility of PFM. PFM may not be feasible in all forests, hence the need to conduct appraisals on its feasibility prior to implementation;
- Devolution of power. The government, for the time being, may not be willing to devolve substantial powers to local communities. The decision-making and benefit-sharing process from government to rural communities has so far not been adequate. But the emerging local institutions currently may not be capable of managing forests in case of devolved responsibilities. There is need for capacity building;
- Governance. Governance of local institutions is a major challenge in most CFAs;
- Conflicts. This includes eviction of people from forests. Examples include Mau forest in the Rift Valley Province of Kenya where people have refused to move out despite the forest being the largest water tower in the country and Maduguni forest in Coast Province where people residing in the forest have refused to move out;
- Benefits. There are high expectations among communities over PFM that may in the long run be counterproductive to PFM. The user rights provided for in the Act may not be adequate to motivate local communities to be engaged in PFM;
- Sustainability. How do we ensure that PFM initiatives are sustainable in the long-term? Some of them are there as long as the donor is in place. In some, more funds are being put in compared to the returns.

Conclusions

- There is need for sharing of PFM experiences to perfect the process over time. We should replicate success stories and learn from failed initiatives
- There is need to develop a PFM benefit sharing mechanism (costs and benefits)
- There is need for PFM monitoring. How do we monitor PFM initiatives and its contribution? (Success stories may actually be failures.)
- Local level governance structures need to be strengthened. How can this be addressed?
- For PFM to succeed, capacity building is essential at all levels.

Importance of Taxonomy in Insect Production Systems

Fabian Haas
International Centre of Insect Physiology and Ecology (icipe)
P. O. Box 30772-00100, Nairobi, Kenya

Biosystematics Support Unit

Infrastructure

- Policy work in the Convention on Biological Diversity
- Insect collection with ca. 75,000 specimens
- Morphology laboratory, digital photography and image processing, GPS capabilities.

Contributions in Current Projects

Uchambuzi wa Viumbe kwa Maendeleo (UVIMA)—Taxonomy for Development in East Africa, 'Mobilising vital taxonomic information to support human well-being and ecosystem health in Eastern Africa' project ABS processes and reporting in IOBC, CBD and FAO.

Teaching Activities

Entomology Course for ARPPIS students and staff (10 days, annual)
Digital Photography Course (open to all).

Basic Taxonomy

According to Schuh R.T. (2000) *Biological Systematics: Principles and Applications*. Cornell University Press, Ithaca, 236 pp. (Glossary):

Taxonomy is the practice of recognising and classifying organisms; frequently used in a sense equivalent to systematics.

Systematics is the practice of recognising taxa, determining hierarchic relationships among those taxa, and formally specifying those relationships; frequently used in a sense roughly equivalent to taxonomy.

According to CBD-GTI PoW, broadly understood, taxonomy is the classification of life, though it is most often focused on describing species, their genetic variability, and their relationships to one another. For the purposes of the Convention, taxonomy is taken in its broadest sense and is inclusive of systematics and biosystematics at the genetic, species and ecosystem levels.

Names Hierarchy and Rank Description

Having the right name is essential.

Taxonomy: Origin of Names

Nadzikambia for chameleon genus (derived from the species name in Chichewa, a language in Malawi).

Pundamilia nyererei or *Pundamilia pundamilia* for cichlid fish species derived from the Kiswahili word for zebra.

Maize (*Zea mays*) based on the American Indian word for maize (from Spanish maíz, after Taino mahiz.)

It is a scientific not a Latin name, but grammar and alphabet applied is Latin.

http://www.iczn.org

http://en.wikipedia.org/wiki/ICZN

Collection

Why have a collection?

- Voucher specimens/research documentation
- Specimen and taxa for comparison
- Material exchange
- Assembling specimens for a revision of a taxon
- Documentation of biodiversity
- Re-analyses with new techniques
  - o (DNA and biodiversity informatics)
- Feeding into larger systems such as GBIF (Global Biodiversity Information Facility).

The Bees

Each species is different and needs different flowers; each species builds different nests, has different diseases and occurs at different places.

Honeybees belong to the order Hymenoptera and Apidae family:

- Western (European) honeybee, *Apis mellifera* Linnaeus
- Eastern (Asiatic) honeybee, *Apis cerana*
- Giant honeybee, *Apis dorsata*
- Dwarf honeybee, *Apis florea*

- Cape honeybee, *Apis mellifera capensis*
- African honeybee, *Apis m. scutellata*

Stingless bees (stingless honeybees) belong to the order Hymenoptera, family Apidae and tribe Meliponini.

Further reading on stingless bees:

Byarugaba D. (2004) Stingless bees (Hymenoptera: Apidae) of Bwindi impenetrable forest, Uganda and Abayanda indigenous knowledge. *International Journal of Tropical Insect Science* 24, 117–121.

Heard T. A. (1999) The role of stingless bees in crop pollination. *Annual Review of Entomology* 44, 183–206.

The Bee Pests

Varroa Mite

Varroa destructor Anderson & Trueman (Parasitiformes: Varroidae) adults and larvae feed in hives and may kill the colonies; by sucking haemolymph they transmit viruses.

Greater Wax Moth

The greater wax moth, *Galleria mellonella* (Linnaeus) (Lepidoptera: Pyralidae: Galleriinae) larvae feed in hives.

Small Hive Beetle

Aethina tumida (Murray) (Coleoptera: Nitidulidae: Nitidulinae) adults and larvae live in hives and feed on comb and honey. In addition, they might spoil the produce.

Large Hive Beetle

Oplostomus fuligineus (Olivier) (Coleoptera: Scarabaeidae) adults feed in hives, and larvae in cow dung.

More Information

- GEF/UNEP/FAO Global Pollination Project on "Conservation and Management of Pollinators for Sustainable Agriculture, through an Ecosystem Approach".
- UVIMA Project focusing on invasive alien species (IAS), pests and pollinators
- Bee-BOL
- Bees for Development.

Sources

The African Insect Taxonomy Toolkit: http://taxonomy.icipe.org

Pest and Disease Image Library PaDIL: http://www.padil.gov.au

UVIMA: http://eafrinet.museums.or.ke/uvima.html

Apiforestry for Improved Livelihoods

Abednego Kiwia, Jephine Mogoi and Rose Onyango

World Agroforestry Centre (ICRAF), United Nations Avenue, Gigiri
P.O. Box 30677-00100, Nairobi, Kenya

Introduction

Apiculture is bee domestication as an agricultural undertaking. Apiforestry is agroforestry practice (deliberate tree/shrub growing) plus apiculture. In apiculture, the apiary is fenced by dead material but in apiforestry, living fences are used.

Agroforestry Technologies and Tree Species for Apiforestry

The tree-planting niche can be within or near the apiary area.

Apiforestry tree species include:

1. *Sesbania sesban;*
2. *Leucaena trichandria;*
3. *Faidherbia albida.*

Why Promote Apiforestry?

- Quality honey: Species diversity under apiforestry is higher than apiculture with higher honey quality of organic nature.
- Reduced insect–human and insect–livestock conflict: A living fence provides a barrier. Bees fly like airplanes when carrying nectar.
- Reduced aggression of bees: Apiforestry environment allows many bees from different colonies, hence aggression to humans while managing them is minimal.
- Sustainability: Apiforestry bees are friendly. This averts disasters that could kill the industry.
- Desirable effects: Apiforestry has a cooling effect, especially in drylands. Drylands are ideal for beekeeping because of less pollution from agricultural activities.

Apiforestry and Livelihoods

How Apiforestry Improves Livelihoods

Honey and its products: Apiculture provides income from sale of honey, wax, propolis and royal jelly.

Health: Propolis and royal jelly are highly nutritious and medicinal. Use of honey enhances body immunity against ailments such as colds and coughs caused by bad weather, climate change, etc.

Weather: Apiforestry helps to lower temperature, which limits pathogenesis (reduces the impacts of global warming).

Food and nutritional security: In apiforestry hives are put at 2 x 5 m to allow high value trees in the rows between hives, e.g. pawpaws and grafted mangoes.

Enhanced pollination of crops: Bumblebees and stingless bees are important for pollination in greenhouses.

Benefits of Apiforestry

The following are the benefits resulting from trees in apiforestry systems:

- Water/hydrological cycle:
  - Act as water catchment areas,
  - Break the force of falling rain hence reduce erosion,
  - Regulate adverse climate events, e.g. drought/flooding.
- Energy:
  - Water stored in the catchment areas flows to dams and is used to produce electricity,
  - Woodlots produce fuelwood.
- Soil conservation and fertility amelioration:
  - They reduce soil erosion (caused by wind and rain),
  - Leaves and the micro-organisms under trees enrich the soils around them.
- Air quality and environmental services:
  - Apiforestry trees help to moderate the climate,
  - Apiforestry trees absorb CO_2, and regulate the gases in the atmosphere.
- Timber:
  - Apiforestry trees provide timber for

construction, furniture, fences, telephone and electricity poles, paper, tools and works of art.

- Non-wood products:
  - Apiforestry trees provide medicines, fibres for making ropes, gums and resins, and seeds for ornaments, etc.
- Biodiversity conservation:
  - Trees shelter different kinds of animals, plants and micro-organisms.
  - People need biodiversity—the genes they contain and the ecosystems in which they live—to survive.
- Drought refuge:
  - Tree foliage may be used for emergency fodder in times of drought.
  - By storing and releasing water, apiforestry ecosystems reduce the effects of drought.
- Agrotourism:
  - Apiforestry sites attract people to see and learn many things.

Shortcomings of Apiforestry

Limitations of apiforestry include:

- Poor knowledge of management systems;
- High focus on pesticide/insecticide use in commercial/horticultural farming;
- Value chain approach to apiforestry management is lacking, there is more focus on honey production;
- Poor marketing strategies, there is a need for value addition and packaging.

Conclusion

Apiforestry improves livelihoods by providing tangible products that can be eaten or sold to earn income thereby reducing poverty. Apiforestry also provides a wide range of services that cushion human beings against adverse weather conditions.

Sustainable Wild Harvest of Commercialised Plants

Susie Wren
Desert Edge, P.O. Box 708-10400, Nanyuki, Kenya

Growing Threats to Commercialised Indigenous Plants

The following are the growing threats to commercialised indigenous plants:

- Population and livestock (numbers v units) increase puts higher demands on all natural resources, especially in the more fragile environments, and the situation is worsening.
- There is loss of indigenous knowledge of the importance and utilisation of indigenous natural resources.
- A dramatic loss of natural resources is seen in areas where there is increasing human settlement.

Source of Saplings

An estimated 50,000 – 70,000 plant species are used in traditional and modern medicine throughout the world, as a wide variety of products. The great majority of these species are obtained through collection from the wild habitat (Fig. 1). Plants harvested from natural populations continue to be the most important source of medicine to cover the primary health care needs of more than two-thirds of the world's population.

Despite alternative sourcing strategies such as cultivation, the global industry is still dependent on wild collected plants as raw materials for food, medicine and cosmetics. Over 90% of commercially used plant species are sourced from wild collection, this is over 70% of material trade. Only several hundred plant species are commercially cultivated today (Schippmann et al., 2002).

Figure 1. Children displaying native tree saplings grown from locally sourced seeds

Existing Challenges to Developing Ethical Enterprise in Indigenous Plant Products for Rural Communities

- Lack of capital or credit within the rural communities;
- Facilities are basic or non-existent;
- Insecurity;
- No direct market linkages (apart from local sales);
- Low incomes from sale of rangeland products;
- Donor and relief dependency in some areas;
- Repetitive severe drought;
- Little experience of non-traditional enterprises.
- Lower grades of gums and resins for essential oils.

Commercialisation Opportunities for Rural Communities for Indigenous Plant Extracts/Products

- There is a commercial reward for the harnessing and utilisation of the traditional knowledge;
- Improvement in social conditions;
- Realistic, sustainable and viable options to

natural resource utilisation;

- Big market demand for natural products/ ingredients nationally, regionally and globally;
- Certification systems have been developed and refined for commercial natural resource utilisation;
- Natural plant enterprise is capable of bringing environmental and social benefits (income generation into these often-remote rural areas, and to the disadvantaged, i.e. HIV affected and single parent headed households.

Potential

- Openness to participate in income generating activities;
- Widespread interest in and willingness to drive forward new livelihood enterprise;
- Strong community bond and linkages;
- Existing organisational and governance capacity (traditional);
- Rich biodiversity providing income opportunities (i.e. *Acacia* genus or Proteaceae plant family prevalent in high country which produce top quality honey);
- Strong culture and traditions (i.e. utilise existing trading system and traditional knowledge, such as ethnobotanical);
- Existing areas set aside for cultivation with potential for domestication and cultivation of high value natural plants.

Natural Resource Enterprise Opportunities

Wild Harvest of Non-timber Forest Products (NTFP)

Need for rapid evaluation of the indigenous plant materials to assess the commercial value, economies of scale and prospects for certified organic sustainable wild harvest, i.e. develop sustainable wild harvest protocols. For example bee products, wild silk and mushrooms (such as those in the genera *Chantharellus* and *Amanita*), ethnobotanicals, gums and resins, cold-pressed tree seed oils, essential oils from aromatic indigenous plant materials (wild plants and shrubs, e.g. *Ocimum, Lippia, Tagetes,* lelechwa [*Tarchonanthus camphoratus* L.], gums and resins) (Figures 2–3).

Figure 2. Natural gums and resins harvested from wild trees

Figure 3. A woman in an *Ocimum kilimandscharicum* field

Wild Harvest of Indigenous Essential Oils Plant Species

In Kenya, indigenous *Ocimum, Lippia* and *Tagetes* species are wild harvest options for essential oil production. Distillation of these species is useful in keeping the equipment in commercial operation between the main harvest periods of other commercial essential oil crops.

The potential indigenous essential oils plant species include:

- *Ocimum americanum, O. kilmandscharicum, O. gratissimum*
- *Lantana camara*
- *Tagetes minuta*

- *Becium obovatum*
- *Lippia kituiensis, L. javanica*
- *Cyperus esculentus*
- *Boswellia* spp.
- *Acacia kirkii*
- *Ziziphus mauritiana*
- *Tarchonanthus camphorates.*

Domestication and Cultivation of Natural Products

The small-scale cultivation of high value natural products opportunity is within the various climatic zones, for a wide range of products to be commercially produced for national, regional and international markets.

Low risk and good returns options include indigenous *Aloe* spp., *Hoodia* spp., African potato (*Hypoxis hemerocallidea*), wild yam, *Prunus africana*, *Warburgia salutaris*, and so on.

Locating Species Richness/ Population Density for Ensuring Sustainable Wild Harvest and Achieving Economies of Scale

Bodycare Industry

Yangu oil is cold-pressed from the seeds of the Cape chestnut tree and is used in African skin care. It is popularly used in natural cosmetics and has properties such as UV protection.

Utilising Invasive Species

Opuntia (cactus) is used in making jam, syrup, beverages, and as biofuel crop, among other uses.

Market Pressure

The increasing international demand for indigenous plant products in the sectors of food, cosmetics, wellness and medicinal ingredients poses major ecological and social challenges. The high pressure on potentially vulnerable plants can endanger local ecosystems and the livelihoods of collectors who often belong to the poorest social groups in the countries of origin.

Driving Environmental Sustainability

Environmental sustainability is a critical feature of all indigenous plant product development. It is a concern to consumers in the North as well as environmentalists the world over.

The 'Feel Good Factor' That Comes with Organic Certified Products

Market interest in organic certification and fair trade certification is rewarded by price premiums. Certification options for community/smallholders can achieve premium markets and higher price returns. This is through products that meet the sustainability standards—for organic production, e.g. EU/NOP, fair trade, e.g. the current international FairWild standard, developed through a combination of an original FairWild Standard dealing with social aspects and the International Standard for Sustainable Wild Collection (ISSC-MAP) dealing with ecological aspects, and FSC and Rain-forest Alliance standards.

Focus on Sustainable Wild Harvest Standards

The future of commercially utilised indigenous plant species shall be secured through the introduction and adoption of community-driven management systems, sustainable harvest practices, driven by tangible incentives received by collectors as a result of certification/labelling and entry into international ethical markets for these materials.

International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants (ISSC-MAP)

The International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants (ISSC-MAP) was developed by the Medicinal Plant Specialist Group (MPSG) of the Species Survival Commission (SSC) and IUCN – The International Conservation Union, on behalf of a Steering Group consisting of the MPSG, Bundesamt für Naturschutz (BfN), WWF Germany, and TRAFFIC. An international Advisory Group of more than 150 experts from diverse backgrounds provided guidance in drafting the ISSC-MAP.

The ISSC-MAP is designed to enable and involve those participating in the harvest, management, trade, manufacture, and sale of wild-collected medicinal and aromatic plant (MAP) resources to understand and comply with the conditions under which sustainable

collection of these resources can take place.

International FairWild Standard

The ISSC-MAP has evolved into an international standard and regulatory body, FairWild. FairWild Foundation provides a certification system and standard for socially and ecologically positive collection and production of indigenous plants. FairWild Foundation Standards are based on existing knowledge and appropriate resource management, focusing on:

- Promoting sustainable resource management and conservation of wild plants;
- Establishing a system for certification of sustainable wild collection and fair trade practices;
- Providing advice on the application of standards for sustainable and fair trade in conservation and trade policy and regulations;
- Encouraging sustainable and fair business practice and influencing consumer choice.

The Institute for Marketecology (IMO), a Swiss company, manages the certification services.

Developing Sustainable Wild Harvest Certification under these Standards

- Situation analysis targets collection areas (outer and inner borders, exempted areas, existing management plans, overlap with protected areas, activities of other collection companies, etc.).
- Situation analysis targets plants (protection status, taxonomic determination, collection methods, quality requirements, etc.).
- Situation analysis targets local communities (traditional access and user rights, degree of involvement and interest, analysis of cost of living).
- Assessment.
- Interaction with stakeholders and beneficiaries.

Methodology Part 1:

- Definition of collection area (rough mapping)
- Risk assessment of area, company and of social structure
- Identification and assessment of target plants (1–3 per company)
- Map and zone collection areas
- Agree with stakeholders
- Action Plan (Implementation: Responsibility, activities, results and deliverables)
- Risk assessment and intervention concept to vulnerability and strengthen resilience of the communities of resource users.

Methodology Part 2:

- Designing individual guidance manuals for each company
- Applied resource assessment for each collected species
- Area analyses by GIS and mapping and zoning completed
- Production cost.

Outcome: A system to feasibly implement a management for sustainable and economically viable wild collection.

Methodology Part 3:

- Certification—Implementation on each level of value adding chain (collector, purchase centre, processor, exporter)
- Collection of data with the help of GPS system in all the projects selected and analysis of results
- Monitoring of implementation of standards, processes and traceability
- Additional training where needed and consulting to overcome problems by reviewing the conversion process in the collection areas.

Standard Procedures 1:

Mapping and zoning: The map should identify the:

- Main ecosystems and predominant botanical species. The species that is to be the subject of wild harvesting is then marked clearly in the regions where it is most abundant.
- The areas where wild harvesting would damage the health of the species/habitat/natural diversity should be marked in red as non-intervention zones (blocked from collection).
- Define harvesting capacity and exact harvesting thresholds of the selected species within the identified zones. From this position the rotation of harvesting across and within the zones over the entire mapped areas can be developed. This is the foundation for the sustainable wild harvesting protocols.

Standard Procedures 2:

Table 1. Harvesting methodology

Species	Frequency of harvesting	Harvesting technique	Comment
Helichrysum citrispinum	Harvesting interval of 4 years (of the same plants)	Cut no lower than 8–10 cm from the ground	Ensure that the harvesting areas are well-defined to ensure no harvesting within the park boundaries
Helichrysum splendidum	Harvesting interval of 4 years (of the same plants)	Cut no lower than 8–10 cm from the ground	As above
Thymus schimperi	Harvesting interval of 2 years (of the same plants)	Cut no lower than 5 cm from the ground or 35% of the plant foliage	Common abundance across plateau

Standard Procedures 3:

Table 2. Monitoring and evaluation information for measuring impact

Quadrat Yield	Data Collection Sheet
Date	
Location	
Target species (e.g. *Helichrysum*)	
Quadrat No.	
Treatment: Harvested/ non harvested	
No. of plants per quadrat	
No. of target species plants per quadrat	
Clipping yield (g DM)	
No. of clippings this year	
Annual yield (above ground plant) g DM	

Standard Procedures 4:

Once demonstrated that wild harvest can be done sustainably, collectors should use recording sheets whenever wild plants are harvested.

Table 3. Recording sheet for sustainable wild harvest

Botanical name: Common name:
Location: GPS:
Coordinates:
Altitude: Date: Time:
Weather: Parts harvested:
Daily yield (kg): DM yield (kg):
Distance from fields, settlements: Handling methods:
Cleaning method:
Name of collector:

Harvesting Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
1			X	X	X						
2						X	X	X	X		
3										X	X
Activity											
M&E		X	X	X	X	X					
Training sessions (Harvester group leaders, field officers, managers)			X	X	X						
2						X	X	X	X		
3										X	X
4		X	X	X	X	X					
5			X	X			X	X			X
Internal Inspection			X								
External Inspection					X	X					
A1 Harvesting and distillation	X	X	X								
A2 Harvesting and distillation		X	X	X	X						
A3 Harvesting and distillation					X						
Extension programme	X	X	X	X	X	X	X	X	X	X	X
Preparations: for External certification			X	X	X						
External inspection						X					

Sample Documentation

Internal regulation includes:

- Organic production standards equivalent to those in country of product destination;
- Rules of participation for new members, including procedure for conversion to organic;
- Procedure for excluding individual operators in case of violation of standards.

All producers must be informed of the Internal Regulations.

Structure of Producer Organisation

- Organisation chart
- Constitution
- Other activities of the organisation
- Producer lists (includes producer's code, full name of harvester, location, entrance date, total surface area of organic harvesting, amount delivered in past year, harvest estimation for next year, name of internal inspector, date of internal inspection, result of internal inspection).
- Names, qualifications and responsibilities of ICS staff
- List of members being sanctioned
- Completely filled in internal inspection report forms
- Updated maps
- Product flow: Traceability from land to final product.

The following documents must be available for each member:

- Formal commitment of harvester members to fulfill internal standard (written contract)
- Member Entrance Form—harvesting data sheet
- Harvesting records—harvested quantities, postharvest procedures
- Map
- Annual inspection checklist.

Non-physical Value Addition

Organic standards offer:

- A template for quality
- Independently verified traceability system
- Independently verified production and management system
- Attracts premium prices in export markets
- Attracts higher demand in a competitive market.

ICS Required for Producer Group Certification

Small-scale Producer Group Certification:

- ICS (Internal Control System)
- Organic and other certification
- Supply chain structure.

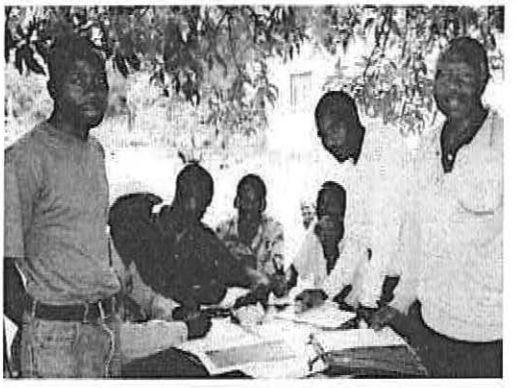


Figure 4. Producer group

Group of Nucleus Farms

- Several nucleus farm groups with a common ICS operator.

In the HIVOS Project Internal Control Systems for Various Quality Standards:

- Each nucleus group acts as ONE FARM UNIT with regard to standard compliance.
- Farmers are not free to decide individually on standard relevant activities, they agree on 'one' management.
- One person is responsible for the nucleus group.

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Schippmann U., Cunningham A. B. and Leaman D. J. (2002) Case Study 7: Impact of Cultivation and Gathering of Medicinal Plants on Biodiversity: Global Trends and Issues, pp. 140–167. In *Biodiversity and the Ecosystem Approach in Agriculture, Forestry and Fisheries.* Satellite event on the occasion of the Ninth Regular Session of the Commission on Genetic Resources for Food and Agriculture. Rome, 12–13 October 2002. Inter-Departmental Working Group on Biological Diversity for Food and Agriculture. FAO, Rome. http://www.fao.org/docrep/005/y4586e/y4586e00.htm

Climate Change Adaptation and Mitigation Measures Through Increasing Forest Connectivity and Improving Biodiversity

Suresh K. Raina[1], Sospeter Makau[1], Ganesh Pokhariyal[2]

[1]International Centre of Insect Physiology and Ecology (*icipe*), P.O. Box 30772-00100 Nairobi, Kenya
[2]School of Mathematics, CBPS College, University of Nairobi, P. O. Box 30197-00100 Nairobi, Kenya

Introduction

The aim of the project entitled: 'Climate change adaptation and mitigation measures through increasing forest connectivity and improving biodiversity' is to strive to succeed in climate change adaptation and seek mitigation measures through increasing forest connectivity and improving biodiversity values in Kenya.

