

## **PROMOTION OF INTEGRATED PEST MANAGEMENT FOR VEGETABLE PRODUCTION IN THE EASTERN ARC MOUNTAINS & EAST AFRICAN COASTAL FOREST MOSAIC BIODIVERSITY HOTSPOTS**



**Baseline study, April/May 2006**

**Brigitte Nyambo, Janet Maundu and Ibrahim Macharia**  
**June 2006**

## **Table of contents**

Executive summary.....	3
Background information.....	4
Selection of Pilot sites.....	5
Taita Hills.....	5
Western Usambara.....	6
Selection of farmer groups and data collection.....	8
Data collection.....	8
Results.....	9
Groups profiled.....	9
Group information.....	9
Reasons for group formation.....	10
Types of Vegetables grown.....	10
Market access.....	12
Taita Hills-Kenya.....	12
Western Usambara.....	13
Vegetable production problems.....	14
Taita Hills.....	14
Western Usambara.....	15
Irrigation water sources.....	15
Taita Hills.....	15
Development agencies.....	16
Taita Hills.....	16
Western Usambara.....	16
Sources of extension information.....	16
Taita Hills.....	16
Western Usambara.....	16
Seasonality of major vegetable crops, pest problems and pesticide use.....	17
Taita Hills.....	17
West Usambara Tanzania.....	21
Area-wide pesticide use trends in Taita-Hills and Western Usambara.....	27
Conclusions.....	30
Acknowledgement.....	31
Reference.....	32

## **Executive summary**

A baseline study on the types of vegetables grown, production constraints, market access, and use of synthetic pesticides was conducted in the Taita-Hills (Kenya) and Western Usambara (Tanzania), two areas within the Eastern Arc Mountains Conservation Hotspot in April /May 2006.

The objective of the study was to collect baseline information that could be used as a basis for the formulation, development and implementation of locale specific integrated pest management (IPM) training programme for small-scale vegetable growers in the areas.

The study provided evidence that (1) a wide range of vegetables are grown for sale in urban centers (Mombasa and Voi-Kenya; and Dar es Salaam, Tanga, Zanzibar and Arusha-Tanzania), (2) vegetable production in both project sites are a source of income and therefore contributes to livelihoods for communities living in the environs of conservation forests (3) a wide range of synthetic pesticides are used in vegetable production and therefore a threat to biodiversity conservation efforts, and, (4) Pesticide use is the first option for the majority of vegetable producers, and hence the need for the introduction of IPM as a strategy to reduce the current over reliance on synthetic pesticides.

Whereas in Western Usambara some farmer groups have established organized markets, in Taita Hills farmers sells individually to brokers.

Based on the information collected, Chawia environmental committee (Taita Hills-Kenya), and, Malindi-Lukozi and Shashui-Soni (Western Usambara-Tanzania) were earmarked for IPM training in the pilot phase of the project starting in July 2006.

## **BASELINE STUDY ON VEGETABLES PRODUCTION, CONSTRAINTS PESTICIDE USE, PRACTICE AND MARKET ACCESS, April-May 2006**

### **Background information**

Commercial vegetable cultivation for urban centers, an important contributor to rural livelihoods, has been identified as the key threat to biodiversity efforts in the Eastern Arc Mountains and East African Coastal Forest Mosaic Hotspot (EACF) hotspot because they lead to forest clearance, and, pollution of soil and water due to excessive use of inorganic agro-chemical inputs.

The current threat come from the commercial cultivation of vegetables, which are sold in the domestic markets, notably in urban centers like Dar es Salaam, Arusha, Mombasa and Nairobi, and from the growing of cardamom and other spices under forest cover. These activities result in forest clearance and the destruction of undergrowth in the forest and pollution as a result of excessive use of inorganic agro-chemical inputs (fertilizers and pesticides). They are an important contributor to rural livelihoods, and therefore pose a real problem for forest conservation as the population and the demand for arable land grows. More particularly, increased vegetable production with over dependency on excessive use of pesticides in recent years is of major concern because of potential ill effects on on-going biodiversity efforts. To minimize the negative effects of increased vegetable production in these EACF Hotspot, promotion of more sustainable and productive farming methods are required to mitigate this threat. This can be done through the promotion of effective agricultural extension, and more particularly, integrated crop and pest management in vegetable production.

The ICIPE led diamond back moth (DBM) IPM-based biocontrol programme for Eastern Africa has already started to promote the technology for brassica crops and the results, in terms of reduced insecticide spraying in the Taita Hills, are quite impressive. In this area, spraying cabbage and kale to control the DBM, one of the key pests, has been reduced from 12 sprays to zero per season. This was achieved through the introduction of a successful biocontrol agent, and awareness creation and training of farmers and extension agents about effective IPM approaches for brassica crops. Based on the fact that a wide range of vegetables are grown in the target area, and that the DBM project developed solutions largely for brassica crops only, there is a need to promote IPM for other popular vegetables grown in association with brassicas to facilitate wide scale use of environmentally acceptable production practices.

Horticultural production activities are the major threats to biodiversity conservation but the current status of the types and amount of synthetic agro-chemical (synthetic pesticides and inorganic fertilizers) use is not well document. Therefore, before the introduction of IPM to horticultural growers in the area, it was necessary to collect baseline information on the types of vegetables grown, production practices, types and frequency of agro-chemical inputs, sources of plant protection information and market access. The information would be used

as a basis for formulating locale specific IPM training curriculum for farmers to reduce over dependency on synthetic agro-chemical inputs.

### Selection of Pilot sites

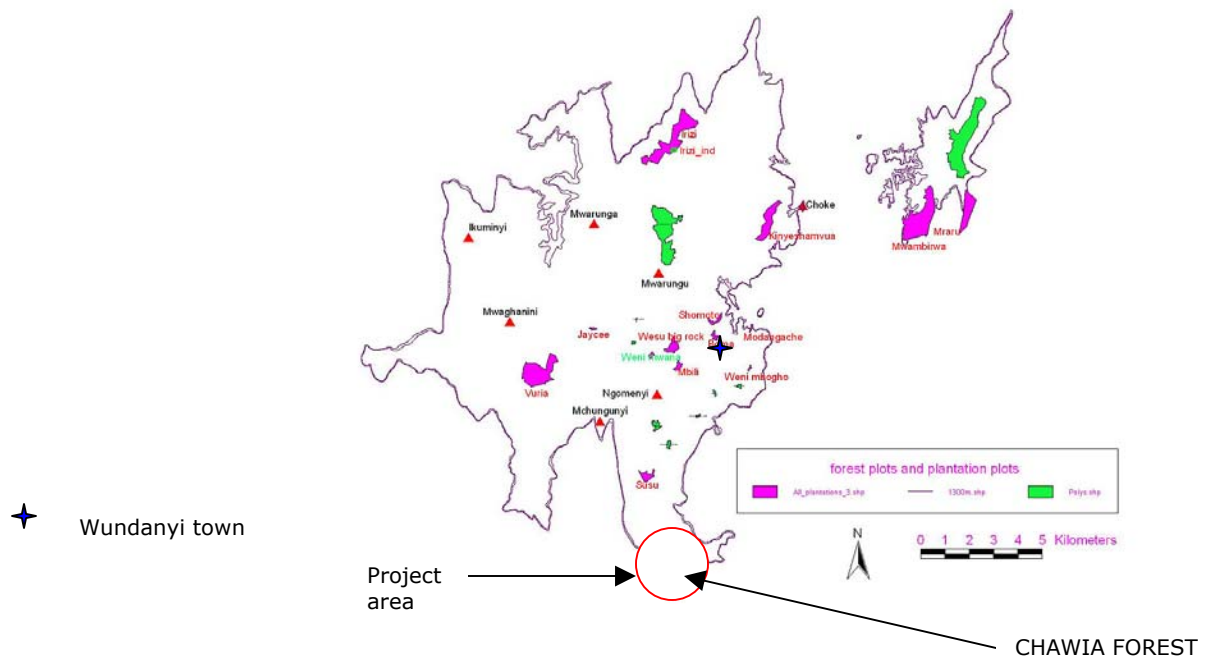
Two sites within the Eastern Arc Mountains were selected based on their long tradition of vegetable production for urban centers. These included the Taita Hills (Kenya) and Western Usambara (Tanzania).