The project objective is to achieve emission reductions through the creation of forest corridors and providing the best mix of wild harvest and commercial insect based incentives to capture the large mitigation potential and conserve biodiversity in the forests.

A carbon footprint is "the total set of greenhouse gas (GHG) emissions caused by an organization, event or product". For simplicity of reporting, it is often expressed in terms of the amount of carbon dioxide, or its equivalent of other GHGs, emitted.

The GHG emissions associated with land use change include carbon dioxide (CO_2), nitrous oxide (N_2O), carbon monoxide (CO), methane (CH_4) and oxides of nitrogen (NO_x).

The mitigation of carbon footprints through the development of alternative projects, such as energy/solar or reforestation, represents one way of reducing a carbon footprint and is often known as carbon offsetting (IUCN 2009; UNFCCC, 2008).

Project components include:

1. Mapping the forests for establishing corridors to strengthen carbon sinks and sustainable livelihoods;
2. Reducing pressure on forest resources and generate forest ecosystem services;
3. Enhanced institutional capacity to account for GHG emission reduction and increase in carbon stock;
4. Permanence, barriers and policy issues for sustainable forest management;
5. Monitoring and evaluation;
6. The impact analysis drawn upon three data sources: baseline, follow-up survey and data gathered by the community.

icipe's Strategy

The Centre shall:

- Develop a low cost climate change mitigation model through the development of connectivity corridors within forests; and
- Provide means for energy saving devices (such as small intensive wood burning stoves, known locally as *jikos*) that offer synergies and incentives through local adaptation. As well, we shall introduce community-driven development of biodigesters for fuel and bioenterprises for income.

Overarching Issues

- Increasing population and rising poverty levels continue to exert pressure on the country's forest resources;
- Approximately 17% of global greenhouse gas (GHG) emissions result from deforestation and forest degradation (IUCN, 2009);
- Greenhouse gas emissions from land use changes in Kenya for 1990 were 57,181Gg. (One gigagram is equal to one million kilogrammes.) This demonstrates the importance of Kenya's forests as sinks for CO_2.

Crosscutting Issues

Reducing emissions from deforestation and degradation in the forestry sector is considered in the Bali Action Plan (BAP) (UNFCCC, 2008) for all developing countries.

Addressing the Issues

Innovative Approaches to Stock Carbon and Conserve Forests in Kenya

First, the project will encourage farmers to reduce the sources of greenhouse gases (GHG) that result from deforestation by substituting renewable sources of energy for fossil fuel such as the use of energy saving

jikos (small intensive wood burning stoves) and use of biodigesters as a cooking fuel.

Second, the project will enhance the planting of carbon sinks through afforestation and forest connectivity corridors. This includes planting of bamboo and Napier grass.

Third, the project will create feasible incentives to rural communities to conserve the critically valuable remaining forests and create new carbon sinks through the development of bio-enterprises in commercial insects, such as honeybees, silkmoths and butterflies, and of indigenous plant products. (Raina et al., 2009).

Project Benefits

Global Level Benefits:

- The project will increase the forest cover, by restoring forest buffer zones through reforestation of connectivity corridors;
- The project shall help increase the carbon sinks (approximately 55 km² (55,000 hectares) in two connectivity corridors by planting 4 million trees at the rate of 700 trees per hectare);
- Community forest associations will benefit through additional incentives of commercial insects and wild harvest enterprises;
- The project linking forest fragments through connectivity corridors will benefit biodiversity of rare bird and reptile species.

Below is an example of the carbon sequestration rate of a three-year-old acacia tree calculated using the average age, girth size and height of 20 sampled trees for each parameter of years after plantation. (Data provided by Kenya Forestry Service.)

Step 1—Tree measurement

- 10 inches (25 cm) girth at 1 foot above ground level and 3 meters (300 cm) height.

Step 2—Carbon weight of the tree

Total weight of the tree = αx volume (acacia wood density is 0.65)

= $\pi r^2 h$ (height 300 cm)

= 3.14 (3.98) 2300

= 3.14 (4752.12)

= 14,921.656 cm^3 x density 0.65 to get = 9699.0764 gm divide by 1000

= 9.699 kg

= 10 kg (total weight of the tree)

To determine the dry weight of the tree multiply the weight of the tree by 72.5%

= 0.725 (10) = 7.25 kg

Average carbon weight in the tree = 0.5 dry weight

= 0.5 (7.25)

= 3.625 kg divided by density.

Step 3— CO_2 sequestration in the tree

To determine the weight of CO_2 sequestered in the tree multiply the weight of carbon in the tree by 3.6663 (ratio of carbon dioxide to C)

= 3.625 (3.6663)

= 13.290 = 13 cm^3

Therefore: 1 hectare having 1100 trees of acacia plantation will sequester 14,300 cm^3 of CO_2 per year.

Table 1. The global economic gain through establishment of forest corridors in terms of carbon sequestration and credits and tentative carbon sequestration rate of acacia trees in the forest and expected carbon payment to the forest community (Raina et al., 2009—communication)

No. of years after plantation	Average growth of acacia		Carbon sequestration per tree (in cm^3/kg)	Carbon sequestration per ha with 700 trees (tonnes cm^3)	Expected CO_2 sequestration by 4 million trees in 55,000 hectares (in metric tonnes)	Proposed carbon payment schemes (UN-REDD programme established in 2009) metric tonnes of CO_2 equivalent ($mtCO_2e$) costing US$ 15–20	
	Girth size (inches)	Height (metres)				Carbon payment per hectare of forest in US$	Total US$ gained by community from 55,000 ha through corridor establishment
1	5	0.5	0.85	0.093	340	0.108	5950
3	25	3	4.3	14.3	17,200	5.47	301,000
5	62.5	6	32.2	177.1	128,800	40.98	2,254,000
8	90	8	55.6	489.5	222,400	70.76	3,892,000
10	127	10	111	1221	444,000	141.27	7,770,000

Step 4—CO_2 sequestration per year

Divide the weight of the CO_2 sequestered in the tree by the age of the tree

= Volume divided by age of the tree in years

= 13/3= 4.3 cm^3

= 4.3 kg

CO_2 sequestration by 1 million trees = 4.3 kg x 1 m = 4,300,000 cm^3.

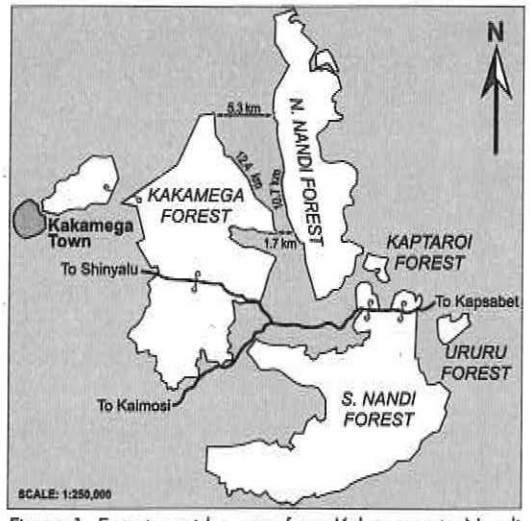

Figure 1. Forest corridor area from Kakamega to Nandi forest in km^2: (5.3 km + 12.4 + 10.7 + 1.7 = 30.1 km^2 = 30,100 hectares)

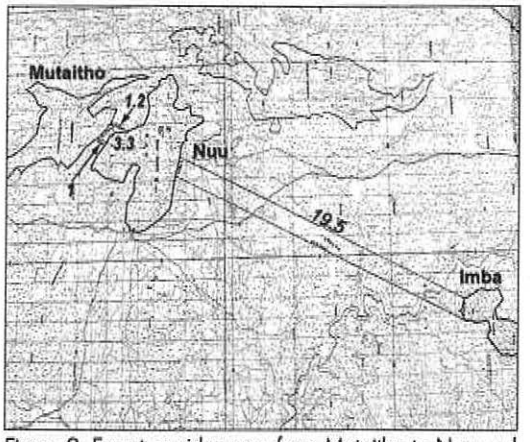

Figure 2. Forest corridor area from Mutaitho to Nuu and Nuu to Imba forests in km^2 (19.5 km + 3.3 + 1 + 1.2 = 25 km^2 = 25,000 hectares)

Key Facts about Kenya

- Kenya's loss of forest cover and associated biodiversity has led to serious environmental deterioration
- Closed canopy forests, today, cover less than 1.8% and woodlands less than 15% of the total land area, and every year these forests further decrease in size and regeneration capacity
- The consequence of this is the marked decrease in food production and increase in rural poverty.

Figure 3. Tree plantation by Mukima Community Forest Group (The seedlings were obtained from their nurseries)

Figure 4. Kilifi Central nursery where a total of 9000 seedlings were being raised for buffer zone planting

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IUCN (2009) UNFCCC Climate Change Talks: Reducing emissions from deforestation and forest degradation (REDD) in developing countries. International Union for Conservation of Nature (IUCN). www.iucn.org/unfccc

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Insects: Climate Change, Ecosystem Services and Agricultural Biodiversity*

Ian Gordon

International Centre of Insect Physiology and Ecology *(icipe)*
P.O. Box 30772-00100 Nairobi, Kenya

Outline of Presentation

1. Importance of insects for functional agrobiodiversity and ecosystem services
2. Current knowledge on insect responses to climate change
3. Knowledge gaps and research opportunities.

Insect Ecosystem Services

Insects contribute to 7 of the 17 ecosystem services recognised by Turner *et al.* (2007). These are:

1. Food production
2. Soil formation
3. Nutrient cycling
4. Pollination
5. Biological control
6. Waste treatment
7. Raw materials.

Insects contribute to 11 of the 21 agricultural benefits from biodiversity recognised by GEO4 (UNEP, 2007):

1. Food and nutrients
2. Animal feed
3. Medicines
4. Fibres and cloth
5. Materials for industry
6. Pollination
7. Pest regulation
8. Soil formation
9. Nutrient cycling
10. Agricultural lifestyles
11. Genetic material reservoirs.

Insect Responses to Climate Change

Fifty percent (50%) of over 1700 species (including insects, vertebrates and plants) are already affected by climate change (Parmesan and Yohe, 2003). Other authors have also reported that insects have responded to global warming in all the predicted ways.

Key References for Insect Responses to Climate Change

Menéndez R. (2007) How are insects responding to global warming? *Tijdschrift voor Entomologie* 150, 355–365.

Kiritani K. (2006) Predicting impacts of global warming on population dynamics and distribution of arthropods in Japan. *Population Ecology* 48, 5–12.

Phenology

Early adult emergence:

- Aphids in UK—Zhou *et al.* 1995; Harrington *et al.* 2007
- Butterflies in UK, Spain, and California—Roy and Sparks 2000; Stefanescu *et al.* 2003; Forister and Shapiro 2003
- Microlepidoptera in the Netherlands— Ellis et al. 1997
- Odonata in the UK— Hassall et al. 2007
- Lepidoptera, Coleoptera, Diptera and Hymenoptera—Gordo and Sanz 2005
- Two tortricid moths, one thrip, one diaspid scale insect, several aphids and one mites species in Japan—Kiritani 2006.

Increased number of generations:

- Predicted and or recorded for 41 species of rice pests, 30 species of pest parasitoids and predators, and 10 species of spiders.

Earlier larval emergence:

- Winter moth eggs hatching earlier in the Netherlands—Visser and Holleman 2001
- Eastern spruce budworm eggs hatching earlier in North America (inferred from model) —Visser and Both 2005.

Earlier migration:

- Migratory aphids arriving earlier in the UK— Zhou *et al.* 1995; Harrington *et al.* 2007
- Red Admiral arriving earlier in Britain—Sparks *et al.* 2005.

*This is a presentation for which no paper was available.

Phenology: Generalities

- All recorded changes consistent with global warming trends
- Significant increase in the strength of advancement of spring events in the northern hemisphere with increasing latitude—Parmesan 2007.
- BUT latitude explained only 4% of overall variation of phenological changes—Parmesan 2007.
- Parasitoids and predators may benefit more from warming as result of increased number of generations.

Distribution: Latitudinal Shifts

North expansions and south contractions in northern hemisphere:

- Lepidoptera in Europe—Mikkola 1997; Parmesan *et al.* 1999; Hill et al. 2002; Franco *et al.* 2006
- Checkerspot butterfly in North America—Parmesan 1996
- Sachem skipper butterfly in North America—Crozier 2003
- Garden tiger moth in UK—Conrad *et al.* 2002
- Odonata, Coleoptera, Neuroptera and Orthoptera in UK—Hickling *et al.* 2006
- >50 species of butterflies in Japan—Kiritani 2006
- 10 species of previously migratory butterflies now permanently established on Nansei Island in Japan—Kiritani 2006
- Green stink bug (rice pest) in Japan—Yukawa *et al.* 2007
- Three heteropteran species in Japan—Kiritani 2006.

Distribution: Altitudinal Shifts

Uphill expansions and downhill contractions:

- Lepidoptera in Europe—Konvicka *et al.* 2003; Wilson *et al.* 2005
- Pine Processionary Moth in Italy and Spain—Hódar and Zamora 2004; Battisti *et al.* 2005
- Checkerspot butterfly in North America—Parmesan 1996
- Mountain Ringlet butterfly in UK—Franco *et al.* 2006
- Mountain Apollo butterfly in the Alps—Descimon *et al.* 2005
- Odonata, Coleoptera, Neuroptera, Heteroptera and Orthoptera in UK—Hickling *et al.* 2006.

Expansion of Tropical Species into Temperate Areas

- Dragonflies from Cuba and the Bahamas to Florida—Paulson 2001
- African Queen butterfly in Spain—Haeger 1999; García-Barros *et al.* 2004
- Violet Dropwing dragonfly into southern Europe—Bonet-Betoret 2004.

Distributional Changes: Generalities

- All recorded changes consistent with temperature changes: North and uphill expansion, south and downhill contraction
- Range expansions more frequently recorded than range contractions (artefact: absence harder to establish than presence?)—Menéndez 2007
- Altitudinal changes respond to tolerance of minimum and maximum temperatures, but the former rising at twice the rate of the latter—Crozier 2004; Wilson *et al.* 2005; Franco *et al.* 2006.

Microevolutionary Responses

- Chromosomal-inversion polymorphisms in *Drosophila*: Warm-adapted genotypes favoured in Europe, Australia, North and South America—refs in Menéndez 2007
- Pitcher-plant mosquito initiated diapause nine days later in US in 1996 than in 1972—Bradshaw and Holzapfel 2001
- Host plant preferences in two butterfly species in US and Britain—Singer and Thomas 1996; Thomas *et al.* 1996; Thomas et al. 2001
- Colonising genotypes favoured—Hill *et al.* 1999a, b; Hughes *et al.* 2003; Simmons and Thomas 2004.

Microevolutionary Responses: Generalities

- Short generation times, large populations and high reproductive rates favour micro-evolutionary responses in insects
- Colonising genotypes favoured by range expansion—Hill *et al.* 1999a; Hughes *et al.* 2003; Simmons and Thomas 2004
- Low genetic variation in tolerance of minimum temperatures may constrain microevolutionary responses—Crozier 2004
- No evidence yet for evolutionary responses at the species level (extinction, speciation)—Menéndez 2007

Species Interactions

- Uphill expansion of Pine Processionary moth led to utilisation of new tree host plant— Hódar and Zamora 2004

- Maladaptive early hatching of winter moth eggs before oak leaf bud burst in the Netherlands—Visser and Holleman 2001
- Red Admiral butterfly in Britain arriving before host plant flowers—Sparks *et al.* 2005
- Phenological mismatches in timing of bird migration and peaks in insect prey species—Visser and Both 2005
- Two lepidopteran stemborer species recently expanded from wild grasses to maize in Kenya (forced by habitat changes?)—Le Ru pers. commmun.

Species Interactions: Generalities

- Trophic decoupling of food web phenology can outstrip evolutionary responses (prey–predator, plant–insect)
- Potential disruption of mutualisms (pollination)
- Potential biodiversity losses due to mismatches in response times to climate change between interacting species
- New trophic encounters and relationships can arise from expansions in distribution
- Modeling of tritrophic interactions (plant–herbivorous insect–parasitoid) suggests potential for pest outbreaks—Hance *et al.*, 2007.

Species Extinctions

None yet recorded, but:

- Local population extinctions reported for four species of butterflies in Britain at lower altitudes and latitudes—Franco *et al.* 2006
- Habitable areas for 16 mountain species in Spain reduced by one-third—Wilson *et al.* 2005
- Modeling suggests that parasitoid extinctions could result from extreme weather events—Hance *et al.* 2007.

Community Changes

- Differential range expansions, phenological and evolutionary responses, interacting mismatches, and species extinctions will reshuffle communities
- Generalist butterflies in Britain better able to expand range than specialists—Menéndez 2007
- Butterfly communities in Spain show altitudinal shifts (+293 m) consistent with movements of annual isotherms (+225 m)—Wilson et al. 2007.

Knowledge Gaps and Research Opportunities

1. Geographical: IPCC summary of significant changes in biological systems that may be attributable to climate change from 1970 to 2004: 28,115 changes recorded in Europe, but only 2 for Africa.
2. Agrobiodiversity: Despite clear evidence for climate change affecting wild insects, very few records exist regarding FAB.
3. Taxonomic: Lepidoptera especially butterflies, hugely over-represented in insect climate change research.
4. Pollination: Despite major economic impacts from pollinator losses (CCD in US), very little research on effects of climate change on pollinators.
5. Monitoring actual changes: Some FAB modeling but very few (none?) long-term FAB monitoring programmes in place.
6. FAB monitoring against existing model predictions for spread of invasives, e.g. stemborers.
7. Understanding multitrophic interactions in climate change context—plant/herbivore, pest/parasitoid, and predator/prey.
8. FAB monitoring to detect distributional shifts in ecotones—montane ecosystems act as biotic thermometers and proxies for climate change.
9. Phenological monitoring across crop–pest–natural enemy food chains to detect emerging mismatches.
10. Monitoring of host shifts and agrobiodiversity exchanges between cultivated and natural habitats.

Table 1. IPCC reports summaries

IPCC Report	Insect	Pest	Pollination	Biodiversity
WG 2.5: Food, Forests and Fibre	13	28	0	14
WG 2.4: Ecosystems, Goods, Services	18	9	1	3
WG 2.9: Africa	3	7	0	10
WG 2: Technical Summary	7	6	0	21
WG 2: Policy Summary	2	2	0	20
TOTALS	43	52	1	68

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DNA Barcoding and Morphometrics of Stingless Bees in Kenya

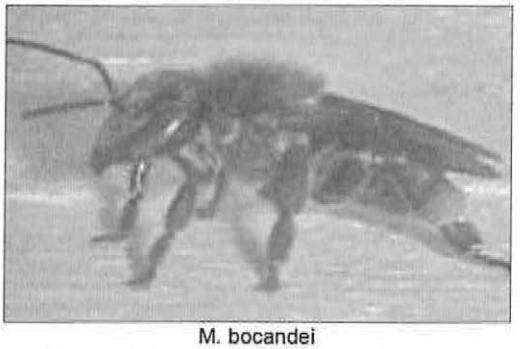
Nelly Njeri Ndungu

International Centre of Insect Physiology and Ecology *(icipe)*
P.O. Box 30772-00100 Nairobi, Kenya

Stingless Bees

There are two main genera in the world, *Trigona* and *Melipona*, that are identified based on their morphology. They are both of the subfamily Meliponinae (Danaraddi, 2007).

Dactylurina spp.



M. bocandei

H. gribodoi

Figure 1. Various stingless bees species: *Dactylurina* spp., *Meliponula bocandei* and *Hypotrigona gribodoi*

There are two tribes:

1. *Meliponini*—Tropical America
2. *Trigonini*—Africa, Southern Asia to Australia.

Biodiversity and Ecology

Stingless Bees Nests

Dactylurina schmidti nest

Hypotrigona gribodoi nests in dead logs and house walls

Figure 2. *Dactylurina schmidti* and *Hypotrigona gribodoi* preferred nesting sites

Meliponula ferruginea

Hypotrigona gribodoi

Figure 3. Arrangement of the brood cells can be used to differentiate colonies of *Hypotrigona gribodoi* and *Meliponula ferruginea*

Economic Importance

Stingless bees' farming (meliponiculture) can be a sideline activity for the rural poor due to its low cost. The bees have many desirable attributes, including human safety, and the honey is valued for food and for its curative properties.

Figure 4. Meliponiculture (stingless bees rearing)

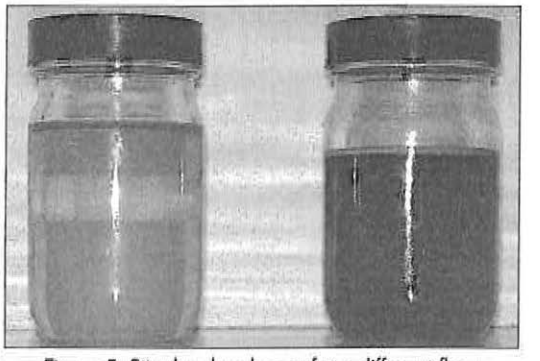


Figure 5. Stingless bee honey from different flora

DNA Barcoding

- DNA barcoding is the use of a short 650bp *COI* gene for identification of species.

Benefits include:

- A global reference library, i.e. the BOLD database
- Addressing practical problems, to differentiate morphologically similar species
- You can identify all stages of specimens
- A cost effective tool for biodiversity research.

Justification of the study

- To obtain current identification of morphological features—Nest site and architecture
- Morphometrics and DNA barcoding—Undertake comparative studies, and vouchering of specimens.

Hypotheses

- Morphometrics can be used to differentiate *Trigona* species
- Stingless bees from various forests in Kenya that are geographically isolated can be identified using barcodes.

Objectives

Overall Objective

The overall objective was to develop molecular and morphometric tools to identify stingless bees in Kenya.

Specific Objectives

Specific objectives were to:

1. Determine variations among *Trigona* species from various localities in Kenya using morphometry;

2. Develop and apply DNA barcodes for identifying stingless bees in Kenya.

Methodology

Selected Forest Sites in Kenya

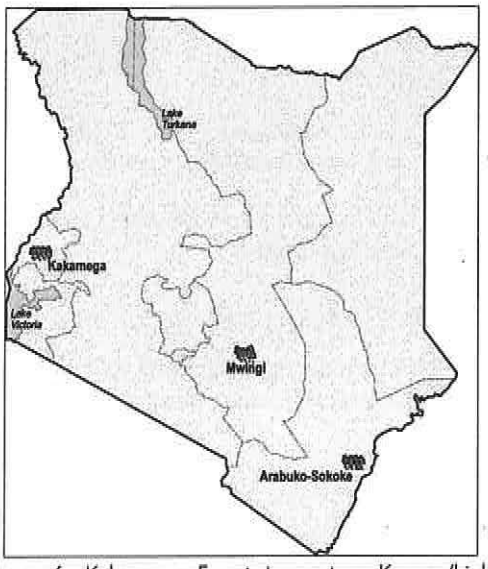


Figure 6. Kakamega Forest in western Kenya (high altitude), Mwingi region (mid altitude) in eastern Kenya and Arabuko-Sokoke Forest in coastal Kenya (low altitude)

Morphometric Methodology

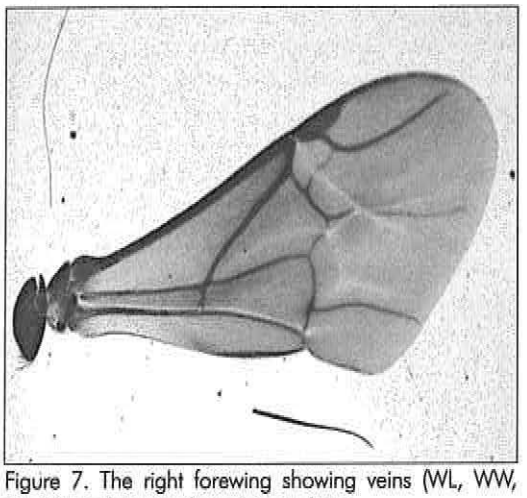


Figure 7. The right forewing showing veins (WL, WW, v3–v8) used in morphometric analyses

Morphometrics Analysis

Morphometric analysis was performed using statistical analysis system version 9.1 (SAS Institute Inc., 2003) software. For multivariate analysis, principal components analysis (PCA) and canonical variate analysis (CVA) were applied to detect the

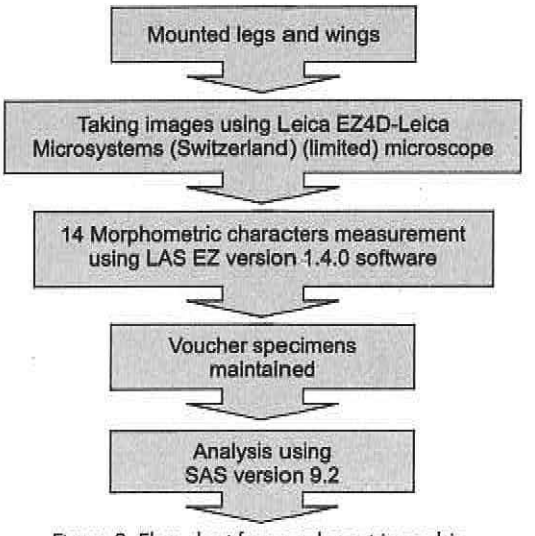


Figure 8. Flow chart for morphometric analysis

linear relationships of the species and regions. The principal component analysis was performed on the variance–co-variance matrix for the 10-wing variables (log transformed) to determine the effects of size and shape on the distribution scores along the first two principal component axes (Sokal and Rolf, 1995) and their distribution without constraints of prior assignment to particular populations observed. The data matrix was also subjected to canonical variate analysis to visualise shape differences and evaluate the values for discrimination among populations. Leg measurements were arcsine transformed before being analysed using general linear model procedure (PROC GLM; SAS Institute Inc., 2001). Significant ($p<0.05$), means were separated using Student–Newman–Keuls (SNK) test.