### Taita Hills

The Taita Hills, (Map 1) 3°15′–3°30′S, 38°15′–38°30′E, are located in southeastern Kenya about 25 km west of Voi town. They cover an area of about 250 km<sup>2</sup> and rise abruptly from the surrounding Tsavo plains at an altitude of 600-700 m, to a series of ridges with Vuria, the highest point, at 2208 m. The Taita Hills form the first large inland barrier for moisture-laden clouds, which comes in from the coast, and the precipitation from trapped moisture creates almost permanently humid conditions in the hilltop forests (Chege and Bytebier, 2005).

Due to human settlements and agricultural activities, the once continuous mist forest is presently highly fragmented and comprise of up to 52 patches completely detached from each other (Chege and Bytebier, 2005). The forests greatly vary in size with the smallest being Kulundu (0.08 ha) and the largest being Igho Mkundu (2000 ha). Out of the 52 forest patches only 24 are gazetted and only 3 out of the 24 gazetted are surveyed. The surveyed ones are Mbololo Juu, Mwambirwa, and Ngangao Forests. Both gazetted and non-gazetted forests occupy 8902.01 ha (approximately 0.52% of the total district area).

Map 1 Taita Hills



Vegetation types in these forest patches vary from indigenous exotic with most of them being a mixture between the two. These forests are home to endemic animals including birds and insects (Anon, 2005). Unfortunately, the local community members have low awareness of the biodiversity richness of the forests because they provide little or no tangible benefits to them.

The biodiversity richness and endemism of the Taita Hills have been influenced by more than 100 years of isolation (Anon, 2005). Various studies indicate that the forests are home to :

- 13-plant and 9-animal taxa endemic;
- 22-plant and 3-animal species are characteristic of the East Arc Mountains;
- 37-plant species rare both nationally and globally;
- 3 endemic birds listed in various threat categories;
- High endemism in invertebrates (both specific and related to Eastern Arc Mountain forests) at genus and species levels
- the nationally endemic gecko and the Taita reed frog

However, continued human population pressure and agricultural activities continues to threaten the existence of these few endemic species.

Vegetable production for Mombasa urban started from the colonial days, and therefore has a long history in the area.

A number of initiatives that aims to minimize continued loss of biodiversity have been carried out in recent years. The ICIPE Environmental Health Division (EHD) led project on “*promotion of nature-based, sustainable businesses for forest-adjacent communities in the East Usambara-Tanga, Taita Hills and Lower Tana rivers forests*”, is one of them. The ICIPE-led project is promoting community-based butterfly and silk farming, and, bee keeping with emphasis on organic production in Chawia Forest-Taita Hills in close collaboration with the Environmental committee. This effort is jeopardized by vegetable production activities, that rely on the use of synthetic pesticides on farmlands adjacent to natural forest reserves, and hence the need to introduce IPM to the farmers. Chawia forest with an areas of 86ha is located in Mwatate division, Taita-Taveta District, Coastal province-Kenya. Farmers in the surrounding environs grow vegetables for food and for cash.

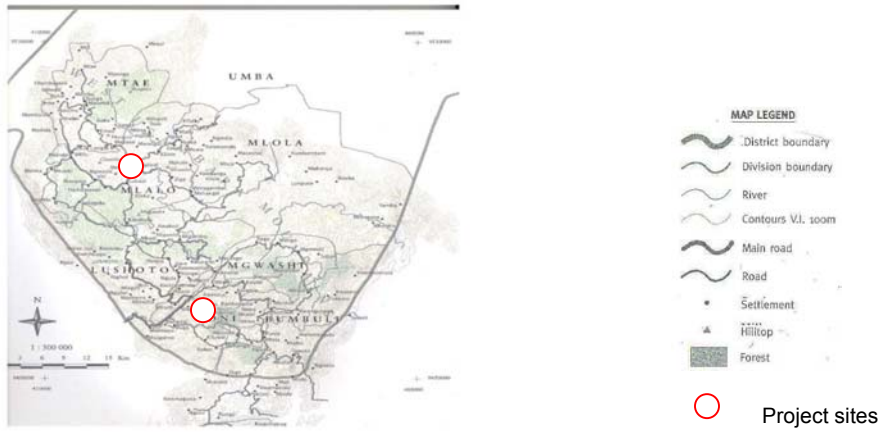
### **Western Usambara**

Western Usambaras is located in Lushoto district-Tanga region between 610m to 2300m.a.s.l, characterized by steep slopes and narrow valleys (map 2). These mountains occupy about 1968km<sup>2</sup> out of which 1575km<sup>2</sup> are arable lands. It is estimated that about 220km<sup>2</sup> are forests. According to the 2000 population census, the total population is 450,000, this giving a population density of 210 persons/km of agricultural land (Anon, 2000).

Similar to the Taita Hills, the natural forests have been highly fragmented. To date there are 18 national forest reserves out of which 10 are classified as local forest reserves (Anon, 2001). Village management committees manage the local forest reserves. These forests are among the last remaining patches of

submontane forest, which are home to 66 threatened species (23 animals 43 plants).

Plate 2 Map of Western Usambara-Lushoto district Tanga region-Tanzania



Land use is a combination of traditional subsistence farming and modern cash production (Anon, 2000). Subsistence crops such as maize, field beans, bananas, cassava and sweet potatoes are grown on hillsides, while vegetables are mostly grown in valley bottoms (Anon, 2000).

Vegetable production in the area started in the pre-independence period when settler farmers and missionaries were the major producers for Dar es Salaam and Tanga urban centers (Anon, 1994). Since then, various initiatives to promote the vegetable industry (production and marketing) have taken place (Anon, 1994). These include the Lushoto Integrated Rural Development Project (LIDEP) that was established in 1969, the Usambara Agricultural Corporation (UCA) in 1977, and currently, Usambara Lishe Trust and Ubiri Lushoto (ULU).

In the 1970s LIDEP handled about 30 different vegetable types (leafy: cabbages, stalks: leeks and fruits: tomatoes, cucumber, etc. By the 1990s the variety of vegetables had declined. Farmers started to grow more of tomatoes, cabbage, onion, peppers, carrots, eggplants, Swiss chard and cucumber. Tomatoes formed 50% of all vegetable produced in Western Usambaras (Esche, 1993, Anon, 1994). According to Esche (1993), all farmers use commercial fertilizers and synthetic pesticides in the production of vegetables. Most of the commonly used synthetic pesticides were bought from the coffee authority, as this was the major source of pesticides used on coffee.

### **Selection of farmer groups and data collection**

Selection of project groups was a two-stage process. For a community to qualify, (1) the community must be actively producing vegetables for income generation, (2) be active and cohesive groups, (3) carrying out production in the environs of known indigenous forest reserves and/or (4) involved in natural forest/environmental conservation activities. Based on the above criteria, the liaison officers in Western Usambara and Taita Hills were requested to identify groups for profiling. The second stage involved group profiling and baseline data collection that was done by ICIPE in April/May 2006.

The study was conducted in Western Usambara in April 27-28<sup>th</sup> and in Taita Hills in May 9-10<sup>th</sup> 2006.

#### **Data collection**

Data was collected using RRA tools (farmer meetings, discussions) and a checklist. The checklist covered the following issues:

- ⇒ Group information (group age, structure, membership, activities, purpose and management)
- ⇒ Type of vegetable crops grown (types, seasonality, inputs etc)
- ⇒ Pesticide usage (trade names, sources and frequencies of major synthetic pesticide commonly used)
- ⇒ Major production constraints.
- ⇒ Sources of irrigation water.
- ⇒ Market access and seasonal prices



⇒ Sources of production information (extension services).

The base period for the study was the production seasons between years 2003 to May 2006

## Results

### Groups profiled

In Western Usambara, the study covered three large groups (Shashui-Soni, Malindi-Lukozi and Ubiri-Lushoto), and in Taita Hills, the study covered Chawia environmental group-Chawia and Charoni group-Ngangao (Table 1).

The Chawia environmental committee is an umbrella group consisting of Tekida (60 members), Wucha (14 members), Mazingira committee (15 members) and Mnyaya (11members), each with different activities. For example, the Mazingira committee is responsible for the indigenous tree nursery, while the Wucha group is regarded as the vegetable production group.

Table 1 Groups Profiled in April/May 2006

Taita Hills (Kenya)	Group size	Western Usambara (Tanzania)	Group size
Chawia environmental group	100	Usambara lishe trust (Malindi group)	22
Charoni group	25	Shashui group	50
		Ubiri Lushoto cooperative limited (ULU)	34

In Western Usambara, the Malindi group is a member of the Usamabara Lishe Trust, an umbrella group with members in four other villages, whereas Shashui is an umbrella group consisting of Kilindi (18 members), Kwemashai (20 members) and Mzungu (20 members). Ubiri is a group of farmers based in Lushoto town.

All the groups could be classified as peri-urban producers since their major market is urban centers.

### Group information

All five groups are all organized (all have a constitution, an organizational structure consisting of a chairman, vice chairman, secretary and treasurer) and registered with various ministries (except Shashui), and therefore have legal status. The current status of individual group is summarized in Table 2. Shashui is still in the formation stage since it does not have legal status (not legally registered).

Table 2 Current status of groups profiled in April/May 2006

	Taita Hills (Kenya)		Western Usambara (Tanzania)		
	Chawia	Charoni	Malindi	Shashui	Ubiri
Year formed	2000	2005	1996	2005	1991
Registration status	Yes	Yes	Yes-1996	No	Yes-1995
Institution responsible	Ministry of social services Wundanyi	Ministry of social services Wundanyi	Ministry of home affairs	in process	Ministry of Agriculture, food security & cooperatives
Membership (when formed)	18	50	16	50	107
Membership (active)	18	25	21	50	34
% of women	50	64	0	60	47

### Reasons for group formation

In Taita Hills, the Chawia environmental committee was formed to carry out environmental conservation activities (carry out vigilance of illegal activities in Chawia forest, develop conservation-based income generating activities e.g. butterfly farming, silk farming, beekeeping and establishment of indigenous tree nurseries for planting in the conservation forest and on own farm lands), whereas the Charoni group was formed for market access (to market vegetable produce together).

In Western Usambara, the groups formed to improve market access (marketing vegetables together). In addition, Shashui came together as a group to improve access to extension information and to construct a water dam jointly for vegetable irrigation. In recent years, the groups are actively involved in the management of forest reserves in their respective villages. The Shashui group is solely responsible for the management of Ndelemai forest, which is the source of the water they use for irrigation. The group provides tour guides through the forest, and part of the income generated is given to the village. Similarly, the Malindi group is responsible for joint management of Mtumbi and Chambogo forest reserves (Johansson, 2001).

### Types of Vegetables grown

A wide range of vegetables is grown in the pilot study areas (Table 3). The results of this study in Western Usambara vary from previous reports (Anon, 2000, Esche 1993 and Anon, 1994) particularly for the Malindi farmers most probably because of changes in consumer demand. The Malindi group produces and sales to niche markets (tourist hotels, supermarkets etc) in Dar es Salaam,

and therefore production is driven by consumer demands. However, this does not apply to all the other groups in Western Usambara and Taita Hills.

Table 3 Summary of vegetables grown and their popularity (ranking) in Taita Hills-Kenya and Western Usambara-Tanzania.

Crop	Taita Hills-Kenya		Western Usambara-Tz		
	Chawia	Charoni	Malindi	Shashui	Ubiri
Broccoli	0	0	1	3	9
Cauliflower	0	6	1	4	9
Zucchini	0	0	1	4	6
Capsicum	5	3	1	1	1
Lettuce	7	6	1	5	5
Spinach	7	5	1	0	0
Leek	10	5	1	0	9
Parsley	6	6	1	0	0
Beetroot	10	0	1	6	2
Carrots	0	6	1	4	7
Celery	8	0	1	0	0
Tomato	3	2	1	3	7
Cabbage	4	3	1	4	5
Onions	6	5	1	2	0
Turnips	8	0	0	0	10
Cucumber	2	6	0	4	4
Kales	1	1	0	0	3
Baby marrow	8	4	0	0	0
Black night shade	1	6	0	0	0
Garden peas	6	0	0	0	0
Green beans	0	0	1	4	8

### Market access

#### Taita Hills-Kenya

The marketing organization and channels for Chawia and Charoni group are similar. Both groups sell their produce locally through middlemen (figures 1 and 2).

Figure 1 Vegetable market organization: Chawia environmental committee group

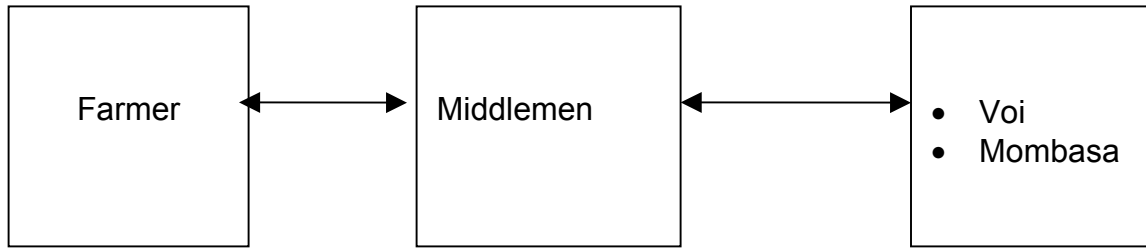
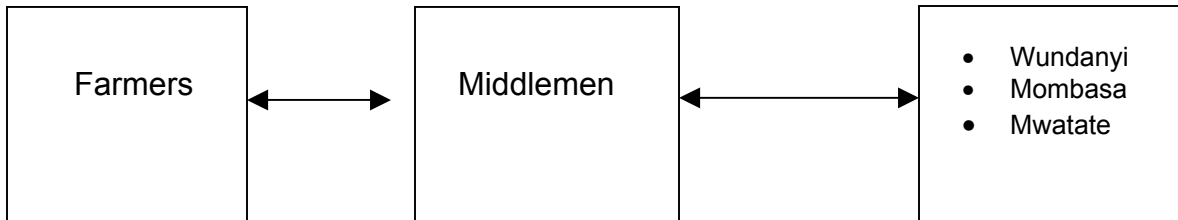


Figure 2 Vegetable market organizations: Charoni group



### Western Usambara

On the other hand, the Malindi and Ubiri groups in western Usambara have organized marketing system. Farmers in these two groups sell their produce to linked markets through Usambara Lische Trust and Ubiri Lushoto Cooperative respectively (figures 3 and 4). The Usambara lische trust is an umbrella group consisting of Malindi, lushoto, Ngare and Lukosi groups that market produce together.

In contrast, the Shashui group sells produce through brokers (businessmen) as shown in figure 5.