Results and Discussion

PC and CV Plot of Wing Venation of Hypotrigona gribodoi

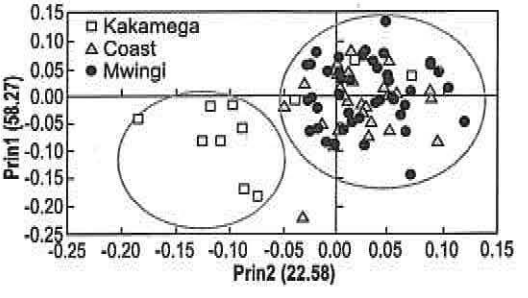


Figure 9. Projection of wing vein data on first two principal components (PC) for *Hypotrigona gribodoi* population collected from Kakamega, Mwingi and Coast

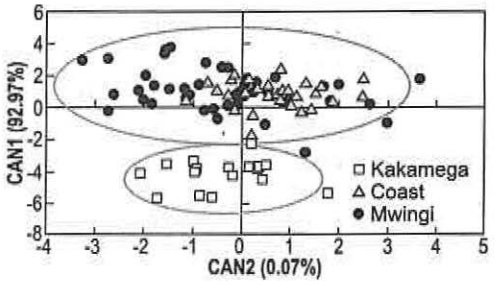


Figure 10. Projection of wing vein data on first two canonical variates (CV) for *Hypotrigona gribodoi* population collected from Kakamega, Mwingi and Coast

PC and CV Plot of Wing Venation of Meliponula bocandei

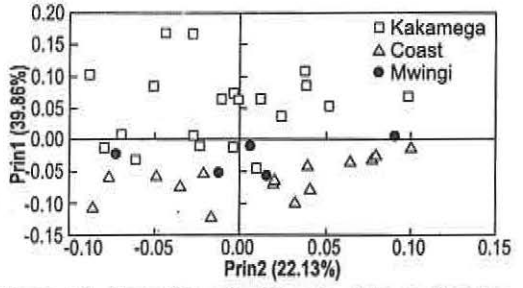


Figure 11. Projection of wing vein data on first two principal components for *Meliponula bocandei* population collected from Kakamega, Mwingi and Coast

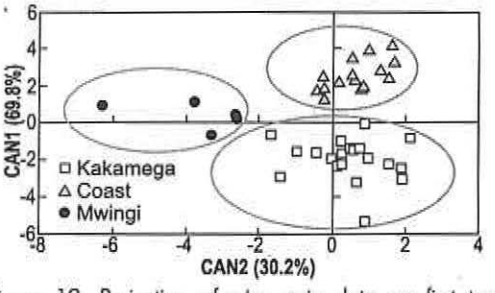


Figure 12. Projection of wing vein data on first two canonical variates for *Meliponula bocandei* population collected from Kakamega, Mwingi and Coast

DNA Barcoding Analysis

Purified PCR products were sequenced in both directions and the resulting sequences assembled and edited using ChromasPro version 1.34 (Technelysium Pty Ltd.). The consensus sequences were aligned in Clustal X version 1.81. The aligned sequences were submitted to the Barcode of Life database (BOLD) (www.barcodinglife.org). The sequences were submitted to BOFAS (Bees of the World - Africa (Stingless bees)) database, accession numbers BOFAS001-08–BOFAS090-08 (http://www.

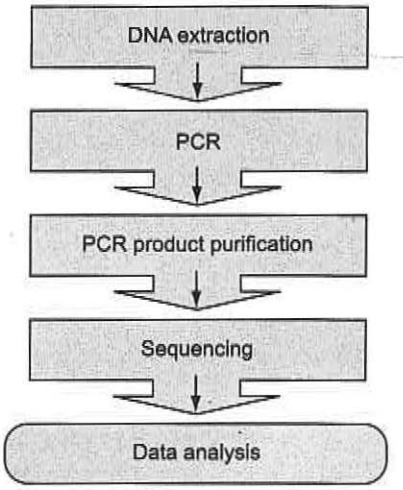


Figure 13. DNA barcoding methodology

barcodinglife.org/views/projectmenu). To validate the *COI* sequences obtained in this study, we compared *COI* sequences from *Meliponini* for which the whole mitochondrial DNA sequences have been generated and deposited in GenBank. Sequence divergences were calculated using the Kimura 2-parameter (K2P) distance model (Kimura, 1980), bootstrap values were based on 1000 replicates and neighbour-joining (NJ) tree (Saitou and Nei, 1987; Howe *et al.*, 2002) was created to provide a graphic representation of among-species divergences using MEGA 4.0.2 (Kumar *et al.*, 2008). Pair wise distances were also calculated using Kimura 2-parameter model using MEGA 4.0.2.

DNA Sequence Size Length

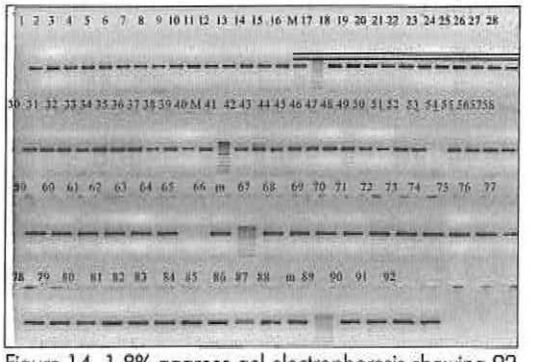


Figure 14. 1.8% agarose gel electrophoresis showing 92 samples

Nearest Neighbour Distance Summary Constructed Using BOLD Management and Analysis System

Bootstrapped Neighbour-joining Tree

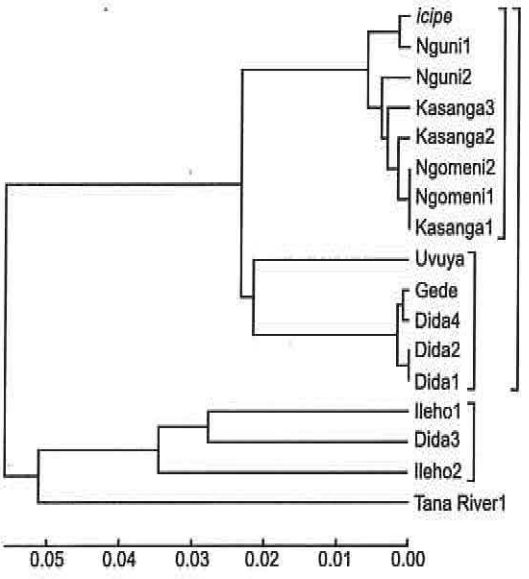


Figure 15. Bootstrapped Neighbor-joining tree calculated from Kimura 2 parameter distances and based on 1000 replicates

Conclusion

- DNA barcoding and morphometry discriminated stingless bees species from different ecosystems in Kenya
- Species differentiation is an integrative process employing molecular markers, behaviour and morphology of the stingless bees
- Discrimination of species is important to farmers for breeding purposes and the production of quality honey.

Recommendations

- More species should be discovered and barcoded in future
- Study population genetics of the bees for better understanding of their diversity
- Barcoding for nine more species
- Commercial breeding aspects of these bees should be enhanced to improve honey production.

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SESSION 2

Workshop Presentations: Apiculture

Rural Livelihoods Support Programme and Beekeeping Activities in Malawi

Precious Chambize Magombo
Nsanje District Assembly, P/Bag 1 Nsanje, Malawi

Introduction

Malawi is an agro-based economy with over 85% of the population directly or indirectly relying on agriculture for food security as well as for income generation. While the traditional crops (tobacco, sugar and tea) remain high on the list of export crops, the Malawi Government currently recommends that we diversify our export base to cushion against adverse climate and uncertainties on the global market. Besides this, with the ever-increasing human population, per capita land holdings are diminishing, hence the need to explore alternative income-generating activities by households.

Overview of the RLSP and Beekeeping Activities in Malawi

One of the industries that fit well in the government's diversification policy is commercial beekeeping. Beekeeping ensures that rural communities care for and sustainably use their forest resources since they are the major source of the much-needed nectar, a key ingredient in honey making. Malawi is likely to benefit from reduced deforestation if communities are encouraged to engage in beekeeping. Moreover, beekeeping can be practised even on marginal land. Extensive beekeeping will also help in mitigating the adverse impacts of climate change.

Beekeeping is also in tandem with the Rural Livelihoods Support Programme's objective of "promoting both on- and off-farm income generating activities".

Rural Livelihoods Support Programme (RLSP)

The Rural Livelihoods Support Programme (RLSP) is a nine-year Government of Malawi programme funded by the International Fund for Agricultural Development (IFAD) in three Southern Region districts, namely Thyolo, Chiradzulu and Nsanje. The programme is intended to benefit rural poor households living in villages in the programme area particularly female headed, those with smallest land holdings, school dropouts and other disadvantaged households.

Programme Target

- Nsanje: 10,000 households
- Chiradzulu: 8000–10,000 households
- Thyolo: 20,000 households
  Total population: 180,000 people (22% for each district).

Overall Goal

The overall goal of the Rural Livelihoods Support Programme (RLSP) is sustainable poverty reduction through the promotion of on- and off-farm and wage-based incomes.

Specific Objectives

- Promoting sustainable agricultural production and simple but efficient natural resources management technologies for improved food security, nutrition and agriculture-based incomes for better living conditions for selected target groups
- Promoting the development of skills for selected target groups and availing financial support for both on- and off-farm investments that will utilise the acquired skills to improve their incomes
- Promoting employment through support for infrastructure development to provide incomes especially during off-seasons
- Developing/improving individual and local community capacities and capabilities in terms of their organisation to access relevant resources to improve their livelihoods.

Rationale and Approach

The Rural Livelihoods Support Programme is drawn up and implemented within Malawi's decentralised framework and policy and is based on two pillars of

the Poverty Reduction Strategy Paper (PRSP) namely sustainable pro-poor growth and human capital development. Again, RLSP strategies are in line with the new Malawi Growth and Development Strategy (MGDS) 2006 to 2011, which has since superseded the original Poverty Reduction Strategy Paper. The MGDS emphasises that poverty alleviation should be brought about by sustainable economic growth, improved governance and infrastructure development that will increase returns and earnings from productive self-employment and formal employment, and move subsistence farming into the commercial sector.

The programme promotes participation of the target groups at all stages of the programme design, implementation and review through participatory approaches. The participatory techniques and methodologies developed will be institutionalised for long-term sustainability of Rural Livelihoods Support Programme's interventions.

Background to the Beekeeping Industry in Malawi

Development of a commercial sector of the honey industry in Malawi was started in the late 1980s by the German Agency for Technical Cooperation (GTZ). Beekeeping clubs were established and honey production picked up. It was immediately evident that marketing posed a big challenge to the beekeepers.

Much as the formation of the now defunct Beekeepers Association of Malawi (BAM) was viewed as a relief to the beekeepers' marketing nightmares, the organisation did not last long; it collapsed, just a year after its inception, due to mismanagement. The collapse of BAM was a big disincentive to existing as well as potential beekeepers. Subsequently, the country's honey output dropped. Local processors had to resort to importation from neighbouring Tanzania to sustain the product's availability on the market. There was high demand for the product in the supermarkets. As recently as 2004, Mzuzu Coffee Planters Cooperative Union, the country's biggest honey processor, imported some 5 tonnes of honey from Tanzania.

Efforts by several organisations and the private sector have, in recent years, greatly rejuvenated the industry. A COMPASS survey in 2005 revealed that the country's total honey annual output was around 60 tonnes. As of today, because of joint efforts by various players, the country's honey output is estimated at 150 tonnes, 75% of which still comes from the northern region of the country.

RLSP and Beekeeping—Advantages and Potential

- RLSP is implementing beekeeping activities in Thyolo and Nsanje districts in southern Malawi
- These two districts are strategically located so that access to lucrative honey markets in Blantyre is easy
- Beekeeping in Thyolo and Nsanje is a traditional part time occupation as there are natural forest reserves and mountains where bees get nectar and pollen
- Nsanje is also a flood- and drought-prone area with regular food shortages
- Beekeeping is a potential income-generating activity that could increase households' food security
- Beekeeping does not require huge pieces of land
- Beekeepers can produce enough honey to supply the domestic market and keep the processors operating throughout the year
- With major pharmaceutical, confectionery and industrial honey processors based in Blantyre, Nsanje and Thyolo, they have a comparative advantage over the traditional northern region suppliers by virtue of lower transportation costs.

Programme Support

The RLSP currently supports about 345 beekeepers (214 males + 131 females) in the two districts. The beneficiaries are supported with modern equipments/materials, e.g. bee suits, smokers, gloves, boots, pails, bottles and beehives. These materials/equipments are given as loans that the Village Development Committees (VDCs) administer as village revolving funds. Technical and business training is also provided to all the beneficiaries. Groups are linked to the forestry and wildlife sectors for technical support.

Sustainability

The programme has mobilised beekeeping farmers into groups. They have been trained in group dynamics, apiary management, honey harvesting and processing. Efforts are underway for farmers to market other associated products like wax. For sustainability purposes, training has also targeted frontline extension staff, both from the government and the programme. Natural resource management has been mainstreamed into the programme activities. As such, natural forest management and afforestation are on-going activities. By organising

farmers into groups, they now have bargaining power and are now being linked to the Bee Products Association of Malawi, a successor to the defunct Beekeepers Association of Malawi.

Challenges/Constraints

Beekeepers in RLSP impact areas face a number of challenges, which need to be addressed to accelerate the development of this sector. These challenges are:

(i) Poor Beekeeping Management:
The productivity of honey produced in RLSP local impact areas is too small. Currently the production is at 750 kg per 100 hives annually. The expected yield is 1500 kg per 100 hives. To increase honey production there is need for more technical training in bee management. Apart from increasing production this should also ensure that good quality honey is produced. The training will enable beekeepers to produce and improve quality of the honey and other products, e.g. beeswax.

(ii) Inadequate Market:
The local market for honey in Malawi, especially in the RLSP impact areas, is currently small and the per capita consumption is relatively small. Honey is facing stiff competition from other substitutes especially sugar. If production increases, there is need to link these producers to big market outlets like Tambala Food Products, Nali Ltd, and Malawi Pharmacies etc.

Improving Linkages

The current situation in the impact areas shows that there is a very weak link between stakeholders in the beekeeping industry. It is apparent RLSP farmers should be linked to relevant stakeholders if they are to develop and benefit from their efforts. There is, therefore, need to improve business contacts and working relationship between:

- Beekeepers and consolidators/processors
- Beekeepers, retailers and consumers
- Beekeepers, consolidators/processors and input manufacturers and importers
- Beekeepers, government departments and the stakeholders in the honey sub-sector.

Conclusion

Beekeeping is in tandem with the Rural Livelihoods Support Programme's objective of "promoting both on- and off-farm income generating activities". Therefore, RLSP will continue promoting beekeeping in complementing government efforts of poverty alleviation as long as there are readily available domestic and international markets for honey and other beekeeping products.

Scaling-Up of Apiculture in Masaba Division, Southern Nyanza Community Development Project

Walter R.O. Ogot
Divisional Livestock Officer, Masaba
Southern Nyanza Community Development Project (SNCDP), Nyanza, Kenya

Background

District: Kuria West

Location: Nyanza Province, borders Migori District to the North and Tanzania to the South.

Masaba Division

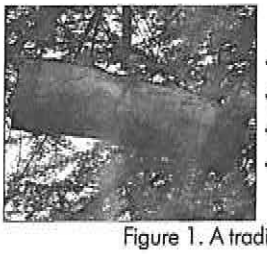
Size in area: 147.1 km²
Rainfall: 850–1100 mm per annum
Pattern: Bimodal
Population density: 149 people per square km
Vegetation:
- Evergreen natural shrubs
  Common trees—*Acacia, Grevillea, Sesbania, Terminalia*
- Common grass— manyatta grass
- Fruit trees—guavas, mangoes, avocado

Crops: Maize, cassava, sweet potatoes and tobacco
Livestock enterprises: Beef, sheep and goats, local chicken and beekeeping.

Honey Beekeeping

Types of Hives	No.	Comments
Log Hives	56	Made from wood or pipes
Kenya Top Bar Hive	17	Some not to standard
Langstroth	64	Mostly acquired through Projects funding

Log Hives



- Long harvesting interval
- Low yields
- Exposed to destruction
- Difficulty in harvesting

Figure 1. A traditional log hive

Modern Hives

Funding Agencies	Type of Hive	No.	Comments
Action Aid	Langstroth	9	Moved out
CCF	Langstroth	3	Not active on livestock enterprises
SNCDP	Langstroth	45	Active on the ground
Farmers' Initiatives	Langstroth	7	Some hives not to standard
Farmers' Initiatives	Kenya Top Bar Hive (KTBH)	1	Newly acquired

Figure 2. Farmers receiving demonstration hives from SNCDP

Figure 3. Established apiary with Langstroth hives from SNCDP

Honey Production

Type of Hive	Average yield per hive (kg)	No. of harvests per year
Langstroth	10.0	
Log hive	3.5	2
KTBH	5.0	

Marketing

- Marketing is still very low
- Kuria Bee Keepers Network assists farmers; however, it is not active
- The little production is mostly sold at farm gate.

Challenges/Constraints

- Low adoption
- High level of illiteracy
- Group wrangles/no accountability/individualism
- Tobacco growing
- Honeybee phobia
- Environmental degradation

Coping Mechanisms/ Solutions/Recommendations

1. To intensify level of sensitisation
2. Approach of groups through adult learning centres
3. To upscale the rate of project follow-ups
4. Emphasise the need for demonstration on safe use of chemicals
5. Take seriously the laws governing environmental protection/conservation.

Apiculture Projects in South Kordofan, Sudan

Suliman Ahmed Yagoub
The Sudan

Introduction

IFAD has projects all over the world. In Sudan, IFAD executes many projects in the health, agriculture and education sectors. Apiculture in South Kordofan state, in the mid west of Sudan is one of most important income-generating activities. Project activities started in June 2007 with a survey of the honey production sites to determine whether the communities in these villages want to change to modern apiculture or not.

The goals were to:

1. Reduce poverty by introducing a new income-generating project;
2. Increase agricultural and horticultural yields;
3. Increase the forest area by planting honey-producing plants;
4. Increase the quantity of honey and other beehive products;
5. Construct honey centres for buying and selling, and also provide other apiculture equipments;
6. Promote modern beekeeping.

Activities

- Survey was conducted in 2008 to the honey production sites (Aleeri, Korondi, Omdwal, Omkwaro, Abosafeefa, Bagaaya, Remaily, Alzelaitaia) to determine whether the beekeepers want modern apiculture or not.

Training

- Trained 27 beekeepers and three technicians and provided them with apiculture equipment
- Trained 50 beekeepers (funded by Save the Children Organisation) in Al Dalang town sites and provided all the equipment
- Trained 10 beekeepers in Abosafeefa village in cooperation with the capacity building project and provided 5 modern hives to each of them.

Figure 1. Beehives for distribution

Table 1. Honey production in modern hives in selected honey production sites in South Kordofan State, Sudan (2008)

Site	No. of beekeepers	Modern colonised beehives	Hives absconded	Empty	Honey production (Pounds)
1. Bagaaya	20	6	8	26	–
2. Remala	20	1	11	28	–
3. Agab	20	2	15	23	6
4. Zelataya	20	16	8	16	14
5. Central apiary		1	20		10
6. 17 sites	27	23	14	17	94
Total	107	49	76	110	124

Figure 2. Farmer training

Figure 3. Beekeeping technical trainees

Constraints and Solutions

- A delay in training of the technical staff in *icipe* caused a negative effect in the project.
- The weak financial support from the Ministry of Agriculture for seven months was solved by shifting the beekeeping project to the forestry national corporation administration.
- Modern beekeeping is a complete package, and should not only involve the distribution of modern hives. Honey extractor processors should also be provided.
- The beekeepers need enough bee suits and adequate training to handle aggressive honeybees. Every two beekeepers should share a bee suit.
- The traditional beekeepers have scattered their hives in a vast area, so it is difficult for them to gather their modern hives in one apiary.
- A shortage of nectar and water in the dry season as well as the destructive wax moth larvae are the major causes of honeybees absconding. The solutions are artificial feeding with sugar syrup, migratory beekeeping and pest control training of the technicians and beekeepers.

The IFAD Project's Status and Constraints in the Scaling-Up of Income Generation Options in Tigray Regional State, Ethiopia

Teklay Gebreamlak

Tigray Bureau of Agriculture and Rural Development
Mekelle, Tigray, Ethiopia

Background

Tigray Regional State is located in the northern part of the country with an estimated area of 53,386 square km, and a population of about 4.4 million (rural residents 82% and urban residents 18%) (Figure 1). Forty-eight percent (48%) of the productive age population is between 15–54 years and 18% is under the five years age group. Real GDP growth has registered 10.07% growth on average annually (2000/01–2006/07). The average growth registered during the last four years was 15.8% (2003/04–2006/07).

The percentage contribution of the different sectors in the region is:

- Agriculture 47.2%
- Industry 19.4%
- Service 33.4%.

Agriculture is the mainstay of the population contributing about 80% of employment to the labour force in the region. Agriculture in the region is mixed subsistence farming (both crop and livestock), crop production being dominant. Smallholder farmers who use traditional agricultural practices mainly dominate this sector. The national regional government of Tigray has made an effort to change and improve the existing traditional agricultural practices by introducing different modern agricultural technologies and improvements have been observed especially in the last 4–5 years. But, even though the regional government has made efforts, a lot still remains to be done to increase agricultural productivity so as to improve the living condition of the rural poor. Therefore, the government of Ethiopia and the regional government of Tigray are working with national and international partner organisations that are involved in programmes/projects aimed to reduce food insecurity and alleviate poverty, a move that will help to bring about development in the country and the region. The IFAD project is one of the projects implemented jointly by the government and the donor agencies in the region.

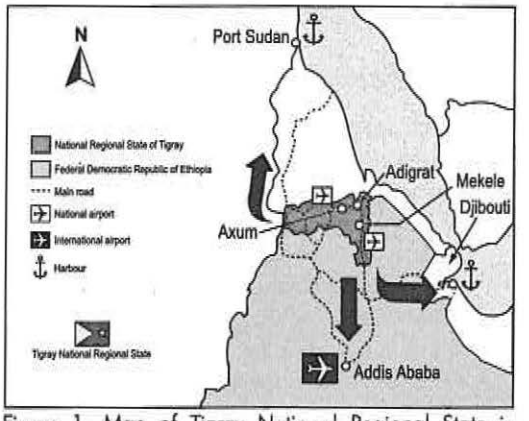


Figure 1. Map of Tigray National Regional State in Ethiopia

IFAD Projects and Their Performance

Projects Supported and Implemented by IFAD

In Tigray, there are IFAD projects having their own regional programme coordination and management units. These projects are supported and implemented by IFAD.

The Irrigation Scheme Development Programme

This project is implemented by the Bureau of Agriculture and Rural Development, and the Bureau of Water, Mines and Energy.

RuFIP (Rural Financial Intermediation Programme)

This project is implemented by the Cooperative and Marketing Promotion Agency in the Bureau of Agriculture and Rural Development.

Agricultural Market Improvement Programme

This project is implemented by the Tigray Agricultural Marketing Promotion Agency.

Table 1. Number of beekeeping cooperatives in Tigray (1996–2001)

Year	No. of cooperatives	No. of members			Capital (Eth. birr)
		Male	Female	Total	
1996	5	108	8	116	58,383.4
1997	6	132	17	149	103,038.6
1998	18	262	17	279	292,867
1999	44	607	52	659	839,441.5
2000	68	945	117	1062	1,017,232
2001	98	1672	252	1924	1,691,280
Total	239	3726	463	4189	4,002,242.5

Source: Cooperative Promotion and Marketing Development Agency, 2002.