Figure 3 Malindi group vegetable market organization

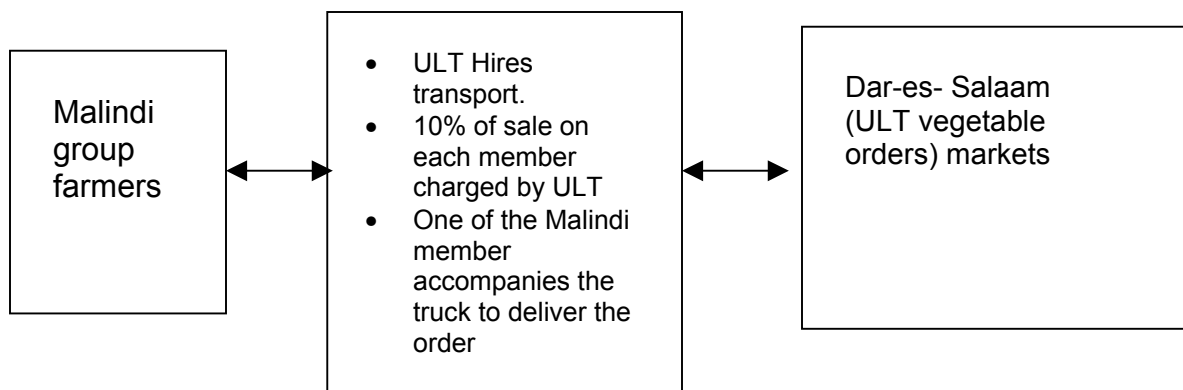


Figure 4 Ubiri Lushoto Cooperative group vegetable market organization

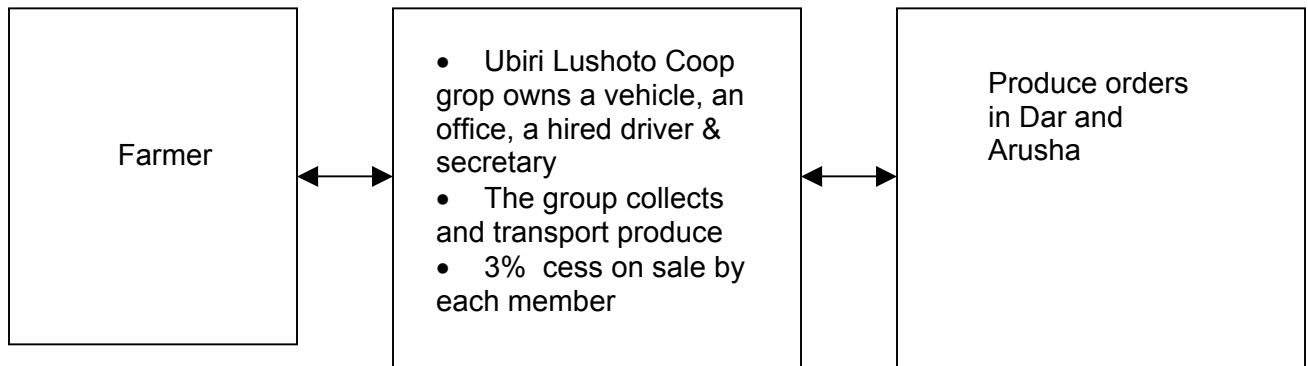
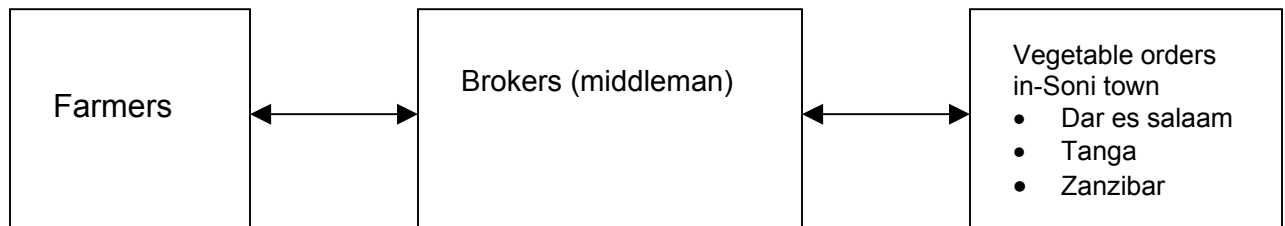


Figure 5 Shashui group vegetable market organization



## Vegetable production problems

### Taita Hills

#### Chawia group

- Lack of water during the dry season, and therefore production largely depends on rain
- High cost of inputs (fertilizers, pesticides, seeds)
- Unreliable market access (have to use middlemen)
- Attack by pests and diseases
- Poor seed quality (e.g. capsicum do not germinate)
- Poor transport system

#### Charoni group

- High cost of inputs (pesticides, fertilizers )

- Lack of transport
- Attack by pests and diseases
- Unreliable market access (have to use middlemen)
- Lack of credit access

## **Western Usambara**

### **Malindi group**

- High cost of inputs (seeds, fertilizer and pesticides)
- Poor transport system
- Attack by pests and diseases

### **Shashui group**

- High cost of inputs (seeds, fertilizer, pesticides)
- Poor transport system
- Poor seed quality (capsicum, 1%)
- Lack of water during the dry season
- High post harvest losses (poor produce shelf life and handling)

### **Ubiri Lushoto group**

- High post harvest losses (poor produce shelf life and handling)
- High cost of inputs (fertilizers, seed and pesticides)
- Attack by pests and diseases
- Unstable produce prices (seasonality fluctuations)

## **Irrigation water sources**

Supplementary source of water during dry spells is essential for all year round production. Such sources could also be threatened due to over exploitation, poor management as well as areas of high pesticide residues.

## **Taita Hills**

### **Chawia group**

Farmers source irrigation water from Gonja (81%) and Mkuronge rivers (18%).

### **Charoni group**

The farmers source water from Kwanyiro, Kinachui, Madumu and Kishenyi rivers

### **Malindi group**

The farmers source water from streams in valley bottoms

### **Shashui group**

Farmers source water from a dam built in the Ndelemai national reserve forest

### **Ubiri lushoto group**

Farmers source water from streams and shallow wells

## **Development agencies**

### **Taita Hills**

#### **Chawia group:**

Ministry of Agriculture (Crops), Critical Ecosystem Partnership Fund (CEPF), East African Wildlife, ICIPE and SITES bee keeping project

#### **Charoni group**

Ministry of Agriculture (Crops), East African Wild life, Kenya Agricultural Production Project (KAPP), Constituency Development Fund (CDF) and Local Authority Transfer Fund (LATFF) through DANIDA/Cross border biodiversity conservation programme

### **Western Usambara**

Ministry of Agriculture, Food Security and Cooperatives, extension services (MOAFS&C), Tanzania, Agricultural Marketing System Development Project (AMSDP), Participatory Agricultural Development and Extension programme (PADEP) and Tanzania Forestry Conservation Group (TFCG).

## **Sources of extension information**

### **Taita Hills**

Up and until early 1990s, the horticulture production center (HPC) in collaboration with MOA was the main sources of information on production and marketing of vegetables for the district. After the demise of HPC, this service is offered by the Ministry of Agriculture (Horticulture extension division) with support from farmer-farmer information sharing.

### **Western Usambara**

A number of extension programmes targeting vegetable production have been implemented since 1964. The Kübel-Foundation funded Lushoto Integrated Rural Development project (LIDEP) initiated in 1964 included production and marketing of vegetables (Esche, 1993). The activities were handed over to Usambara District Development Corporation (USADECO) in 1977. Between 1981 and 2000, the Soil erosion control and agro-forestry project (SECAP) under the umbrella of Tanga Integrated Rural Development programme, offered extension service in Agriculture and agro-forestry. The SECAP activities have now been taken over by the Participatory Agricultural Development and Extension project (PADEP). All the above initiatives were supported by the horticultural extension services under the Ministry of Agriculture (Anon, 1994, 2000, Esche, 1993). Currently farmers



source information on vegetable production from the Horticultural division under the District Agricultural and Livestock Development Office-Lushoto District.

### **Seasonality of major vegetable crops, pest problems and pesticide use**

#### **Taita Hills**

##### **Chawia group, Chawia sub location, Mwatate division**

The major pesticide sprayed vegetable crops grown by Chawia group are kale, cabbage, tomatoes and cucumber in order of priority. Their seasonality is illustrated in figure 6, and the perceived major pest (insect pests and diseases) and current control practices in Tables 4 and 5 respectively.

Figure 6 Seasonality of tomatoes and capsicum for Chawia group

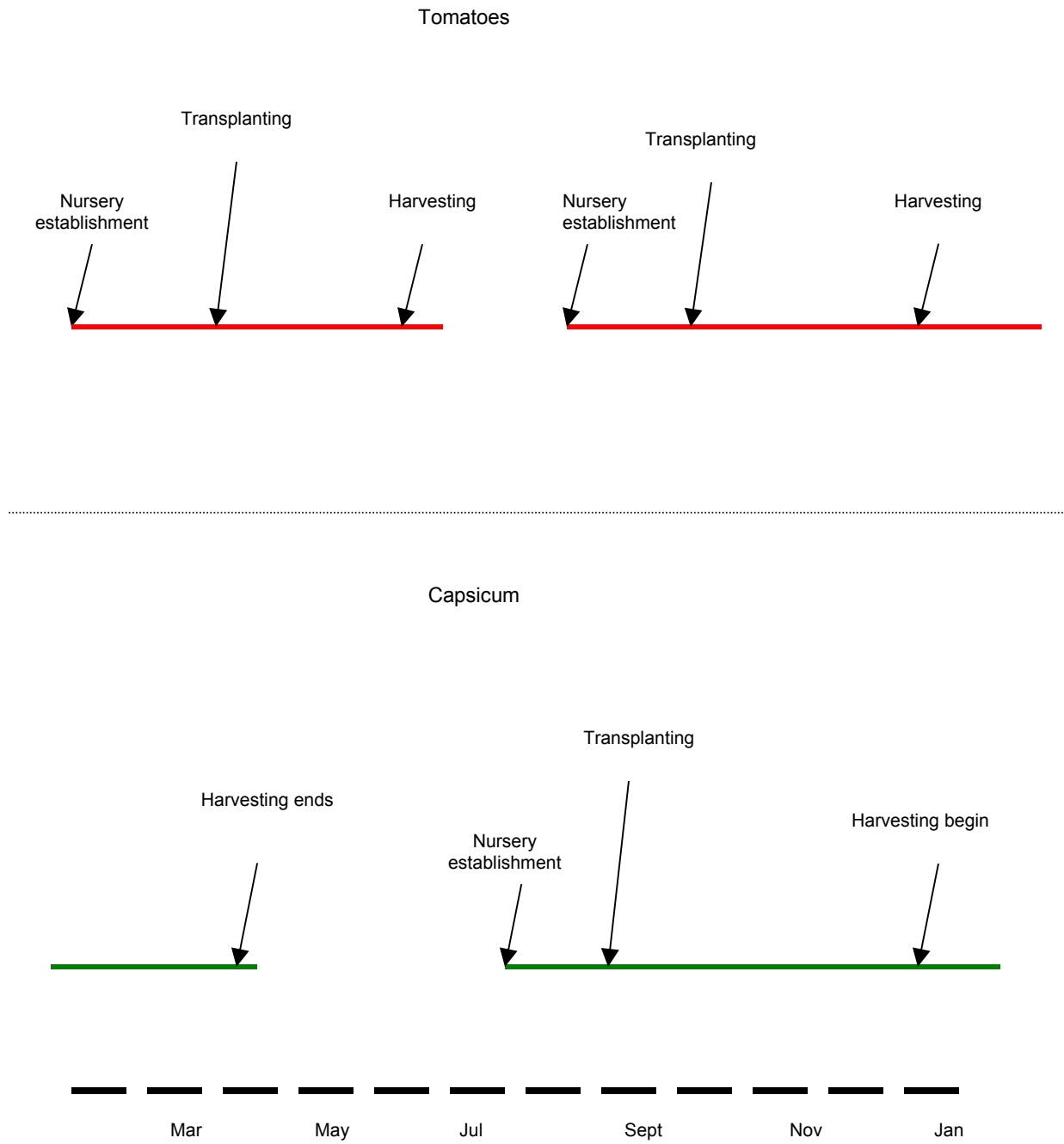


Table 4 Common insect pests and disease problems of tomatoes, and pesticide use by the Chawia group: results of farmer discussions

<b>Pesticide (active ingredient)</b>	<b>Target pest</b>	<b>% usage</b>
Karate (lambda cyhalothrin)	Cutworms / red ants	26
Actellic (Pirimiphos methyl)	Red spider mite's	41
Diazol (Diazinon)		41
Champion (copper hydroxide)	Nematodes	12
Ridomil (Metalaxyl +Mancozeb)	Powdery mildew	33,
Dithane M45 (mancozeb)	Tobacco Mosaic Virus	56
Milraz (cymoxanil/propineb)	Late blight	11
Ridomil (metalaxyl+mancozeb)		
Ridomil	Bacterial wilt	10
Dithane M45		12
Milraz		8
Ridomil	Blossom end rot	11
Dithane M45		10
Milraz		10

Note: 12-18 sprays are applied/crop/season

Table 5 Common insect pests and disease problems of capsicum plus pesticide use by the Chawia group: results of farmer discussions

<b>Pesticide (active ingredient)</b>	<b>Target pest</b>	<b>% usage</b>
Dudu dust (carbaryl)	Red ants	33
Karate, Actellic, Diazol	Cut worms	30 15 22
Karate, Actellic Diazol	Webworm, boll worm, Red spider mites	30 15 22
Milraz, Ridomil Dithane M45	Late blight, leaf rust, Bacterial wilt	30 48 48
Ridomil Dithane M45 Milraz	Blossom end rot	22 10 12

8-12 sprays/crop/season

#### **Alternative pest control methods**

About 37% of the farmer use milk to control tomato powdery mildew and early/late blight. Another 37% use a mixture of tobacco+ hot chilli + marigold extract against insect pests i.e. aphids and red ants.

**Charoni group, Mghambonyi sub location, Wundanyi Division**

The major pesticide sprayed vegetable crops grown by Charoni group are kales, tomato, cabbage and capsicum in order of priority. Their seasonality is illustrated in figure 7, and the pest problems and their control practices in Tables 6

Figure 7 Seasonality of tomatoes Charoni group

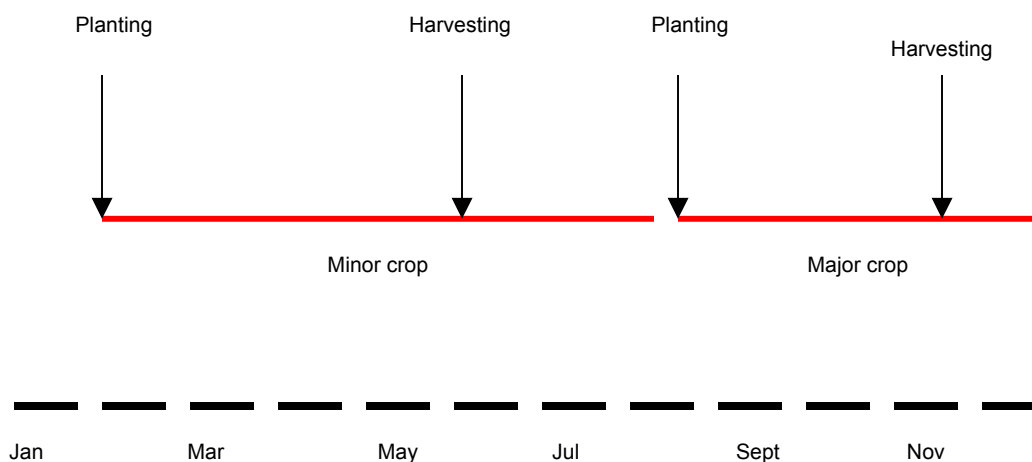


Table 8 Common insect pests and disease problems of tomatoes, and pesticide use by the Charoni group

Pesticide (active ingredient)	Target pest	% usage
Bestox (Alpha cypermethrini)	Boll worm	50
Karate (lambda cyhalothrin)		75
Diazol (Diazinon)		50
DithaneM45	Late blight	100
Ridomil		100
Antracol		100

12-20 sprays are applied during rainy seasons; 12-16 in dry season

**Other alternative methods used**

- Bollworms                      physical killing
- Bacterial wilt                Crop rotation or discard the field
- Powdery mildew              no pesticide used
- Red ants                        Uprooting of infected plants and/or apply wood ash (used by 17% of the growers)

**Based on the information collected and on-going community-based conservation activities, the Chawia environmental committee was earmarked for inclusion in the first year of the project.**

### **West Usambara Tanzania**

#### **Malindi group, Lukozi, Malindi sub-location, Lushoto District**

The Malindi group grows an assorted range of vegetables (table 3) because the group is selling to specialized market outlets in Dar es Salaam. The group sells their vegetables to Dar International Airport catering services, Shoprite super market, and tourist hotels etc. In this area, cabbages, broccoli, tomatoes are ranked highly as sources of income. Their seasonality is summarized in figure 8, and perceived key pest problems and control practices in Table 7.