IFAD Project Performance by Programme

The Irrigation Scheme Development Programme

- This programme has the following components:
  - Institutional development
  - Small-scale irrigation development
  - Agricultural development
- But this programme does not have apiculture and sericulture as a component.

RuFIP (Rural Financial Intermediation Programme)

The main activities performed by this programme are to:

- Establish (saving and credit service) cooperatives and unions
  - 438 cooperatives (107% of the plan) having 26,351 members and an estimated capital (asset) of 25,019,210 Eth. birr
  - 4 unions (25% of the plan) established
  - These cooperatives have given credit (for investment) to their beneficiaries
  - 8201 members have got 22,133,383 Eth. birr credit.

Its role is to encourage farmers to be involved in different income-generating agricultural activities like irrigation, animal fattening, dairy farming and beekeeping.

Agricultural Market Improvement Programme

The activities done include:

- Give market information to farmers and others;
- Create market link inside and outside the region/country.

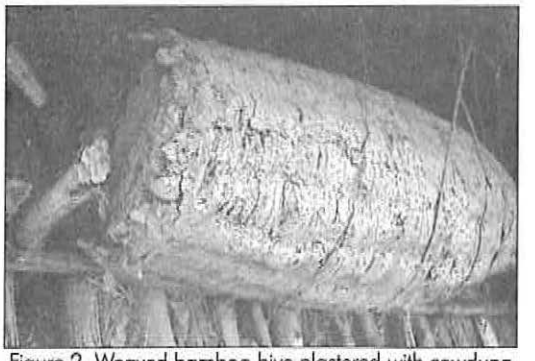


Figure 2. Weaved bamboo hive plastered with cowdung

Figure 3. Zanzibar modified Langstroth hive

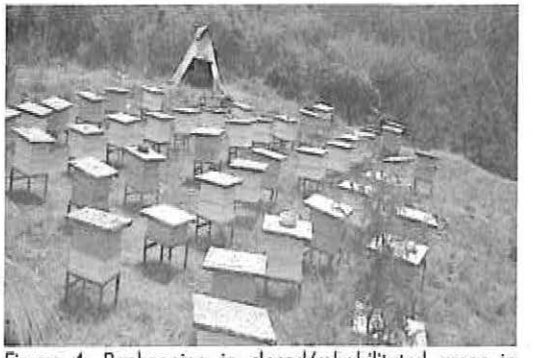


Figure 4. Beekeeping in closed/rehabilitated areas in Ofla District, Southern zone of Tigray

Along the value chain, this programme introduces technologies that help increase productivity, quality and add value of different agricultural products/ commodities (e.g. introduction of honey processing equipment).

Introduction of beekeeping post-harvest technology helps to implement beekeeping development as a source of income in a sustainable manner.

Constraints

- Lack of professionals and high turnover (cooperative and auditing experts) in the IFAD project areas

Table 2. Number of bee colonies in frame/modern hives in Tigray (1996–2001)

Production year	No. modern hives	Remark
1995/1996	1610	
1996/1997	14,482	
1997/1998	10,131	
1998/1999	7743	
1999/2000	15,784	
2000/2001	24,716	
2001/2002	20,000	
Total	94,466	35% of the colony population

Source: Bureau of Agriculture and Rural Development (BoARD), 2002.

- Cooperatives are weak technically and financially
- Long and centralised procurement procedures by NPMCU to the IFAD project areas
- The beekeeping system (65%) is still traditional with low hive productivity and overall honey production
- Lack of awareness, knowledge and practical skills in beekeeping (especially in hive/colony management, queen rearing, producing different valuable hive products and handling them, and in processing and marketing the products, among others)
- Hive products are not diversified and there is no market for these products locally
- Beekeeping extension is not supported by research
- Honey and beeswax are not packed, labelled and graded; they are simply sold at open market in the raw form
- There are no facilities to check the quality/ standard of the hive products (equipments used to grade hive products).

Conclusion

If we perform well in extension, research and marketing the above problems can be solved, and apiculture can be scaled-up as an income-generating activity in the region. But development partners should support the sector technically and financially.

IFAD Project Status and Constraints in Scaling-Up of Income Generation Options in Uganda

Asiimwe Taddeo Barwogeza and Night Sofia Apofia
Area Based Agriculture Modernization Programme (AAMP), Uganda

Background

Land Size and Location

Uganda is a landlocked East African country with a total land size of 236,040 square kilometers (146,675 square miles) and land boundary of 2698 kilometres (1676 miles). The country's capital city is Kampala (Figure 1).

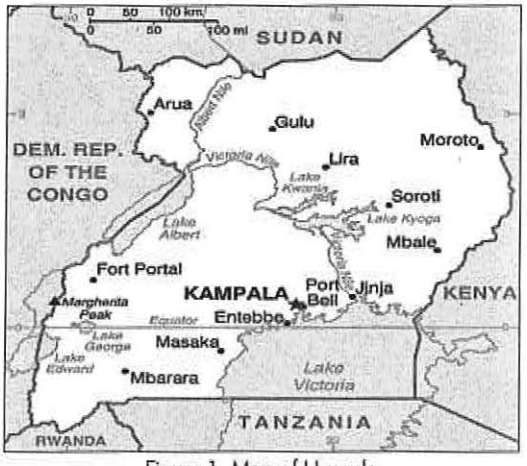


Figure 1. Map of Uganda

Agriculture and Apiculture in Uganda

The agriculture sector in Uganda contributes 40.7% of the national GDP (gross domestic product). Of this, apiculture alone contributes 8%. The country has approximately 80,113 beekeepers producing 5012 tonnes of honey annually.

For the apiculture enterprise, the beehives mostly used and the corresponding production potentials for each currently are as follows:

- Logs and clay pots—Dependant on size
- Woven twig— Yield per hive is 3–6 kg per season
- Kenya Top Bar (KTB) hive—Yield per hive is 5–15 kg per season/extraction
- Langstroth beehive. This has now been further improved locally into:
  1. Deep super Langstroth—Yield per hive is 15–23 kg per extraction, 2 times per season
  2. Shallow super Langstroth—Yield per hive is 8–13 kg per extraction per hive, 3–4 times per season
  3. Long Langstroth—Yield per hive is 20–22 kg per extraction, 2 times per season. However, our bees seem to easily move upward to cross the excluder than across
  4. Dadant Beehive—Yield per hive is 15–23 kg per extraction per hive, 2 times per season.

Uganda's Supporting Policy on Agriculture

In 1997, Uganda underwent a number of macroeconomic reforms to bring about economic and social transformation. These reforms gave birth to a Poverty Eradication Action Plan (PEAP) with interventions designed and implemented within other policy frameworks of liberalisation, privatisation and decentralisation, which opened the business arena and removed the various barriers which hindered the private operators' active participation in commercial activities. PEAP further led to a Plan to Modernise Agriculture (PMA) through market oriented strategies, diversification and increased farm productivity for commercial production as a way of enhancing participatory development.

The Status of the IFAD Project

Over the years, Uganda has been blessed with IFAD's (International Fund for Agricultural Development) enormous monetary support. This IFAD support has always been geared at supplementing Uganda government efforts to alleviate poverty. In Uganda, 85% of the population is scattered in remote rural locations of the countryside accessing minimal necessary services. Two-thirds of the country's poor people are smallholder farmers. Whereas the rural population is estimated to be 26.1 million, the

number of the rural poor stands at 10.9 million and the rural population below the poverty line is thought to be at 38%. IFAD is trying to assist the government in combating the poverty issue, and has undertaken a total of 12 projects in the areas of rural development, credit and financial services, agricultural development, programme loans and research/extension/training. The total costs of these projects have been US$ 492.0 million of which IFAD loan is US $ 230.6 directly benefiting 2,442,150 households. Of the 12 projects, 7 have since completed their operations.

Locally, Kabarole District, with 69,708 households, of which 59,524 (85.4%) are agricultural households, is highly suitable agro-ecologically for apiary enterprises (Figure 2). IFAD has been seen of late undertaking two successful projects/programmes, namely Area-based Agriculture Modernization Programme (AAMP) and District Development Support Programme (DDSP) that completed their operations in 2008.

AAMP replaced Southwest Region Agricultural Rehabilitation Project and operated in 13 districts covering 312,000 farming households and focused on commercialising smallholder farmers, providing technical skills, marketing, financial support as well as investment in rural infrastructure, especially rehabilitation of many road networks. In apiculture, AAMP provided 33 apiary farmer groups with 660 Langstroth beehives along with protective kits.

DDSP operated in the 5 districts of Kibale, Hoima, Kamwenge, Kyenjojo and Kabarole, and consolidated lessons learned from Hoima–Kibale Districts Integrated Community Development Project. This Programme covered diverse areas of community development (including functional adult literacy, building community centres for community meetings, rural finance where it increased off-farm and enhanced integration to the monetary economy through savings and credit through SIDA (Subcounty Integrated Development Association) and BUTO (Bunyoro-Tooro Rural Development Company Ltd) now standing at 122 SIDA's, with 37,468 savers saving close to 802 millions, registering a loan recovery of 95% at BUTO and 90% at SIDA), health and nutrition, water and sanitation, rural infrastructure, agricultural development and institutional strengthening.

In the apiary subsector, DDSP introduced the highly productive Langstroth beehives that replaced the previously used Kenya Top Bar hive. DDSP, after introducing the Langstroth beehives, with the help of an official from *icipe*, Kenya conducted training of Nyabubale Rural Foundation for Development in making Langstroth beehives and this group has since sold 5456 units both within and the surrounding districts at a cost of UShs 120,000/= per Langstroth (Figure 3). The programme then further trained and equipped three big apiary farmer groups of Nyabubale Rural Foundation for Development, Kabarole Beekeepers Group and Bunyangabu Beekeepers Community in queen rearing which is now practised but on a low scale.

However, still being funded is the National Agricultural Advisory Services (NAADS) under the basket funding arrangement in which IFAD will accordingly contribute funds up to 2010. This NAADS programme, as a World Bank-initiated programme manifesting the Poverty Eradication Action Plan through the Plan for Modernisation of Agriculture, generally covers the whole country at the same time targeting 3 million households that form Uganda's farm-family base of which 75% are predominantly

Figure 2. An apiary farmer at his apiary site in Kabarole District

Figure 3. Nyabubale Foundation for Rural Development artisans at their workshop in Kiko, Kabarole making Langstroth beehives as earlier trained under DDSP

Figure 4. Processed honey

subsistence smallholder farmers including women and youth. Whereas the total programme cost is US$ 107.9 million, IFAD loan is US$ 17.5 million. NAADs, in which IFAD also contributes, continues to assist many apiary farmer groups in providing Langstroth beehives (2065 Langstroth beehives given to 68 apiary farmer groups so far), training, essential kit packages, processing by provision of centrifuges (6 centrifuges so far) as well as strengthening market avenues.

Constraints in Scaling-Up of Income Generation Options in Uganda in Relation to the Apiary Sub Sector

Subsistence farming systems: Majority of the poor smallholder farmers are risk averse and use farming approaches that only satisfy family needs. There is generally lack of business culture and farmers are not exposed to other approaches that could enable them to produce more on their small pieces of land.

Lack of apiary-related extension services: Many farmers are unable to access the advisory services that ideally could have helped them increase their agricultural output. The civil service reforms have downsized the civil service and left few extension workers in the community (at a ratio of extension worker to farm household of 1:1500). This has crippled the delivery of extension services including to apiary farmers.

Also, the technology, marketing, financial and other support services are often unattainable. Traditional apiculture is unable to pull them out of poverty. Only 5% of the rural poor apiary farmers have savings and credit. To some extent, farmers even lack a clear timetable to do harvesting.

Pests and predators: Without introduction of suitable technologies to minimise pests and predators such as the wax moth, hive beetles, rodents, lizards and termites that attack beehives and colonies, smallholder farmers are extremely vulnerable and unwilling to invest in larger holdings.

Low productivity: There are considerably low yields per season despite the abundant forage. The low yields are mainly because of the general lack of knowledge and expertise to understand and appreciate the need for an economic unit following the gross margin analysis aimed at offsetting inputs by maximising production outputs.

Also, backward technologies and use of rudimentary inputs/materials/hives still being used by some of the apiary farmers highly affects the quality of honey and beeswax. Due to use of traditional harvesting methods, the harvested honey has a mixture of broken wax, combs, bee larvae and pollen, hence it is of low quality, resulting in possible loss of income.

Policies and Legislation: In Uganda generally, there is lack of a clear policy and legislation to promote the beekeeping sub sector and on setting the market criteria and quality standards of honey as well as price controls. Pricing is left to the free markets under the forces of demand and supply. As honey is available on a seasonal basis, when in plenty, prices drop drastically which discourages the producers. Price fluctuations have of late highly characterised the apiary industry.

Poor quality controls: In some places, quality control is compromised owing to the crude methods of honey extraction where honeycombs are crushed along with the brood population and adult bees are killed by fire during the process of driving them away. This reduces swam size and yields. It also leads to lower quality honey with a characteristic smoky taste.

Inadequate marketing system: Lack of organised production and marketing systems exists. Currently, some beekeepers operate and market their honey individually, as some are not used to working in groups and so marketing in small quantities becomes difficult and discouraging. They are also ignorant of the local and international markets whose demands are increasing.

Inaccessible facilities for value addition: It is difficult to access processing and packaging materials, which when found, are very expensive for the farmers. The few honey-processing units (centrifuges) are not accessible to the apiary farmers who live far away (Figures 4 and 5).

Figure 5. A honey-processing centrifuge funded by NAADS at a farmers' processing site

Inadequate training and information on apiculture: Relevant training and information on apiary practices is scanty. Apiculture training is hardly included and considered in school syllabuses and where it is, it is not well covered although it is one of the fastest growing economic activities in the rural areas.

Limited Access to Financial Credit

Gender: Although women constitute more than 80% of the labour force in agriculture, there exist gender-based constraints in many parts of the country. There are prevailing behavioural taboos and cultural practices in some communities which discourage women from the apiary enterprise activities; however, since the intervention of many stakeholders including IFAD and with the introduction of modern beekeeping and hives, and technological practices, attitudes have been reversed as women and the youth are now encouraged to engage in most income-generating activities, including beekeeping.

Research and technology: In terms of research and technology, apiculture is a comparatively less researched and documented area in Uganda.

Way Forward

- Popularise apiculture as a sustainable income-generating activity to rural households
- More involvement of women and youth in apiculture
- Include apiculture in the school syllabuses as a special agriculture subject
- Intensify apiculture adaptive research and fact-finding
- Strengthen linkages between extension workers, farmers and researchers, plus the possible funding agencies
- Encourage use of the highly productive beehives using improved technologies
- Farmers to engage in apiculture based on an economic unit centered on gross margin analysis
- Establish an organised marketing and production system
- Solicitate funding to support apiary farmers.

Conclusion

Despite the constraints mentioned above, there is a potential for apiculture in Uganda. The government of Uganda through PMA focuses on apiculture as one of the prospective income-generating activities especially in areas where land has been highly fragmented. The government appreciates the effort and funding support extended by IFAD with its collaborators in many areas of implementation. Apiculture has come to the limelight because of its enormous contribution to the livelihoods of the poor farmers.

Apiculture in the District of Kilte-Awlaelo, Ethiopia

Fikre Berhe

Kilte Awlaelo Woreda Office of Agriculture, Wukro, Tigray, Ethiopia

Introduction

Many farmers in the district started beekeeping in 2003 as a component of integrated agricultural activities applied to solve food insecurity. From then on farmers have started to change traditional beekeeping to modern beekeeping system.

Beekeeping Activities

- Modern beekeeping system was fully implemented by 2004
- Inputs were distributed to the beneficiaries on a credit basis
- Beekeeping was started in potential watershed areas of the district
- 35% of the total households are beneficiaries, pracitsing both traditional and modern beekeeping
- Farmers get the following from beekeeping:
  - Bee colony
  - Honey
  - Wax.

Sources of Honeybee Colonies

- 74% of the colonies are now found in modern hives
- A farmer gets a colony through:
  - Swarming
  - Splitting (queen rearing)
  - Buying (purchase).

Distribution of Modern Beehives

- Distribution of beehives started in 1998 with 6 hives to 4 farmers, which has now reached 12,480 beehives and 6513 beneficiaries

Table 1. Distribution of modern beehives

Year	Modern hives	Beneficiaries		
		Male	Female	Total
1998	6	4	–	4
1999	43	23	–	23
2000	140	92	–	92
2001	190	130	11	141
2002	213	156	13	169
2003	125	69	18	87
2004	5241	2270	402	2672
2005	3601	1531	270	1801
2006	163	74	14	88
2007	76	35	9	44
2008	434	217	33	250
2009	2248	1010	132	1142
Total	12,480	5611	902	6513

Table 2. Number of hives, harvests and sales from 1998 to 2008

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number of modern hives	6	49	189	379	592	717	5958	9559	9722	9798	10,232
Number of harvested hives	6	43	126	178	201	625	1537	4621	7300	7888	8528
Percentage of harvest	100%	88%	67%	47%	34%	87%	26%	48%	75%	80%	83%
Honey quantity	2.4	15.05	76.2	23.6	83.3	162	201.7	1551	1997	1952.3	2993.6
Price per kg in Ethiopian birr											
Highest	20	20	23	24	25	30	35	35	45	50	60
Lowest	15	15	16	17	18	20	23	23	30	35	35

- Accessories (such as honey extractors and casting moulds) were also handed over
- During introduction of modern beekeeping, other activities introduced include:
  - Bee forage development
  - Bee management
  - Queen rearing
  - Training
- There are 170 technician farmers helping others in transferring colonies to modern hives, harvesting honey and queen rearing, etc.

Constraints

- Cost of beekeeping accessories
- Lack of knowledge and skill
- No value addition to the obtained hive products
- Low market linkages.

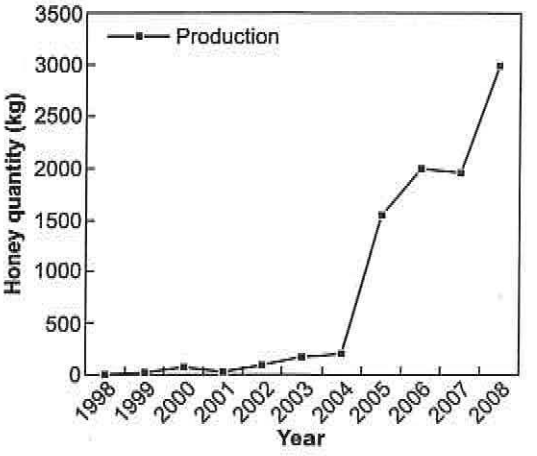


Figure 1. Honey quantity from 1998 to 2008

Beekeeping Activities in Al-Dhala Governorate, Yemen

Fuad Algailani and Ali Alawi Al-Hebshi

Al-Dhala Community Resources Management Project
Ministry of Agriculture and Irrigation, Yemen

Introduction

Apiculture is the second potential sector after livestock keeping. The number of beekeepers is high due to unemployment and poverty, simplicity of beekeeping and availability of rangelands. Wild beekeeping (in caves in the mountains) still exists. In Al-Dhala, 1500 beekeepers own about 7000 traditional beehives (Figure 1). Holdings range from 5 to 500 hives. They have no knowledge of other hive products. The majority of beekeepers in Al-Dhala move from one area to another in search of vegetation, in particular during the dry season from November to March. Honey is harvested two or three times a year using traditional harvesting and processing methods (Figure 2). Many beekeepers are not aware about modern apiculture.

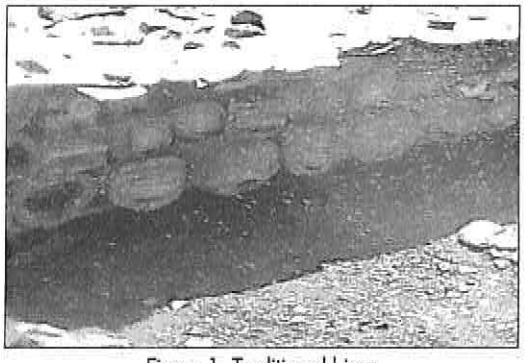


Figure 1. Traditional hives

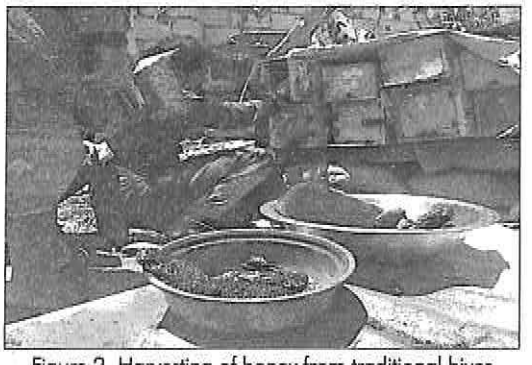


Figure 2. Harvesting of honey from traditional hives

Al-Dhala Community Resource Management Project IFAD Loan No. 638 Ye Supervised by the World Bank (project period from 2007–2013)

The project aims to achieve sustainable and equitable growth in the living condition of the people living in the rural area through rational development, use, and management of the resources and finding new income-generating opportunities.

Project Components

- Land and water development and conservation
- Agricultural development and improving living standards (livestock development sub-component, plant production improvement sub-component, apiculture development sub-component, and off-farm employment)
- Community development component
- Supporting of community self-initiatives
- Institutional support to agricultural office in the governorate.

Apiculture Development Sub-Component

The objectives of the apiculture sub-component are to: (i) transform the traditional low production beekeeping to modern high productive beekeeping through introduction of modern and modified traditional beehives, and sound hive management, and (ii) assist in establishing a network of centres for collecting, processing and marketing the production.

Results expected:

Result 1: Better understanding of the existing ecological system available for beekeeping in Al-Dhala

Main activities include:
1. Determining the rangeland carrying capacity;
2. Estimating the need for afforestation;
3. Estimating the potential to expand apiculture.

Result 2: Improving the methods of beekeeping and honey production

Main activities include:
1. Introduction of modern and modified traditional beehives;
2. Queen rearing;
3. Pest control and construction of disease laboratory.

Result 3: Improving the quality and value of the production

Main activities include:
1. Capacity building of the beekeepers through training;
2. Establishing of extension services;
3. Training of beekeeping leaders.

Result 4: Development of capacity building of the beekeepers

Main activities include:
1. Assisting in capacity building of the beekeepers' association;
2. Assisting in establishing of extension services;
3. Training of beekeepers leaders in the districts.

Developing the Beekeepers Institutional Structure

- Sensitising the beekeepers about the role of group work in improving apiculture and increasing production and returns of beekeeping
- Technical and managerial capacity building of beekeepers and association leaders
- Assisting in forming branches for the association in the districts and training the elected leaders
- Assisting the association at district level to analyse their situation and prepare their development action plans in a participatory way
- Assisting the beekeepers in establishing credit funds
- Advise and support the beekeepers association to establish stations or centres at district level for collecting, processing and marketing the honey production
- Establishing project apiary (Figure 3) for information and as demonstration site
- Provision and distribution of 2000 bee colonies for 400 new and young beekeepers, as credit to be paid back as colonies or in cash to purchase new colonies for others
- Facilitating a research project on pest control for MSc student
- Provision of beekeeping tools for beekeepers and 25 manual honey extractors to be distributed to collective centres
- Provision of manual wax machine.

Figure 3. Project apiary

Conducting a Programme to Build the Capacity of Beekeepers at Three Levels

- Training courses (37) for beekeepers at village level on modern beekeeping methods and hive management benefited about 740 beekeepers, and 60 were women
- Training courses (2) for leaders of the beekeepers at district level benefited 60 trainees (Figures 4 and 5)
- Advanced training for project staff benefited 10 trainees and 4 of them were women (Figures 6 and 7)
- Conducted experience and knowledge exchange visits to other governorates
- Organised 2 workshops attended by beekeepers from all districts to evaluate the status of beekeeping in Al-Dhala, i.e. the constraints, opportunities and solutions.

Figure 4. A training course for leaders of the beekeepers at district level benefitted 60 trainees

Figure 5. The beekeepers' leaders listening attentively to the discussion

Figure 6. Women participants at the advanced level training course for project staff in Al Dhala, Yemen

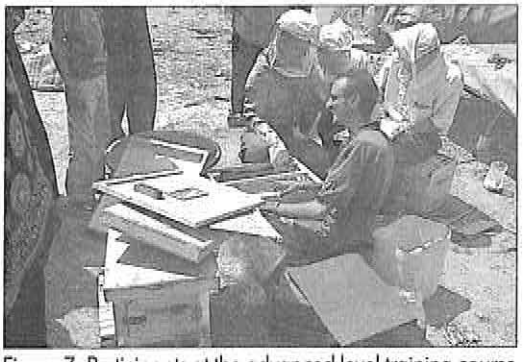


Figure 7. Participants at the advanced level training course for project staff in Al Dhala, Yemen

Effect of Project Activities on Apiculture in Al-Dhala

- Many beekeepers have started to use modern and modified traditional hives and requests for modern hives are increasing
- Beekeepers numbers are increasing
- There is demand for colonies as credit by new beekeepers
- There is increasing awareness on the modern and sound management methods of apiaries
- The membership of the beekeeping association is increasing
- There is increasing awareness on the importance of queen rearing.

Constraints of Apiculture Development and Up-Scaling

- Predominance of traditional beehives and traditional beekeeping
- Most beekeepers lack modern beekeeping knowledge
- Poor financial resources to purchase colonies and modern hives
- Absence of finance for new beekeepers
- The price of modern and modified traditional hives is high compared to the traditional hives (1: 5:10)
- Poor financial ability for established beekeepers to replace their traditional with modern hives
- Deterioration of the vegetation cover due to tree cutting for fuel, overgrazing and drought
- Belief that bees have a harmful effect on agricultural crops and in spreading plant diseases
- Presence of bees pests and diseases and low knowledge in control methods
- Price of beekeeping inputs and materials is high compared to the capabilities of beekeepers
- Poor institutional structures of the beekeepers
- The beekeepers are busy all year round with multiplication and harvest during the wet season and in transportation during the dry season and little time is left for institutional involvement
- Absence of legislation to organise the apiculture sector and beekeeping
- Absence of quality control
- Poor marketing channels
- Traditional methods of harvesting, extracting and packaging of honey and marketing.

Rehabilitation of the Apiculture Sector in Hadramout and Al Mahra Governorates in Yemen Due to Damage by Floods in 2008 (Funded by the Islamic Development Bank and implemented by *icipe*)

Background

Hadramout Governorate is the most famous governorate in honey production in Yemen. The famous Sidr honey is produced mainly from the

vegetation of some wadis in Hadramout, during the dry autumn season, which consists of mainly *Ziziphus* trees. Although the Hadramout environment is dry, to produce Sidr honey, hundreds of beekeepers from other governorates in Yemen migrate to Hadramout during autumn for two months to have one harvest. The Hadrami pure Sidr honey is famous in Saudi Arabia and the Gulf States and costs up to US$ 200 a kilo. The Sidr honey is an ecological product with special characteristics, which could be distinguished from other honey.

The Disaster

In October 2008, at the time of the Sidr season in Hadramout, an unexpected disastrous flood washed away about 200,000 beehives and beekeepers' property, including shelters and cars. Also many beekeepers lost their lives. Like other sectors, the apiculture sector infrastructure suffered huge damages. This included vegetation cover.

The most affected regions were:

1. Districts of Wadi and Desert Hadramout (60% damage)
2. Districts of Coastal Hadramout (30% damage)
3. Al Mahrah Governorate (10% damage).

The Grant and Activities

To assist in the rehabilitation of the apiculture sector, the Islamic Development Bank (IDB) allocated US$ 500,000. The implementation responsibilities were given to *icipe*, in cooperation with the Ministry of Agriculture and Irrigation in Yemen.

The activities planned and implemented were as follows:

1. Three training workshops, each for a region in the affected area, in modern apiculture and queen rearing;
2. One ToT training workshop for selected trainers in the regions.

The training aimed at enabling the beekeepers to produce strong queens and hence strong beehives with high productivity. It also aimed to:

- Avail ready queens for hive multiplication;
- Achieve sound management of hives and apiaries;
- Impart awareness to the beekeepers about the other hive products and their production;
- Provide 12,000 locally made modern Langstroth beehives to be distributed to the affected beekeepers in the affected regions as nominal gift from IDB to the beekeepers;
- Provide beekeeping tools and equipment (such as honey extractors) to be distributed to the beekeepers groups.

SESSION 3

Workshop Presentation: Sericulture

An Overview of Silk Production and Marketing in Ethiopia

Dawit Alemu, Amanuel Tamiru, Yitayal Abebe, Kedir Shifa and Metaferia Habthyimer

Ethiopian Institute of Agricultural Research
P.O. Box 2003, Addis Ababa, Ethiopia

Introduction

Sericulture, silk production from silkworms, is an agro-based industry, which was first developed in China. Since its discovery, the growing demand for silk has created income-generating opportunities to several developing countries of South East Asia. In recent years, its production is expanding in Africa, including in Ethiopia. Successful silk production endeavours involve several processes, the major being feed plant cultivation, silkworm rearing, silk fibre processing and marketing. There are a number of activities under these processes that engage a considerable number of people from different age and sex groups including youth, women and also the disabled throughout the year. In addition to creating enormous income generation and employment opportunities, cultivation of silkworm feed plants (mulberry and castor) provides several benefits such as erosion control, firewood, fence and construction material, landscaping, and industrial products, e.g. jam, acetic acid and oil.

The availability of required resources to produce silk and suitability of the agro-climatic conditions in Ethiopia have opened the opportunity to utilise the technology for income generation and creating employment to people in both rural and urban areas. Moreover, availability of feed plants at different locations of the country and the familiarity of Ethiopians in spinning of other fabrics (cotton) is believed to give an added advantage in adopting the technology. Currently, silk production has become one of the major micro enterprises promoted by the Ethiopian government and non-governmental organisations in many parts of the country as a tool to alleviate poverty mainly in rural and peri-urban areas. Several factors are attributed to the promotion of the technology, the major ones being: (i) it can provide additional income throughout the year, (ii) it involves all household members, (iii) it creates job opportunities for different age and social classes of people, and (iv) the product can fetch a good price and also can be a good source of foreign currency.

In Ethiopia, silk is currently produced mainly by the eri silkworm (*Philosamia ricini* Dru.) followed by the mulberry silkworm (*Bombyx mori* L), which were introduced by the sericulture research project of Ethiopian Institute of Agricultural Research (EIAR). Accordingly, efforts have been made in the past years to introduce, evaluate and adopt silkworm races/breeds and feed plants; investigate easy and economically feasible production techniques; and popularise silk production technologies to users at various levels. As a result silk is produced in many parts of the country, and is marketed locally and also exported to different countries (Habtyimer *et al.*, 2006; Tamiru, 2007).

Objective

The paper provides an overview of silk production and marketing along with the major constraints and opportunities in the country.

Methodology

The study used data from both primary and secondary sources. The primary data were generated using the rapid market appraisal (RMA) method through group and key informant discussions with actors along the market chain in Tigray, Amhara, Oromiya and Southern Nations, Nationalities and Peoples (SNNP) regions of the country. The secondary sources were organiaations involved in the sericulture sector (Ministry of Agriculture and Rural Development, EIAR, non-governmental organisations and private sources).

Results and Discussion

Overview of Silk R&D in Ethiopia

The history of silk production in Ethiopia goes back to the 1930s when Italians realised the suitable agro-climatic conditions for growing feed plants and rearing silkworms. They introduced and cultivated mulberry plants in over 30 locations and conducted silkworm

rearing at 11 sites. As a result, they demonstrated the potential of growing mulberry plants in diverse agroecologies in the country with altitudes ranging from 1500 to 2200 masl. Moreover, several visits paid by expatriate professionals confirmed the immense potential of the country for silk production. Sericulture technology got consideration by the national research system in the mid 1970s as a means of diversifying export crops following the sudden outbreak and devastation of coffee, the major export crop, by coffee berry disease (CBD). Consequently, research and development activities were initiated and efforts continued for some years in mulberry agronomy and silkworm adaptation experiments (Habtyimer *et al.*, 2006; Tamiru, 2007).

Sericulture received considerable attention in early 2000 by the research system, when it became one of the research projects with own funding. The Melkassa Agricultural Research Centre (MARC) has coordinated the research project nationally. Since September 2008, the project was re-organised under the Apiculture and Sericulture Research programme. The main activities include introduction, evaluation and adaptation of silkworm races and feed plants, evaluation of easy and economically feasible production techniques and popularisation of the technologies to users at all levels. Encouraging results have been achieved in this regard, especially in popularising the technology and disseminating selected silkworm races to various stakeholders in different parts of the country including research centres, Agricultural Techniques and Vocational Education Training (ATVET) colleges, Bureaus of Agriculture and Rural Development, NGOs, and others.

Development Support

In general, sericulture has been incorporated as an important component of millennium development goal 1 (MDG 1), to eradicate extreme poverty and hunger. The five-year Plan for Accelerated and Sustained Development to End Poverty (PASDEP) incorporated sericulture development in the document. The Ministry of Agriculture and Rural Development (MoARD) also prepared the five years' action plan (until 2010) in collaboration with regional governments.

As part of the implementation of this strategy, the R&D support for the promotion of silk production and marketing is provided by both the public and non-governmental organisations. The Ministry of Agriculture and Rural Development offices at federal, regional and woreda levels are providing support in terms of availing technologies, provision of training and linking farmers to markets. Trade and industry promotion offices at zonal and woreda levels have also promoted sericulture as a micro enterprise for increased job opportunities and income generation. Similarly, cooperative unions were engaged in linking silk producers to markets.

In terms of building capacity, the MoARD is strengthening ATVET colleges to offer sericulture as an independent course for development agents (DAs). In addition, the Ministry has delegated Alagae ATVET to serve as a centre of excellence for multiplication, dissemination and training in sericulture for wider extension programme. Accordingly, ETB 240,000 (US$ 24,000) for rearing house construction, around ETB 190,000 (US$ 19,000) for mulberry cutting purchase from abroad and ETB 1.3 million (US$ 130,000) for post-harvest processing plant establishment at the premises of the college was invested by the ministry. Moreover, the ministry has developed and distributed a sericulture package, from production to marketing to farmers in all regions.

The involvement of the different public offices varies across different regions in the country. In Amhara region, unlike other regions, three offices are involved in the production and marketing of silk with different roles and responsibilities. In general, micro and small-scale trade and industry enterprise promotion office was involved in promotion, group organisation and credit facilitation role with a view to creating job opportunities and income generation; cooperative unions in the marketing aspect while Bureaus of Agriculture and Rural Development were involved in provision of training and silk production inputs (like silkworms and feed plants). In other regions, the Bureaus of Agriculture and Rural Development at different levels play an overall role in the provision of training, silkworms and feed plants with associated rearing facilities and facilitating producers' linkage to markets.

The major constraint identified in the provision of support by the MoARD at different levels is the lack of a defined body fully accountable for silk production and marketing. As a result different offices and departments (within the same office) were involved in an unorganised way and without defined lines of responsibility. For instance, within zonal Bureaus of Agriculture and Rural Development, there has been confusion as to which department (animal production or natural resources) should deal with sericulture. Lastly, the responsibility for sericulture activities has been given to 'Apiculture, Sericulture and Skin and Hides' section under Animal Production Department following the Business Process Re-engineering reforms made in the office.

A number of NGOs are also involved in the promotion of the production and marketing of silk mainly by considering silk business as a microenterprise for improved income and livelihood of both rural and urban households (Table 1).

Table 1. NGOs involved in the promotion of the production and marketing of silk by region

Region	Name of NGO
SNNP	• SOS village • GOAL Ethiopia • CHF Durame • World Vision Ethiopia, Mudula ADP
Oromiya	• Support Africa (local NGO) • World Vision Ethiopia, Adama ADP • CCF Meki project • Care Ethiopia, West Harerghe office
Amhara	• Save the Children UK, Woldiya area programme • SIDA project • Bridge to Israel in Ethiopia

Research Activities

Melkassa Agricultural Research Centre (MARC) of the Ethiopian Institute of Agricultural Research coordinates the sericulture research activities nationally. However, several research centres of regional research institutes such as Adet Agricultural Research Centre of Amhara Regional Agricultural Research Institute (ARARI), Jimma and Bako Research Centre of Oromiya Agricultural Research Institute (OARI), Hawassa Agricultural Research Centre of the Southern Agricultural Research Institute (SARI) and Mekelle Research Centre of Tigray Regional Agricultural Research Institute and universities like Mekelle University and Ambo University College are involved.

Melkassa Agricultural Research Centre, EIAR: Melkassa Agricultural Research Centre is the focal point for research and most of the development activities undertaken in the field of sericulture. The research focuses on introduction, evaluation, and adoption of silkworm races and feed plants, modest agronomic research and also investigation of easy and economically feasible production techniques. Similarly, the centre is engaged in popularisation of available sericulture technologies (silkworms, feed plants and production techniques).

The introduction of silkworm races by MARC is targeted at selecting silkworm races that provide higher cocoon yield with desirable characteristics including high hatching capacity, higher percentage of silk ratio, low mortality rates, better cocoon cooking, reelability, spinning and filament length, and pest resistance. At the early stages of research endeavours, mulberry silkworm races M113 and M134 univoltine types were introduced from Poland and evaluated. Similarly, NB_7 and NB_{18} bivoltine silkworm races were obtained from India for evaluation. In later years, three bivoltine races (CSR_2 x CSR_4, PM x CSR_2 and Kai, Ryo x Ake, Bono), one multivoltine (white x yellow) mulberry silkworm races and five eri silkworms races (10/5.6, 10/5.62, Tame, J-7 and 10/3.4) were introduced from Japan, India and Vietnam. As a result, two eri silkworm races (Tame and 10/3.4) and bivoltine mulberry silkworm races (PM x CSR_2 and Kai, Ryo x Ake, Bono) were recommended after evaluation, as they were adaptive to Ethiopian climate conditions. Moreover, modest research carried out to recommend suitable agronomic practices showed application of 200 kg N/ha/yr and medium pruning gave better yield of mulberry leaves under irrigated conditions (Habtyimer *et al.*, 2006, 2008; Tamiru, 2007).

To effect fast diffusion of silk production technologies to target clients, several theoretical and practical trainings were offered in the area of feed plant growing, silkworm rearing and fibre processing. Efforts were also made to further popularise the technology through various means such as mass media (radio, TV), workshops and exhibitions. Moreover, several silkworm seeds, planting material and production manuals and leaflets published in the local language (Amharic) and English, were distributed to users throughout the country (Habtyimer *et al.*, 2006; Tamiru, 2007).

Adet Agricultural Research Centre of Amhara Regional Agricultural Research Institute (ARC-ARARI): Promotional activities on silk production went ahead in the region. Micro and small-scale trade and industry enterprise promotion agency has been responsible for promoting silk production in the region. The research centre started to do this in 2004. The major involvements include: (i) carrying out the introduction and evaluation of mulberry varieties (2 mulberry varieties from Kenya, 4 from India and one recently received from Taiwan); (ii) carrying out collection of local mulberry cultivars from nearby; (iii) introduction and evaluation of silkworm varieties (from India, Korea and MARC) and (iv) awareness creation to visiting guests.

The Adet Agricultural Research Centre (under Forestry Department) secured a farm called Bezawit near Bahir Dar Town with a total area of 1.3 ha

mainly for silkworm feed plants (mulberry and castor) cultivation and for research purposes. Out of this 0.75 ha is currently being used for growing mulberry and forest trees. Even though Bezawit farm has some forest tree trials it is mandated for sericulture research, i.e. feed plant evaluation and adaptation, and silkworm rearing and evaluation studies. Varieties K2 and S13 (from India), Kenya variety (from ICRISAT), a variety from Thailand and a local collection of mulberry and some forest species are currently available at Bezawit farm.

Mekelle University: Sericulture activities were started at Mekelle University, Department of Dryland and Horticultural Science, in 2004, for demonstration purpose. They obtained 2 eri silkworm races from MARC and 3 mulberry silkworm races (1 multivoltine and 2 bivoltine) from India. Efforts were made to prepare a business plan by establishing a task force from entomology, resource economics, animal science and crop departments. Moreover, curriculum development is underway to offer short- and long-term sericulture courses. In general, the main involvements of the Dryland and Horticultural Science Department at Mekelle University include: (i) training for DAs and farmers by department staff in collaboration with Mekelle Agricultural Research Centre and the regional agriculture bureau. For example, recently they gave training to 30 farmers on silk production skills for 3 weeks. Moreover, the department gives on-work training and advisory service for silk producers as required, through the technician; (ii) distribution of silkworms for farmers on request; (iii) conduct modest research trials such as silkworm feed plant adaptation and evaluation trials and (iv) interested 4th year undergraduate students carry out their graduate research projects on different aspects of silk production.

Hawassa Agricultural Research Centre of the Southern Agricultural Research Institute (SARI): Hawassa Agricultural Research Centre started sericulture research and development efforts in 2004. Both eri and mulberry silkworms were brought from Melkassa Agricultural Research Centre (MARC); however, the silkworm feed plants (mulberry and castor) were locally collected. The Centre has been involved in sericulture activities through: (i) silkworm seed maintenance, multiplication and distribution for silk producers in the region; (ii) training and demonstration (on-station and on farmers' sites) of silk production as additional income-generating activity to farmers and interested individuals and (iii) modest research such as study on feed preference, and castor/mulberry collection and screening. The research centre has 0.25 ha of mulberry plantation and 1.5 ha of castor plantation for research and silkworm rearing purposes.

Characterisation of Silk Production System

Silk Technologies and Their Major Sources

The silk technology package can be divided into three categories: (i) the silkworm types, (ii) the feed types and varieties and (iii) the rearing and processing facilities. MARC of the Ethiopian Institute of Agricultural Research (EIAR) has introduced two major types of silkworms: (i) mulberry silkworm (*Bombyx mori* L) and (ii) eri silkworm (*Philosamia ricini* Dru.). These silkworms are different mainly in terms of type of feed they consume and biological parameters. The former is monophagous and feeds on mulberry leaves while the latter is polyphagous and feeds on leaves of different plants like castor (*Ricinus communis*) and cassava (*Manihot utilissima*). Currently, both silkworms are maintained and multiplied at the centre and are given to farmers and different development partners for further dissemination.

In terms of feed for silkworms, there is a strong research support for castor, where the research system has already released two varieties of castor even though the released varieties are mainly grown for their oil content. Besides, the local varieties growing in abandoned areas and as hedges can serve as source of silkworm feed. Accordingly, local mulberry cultivars have been collected from different sites and cultivated using recommended agronomic practices to serve as silkworm feed. Moreover, two mulberry varieties (K-2 and S-13) introduced from India through MoARD were found to adapt to different agroecologies of the country especially low to mid high altitude ranges and are currently distributed in different parts of the country. However, there is a report that in some locations, mainly high altitude areas with frost during some seasons of the year, the varieties are not thriving.

The major source of silk technology for farmers in the country is Melkassa Agricultural Research Centre of the Ethiopian Institute of Agricultural Research (EIAR), which has the mandate for introducing the different silkworm races and feed plants in the country. In addition, with considerable variability among regions, the other sources are research centres of regional research institutes, ATVET colleges, and higher learning institutes like Mekelle University and Mertolemariam Forestry College. Unlike other regions,

in Southern Nations, Nationalities, and Peoples (SNNP) region different silkworm multiplication centres that are established in different woredas and also silk producers' cooperatives are serving as major sources of silk technology (Table 2).

Melkassa Agricultural Research Centre recommends the existing rearing and processing facilities that are promoted nationally. These include rearing beds and trays made of wood, timber or bamboo; mountages made of hard paper, plywood or plastic; oviposition substrate made of bundles of dried grass stems *(karica)* and cocoon storage made of bamboo baskets.

Silk Production Systems

Currently, the silk production system can be categorised into two. The first system is the one undertaken as a sideline activity by rural and urban households, and is mainly characterised by its small-scale nature without major investment in required facilities like housing and rearing facilities, involvement of all household members in the activity, and limited engagement in processing. The second system is characterised by the commercial nature of the production, where there are full-time workers, existence of modern rearing facilities (like feeding tray and stand, and mountages), and engagement in processing.

On average, one silk production cycle (from egg to cocoon harvest) takes around 2 months. After mating of adult silkworms overnight, the females are separated and placed in a *karica* (egg laying structure made of bunch of grass stems). The *karica* with female moths is suspended from a string in a vertical position (preferred for oviposition). The female starts laying eggs 72 hr after mating. The eggs are disinfected with 2% formaldehyde (formalin), washed with detergent

Table 2. Sources of silk technology in Ethiopia by region

Region	Silk technology sources	Type of silk technology
SNNP	Hawassa Agricultural Research Centre	Eri and mulberry silkworm, castor seeds and mulberry cuttings
	Melkassa Agricultural Research Centre (MARC)	Eri and mulberry silkworms
	Shebedino Woreda Silkworm Multiplication Centre (Sidama zone)	Eri silkworms
	Silk Producers Union in Alaba woreda	Eri silkworms
	Alage ATVET College	Mulberry cuttings and silkworms
	Meskan Woreda Silkworm Multiplication Centre (Butajira)	Eri silkworms
	Lemmu Kalisha Silk Producers Cooperative (Hossana)	Eri silkworms
	Rural Women Extension Group, Wolayita Zone Agriculture and Rural Development Office	Eri silkworms
Tigray	Wukro ATVET College	Mulberry silkworms
	Hiltew Lealew Woreda Agriculture and Rural Development Office	Mulberry cuttings
	Department of Dryland and Horticultural Science, Mekelle University	Eri and mulberry silkworms
	Tigray Development Association (TDA)	Mulberry cuttings
Amhara	Mertolemariam Forestry College	Eri silkworms
	Melkassa Agricultural Research Centre (MARC)	Eri and mulberry silkworms, castor seeds, mulberry cuttings
	Adet Agricultural Research Centre	Mulberry cuttings
	Kombolcha ATVET College	Eri silkworms
	Ataye ATVET College	Eri silkworms
Oromiya	Jimma Agricultural Research Centre	Eri silkworms
	Chiro ATVET College	Eri silkworms
	Agarfa ATVET College	Eri silkworms
	Hirna and Nekemte Plant Health Clinic	Eri silkworms and castor seeds

and rinsed in cold tap water to remove traces of formaldehyde, and then dried under shade and kept in newspaper and/or cartons until hatching. Egg hatching takes 10–14 days while the larval and pupal periods take 20–25 days and 10–14 days, respectively depending on temperature. Cocoons are kept for 7 days before harvesting and sun drying for selling.

Almost all producers keep eggs for the subsequent production. Normally, eggs are kept inside on clean newpapers/paper inside cartons for subsequent production after collecting silkworm eggs from egg laying structure, *karica*. The top of the carton is usually covered by a piece of cloth to avoid desiccation.

Basically the farmers produce silk throughout the year but due to shortage of feed during the dry season, they tend to reduce the production during this time, especially those living in relatively drier areas. Farmers with access to the existing market produce 3–5 times a year. From the survey, it was recorded that cocoon production level varies widely ranging from 2 kg up to 150 kg per production cycle per producer.

As per the reported productivity level, producers get about 1000 eri and 2000 mulberry silkworms to produce on average a kg of cocoons, respectively.

The Status of Silk Value Addition

The limited experience in value addition shows that the major silk processing operations such as boiling, degumming, spinning and weaving are undertaken mainly through manual (hand) processing equipment and it is commonly done by women. The pioneering and major actor among the cocoon processors in the country is Saba Har, a private company located in Addis Ababa. It was estimated that 80% of the spinning work was done manually while only 20% through wheel spinning. The efficiency of such manual processing is low and it is costly. The estimated spinning efficiency is 60–100 g/day/person, which is about 3 *likakit* (rolls) of silk fibre per day.

Simple hand processing is carried out, where the cocoons are boiled and spun by hand in a *likakit* and/or wheel spinner to get silk fibre. The silk fibre is woven using traditional handloom machines and knitted to make traditional scarves, blankets and shorts.

Spinning using a spinning wheel is reported to improve considerably the efficiency of the operation with about 100–200 g of spun silk fibre per day. However, the availability of spinning wheels is limited for wider use not only by Saba Har but also to others who may be interested. Therefore, it is important that such equipments are introduced for better processing efficiency.

The poor quality of supplied cocoons is another constraint reported. This is mainly due to the poor skill of producers in post cocoon handling, particularly the drying of cocoons and also the absence of cocoon drying facilities.

The total amount of cocoons processed by Saba Har is summarised in Table 3. It was noted that the processor is not getting the required quality and quantity of raw silk. However, there is an increased trend in terms of better quality and quantity of cocoon production since the start of work.

Product Handling and Marketing

In the country, producers do not practice special cocoon handling. After harvesting from mountage, collected cocoons are sundried for 5 to 7 days using sacks and bamboo trays in SNNP and Oromiya regions, and using cotton cloth and sacks in Amhara and Tigray regions. It was observed that the cocoon-storing box, made locally from bamboo, contributed to better-quality cocoons as it provided good ventilation.