Figure 8 Seasonality of cabbage, broccoli and tomatoes for Malindi growers

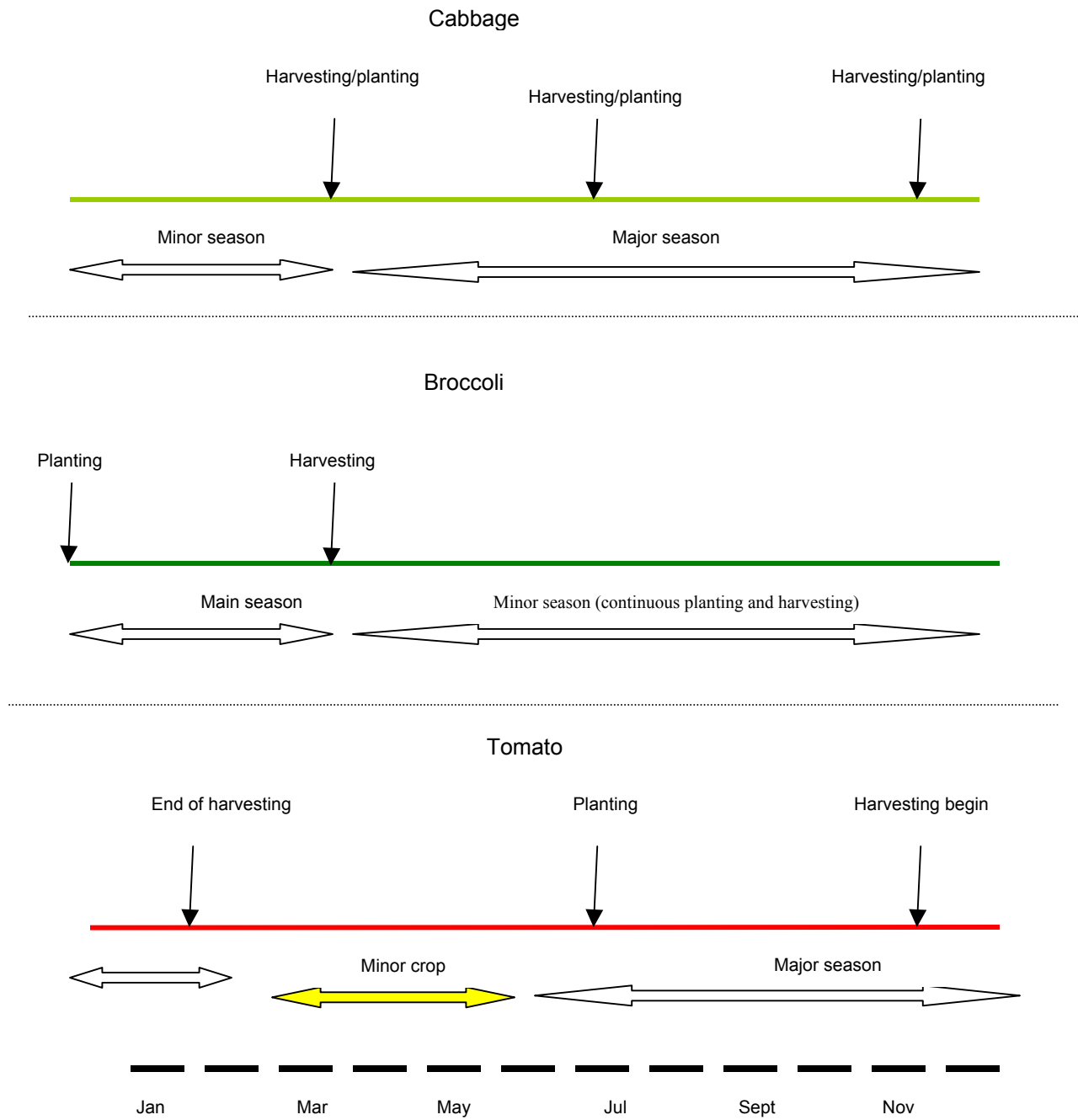


Table 7 Common insect pests and disease problems of broccoli and cabbage, and pesticide use by the Malindi group

<b>Pesticide (active ingredient)</b>	<b>Target pest</b>
Selecron (Profenofos) Karate (lambda cyhalothrin)	Cutworm
Neem extract, Selecron, Karate, Thionex (Endosulfan), Keshet (Deltamethrin), Actellic (Pirimiphos methyl)	Aphids
Keshet	Diamond Back Moth
Furadan (Carbofuran), Dithane M45 (Mancozeb), Ivory (Mancozeb)	Root rot
Furadan	Nematodes

### **Tomato**

Although tomato production is ranked highly by the Malindi group, its production is constrained by the following factors below

- High cost of production: it costs TSH 70,000 approximately US\$70 per 400 plant plot, while the farm gate prices are often as low as Tsh 500 per 15 Kg of tomatoes.
- The crop is attacked by many insect pests i.e. cutworm, red spider mites, aphids etc. and this requires many spray applications ( up to 20 per season) and therefore considered uneconomical
- Similarly, the crop is attacked by many diseases i.e. Bacterial wilt, fungal diseases etc., this also requiring frequent pesticide application

The pesticide spraying to control pests is considered rather expensive and the returns do not justify the costs of pesticide application. However, some group members still try to produce tomatoes in high seasons (targets seasons of high prices)

### **Shashui group, Shashui, Soni sub location, Lushoto district**

The original Shashui group, consisting of five water users' groups, was formed for purposes of environment conservation, construction of small irrigation dams and training in leadership skills. Since some members did not participate fully in group activities, a "new" Shashui group was formed out of the 5 water users' groups. The "new" group consists of only those who participated in the construction of the small irrigation dams. Each member contributes an annual fee of Tsh 5000.

Unlike the Malindi group in Lukozi, capsicum, beetroot, kale, cucumber, cabbage lettuce and tomatoes are major vegetable types grown by the Shashui farmers (table 3). The seasonality of cabbage, capsicum and tomatoes, the most heavily

sprayed crops is summarized in Figure 9. The perceived pest problems and control methods are summarized in Tables 8, 9, and 10.