The main buyers in the SNNP are Saba Har PLC, Datoo Hand Spun Ethiopian Silk PLC and cooperative unions like Awassa Zuria and Damota farmers'

Table 3. Silk cocoons processed by Saba Har by region and year (in kg)

Year	Grade	Regions				
		SNNP	Oromiya	Amhara	Others	Total
2006/7 (12 months) July 2006–June 2007	1st Grade	456.60	354.60	309.3	96.40	1216.9
	2nd Grade	378.80	191.00	123.2	57.00	750.00
	3rd Grade	143.40	60.00	79.5	26.00	308.90
	Total	**978.80**	**605.60**	**512.00**	**179.40**	**2275.80**
2007/8 (6 months) July 2007–December 2007	1st Grade	161.2	145.7	56.3	44.3	407.5
	2nd Grade	203.5	231.8	17.1	4.4	456.8
	3rd Grade	326.9	85.7	4.9	8.5	426
	Total	**691.6**	**463.2**	**78.3**	**57.2**	**1290.3**

unions. The cooperative unions purchase cocoons from farmers and then sell to processors like Saba Har PLC with minimum profit margin. The dominant purchaser of silk in SNNP is Saba Har, which collects the product also through the linkage commonly created by zonal and woreda bureaus of Agriculture and Rural Development. Datoo Hand Spun Ethiopian Silk PLC is also engaged in production in addition to processing and marketing of silk. Though Datoo mainly use the produced cocoons for own processing, they also purchase cocoons from other cocoon producers in the vicinity. The dried cocoons are hand spun to obtain silk fibre and then woven into clothes (scarves, shirts, etc.) using traditional weaving handloom. The Datoo Hand Spun PLC is not linked to the national market. It purchases cocoons from silk producers in Hawassa town and its vicinity in addition to the cocoons it produces.

In Oromiya, Amhara and Tigray, silk producers have reported lack of market as their major constraint as they do not have direct access to the central market in Addis Ababa. The producers were able to sell to Saba Har through linkage created by woreda and zonal bureaus of Agriculture and Rural Development. In addition to MoARD, zonal micro and small-scale trade and industry enterprise promotion offices have played an important role in linking silk producers in Amhara region.

In general, the price setting mechanism is so simple that the purchaser, Saba Har, fixes the prices. However, most of the silk producers, mainly in Oromiya, Amhara and Tigray, did not have access even to this market. In many instances, the produced silk with the assumption that the promoter will buy, had no purchaser, which has created disincentive to producers to engage in silk production. It is evident that a considerable number of producers have quit silk production due to the lack of access to market.

As in the case of Datoo Hand Spun Ethiopian Silk PLC, there is an attempt by the Debere Zeit dairy farm to process produced and also purchased cocoons locally using the cotton spinning method used by women. It was reported that cocoon spinning is a bit more difficult and time consuming as compared to cotton spinning and the performance was 3 *likakit* of silk fibre/day where 1 *likakit* weighs 25–30 g. Eventually this company started selling the cocoons and also the spun silk to Saba Har.

ABC, an NGO working on promotion of the production and marketing of silk, has been involved in the purchase of cocoons in Amhara region. However, the effort by this NGO was not successful as it used inflated prices for cocoons during the promotion, which discouraged many farmers, as they could not get the value they expected in the actual market after producing the cocoons.

Even though it is mainly for educational purposes, Alage ATVET College has traditional processing (spinning and weaving) machines, where the produced cocoons are spun to get silk thread, which is woven on a traditional handloom to make silk products. Some of the products are made of silk fibre mixed with cotton.

Thus, it is necessary to develop the silk market first along with the promotion of production. This involves promotion of silk processing locally along with improved linkage to medium level processing in the short run and large-scale processing in the long run. Unless there is competitive market with considerable number of buyers together with local capacity of alternative small-scale processing, the production will be hindered.

In general, marketing of silk in the country is constrained by the size of the market, the poor marketing arrangements and also linkage among the market actors. Saba Har mainly purchase cocoons from individual households/producers involved in silk production in different parts of the country. Damota Farmers Union in Wolayita Sodo from SNNP is involved in purchasing cocoons from individual producers and supplying to Saba Har. An attempt was made to link the production of Gozamin Farmers Union in East Gojjam of Amhara region with Saba Har during the 2006/7 fiscal year, but it was not successful due to limited amount and poor organisation of the supply. The role of cooperative unions and their respective primary cooperatives in aggregating and grading of individually produced silk is reported to be a good initiative in terms of creating better access to market and also in improving the existing marketing system of silk in the country. In addition, there are intermediate traders, who collect from individual producers and supply to Saba Har.

Silk processors, mainly Saba Har, produce different products from the limited supply for both domestic and export markets. The domestic market is targeted mainly to mid-high income category of the population in Addis as the prices are relatively high and also the target markets are mainly shops at different hotels, where such people can easily access the products. The export market comprises wholesalers and retailers in Canada, USA, Australia, UK and South Africa.

Major Production and Marketing Constraints

As an underdeveloped sector, the major constraints in silk production and marketing are related with limited awareness, know-how and skill, and infrastructure.

The different public institutions engaged in the promotion of the sector have critical shortage of skilled manpower and associated budget along with poor coordination of efforts among the different organs within and among institutions.

The involvement of different public organisations shows that public support is not provided in a coordinated and holistic manner to promote the sector. This has been reported to provide a complete silk production technology provision (silkworms, feed plants, rearing and processing equipments), appropriate capacity building (for promoters, producers, traders, processors), and creation of markets (processing capacity, market linkage along the value chain).

As the result of the uncoordinated intervention of both the public and NGOs, the following constraints were reported:

(1) The major constraints for silk producers are reported in their order of importance to be:
   - Poor market information and absence of good marketing linkages and limited market. In all surveyed areas, producers reported the existence of a single buyer;
   - Limited availability of inputs (silkworms, seeds of feed plants, and rearing facilities);
   - Poor quality of silkworms due to continuous selfing (inbreeding) of existing silkworms. No replacement or additional supply is undertaken;
   - Disease and insect problems on feed plants (spider mites, whiteflies, aphids, blight, rust and powdery mildew).

(2) The major constraints for processors include:
   - Limited supply from producers;
   - Poor quality of cocoons supplied by producers;
   - Lack of modern processing equipment, which makes spinning tedious and time consuming and also reduces the quality of thread. Also, the thread obtained by hand spinning is not uniform in thickness;
   - High price of cocoons as compared to international prices.

(3) The major constraint reported by experts in the public sector is lack of skilled personnel at different levels. This is worsened by a high staff turnover.

Conclusions and Recommendations

Sericulture has a good potential in Ethiopia due to the agro-climatic suitability, abundance of labour and potential market. Currently, the sector is promoted by both the public and NGO organisations and is considered as an income-generating activity, both in rural and urban areas. It has research support, where both silkworms and different feed plants are maintained, multiplied and disseminated to users. Similarly, MoARD and other public institutions like micro enterprise promotion offices at different levels give the development support. Different NGOs are also engaged in promoting the sector.

However, the research results indicate the following issues require due attention if the sector is to play its expected role:

(1) There is a need to design an integrated approach to promote the sector in a coordinated and holistic manner so that the different components of the sector will reach the producers, i.e. complete silk production technology (silkworms, feed plants, rearing and processing equipments), appropriate capacity building (for promoters, producers, traders, processors), competitive markets (processing capacity, market linkage along the value chain);

(2) The need to empower the value chain with efficient marketing system. Currently, there is no central market for silk cocoons or processed cocoons where competitive prices can be set. The major market is Saba Har, which is buying from producers all over the country;

(3) There is a need to improve the processing capacity and promotion of engagement of different processing companies in this venture for improved competition and efficiency;

(4) There is a need to further improve the human capacity at different levels to promote the sector.

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SESSION 4

Workshop Presentations: Apiculture and Sericulture

Arabic Article

Zaghyl Fathy Khalil
Sericulture Research Centre
Gaza, Egypt

ريرحلا و لحنلا عورشم

ويار وبا ليلخ ولغز

ةمدقم

يوجد ريرحلا في مصر منذ وقت بعيد حتي أن لكل مزارع يحرص علي أن يكون علي رأس حقله شجرة تـوت)والتـوت القريبة من الصنف البلدي(وأصبح ذلك موروث لدي المزارعين كما هو الحال في النحيل، كما هو الحال في النخيل أيضا ، نجد أن لكل مزارع يمتلك من 1-4 شجيرات من النخيل يأكل منها ويهدي منها ، والباقي يبقي علي النخلة حتي يتساقط .غير أنه لم يكن هناك أي تربية لدودة الحرير في منطقة النوبارية وعلي وجه التحديد قرية عبد الحليم محمود وتم توزيع أراضي قرية عبد الحليم محمود علي شباب الخريجين منذ عام 1 وبدأت عملية الاستصلاح في تلك الاراضي الرملية.

عورشم الحرير

حيث قام الدكتور/ أسامة محمد غازي مدير المشروع بجانب أصناف التوت الموصي بها)التوت الهندي والرومي والصيني(وتم زراعتها وتربيتها بالطرق الحديثة التي لم تكن معروفة لدينا .

وقد د/ أسامة محمد غازي عدة دورات تدريبية عن أهمية مشروع الحرير :

1- دورات تعريفية للعاملين بالمشروع.

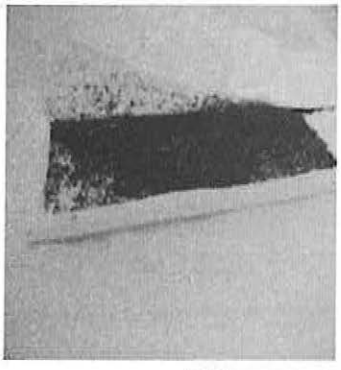
2- دور المرشد الزراعي وطريقة العناية بالنحل.

3- دور المرشد الزراعي وطريقة العناية بالنحل وإقامة المشاتل النحلية.

4- دورات تقييم حقول التوت.




5- دورات تدريبية العاملات الصغيرة.



6- دورات تربية الاعمار الكبيرة.

حيث أصبح لدينا الان معرفة بكيفية تربية دودة الحرير بالطرق الحديثة والعناية بأشجار التوت غير أنه توجد عدة مشاكل تعترض المشروع :

1- لم يفي المشروع بما وعد به منذ بدءه حيث لم يقام حتي الان مركز التسويق

2- وجود كمية كبيرة من الحشائش بالأراضي وخاصة الاراضي المخصصة للجمعية مما يحتاج الي بند للصرف عليه لمقاومتها يدويا أو بالمبيدات.

3- ضعف بعض الاراضي بشكل ظاهر مما يحتاج الي كمية تسميد كبيرة جدا

4- عدم وجود مجفف للشرانق مما يسبب مشكلة وخاصة في فصل الخريف حيث تكون حرارة الشمس ضعيفة لقتل العذاري

5- عدم وجود ماكينات للحل مما أدي إلي توقف المشروع حتي عملية إنتاج الشرانق

النحل

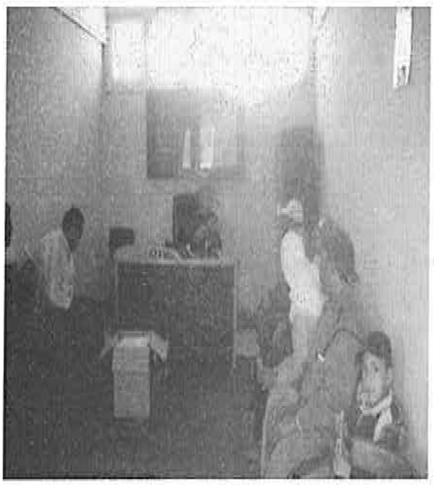
ولقد قام الدكتور/ أسامة غازي مدير المشروع بتوزيع 100 خلية علي المزارعين المشتركين في المشروع بحيث تم توزيع خلايا النحل علي حسب مساحة الارض المنزرعة بالتوت حتي يتم التكامل بين النحل والحرير.

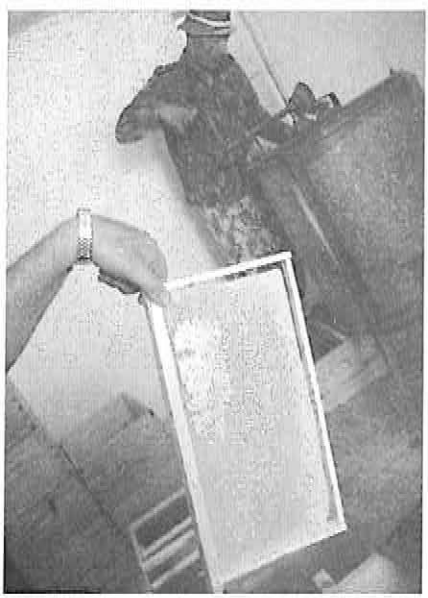
<u>**وقام بعقد عدة دورات تدريبية علي رعاية النحل:**</u>

1- رعاية النحل وتغذيته.

2- جمع العسل.

3- فرز العسل وتعبئته.





المشاكل والصعوبات

1- يوجد في مصر محصولان للعسل المو الح وتوجد بكثرة في منطقة النوبارية، والمحصول الثاني محصول عسل البرسيم ويتم جمع البرسيم قبل الإزهار في منطقة النوبارية ولذلك يتم نقل المنحل الي مناطق تواجد البرسيم.

2- نظرا لأن كل حقل من الحقول يحتوي علي عدد من أشجار النخيل التي يتم أكل بعض ثمارها وترك البعض الاخر مما يعمل علي نمو وزيادة دبور البلح الذي يعمل علي مهاجمة الخلايا وتدميرها في الفترة ما بين شهر يونيو إلي نهاية نوفمبر.

Status of Apiculture and Sericulture Pilot Project in Kassala State, The Sudan

Khalid Mohamed Shareif Elmahi
Sudan

Introduction

Kassala State is situated in eastern Sudan bordering Eritrea and Ethiopia to the east, Red Sea State to the north, Gedarif State to the south and Nile and Khartoum states to the west. It lies between latitudes 14° 45' and 17° 65' north and longitudes 34° 30' and 37° 55' east.

It covers a total area of 42,282 km², which comprises 1.8% of the total area of Sudan. The total population is estimated at 1.7 million with 42 people per km². City dwellers are estimated at 35%, rural inhabitants are 53% while nomads comprise 12% of the total population.

Goal

The national ecosystem is protected and strengthened through improved silk and honey based technologies for generating incentives in collaborative management with the poor communities.

Successful mainstreaming of ecosystem conservation is achieved through adoption of collaborative management using income-generating activities through sericulture and apiculture as incentives for communities.

The Islamic Development Bank, OPEC, *icipe*, IFAD, Viking Limited and Biop Ltd and participating countries (in kind) funded the pilot project for USD 4,575,000. *icipe* staff conducted field visits to Kassala area. The government agreed to offer a piece of land to construct a marketplace at the eastern nursery of the Horticulture Department, and the rest of equipment was launched by *icipe*.

After the last visit on the 17th–22nd March 2008 and the meeting held in the IFAD guesthouse, we agreed on proposed activities for the next plan period which were:

- Increase in mulberry acreage (15 feddans) by September 2008;
- Construction of marketplace buildings;
- Supply of 2 reeling machines by September 2008;
- Silkworm rearing/beekeeping training on-site by *icipe* staff in August/September 2008;
- Supply of 60 hives to 15 farmers;
- Construction of 2 rearing houses (Priority to Mr Babiker for training purposes).

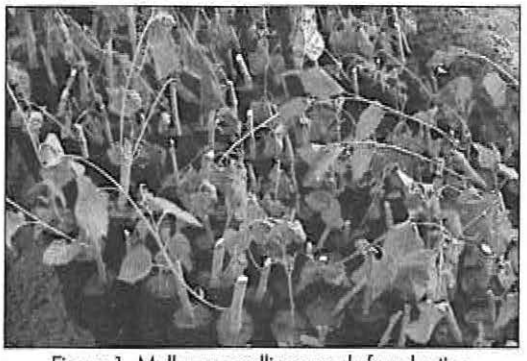


Figure 1. Mulberry seedlings ready for planting

Figure 2. Beehives and equipment

Achievements

- Establishing of the Beekeeping and Sericulture Producers Association in Kassala and Gash areas.
- Achieved 7 feddans, but continue to reach the targeted 25 feddans.
- We received one computer HP530 (laptop) in July 2008 that helps in easy and fast communication.
- Completion of all procedures to buy 60 beehives and beekeeping equipment. After receiving them, we shall transport and store them before beginning to distribute them according to the planned arrangement: Each farmer shall receive 4 hives for each feddan of mulberry cultivated, but at Wagar area we need more discussions.

Figure 3. A part of the thriving mulberry plantation

Figure 4. The project's HP530 laptop

- Distribution of 50 hives for 15 farmers was completed and they began operations after we assisted them to gather and domesticate the wild local types of bees.
- Conducted 30 field surveys to the horticulture areas to assess bee colonies, so as to get a clear map for distribution of the beehives in relation to the target farmers. This was done in collaboration with local beekeepers and technicians.
- Identification of the three sites for the rearing houses with the volunteer farmers (one at N. Sawagi, one at S. Sawagi and one at Wagar area) and the cost was determined (materials and labour). Construction of the rearing houses was finished according to specifications.
- Supplied 11 farmers with fertilisers, cost of electricity, fuel, pruning knives, plastic bags, and packing materials for mulberry cuttings preparation and growing.
- WPB of July 2008–June 2009 was rejected due to limited funding. A new WPB for 2009 with a reduction of 80% from the previous one was raised.
- Negotiations with the General Director of MAI, PCU Kassala and CCU Khartoum were held three times on how to construct the marketplace buildings on the allocated piece of the land, although the cost had gone up for the government at the beginning of 2008 and 2009.

Constraints

- The proposed training with *icipe* staff has not yet started.
- More training on silkworm rearing and beekeeping with the domestic types of bees is essential for the farmers.
- High temperatures, limited electric supply for irrigation purposes, and drought struck in March to June 2009 and had a destructive effect on

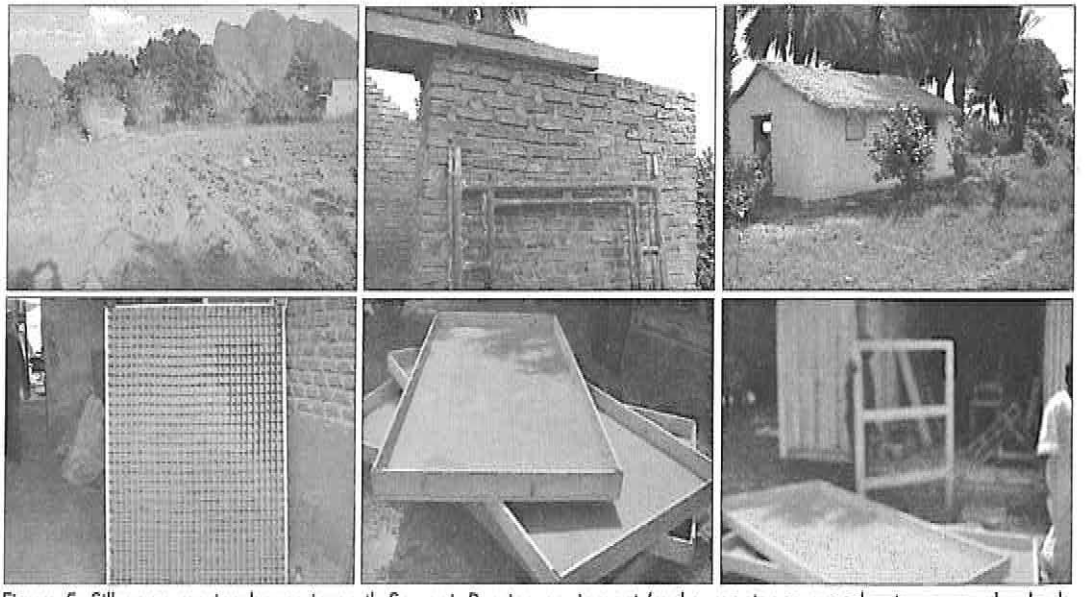


Figure 5. Silkworm rearing house in north Sawagi. Rearing equipment (racks, montages, wooden trays, wooden beds, mats) were prepared

Figure 6. Mulberry cuttings preparation

mulberry seedlings, plants and trees, but efforts are being made to overcome this problem during the coming rainy season.

- The new association is not active due to some constraints that occurred later on.
- Construction of the marketplace buildings is not yet achieved.
- Delaying of the proposed visits and training by *icipe* staff has affected the confidence of the farmers.

Figure 7. Diseased mulberry plants

Mount Kenya East Pilot Project for Natural Resources Management

Boniface Mutuku Kikuvi

Mount Kenya East Pilot Project for Natural Resources Management
P.O. Box 996-60100 Embu, Kenya

Milestones

- The project period is 2004–2011
- Project year 1 was for start-up activities
- Project year 5 was for mid-term review
- Project year 6 is ongoing
- Project year 7 is for completion and evaluation.

Objective

The overall objective is to reduce poverty through improved food security and income levels of the farmers and rural women by promoting:

- More effective use of natural resources;
- Improved access to water;
- Introducing better farming methods; and
- Introducing water management practices for sustainable use of land and water resources.

Coverage and Outreach

The project is implemented in 8 administrative districts. These include:

1. Embu
2. Mbeere
3. Meru South
4. Maara
5. Imenti North
6. Imenti South
7. Meru Central
8. Tharaka.

Implementation Approach

- Participatory and integrated approach
  - Community-led implementation approach
  - The communities identify their development constraints and are assisted to develop sustainable solutions through CAPs based on their priorities and local capacity
  - Annual work plan and budget (AWP/B).

Components

- Water Resources Management
  - River Basin Management
  - Community Water Development
- Environmental Conservation
  - Community Natural Resource Management
  - Ecosystem Rehabilitation and Management
- Rural Livelihood
  - On-farm Soil and Water Management
  - Income Generating Activities
  - Marketing
- Community Empowerment
  - Community Development
- Project Coordination and Management.

Stakeholders

- Ministry of Water and Irrigation—Lead Agency
  - Ministry of Finance
  - Ministry of Agriculture
  - Ministry of Livestock Development
  - Ministry of Gender, Children and Social Development
  - Ministry of Forestry and Wildlife (Kenya Wildlife Service and Kenya Forest Service)
  - Ministry of Environment and Mineral Resources (National Environment Management Authority)
- Local communities
- CBOs/NGOs.

Overview of Income-Generating Activities

Objective of the Rural Livelihood Component

To increase food security and reduce poverty at the household level through sustainable on-farm incremental food production and on- and off-farm income-generating activities.

Rural Livelihood Component

Focuses on three areas:

- On-farm soil and water management
- Income-generating activities
- Marketing.

Technology Dissemination

- Training farmers on improved crop and livestock husbandry practices where the focus is on both diversification and intensification
- Improved seed and planting materials
- On-farm trials
- Training of extension staff.

Main Activities for Income Generation

- Intensification/diversification of agricultural production and enhancing processing and preservation of agricultural products including value addition
- Training on business management and micro-credit
- Promotion of livestock production, apiculture and support to animal health.

Apiculture

- Beekeeping identified in the project design as an income-generating activity for farmers
- The project has promoted this activity across the area
- Over 50,000 households are engaged in beekeeping (both directly/indirectly)
- Marketing of beekeeping products is not organised in the region
- Different stakeholders are involved in promotion of the subsector. These include:
  - Suppliers of equipment/accessories
  - Honey/wax traders
  - Processors
- Prices of honey have remained low since little value addition is done
- Local uses
  - Sold as raw honey/semi refined for household use
  - Medicinal
  - Beer brewing (local)
  - Dowry payment (part payment).

Opportunities

- The project area has high potential for beekeeping due to the following:
  - Adequate forage
  - Many rivers and so crops are grown throughout the year
  - Ongoing tree planting by the project
  - Irrigated agriculture.

Potential for Commercialisation

- Modern beehives allow women and youth to participate in the subsector.
- The local economy has started responding to the initiative:
  - Local artisans have trained and are making the hives
  - The strong relation between woodlot and beekeeping has started bearing fruit.

Project Intervention

- Training carried out for staff and farmers
- Procurement of demonstration materials for apiary setup
- 20 apiaries set up
- Procured 5 centrifuges for demonstration
- Trained 20 artisans on Langstroth hive making.

Sericulture

- High potential but marketing still a challenge
- Activity still at infancy
- Fifteen staff trained on sericulture by Thika Sericulture Station
- Mulberry growing initiated (3 varieties planted—Embu, Thika and Thailand).

Challenges—Apiculture

- Low hive occupancy
- Pests/predators
- Low prices for honey
- High cost of modern hives
- Lack of beekeeping skills by farmers.

Challenges— Sericulture

- The sub-sector is still young
- The farmers have inadequate skills
- Marketing is a big challenge.

Conclusion and Way Forward

- Apiculture and sericulture have a high potential in the project area and there is need to upscale these enterprises for the rural population to derive the benefits.
- Key stakeholders, including *icipe* and others, will be engaged to support the project initiatives to upscale them.

L'Apiculture et la Sériciculture au Burundi (Projet IFAD)

Bigirimana Révocate and Ndikuriyo Rénovat

Burundi

Situation Géographique

- Le Burundi est situé au Centre Est de l'Afrique
- La superficie du pays est de 28.934 km²
- Le climat du Burundi est de type tropical comportant une alternance de 3 saisons: 2 saisons pluvieuses et 1 saison sèche
- La temperature moyenne varie de 10 à 33 °C.