Figure 9 The seasonality of cabbage, capsicum and tomatoes in Shashui-Soni

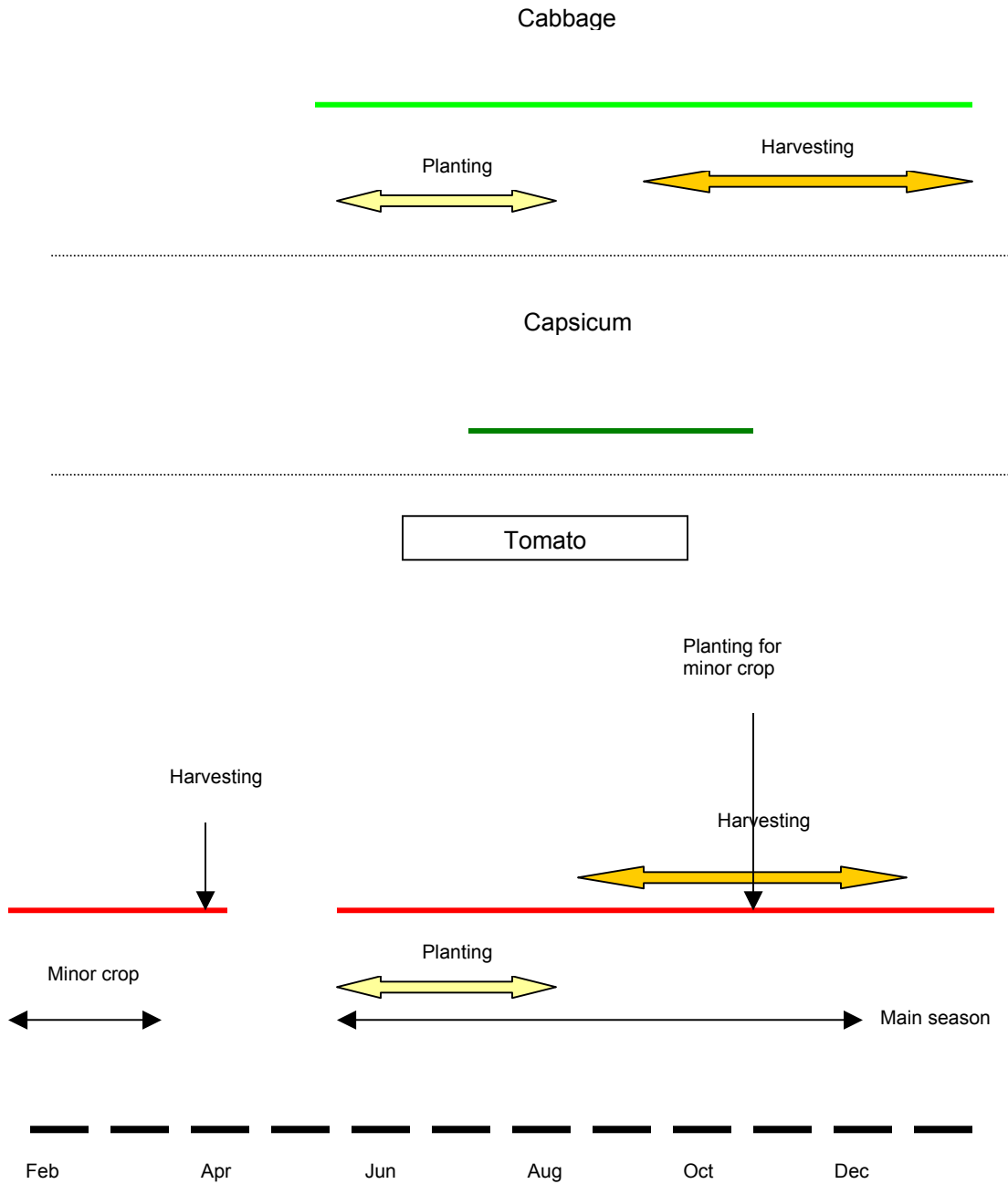




Table 8 Common insect pests and disease problems of tomatoes, and pesticide use by the Shashui group

<b>Pesticide (active ingredient)</b>	<b>Target pest</b>	<b>% usage</b>
Selecron	Cutworms	56
Karate	Red spider mites	
Selecron Dithane M45 Blue-copper (copper hydroxide)	Aphids	67 78
Dithane M45	Powdery mildew	50

**Alternative control methods**

Disease staking practiced by 11% of growers  
 Cut worms barriers (placing a stick next to the seedling plant practiced by 11% of growers)

Table 9 Common insect pests and disease problems of cabbages, and pesticide use by the Shashui group

<b>Pesticide</b>	<b>Target pest</b>	<b>% usage</b>
Selecron	Cutworms	56
Selecron	Aphids	56
Selecron	Diamond back moth	56

**Alternative control method**

Cutworms Hand picking and physical killing practiced by 56% of growers

Table 10 Common insect pests and disease problems of capsicum, and pesticide use by the Shashui group

<b>Pesticide</b>	<b>Target pest</b>
Selecron Dithane M45	Cutworms
Dithane M45	Bacterial wilt

**Alternative control measure**

Grasshoppers wood ash in nurseries  
 Cutworms Hot chilli practiced by 33% of growers  
 Other insects wood ashes practiced by 44% of growers

**Ubiri Lushoto cooperative Ltd group, Magambo-Lushoto division, Lushoto District**

To join the group and maintain membership a new member has to grow vegetables and sell through the group.

Farmers in this area grow a wide range of vegetables. The major ones include capsicum, beetroot, kales, cucumbers, lettuce and cabbage. Tomatoes are unpopular because they are attacked by a wide range of pests (insect pests and diseases problems) and therefore, uneconomical to grow. They are therefore ranked very low (table 4). The seasonality of cabbage, capsicum and cauliflower is summarized in Figure 10 and the perceived pest problems are shown in Tables 11 and 12.

Figure 10 Seasonality of cabbage, cauliflower and capsicum for the Ubiri-Lushoto growers

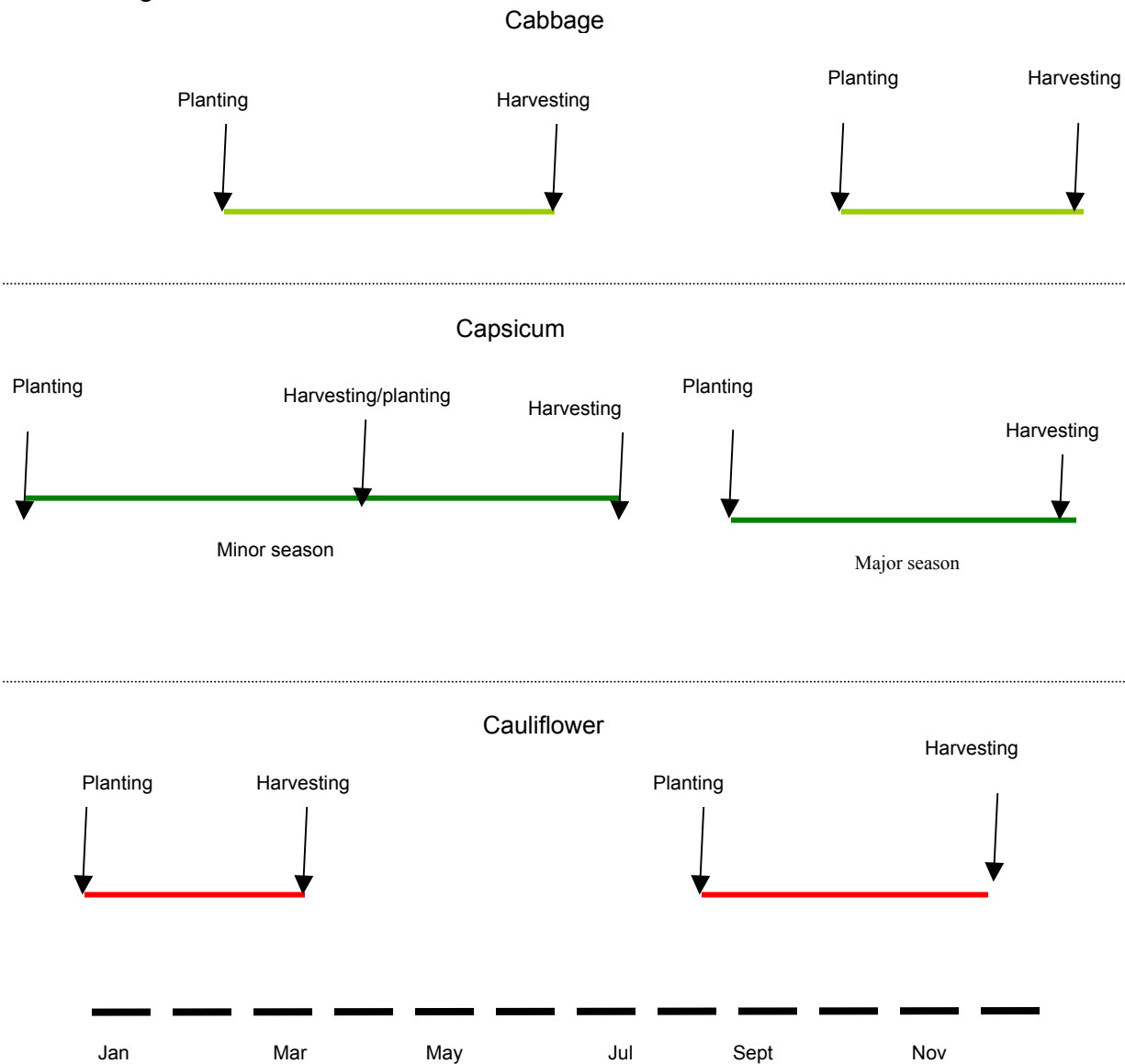


Table 11 Common insect pests and disease problems of cabbage and cauliflower, and pesticide use by the Ubiri group

<b>Pesticide (active ingredient)</b>	<b>Target pest</b>	<b>% usage</b>
Selecron	Cutworms, diamond back moth, aphids and webworms	100
Actellic	Aphids	40
Dithane M45	Powdery mildew	60

Two sprays are applied/crop/season

Table 12 Common insect pests and disease problems of capsicum and pesticide use by the Ubiri group

<b>Pesticide</b>	<b>Target pest</b>
Selecron	Cutworms
Dithane	Powdery mildew
Selecron	Aphids
Selecron	Bollworm

#### **Alternative to pesticides**

Bacterial wilt      Cut and disposes affected plants  
 Cow urine          20%  
 Cutworms          Mexican marigold used by 20% of growers

**Based on the information collected, and taking into consideration group involvement in the conservation of natural forests, the Malindi and Shashui groups were earmarked for IPM training starting in 2006. Other groups would be enrolled depending on lessons learned in the pilot phase.**

#### **Area-wide pesticide use trends in Taita-Hills and Western Usambara**

In a separate study that involved area-wide survey in October 2004 to October 2005 on pesticide use and spray practices in both areas, the results indicated that (1) overall, tomatoes and cabbages are more sprayed in Western Usambara than in the Taita Hills, (2) more spraying is done during the dry than in wet seasons in both areas (Table 13), and (3) a wide range of synthetic pesticides are used in the production of brassica crops (table 14). Some of these synthetic pesticides have been demonstrated to have adverse effects on threatened species including amphibians (Lauriden and Friberg, 2005), and hence the need for the introduction of good agricultural practices, which will include use of environmentally friendly agricultural practices.

Table 13 Number of sprays /crop/season for selected crops in Taita-Hills and Western Usambara: October 2004 to October 2005

<b>Number of sprays</b>	<b>Taita Hills</b>	<b>Western Usambara</b>
<b>Tomatoes</b>		
Dry	15	20
Rainy season	12	15
<b>Brassica crops</b>	<b>Kales</b>	<b>Cabbages</b>
Dry	8	12
Rainy season	4	5
<b>Capsicum</b>		
Dry	5	7
Rainy season	5	?

Table 14 Pesticides used and target pests in cabbages and kales:Taita Hills and Western Usambara, October 2004 to October 2005

Taita Taveta		Lushoto	
Pesticide (chemical name)	Target pest	Pesticide	Target pest
Karate (Labda cyhalothrin)	Cutworms, webworms, Diamond back moth, cabbage looper, white flies & aphids ( <i>Brevicoryne brassicae</i> , <i>Lipaphis erysimi</i> , <i>Myzus persicae</i> )	Karate	Cutworms, webworms, Diamond back moth, cabbage looper, white flies & aphids ( <i>Brevicoryne brassicae</i> , <i>Lipaphis erysimi</i> , <i>Myzus persicae</i> )
Bestox (Alpha cypermethrin)	Aphids, cutworms, webworms, cabbage looper & white flies	Fastac (Alpha cypermethrin)	Cutworms, webworm, Diamond back moth
Antracol (Propineb)	Leaf spots and powdery mildew	Thiovit 80 WP (Sulphur)	Powdery mildew, soft rot & black rot
Diazol (Diazinon)	Webworm, cutworms, cabbage looper and diamond back moth	Milraz (Propineb +Cymoxanil)	Powdery mildew
Milraz ((Propineb +Cymoxanil))	Powdery mildew	Daconil (chlorothalonil)	Leaf spots
Bulldock (Beta-cyfluthrin)	Cutworms, webworms and cabbage looper	Sencor (Metribuzin)	Herbicide for broad leaf and grass weed
Decis (Deltametrin)	Boll worm, webworm & diamond back moth	Atom (Deltamethrin)	Aphids, webworm, diamond back moth and cabbage looper
Fastac(Alpha cypermethrin)	Cutworms, webworm, Diamond back moth & cabbage looper	Rimon (Novaluron)	Diamond back moth
Dimethoate	Aphids and white flies	Ivory (Mancozeb)	Powdery mildew & leaf spots
Blue copper (Copper hydroxide)		Bravo (Chlorothalonil)	Leaf spots and powdery mildew
Red copper		Selecron (Profenofos)	Cutworms, webworms, aphids and cabbage looper
		Dimethoate	Aphids and white flies
		Electis (Zoxamide +Mancozeb)	Powdery mildew
		Banco (Chlorothalonil)	Leaf spots & powdery mildew
		Cyclone (Chlorpyrifos +Cyfluthrin)	Aphids

## **Conclusions**

The study has shown that (1) a wide range of vegetables are grown for food and income generation by communities on farmland surrounding indigenous forest reserves (2) that a wide range of synthetic pesticides are used in the study areas, this justifying the introduction of integrated pest management to vegetable growers, and, (3) communities living adjacent to natural forests are already involved in forest conservation activities. The proposed project would add value to the on-going activities by facilitating reduction of over-dependency on synthetic pesticides in vegetable production, one of the major threats to biodiversity conservation.

## Abbreviations and acronyms

ULU	Ubiri Lushoto Group
ULT	Usambara Lishe Trust
ICIPE	International Centre of Insect Physiology and Ecology
MOA	Ministry of Agriculture
CEPF	Critical Ecosystem Partnership Fund
HPC	Horticultural Production Centre
KAPP	Kenya Agricultural Production Project
CDF-	Constituency Development Fund
LATF	Local Authority Transfer Fund
DANIDA	Danish International Development Assistance
SECAP	Soil Erosion Conservation and Agro-forestry Project
AMSDP	Agricultural Marketing System Development Programme
MECCP	Micro enterprise Community Credit Project
ADF	African Development Fund
TIP	Traditional Irrigation Program
PADEP	Participatory Agricultural Development & Extension Project
USADECO	Usambara District Development Corporation
LIDEP	Lushoto Integrated Rural Development Project

## **Acknowledgement**

We wish to thank James Mwang'ombe (East African Wildlife Association, Taita-Hills) and Levin Mahoo (Horticulture Division, Lushoto District) for carrying out groups pre-selection and organizing for the profiling; the farmers groups involved in the study for their time and enthusiasm during the study.

## Reference

Anon, (2005). Stakeholders workshop on the conservation and management of the Taita hills forests; Taita hills safari lodge, February 7<sup>th</sup> – 10<sup>th</sup> 2005, Workshop report, March 2005.

Anon, (1994). Lushoto vegetable marketing: current situation and suggested strategies for improved marketing. Report prepared for TechnoServe and the Project network Vegetable Production Africa, July 1994, GTZ/SECAP Lushoto Tanzania

Anon, ( 2000). Farmers training handbook for fruits and vegetables propagation and management. (Compiled by H. Rogg and edited by Horticulturalists-SECAP Lushoto). GTZ/SECAP Lushoto, GTZ/ITFSP Nairobi-Kenya and DED-Dar es Salaam Tanzania.

Chege J. and Bytebier B. (2005). Vegetation structure of four small forest Fragments in Taita hills, Kenya. *Journal of East African Natural History* 94(1): 231–234

Esche, H. (1993). Vegetable production and marketing in Lushoto: Evaluation of past strategies and proposals for future development. Report for the Project Network Vegetable production Africa, October 1993. GTZ/SECAP Lushoto Tanzania

Johansson. L (2001). Ten million trees. GTZ/SECAP Lushoto-Tanzania

Lauriden, R. B and Friber, N. (2005). Stream macroinvertebrate drift response to pulsed exposure of the synthetic pyrethroid lambda cyhalothrin. *Environ Toxicol*, 20:513-521