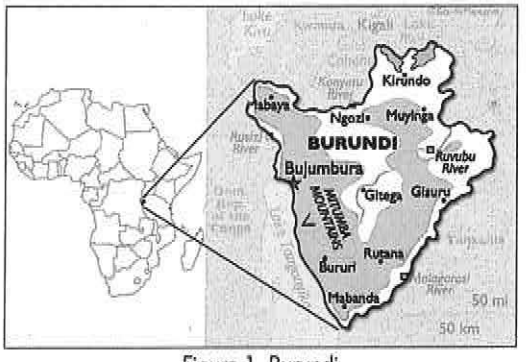


Figure 1. Burundi

Population et Mode de Vie

- La population du Burundi est estimée à 8,4 – 8,6 millions
- Plus de 90% de cette population dépend des activités agricoles.

Population et Mode de Vie-Suite

- Les principales cultures du Burundi sont: la banane, le manioc, le café, le thé, le coton, l'haricot, le maïs, le riz et la patate douce
- L' élevage bovin et caprin sont plus pratiqués au Burundi respectivement dans la partie sud, nord et centrale du pays.

Les Institutions d'Appui Agricole au Burundi

- Organisations non gouvernementales contribuent au développement des activités agricoles en milieu rural:
  - FAO
  - PNUD
  - FIDA
  - STABEX
  - Les institutions d'appui agricole au Burundi —suite GTZ
  - CARE
  - CISV
  - CRS
  - De toute ces institutions précitées le FIDA est l'organisation qui initie plus de projets au Burundi.

Projets FIDA Sont a ces Jours Encours d'Exécution au Burundi

- Projet de relance et de développement du monde rural (PRDMR)
- Projet transitoire à la reconstruction post conflit (PTRPC)
- Projet d'appui pour la construction du secteur de l'élevage (PARSE)
- Projet d'appui à l'intensification et la valorisation agricole (PAIVA).

Les Projets FIDA au Burundi-Suite

- De ces 4 projets précités les deux projets suivant se sont focalisés sur la relance des activités apicoles au Burundi:
  - Projet de relance et de développement du monde rural (PRDMR):
    Cout total: USD 34.2 million
    Durée: 1999–2010
  - Projet d'appui pour la construction du secteur de l'élevage (PARSE):
    Cout total: USD 17.8 million
    Durée: 2008–2014
- La sériciculture au Burundi est une activité non connue par la population. Cependant le Burundi dispose des potentialités énormes pour développer la sériculture en milieu rural.

Le Projet FIDA d'Appui aux Activités Apicoles

Tableau 1. Projet de relance et de développement du monde rural (PRDMR)

Année	Activités réalisées
2004–2005	1. Formations des apiculteurs: *4 provinces sur 17 ont été ciblées; *120 apiculteurs ont été formés par province. 2. Disponibilisation des ruches modernes: 2 ruches Langstroth ont été distribuées par apiculteur; 960 ruches pour toutes les 4 provinces.
2007	Recyclage de quelques apiculteurs: 40 apiculteurs parmis les 120 formés par région ont été recycle.

Production en Miel

- Ruche Langstroth: 15–20 kg par ruche
- Ruche traditionnelle: 5–7 kg par ruche
- Nombre de récolte par an: 2 (juin à Septembre et Décembre à Janvier)
- Prix de vente: 2,5$ par kg de miel.

Conclusion

Potentialités apicoles du Burundi

1. Disponibilité de beaucoup d 'essaim d'abeille;
2. Climat et végétation adéquat pour l'élevage apicole;

Tableau 2. Projet d'appui pour la construction du secteur de l'élevage (PARSE)

Année	Activités réalisées
2008	1. Formation des formateurs à l' *icipe*: *7 provinces sur 17 ont été ciblées; *10 formateurs provinciaux ont été formés.
2009	1. Formation des responsables d' élevage communaux; 2. Formation en construction de la ruche Langstroth: 5 apiculteurs par province ont été formés; 3. Disponibilisation et distribution des ruches modernes: 250 ruches Langstroth ont été distribuées par province.
En cours de réalisation	Mises en place des mielleries: Une miellerie devra être implantée par province.

3. Disponibilité en matières premières pour la fabrication des ruches et autres accessoires apicoles.

Recommandations

1. Renforcement de capacité en ressources humaines en apiculture et sériciculture;
2. Disponibiliser le pays en équipement apicoles et accessoires (extracteur, enfumoir, bouteilles d'emballage, etc.);
3. Introduction de la sériciculture;
4. Introduction des projets api-forestier en milieu rural.

La Situation des Projets du FIDA au Rwanda (Cas de la Sériciculture et Apiculture)

Claude Manirakiza
Secretary
ISABANE Cooperative, Rwanda

Situation Géographique

- Le Rwanda est un pays enclavé situé dans la partie Centrale Est de l'Afrique, ayant la superficie de 26,338 km²
- La capitale est Kigali
- Sa population est éstimée à 9.300.000 avec un taux de croissance de 3.5%
- 70% de la population totale est concentrée en milieu rural.

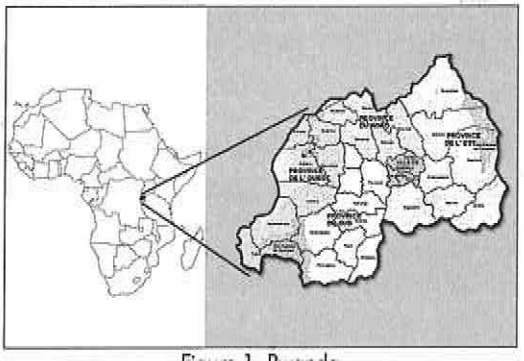


Figure 1. Rwanda

Le FIDA au Rwanda

- Le FIDA a commencé ses opérations au Rwanda en 1981
- Depuis lors il a financé un total de 12 projets dont 8 sont en terme d'exécution et 4 en cours d'exécution
- Le montant total de ces 12 projets s'éleve à 120.17 millions de dollars américains
- Un nombre de 350.700 ménages ont été bénéficiaires directs de cette aide.

4 projets sont à ces jours en cours d'exécutions:

- Projet de développement des ressources communautaires et des infrastructures de l'Umutara: Phase I et II (PDRCIU) Prêt du FIDA: 27,9 millions de dollars; durée prévue 2000–2011; bénéficiaires 86.000 ménages de la province d'Umutara (huit districts);
- Projet de promotion des petites et des microentreprises rurales: Phase I et II (PPMER); Prêt du FIDA: 14,9 millions de dollars; durée prévue: 2004–2011;
- Le projet d'appui au plan stratégique de transformation de l'agriculture (PSTA) prêt de 8,21 millions de dollars et don de 200,000 dollars; durée: 2006–2012; bénéficiaires: 20.000 ménages. Opérationnel dans 6 ex préfectures: Kibuye, Gikongoro, Kigali Ngali; Butare, Kibungo et Ruhengeri;
- Projet de développement des cultures de rente et d'exportation (PDCRE) Prêt du FIDA: 16,3 millions de dollars; durée prévue: 2003–2011; bénéficiaires: 28.000 ménages des provinces de Gikongoro, Kibuye, Kibungo et Kigali-Ngali.

Les projets financés par FIDA sont connus sous deux générations:

- la première se situe entre 1980 et 1990 et concernait les programmes intégrés de développement rural;
- l'autre qui a commencé au milieu de l'an 1990 visait un seul aspect du développement comme l'accès au marche ou la production agricole.

En général la stratégie du FIDA au Rwanda est compilé dans un document appelé Country Strategic Opportunities Programme «COSOP» de 2007 qui est basé sur la Vision 2020.

Cette stratégie du FIDA s'insert dans le Document de Stratégie pour la Réduction de la Pauvreté (DSRP) du gouvernement Rwandais entamé à la fin de l'année 2003.

La Sériciculture et Apiculture au Rwanda

La Sériciculture

- Depuis 2006, le gouvernement rwandais a commencé la vulgarisation de la culture des mûriers et l'élevage des vers à soie;

Figure 2. Trois hectares de mûrier cultivé à Karongi dans la province de l'ouest

- Deux variétés de mûrier sont cultivées:
  - Kanva 2: Feuilles de qualité,
  - Thaïlande: Résistante au sol acidifié;

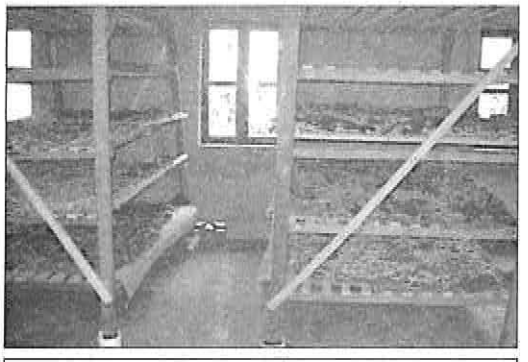


Figure 3. Maison d'élevage de vers à soie

- L'élevage des vers à soie ne pourrait être plus productif car 20.000 oeufs de vers à soie donnent entre 25 et 35 kg de cocons;
- Le marché des cocons se trouvent à Kigali. L'acheteur le plus offrant est UTEXRWA (qui est une industrie de textiles) qui achète le kilo de cocons de première catégorie à 1900 Frws (3.5$ par kg de cocons);
- L'UTEXRWA a une capacité d'absorption de 2.5 tonnes de cocons par jour mais la production quotidienne de différents éleveurs n'est que de 850 kg, cette différence montrant combien le trajet à faire est long.

Facteurs limitant la production et exploitation maximale des cocons

- Le cout élevé pour la construction des maisons d' élevage et équipements;
- Le manque d'un centre spécialisé dans la production des oeufs;
- Manque de formation et de sensibilisation pour différents éleveurs locaux potentiels en culture des muriers et élevage des vers à soie.

Facteurs limitant la production et exploitation maximale des cocons – suite

- Manque de terrains suffisants pour la culture des mûriers;
- Absence de marchés locaux des cocons;
- Absence de connaissances en bobinage et peinture.

Perspectives 2009

- Construire un Centre National pour le Développement de la Sériciculture;
- Produire une qualité supérieure des oeufs F1;
- Etablir une pépinière des mûriers (Kanva 2 et Thaïlande);
- Mobiliser la population à cultiver les mûriers afin de couvrir au moins 264 hectares;
- Former plus de 214 éleveurs et 74 techniciens;
- Aider techniquement et financièrement des associations locales;
- Aider a l'établissement d'une association nationale des producteurs de cocons.

Apiculture

- Si l'apiculture traditionnelle existe au Rwanda depuis des siècles celle moderne n'a été réellement introduite qu'en 1990 avec la

Figure 4. Ruches modernes

création d'un Programme National pour le Développement de l'Apiculture rwandaise;

- Une ruche kenyane (KTBH: Kenya Top Bar Hive) peut donner plus de 15 kg;
- La ruche Langstroth peut donner plus de 25 kg de miel;
- La ruche traditionnelle donne 3 kg de miel par saison;
- Groupements: 732 coopératives apicoles;
- Individus privés: 21.312;
- Ruches traditionnelles: 75.103;
- Ruches modernes: 15.660 (Langstroth et Kenya Top Bar Hive);
- Production annuelle: 400.796 kg de miel. (Source: Mbarubukeye et Niang; 2003).

Contraintes rencontrées dans l'apiculture

- Pas bon nombre des ressources humaines qualifiées en apiculture; d'où l'apiculture très traditionnelle dans bon nombre des régions du pays;
- Insuffisance des arbres mellifères dans certaines régions;
- Problème de marketing pour les apiculteurs.

Conclusion

- L'apiculture et la sériciculture sont au Rwanda des bonnes activités génératrices de revenue qui contribuerait à améliorer le niveau de vie de la population rurale;
- Le marché tant local qu'international sonts disponible; cependant la pièce manquante n'est que l'augmentation de la production et l'amélioration de la qualité de la production;
- Le gouvernement ainsi que ses partenaires au développement en l'occurrence le FIDA doivent concentrer leurs efforts dans la disponibilisation des équipements adéquate, la formation de fermiers et leurs organisations en coopératives.

SESSION 5

Workshop Presentations: Other Projects

IFAD Programmes in Nyandarua North District, Kenya

Mary Wambui Karanja
District Agricultural Officer, Nyandarua North, Kenya

Introduction

Nyandarua North District is one of the eleven districts in Central Province. Nyandarua North district was hived from the larger Nyandarua District to form Nyandarua North and Nyandarua South districts. Nyandarua North comprises three administrative divisions (Ndaragwa, Oljoro Orok and Olkalou) and two constituencies (Olkolou, covering Oljoro Orok and Olkalou divisions and Ndaragwa constituency covering Ndaragwa division). The district has institutions such as Oljoro Orok Agricultural Training Centre and Agricultural Mechanization Services Station (Nyahururu). It covers an area of 1797.25 sq km (179,725 ha) inclusive of the forest area of 139.25 sq km. Of the total area there are 1142.3 sq km (114,230 ha) of arable land.

Nyandarua North District is bordered by Nyandarua South District to the south, Laikipia to the north, Nyeri, Murang'a and Maragwa to the east and Naivasha and Subukia districts to the west. It has sixteen locations and 45 sub locations.

The population is 335,485 people, with 44,412 farm families and an average farm size of 3 ha. Nyandarua North district is mainly a horticultural district. The major crops are Irish potatoes, cabbages, carrots, peas, as well as onions, shallots and kales. The major field crops are maize and wheat, which are grown mainly in Oljoro Orok and Olkalou divisions. The only industrial crop is pyrethrum but its production has been on the decline. Dairy sheep is the major livestock enterprise.

The district is involved in the adoption of modern agricultural technologies with emphasis on greenhouse technologies where high value crops are growing. Value addition is one of the key drivers towards Kenya's Vision 2030 being emphasised in the district.

Central Kenya Dry Areas Programme (CKDAP)

Purpose

To improve food security, farm incomes and nutritional status of the beneficiaries/community.

Coverage

Ndaragwa Division—Uruku, Mbuyu and Ndivai Focal Development Areas.

Main Outputs

- Promotion of drought-tolerant crops and fodder crops
- Upgrading of small livestock
- Application of micro-irrigation technologies
- Promotion of agroforestry and environmental conservation
- Strengthening partnerships among service providers and beneficiaries
- Enhancing agricultural produce utilisation, processing and value addition
- Capacity building of beneficiaries
- Capacity building of staff
- Strengthening monitoring and evaluation systems
- Promotion of agroforestry and environmental conservation.

Energy Conservation

1. Fireless Cooker

- The fireless cooker is an insulated basket for cooking food using energy or heat stored by water and food

Table1. Project achievements

Activity	Unit	Cumulative achievement(s)	Impacts/ Effects
Establishment of agroforestry and fruit tree nurseries	Nurseries	30 group tree nurseries (26 ADGs, 11 CiGs)	140,000 seedlings worth about kshs 200,000 Planted citrus, avocado, tree tomato, *Calliandra, Leucaena, Grevillea robusta.*
Fodder production and conservation demonstration	Demos	43 demos	Demonstrations on silage making done, 35% of the trained farmers have adopted the *tumbukiza* technology: Napier, mulberry, vetch, tree lucerne, desmodium, sweetpotato vines, oats, sorghum.
Promotion of micro irrigation technologies and kitchen gardening	Demos	13 demos	75 farmers have purchased the drip kits and adopted the kitchen gardening technology.
Farms laid with soil and water conservation structures	Farms	163 farms laid, 7 CiGs formed, 324 (195 male, 129 female) farmers trained	7700 metres of terraces done.
Fish farming demonstration/stocking	Demos	3 demos done on fish farming. 2 dams stocked with 5750 tilapia fingerlings	3 farmers have adopted and stocked ponds with fish.
Demo on drought tolerant crops	Demos	50 demos of 35 ADGs and 47 CiGs (982 farmers)	1716 farmers have adopted, 2060 farmers reporting increased yields.
Non residential CiG training	Farmer groups	4241 farmers trained on various crop and livestock production technologies	2590 farmers adopting the technologies.
Demo on drought tolerant crops	Demos	50 demos of 35 ADGs and 47 CiGs (982 farmers)	1716 farmers have adopted. 2060 farmers reporting increased yields.
Shoats Technical Meeting	Meetings	4 sheep and 4 goat meetings held	Technical meetings held to initiate formation of associations.
CEPs training	Persons	45 CEPs	To build capacity of community members and monitor performance, 1 inseminator trained.
Purchase of bicycles	Bicycles		Building capacity of CEPs to offer mobile extension services. 40 CEPs given bicycles.
Livestock vaccination	Animals	5520 poultry, 1125 shoats	Vaccination done against Newcastle, fowl pox and pulpy kidney.
Farmer exchange visits and youth training	Visits	4	37 farmers toured Sagana, Nyeri, Nakuru and Lare on water harvesting and beekeeping. 46 4k club members trained.
Promotion of environmental conservation	Groups	3	3 farmer groups given over 500 jiko liners to initiate income-generating activities (IGA).
Livestock vaccination	Animals	5520 poultry, 1125 shoats	Vaccination done against Newcastle, fowl pox and pulpy kidney.
Farmer exchange visits and youth training	Visits	4	37 farmers toured Sagana, Nyeri, Nakuru and Lare on water harvesting and beekeeping. 46 4k club members trained.
Promotion of environmental conservation	Groups	3	3 farmer groups given over 500 jiko liners to initiate IGA.
Introduction of breeding stock	Animals	38 rams, 37 bucks, 20 does, 1750 cockerels	452 and 963 offspring realised, 250 farmers reporting improved milk production (0.5–1.5 lts) and registered with DGAK
Construction of water pans	Water pans	6 pans constructed	Technology adopted, an estimate of 185 adopted and excavated by farmers, farmers reported agricultural yields increased by over 20%.

- Fireless cookers save time and energy, are clean, pose no risk of accidents, and the food cooks evenly with no risk of burning.

2. Biogas Technology

- Biogas is produced by anaerobic digestion or breakdown of organic material
- Its components are 60% methane and 40% Co_2
- Biogas is clean, reduces workload of looking for firewood and reduces pressure on existing wood stock while the slurry improves soil when used as manure.

3. Maendeleo Jiko

Maendeleo Jiko liners are built around a ceramic liner that gives the proper size door and firebox. It saves up to 30–50% energy or heat. The liners save money on firewood, retain more heat and cook faster, are smoke free and safe, beautify the kitchen and are environmentally friendly.

Small Livestock/Emerging Livestock

- Rabbit sales
  Young – Kshs 300/-
  Adult – Kshs 500/-
  New breed stock of chinchilla going for Kshs 3000/- with ready market in Gilgil.
- Rabbit meat contains high fat content than poultry. Its fat has better digestibility and is cholesterol free.
- It is a cheap source of protein for the family.
- Engages the youth in productive farming.

Smallholder Horticultural Marketing Programme (SHoMaP)

Objective

Raising the quality of horticultural produce traded in the domestic market, reducing the unit cost of farm inputs, increasing and stabilising farmgate prices, employment and wealth creation.

Components:

- Market systems analysis
- Institutional strengthening
- Investment in domestic horticultural value chains—potatoes, cabbages, carrots, tomatoes, peas.

Coverage

Nyandarua North. It also extends up to Nyandarua West, Central and Mirangine districts (Larger Nyandarua North).

Achievements

- Community mobilisation
- Ndaragwa Fresh Produce Market plan and BQs in the process of completion for the market's construction
- District and divisional horticultural investment committees in place
- Formation and training of 22 marketing groups
- Pilot initiatives funding for: Bahati SHG (funded Kshs 102,000.00—Greenhouse tomato growing); Jamrock Youth Development Project (Kshs 394,700.00—Vegetables irrigation); Ambui A Mwananiki (Kshs 476,720.00—Greenhouse tomato growing).

Challenges

- Poor infrastructure
- Late arrival of AIEs
- Frequent transfers of implementing officers
- Weather hostilities (drought)
- Low adoption levels by farmers.

Lessons Learned

- Farmers are responsive to specific technologies, which meet their immediate needs and when these demands are not met, adoption and rate of spread of technology declines.
- Non-access to markets for produce de-motivates the farmers particularly due to poor infrastructure.
- Issues related to soil fertility management should be emphasised as this forms the key to solving a majority of the farmers' production problems.

Exit Strategy

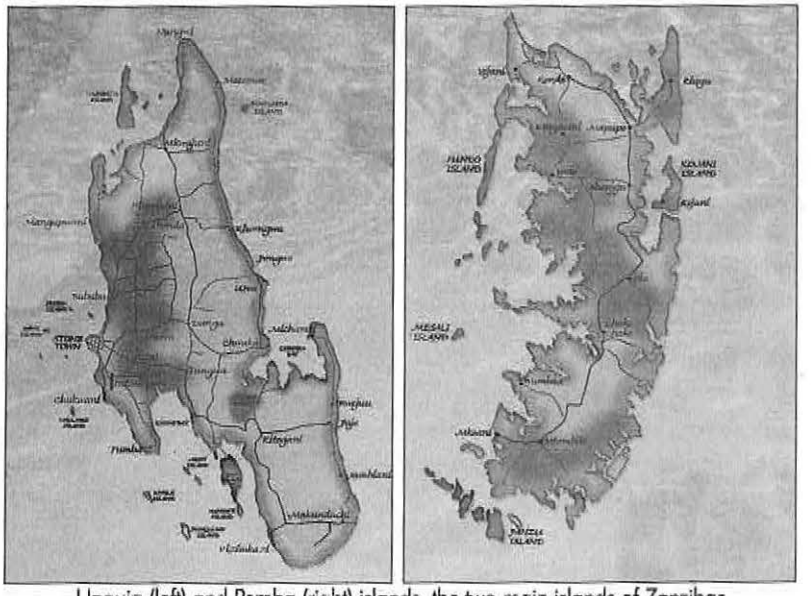
- A micro credit component shall be considered and tailored to meet farmers' requirements in terms of purchase of fertilisers, seeds and chemicals, thus increasing the size of their enterprises.
- A stakeholder's forum at the project level with the buyers/exporters of produce is being organised.
- Closer linkage between Constituencies Development Fund (CDF) committees and Focal Area Development (FAD) committees being encouraged so as to ensure farmers' priorities are addressed.

- Formation of umbrella groups for marketing produce for all crops including drought tolerant crops in an advanced stage of formation. Maize and legumes umbrella committee already in place and registered.
- Construction of an input/output store and a market in progress.
- Value addition of these crops by the farmer groups and provision of processing equipment.
- Initiate income-generating groups/table banking.
- Upscaling of drought-tolerant crops production/ increase the number of bulking sites.
- Institutionalising the trained CEPs—Registration, income generation.
- Upscaling efficient water use technologies.

Brief on the Agricultural Services Support Programme (ASSP) and Agricultural Sector Development Programme–Livestock (ASDP-L) Zanzibar Sub-Programmes

Mgeni Rajab Mgeni

Department of Cash Crops, Fruits and Forestry
P.O. Box 3526, Zanzibar, Tanzania



Unguja (left) and Pemba (right) islands, the two main islands of Zanzibar

Background

Zanzibar is part of the United Republic of Tanzania with semi-autonomy status. It comprises of two Islands: Unguja and Pemba and numerous small islets. The total area of Zanzibar is 2654 km². A tropical climate with bimodal rainfall pattern is experienced. The average annual rainfall is 1800 mm and temperature ranges between 21–34 °C. The population is 984,531 (2002 census).

Its society is cosmopolitan with 80% Africans, 15% Arabs and mixed, and 5% ethic Indian, Chinese and others. Kiswahili is the native and national language. Ninety-seven (97%) of the population is Muslim, 3% Christian, Hindu and other denominations. The villagers depend on agriculture and apiculture to raise their income.

Apiculture Status

- Apiculture in Zanzibar is practised mainly in the eastern part where the coral rag forest occurs.
- The number of beekeepers is estimated to be 518 (422 male and 96 female).
- They possess about 4000 traditional hives and 100 Kenya Top Bar Hives.
- The honey production ranges from 9 to 30 tonnes per year.
- The individual beekeepers can get between 208,000 to 1,528,000 Tanzania shillings per year from sales.

About ASSP and ASDP-L Programmes

- Zanzibar sub-programmes of the Agricultural Services Support Programme (ASSP) and Agricultural Sector Development Programme-Livestock (ASDP-L) will last 7 years.
- They started on 30 January 2007.
- The project is co-financed by IFAD, Government of Zanzibar and project beneficiaries.
- ASSP and ASDP-L Zanzibar sub-programmes are implemented together.

ASSP Goal

Greater productivity, profitability and farm incomes from increased investment in agriculture (through higher private sector involvement and improved public service delivery).

ASDP-L Goal

To reduce poverty, improve food security and incomes of the target group of approximately 22,500 households, in particular communities with a high level of livelihood dependence on livestock, in nine districts of Zanzibar.

Implementation

ASSP/ASDP-L are implemented at three levels:

1. National—MALE supported by various committees and facilitation team;
2. District—DMT and DFT oversee programme implementation;
3. Shehia—Agro-pastoralist groups and service providers provide important structures for the implementation of the programme.

Beneficiaries

- Agro-pastoralists
  - ASSP— 42,000 beneficiaries
  - ASDP-L— 22,500 beneficiaries
- Ministry of Regional Administration and Local Government
- District authorities
- Ministry of Agriculture, Livestock and Environment
- NGOs and private service providers.

Components

ASSP Components

1. Agro-pastoralist empowerment
2. Strengthening support services for research and extension
3. Programme coordination, monitoring and evaluation.

ASDP-L Components

- Agro-pastoralist empowerment
- Technical support to livestock development
  - Animal production
  - Animal health
  - Livestock commercialisation and market development
- Support to policy dialogue, legal and regulatory frameworks and institutions
- Programme management.

Achievements

Farmer Field Schools Status

- Farmers are organised in groups that are coherent, independent and sustainable.
- Facilitation of 360 FFS with a total of 6120 households (target HH 42,000).
- FFS members are now able to articulate technology, extension and development needs.
- Mobilise/facilitate registration of FFS groups towards SACCOs formation.
- The programme monitoring system identified 416 individual (206 men and 210 women) Unguja farmers and Pemba 532 (291 men and 241 female) plus 15 groups as those that have adopted some enterprises and technologies in both crops and livestock production.
- Strengthened beneficiary capacity in effective participation and influence in planning, implementation and evaluation of services.
- Farmer Field Schools have helped to change farmers' attitude towards agriculture, encouraging results in terms of technology adoption.
- Increased production from different enterprises.
- Farmers' Field Schools are composed of 56% female; and 50% in female leadership.

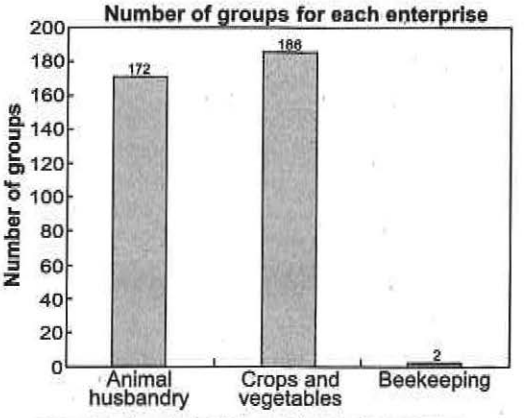
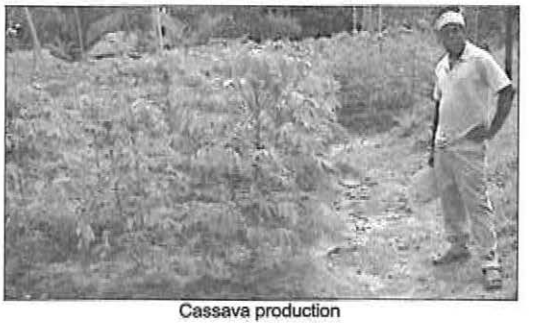


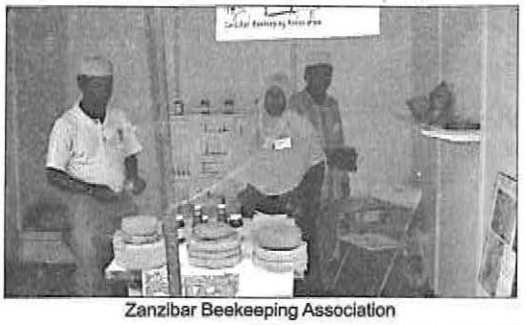
Figure 1. Number of groups for each enterprise

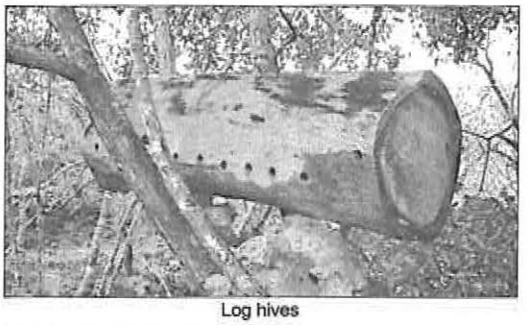
Constraints

- The culture of expecting physical benefits (such as livestock, machinery, or seed stock) from donor projects was an obstacle to the implementation of the two sub-programmes that have the


Goat keeping


Cassava production

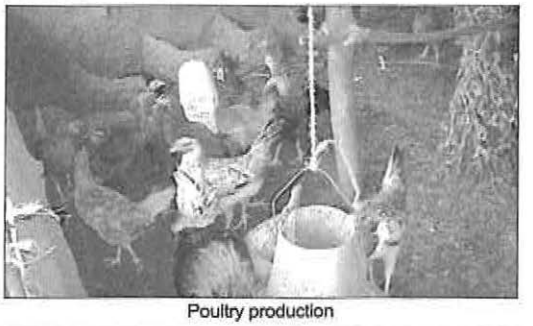

Zanzibar Beekeeping Association


Log hives


Stingless bees hive


Beekeeping Farmer Field School


Local hives for sting bees


Poultry production


Vegetable production

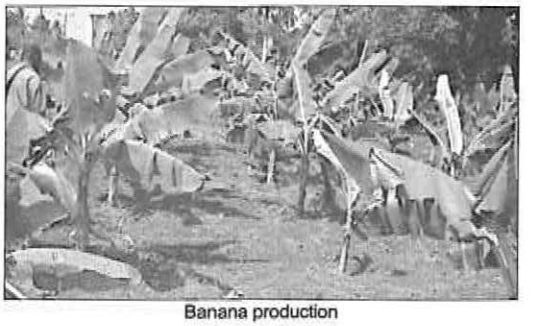

Banana production

Figure 2. Some initiatives undertaken by the programme as well as hives used

objective of achieving sustainable development through helping people to help themselves.
- Weak coordination with other on-going sector projects and programmes.
- There are no financial institutions that provide soft loans or grants for smallholder farmers.
- Insufficient Government financial contribution.
- Inflation.
- Shortage of land.
- Different project modalities in the area.
- Low quality and quantity of bee products and lack of market centre.
- Transparency in programmes modalities.

- Sensitisation on the importance of knowledge and skills.
- Training of financial personnel.
- Mobilisation for the formation of SACCOs and increase collaboration between Programmes.
- Activities prioritisation.
- Sensitise intensification of production of high value crops.
- The programme is exploiting partnership and engagement with other organisations to complement programmes achievements, e.g. TASAF, PADEP and food security.
- Introduce modern hives and establish market centre for beekeeping products.

Smallholder Dairy Commercialisation Programme (SDCP)

Lorna Mbatia

Dairy Enterprise Development Officer
Programme Management Unit, Smallholder Dairy Commercialisation Programme

Introduction

SDCP is a six-year programme that commenced in July 2006 and is expected to close on 30th September 2012.

Goal

To increase income of those poor rural households that depend substantially on production and trade of dairy products for their livelihoods.

Purposes

1. Improving the financial returns to market-oriented production and trade activities by small operators through improved information on market opportunities, increased production, cost reduction, value addition and more reliable trade relations.
2. Enabling more rural households to create employment and benefit from expanded opportunities for market-oriented dairy activities as a result of strengthened and expanded farmer organisations.

Target Groups

- Resource-poor dairy farmers
- 'Part-time' dairy farmers
- Small-scale intensive dairy farmers
- Crop-oriented farmers with dairy cows
- Small-scale milk bars and shop operators
- Mobile milk traders.

The programme is also reaching out to the poor and vulnerable in its area of operation. The target is 24,000 households represented in 600 groups of beneficiaries.

Area

The programme covers nine districts:

- Bungoma and Lugari (in Western Province)
- Kisii Central and Nyamira (in Nyanza Province)
- Bomet
- Nakuru
- Nandi North
- Trans Nzoia
- Uasin Gishu (in Rift Valley Province).

The programme works in units called Dairy Commercialisation Areas that were selected on the basis of poverty levels, milk density and market accessibility as the main criteria.

Components

Component A: Organisation and Enterprise Skills

Provides for substantial capacity building of groups of smallholder dairy producers, processors and traders to move through the MODE approach to become effective enterprises.

Outputs

1. Improved group organisation to access benefits from marketing of milk and dairy products;
2. Effective application of the MODE approach and improved capacity of beneficiaries for business planning and enterprise development;
3. Improved access to financial services by the programme target groups.

Component B: Technical Support to Smallholder Dairy Producers

Supports a range of measures to strengthen smallholder dairy producers' access to relevant up-to-date information and techniques, necessary for improving their production and productivity.

Outputs

1. Enhanced smallholder dairy farming production skills;
2. Increased technical capacity on appropriate feed strategies (production, sources, conservation and utilisation of fodder);

3. Improved capacity of public and private sector providers to deliver good quality and cost-effective AI/breeding and other technical services;
4. Improved availability of viable technologies at low cost in the programme area, e.g. energy saving *jikos*, biogas, water harvesting, locally made labour-saving devices.

Component C: Development of the Milk Marketing Chain

Aims to improve the milk market chain and the smallholder dairy operators' access to it, through support to the development of a low cost market information system, strengthening of the Dairy Information Centre at the Kenya Dairy Board, capacity building for milk marketing groups, a school milk programme and a study on rural infrastructure.

Outputs

1. Sustainable Low Cost Market Information System (LCMIS) set up and operational and linked to the Dairy Information Centre at Kenya Dairy Board;
2. Information gathering and elaboration of a strategy for improvement of market access;
3. Improved capacity of dairy groups to market their products:
   - Market research, milk hygiene and standards, cost reduction, value addition, promotion of milk and dairy products, contracts, record keeping, estimating and monitoring market demand,
   - Establishment of pilot milk processing units.

Sub-Programme

There is also a dairy goat sub-programme that is targeted at the poor and vulnerable in the programme area.

Programme

OPENING CEREMONY	
Venue: *Thomas Odhiambo Conference Centre* | Master of Ceremony: *Elliud Muli*	
TRAINING COURSE	
21st October (Wednesday)	
0830–0900 hrs	Registration – *Gladys Mose and Sospeter Makau*
0900–1000 hrs	Welcome address and introducing Commercial Insects Programme – *S.K. Raina, Programme Leader, Commercial Insects*
1000–1030 hrs	**Health Break**
1030–1230 hrs	Visit to Commercial Insects Programme laboratories – *E. Muli, E. Nguku and CIP staff*
1230–1400 hrs	**Lunch Break**
1400–1600 hrs	Visit to Commercial Insects Programme field sites – *E. Muli, E. Nguku and CIP staff*
1600–1630 hrs	**Health Break**
22nd October (Thursday)	
0900–1000 hrs	Scaling up operations in apiculture and sericulture enterprises for livelihood improvement and forest conservation – *S. K. Raina, icipe*
1000–1030 hrs	**Health Break**
1030–1230 hrs	Environment and poverty: Role of nature based enterprises – *E. Muli, icipe*
1230–1400 hrs	**Lunch Break**
1400–1600 hrs	Establishing sericulture as a nature based enterprise for income generation (Practical) – *E. Nguku, R. Macharia and M. Kahinya, icipe*
1600–1630 hrs	**Health Break**
23rd October (Friday)	
0900–1030 hrs	Spillover benefits of sericulture industry for rural income and nature conservation – *E. Nguku, icipe*
1000–1030 hrs	**Health Break**
1030–1200 hrs	Research and development in beekeeping technologies – *E. Muli, icipe*
1200–1230 hrs	DNA fingerprinting for bees identification – *N. Ndugu, icipe*
1230–1400 hrs	**Lunch Break**
1400–1500 hrs	Participatory forest management in Kenya – *E. Wang'ombe, Kenya Forest Service*
1500–1600 hrs	Monitoring forest connectivity using GIS and GPS – *K. Mithoefer, icipe*
1600–1630 hrs	**Health Break**
26th October (Monday)	
0900–1030 hrs	Wild sericulture and diversity of wild silkmoth species in Africa. (Theory and Practical) – *B. Ngoka and F. Kiilu, icipe*
1000–1030 hrs	**Health Break**
1100–1230 hrs	Mulberry and wild silk post-harvest up-scaling technology (Practical) – *B. Ngoka, F. Kiilu, J. Lumumba, C. Mbugua and A. Maina*

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1230–1400 hrs	**Lunch Break**
1400–1600 hrs	Beekeeping post-harvest scaling-up technologies (Practical) – *E. Muli, J. Ng'ang'a, J. Kilonzo and S. Amboka*
1600–1630 hrs	**Health Break**
27th October (Tuesday)	
	Field trip to Mwingi Training Site
0900 hrs	Departure to Mwingi Assembly point: Duduville International Guest Centre (DIGC)
1800 hrs	Return to Nairobi – *B. Ngoka and F. Kiilu*
28th October (Wednesday)	
0930–1000 hrs	Marketing and marketplace development – *S. K. Raina*
1000–1030 hrs	**Health Break**
1030–1100 hrs	Insects: Climate change, ecosystems services and agricultural biodiversity – *I. Gordon: Head CBIDP and EHD*
1100–1200 hrs	Climate change adaptation measures through increasing forest connectivity and enterprise development – *S. K. Raina*
1200–1230 hrs	Importance of taxonomy in the insect production systems – *F. Haas*
1230–1400 hrs	**Lunch Break**
1400–1430 hrs	Livelihood monitoring process – *R. Onyango, ICRAF*
1430–1530 hrs	Organic certification of silk and honey products: Mwingi Case Study – *E. Kioko, NMK*
1530–1630 hrs	Sustainable wild harvest for commercialised ethnobotanicals – *S. Wren*
1630–1700 hrs	Branding and marketing of the nature based products – *Milba Advertising Ltd*
1700–1730 hrs	**Health Break**
WORKSHOP	
29th October (Thursday)	
Chair – *S.K. Raina* | Rapporter – *E. Nguku*	
0830–0900 hrs	Bigirimana Révocate and Ndikuriyo Rénovat, *Burundi*
0900–0930 hrs	Zaghlol Fathy Khali, *Egypt*
0930–1000 hrs	Amanuel Tamiru, *Ethiopia*
1000–1030 hrs	**Health Break**
Chair – *I. Gordon* | Rapporter – *E. Muli*	
1030–1100 hrs	Teklay Gebreamlak, *Ethiopia*
1100–1130 hrs	Fikre Berhe, *Ethiopia*
1130–1200 hrs	Walter R.O. Ogot, *Kenya*
1200–1230 hrs	Boniface Mutuku Kikuvi, *Kenya*
1230–1400 hrs	**Lunch Break**
Chair – *S. Wren* | Rapporter – *E. Nguku*	
1400–1430 hrs	Lorna Mbatia, *Kenya*
1430–1500 hrs	Mary Wambui Karanja, *Kenya*
1500–1530 hrs	Precious Chambize Magombo, *Malawi*
1530–1600 hrs	Principal James Okpu, *Nigeria*
1600–1630 hrs	**Health Break**

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30th October (Friday)	
Chair – *E. Kioko* | Rapporteur – *E. Muli*	
0900–0930 hrs	Claude Manirakiza, *Rwanda*
0930–1000 hrs	Mwajuma Haji Ussi and Mgeni Rajab Mgeni, *Tanzania*
1000–1030 hrs	Maymona Amin Saad, Suliman Ahmed Yagoub and Khalid Mohamed Shareif Elmahi, *The Sudan*
1030–1100 hrs	**Health Break**
Chair – *E. Wangombe* | Rapporteur – *E. Muli*	
1100–1130 hrs	Asiimwe Taddeo Barwogeza and Night Sofia Apofia, *Uganda*
1130–1200 hrs	Ali Alawi Al-Hebshi and Fuad Algailani, Yemen
1200–1230 hrs	Simon Samuel Tesfay, *Eritrea*
CLOSING CEREMONY	
Venue: Thomas Odhiambo Conference Centre, *icipe*, Duduville | Master of Ceremony – *Mr Willis Awori* Arrival of Guests: *Ms Kristine Karanja PR Office*	
1245–1430 hrs	Lunch hosted by Prof. Borgemeister in honour of the guests
1430–1440 hrs	Introductory Remarks – *Prof. Suresh K. Raina, Programme Leader, Commercial Insects Programme*
1440–1500 hrs	Welcome address – *Prof. Christian Borgemeister, Director General, icipe*
1500–1530 hrs	Address – *Mr Aeneas Chuma, Resident Representative, UNDP*
1530–1540 hrs	Book Launch – *Resident Representative, UNDP and Director General, icipe*
1540–1600 hrs	Presentation of certificates to trainees – *Director General, icipe*
1600–1605 hrs	Vote of thanks – *Ms Everlyn Nguku*

Participants' List

Participant's Name	Details/Adress	Country
Ali Alawi Al-Hebshi	c/o Abdulla Salem Al Dukail IFAD Al Dhala Community Resource Management Project E-mail: a-dukail@y.net.ye	YEMEN
Amanuel Tamiru	*icipe* Thomas Odhiambo Campus, Mbita Point, Kenya E-mail: atamiru@icipe.org	ETHIOPIA
Asiimwe Taddeo Barwogeza	Tel: +256 772 991503 E-mail: asiimwetaddeo@yahoo.com	UGANDA
Boniface Mutuku Kikuvi	Mount Kenya East Pilot Project for Natural Resources Management E-mail: bmkikuvi@yahoo.com	KENYA
Claude Manirakiza	ISABANE Cooperative, Rwanda	RWANDA
Fikre Berhe	Kilte Awlaelo Woreda Office of Agriculture Wukro, Tigray, Ethiopia Tel: +251 914748492	ETHIOPIA
Fuad Algailani	c/o Abdulla Salem Al Dukail IFAD Al Dhala Community Resource Management Project E-mail: www.faud@gmail.com	YEMEN
Khalid Mohamed Shareif Elmahi	c/o Mr Mohammed Sir ELKhatim E-mail: m_sirelkhatim@yahoo.co.uk	THE SUDAN
Lorna Mbatia	Programme Management Unit Smallholder Dairy Commercialisation Programme E-mail: lorna_mbatia@yahoo.com	KENYA
Mary Wambui Karanja	Smallholder Horticulture Marketing Programme E-mail: mkaranja@yahoo.com daonyandarua@yahoo.com	KENYA
Maymona Amin Saad	c/o Mr Mohammed Sir ELKhatim E-mail: m_sirelkhatim@yahoo.co.uk	THE SUDAN

Continued on next page

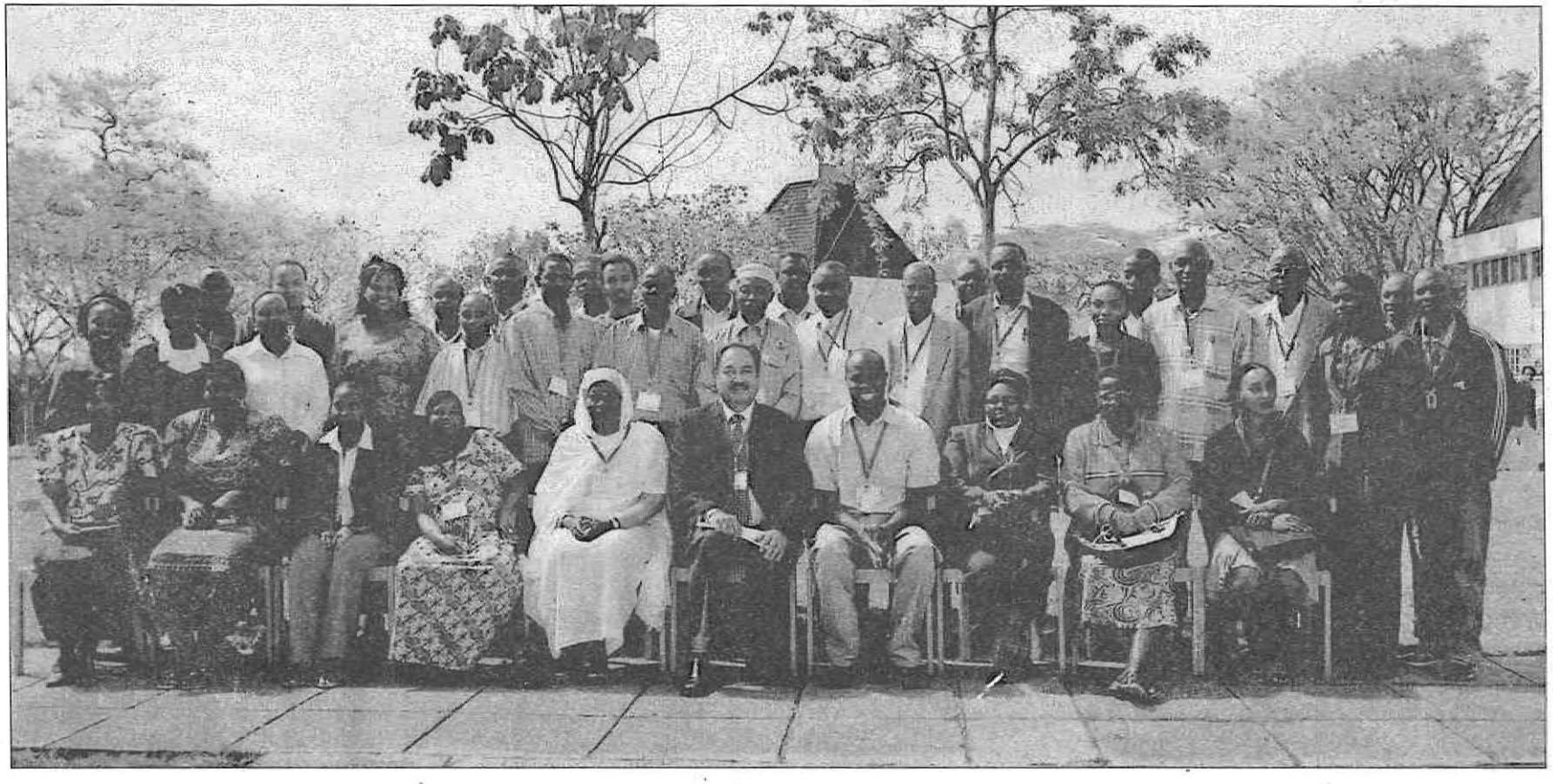
Participant's Name	Details/Adress	Country
Mgeni Rajab Mgeni	Department of Cash Crops, Fruits and Forestry P.O. Box 3526, Zanzibar, Tanzania Tel: +255 777 854571 E-mail: Mgeniyy@hotmail.com	TANZANIA
Mwajuma Haji Ussi	Department of Cash Crops, Fruits and Forestry P.O. Box 3526, Zanzibar, Tanzania Tel: +255 773 296 974 E-mail: mwajumanyuki@yahoo.com	TANZANIA
Night Sofia Apofia	Tel: +256 782 488 339	UGANDA
Precious Chambize Magombo	Nsanje District Assembly, P/Bag 1 Nsanje Tel: +265 0888863484, +265 0995546267 Fax: +265 1 456311 E-mail: rlsp@africa-online.net	MALAWI
Principal James Okpu	c/o Dr Ben Odoemena C.P.O. Abuja, Nigeria E-mail: benjamin.odoemena@undp.org	NIGERIA
Rénovat Ndikuriyo	E-mail: ndikuriyo.renovat@yahoo.com	BURUNDI
Révocate Bigirimana	Tel: +257 078 813 779 E-mail: bikori_ngendahayo@heinken.n	BURUNDI
Simon Samuel Tesfay	c/o Mr Heruy Asgedom, Director General of MOA E-mail: heruyasg@moa.gov.er	ERITREA
Suliman Ahmed Yagoub	c/o Mr Mohammed Sir ELKhatim E-mail: m_sirelkhatim@yahoo.co.uk	THE SUDAN
Teklay Gebreamlak	Tigray Bureau of Agriculture and Rural Development Mekelle, Tigray, Ethiopia Tel: +251 914729166 E-mail: dawiteklay@yahoo.com	ETHIOPIA
Walter R.O. Ogot	Southern Nyanza Community Development Project E-mail: Sncdp.pmu@gmail.com	KENYA
Zaghlol Fathy Khalil	c/o Dr Usama Ghazy E-mail: usamaghazi@yahoo.com	EGYPT

Resource Persons' List

Participant's Name	Details/Adress
Boniface Ngoka	*icipe*
Elliud Muli	"
Everlyn Nguku	"
Fabian Haas	"
Ian Gordon	"
Klaus Mithöfer	"
Nelly Ndungu	"
Suresh K. Raina	"
Esther Wang'ombe	Kenya Forest Service
Abednego Kiwia	ICRAF
Jephine Mogoi	"
Rose Onyango	"
Esther Kioko	National Museums of Kenya
Susie Wren	Bio-Enterprise Development Programme
Victor Mabachi	MilbaBrands Associates Lmited

International Group Training Course and Workshop on Scaling-Up Apiculture and Sericulture Enterprises to Promote Rural Livelihoods

Duduville, icipe – Kenya, 21st–30th October, 2009



Participating IFAD Project Countries

Eritrea, Egypt, Yemen, Ethiopia, Southern Sudan, Uganda, Tanzania, Burundi, Nigeria, Congo, Kenya and Rwanda

PROCEEDINGS FOCUS:
Poverty alleviation through commercial insects enterprises development

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