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African nightshade, eggplant, spiderflower et al. - production and consumption of traditional vegetables in Tanzania from the farmers point of view

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List of abbreviations

AVRDC-RCA	Asian Vegetable Research and Development Centre - Regional Centre for Africa
FAO	Food and Agriculture Organisation of the United Nations
HKI	Helen Keller International, NGO working on VAD and eye diseases
HORTI - Tengeru	HOrticultural Research and Training Institute of the Ministry of Agriculture and Food Security, Tengeru, Tanzania
IDA	Iron Deficiency Anaemia
NGO	Non-Governmental Organisation
TSH	Tanzanian Shillings
VDA	Vitamin A Deficiency
WHO	World Health Organisation of the United Nations

1 INTRODUCTION

A vegetable as a product may be defined as a usually succulent plant or portion of a plant, which is consumed as a side-dish with the starchy staple (SIEMONSMA & PILUEK, 1994). However, the term "vegetable" is highly subjective from a scientific point of view and is a term of convenience rather than one based on a systematically ordered scientific classification (WEAVER, 2003). There is no general agreement on a strict definition of what is meant by vegetables, yet, five main groups are distinguished. These are leaf vegetables (e.g. amaranth), fruit vegetables (e.g. African eggplant), pulse and seed vegetables (e.g. cowpea), tuber vegetables (e.g. sweet potato) and, finally, other vegetables of which for example flowers (e.g. cauliflower) are used (TERRA, 1966). Furthermore, many vegetables are defined as annuals since they are grown for one season only, whereas several of these plants are true biennials, and some are even perennials (WEAVER, 2003). Consequently, vegetables form a large and diverse commodity group and are considered as a distinct group not because of their botanical features in common, but rather because of the way in which they are grown and their produce is used. Vegetable cultivation is usually highly intensive performed in gardens and, therefore, it is regarded as part of horticulture (SIEMONSMA & PILUEK, 1994).

Pre-agricultural peoples, such as neolithic hunter-gatherers and pastoralists, had access to over 1,500 species of wild plants for food, while later, ancient civilisations used at least 500 vegetables (MUCHIRU, 1985; in: SLIKKERVEER, 1995). The relevance of such historical research findings for future strategies lies in the fact that, through diachronic comparison, diversity is declining.

In fact, the Green Revolution – as far as the conservation of biodiversity is concerned – has intensified the erosion of indigenous and traditional plant varieties and for a long time, the genetic variability of these indigenous and traditional plants and their wild relatives have received minimal attention in research and development. However, now, as there appears some interest in the indigenous knowledge system, traditional plant species and farmers' knowledge of how to manage, select and breed them have been partially replaced by modern agriculture (SLIKKERVEER, 1995).

Unfortunately, only few important crops get more attention through the development of appropriate varieties and agronomic research, while there is a tendency for the rarely cultivated crops to disappear (SCHIPPERS, 2002). With the onset of the market economy and modernisation of agriculture in Africa, attention has been given to crops that offer a potential for export. As a result, exotic vegetables have become more prestigious than traditional vegetables and conventional agronomy has, to a large extent, concentrated on conserving the genetic resources of exotic rather than indigenous

or traditional vegetables. Consequently, the latter are threatened with extinction as they have to compete for attention with the much more popular exotic vegetables (MAUNDU et al., 1999b). Another reason for a decline in traditional vegetable usage is that the indigenous knowledge on their production methods, preservation, use and nutritive value is not anymore systematically transmitted from one generation to another (ANONYMOUS, 1998). Furthermore, urbanisation has also led many growers to prefer introduced vegetable crops.

This neglect of traditional vegetables is not reasonable at all as these vegetables are especially important to the countries of sub-Saharan Africa, being better adapted to the environment than the introduced commercial vegetables. Furthermore, traditional vegetables represent cheap but quality nutrition for large parts of the population in both rural and urban areas (CHWEYA & EYZAGUIRRE, 1999). In fact, almost all of these vegetables are good sources of micronutrients including iron and calcium as well as vitamins A, B complex, C and E and, for example, amaranth contains a multiple of these nutrients compared to green cabbage (IPGRI, 2003).

As traditional vegetables play such a vital role, their genetic diversity must not get lost but conserved and enhanced. Species domestication, crop improvement, and plant introduction usually takes place in traditional home gardens, which are important in terms of production of food, spices, medicine and other essentials, comprising unique and, sometimes, rare genetic diversity of our crop plants as well as some of their wild relatives (ENGELS, 1999). Thus, home gardens as microenvironments containing high levels of species and genetic diversity, are important for *in situ* conservation of a wide range of plant genetic resources (EYZAGUIRRE & WATSON, 1999), i.a. traditional vegetables.

MWASHA (1998) reported that in Tanzania, vegetables are typically grown on a rather small scale, however, horticultural crops usually generate higher earnings per unit area and represent an alternative for farmers with too small cultivable land to provide adequate income from field crops. While vegetables were considered as luxury products and of secondary importance in Tanzania for a long time and the government gave priority to cereals production, recently a rapid increase in fruit and vegetable production has occurred due to the revival of economic growth and liberalisation of non-traditional export marketing. However, the ten most important vegetables produced in terms of yield in 1995/96 were cabbage, tomato, onion, garden pea, amaranth, Chinese cabbage, eggplant, carrots, cauliflower and, finally, okra (MWASHA, 1998). Thus, only three traditional vegetables were included, namely amaranth, eggplant and okra. Consequently, a displacement of traditional vegetables through exotic ones already took place in Tanzania and exotic vegetables are highly favoured.

However, there exist some 450 plant species of African origin, which could be consumed as a vegetable (SCHIPPERS, 2002).Therefore, a project on „Promotion of Neglected Indigenous Leafy and Legume Vegetable Crops for Nutritional Health in Eastern and Southern Africa“ was launched by the Asian Vegetable Research and Development Centre - Regional Centre for Africa (AVRDC-RCA) and partners, in which scope this study took place. The main objective of this study was to collect baseline information on the current consumption and production status of indigenous vegetables in Tanzania. This information was gained directly from farmers in four different agro-ecological regions of Tanzania to identify producers' and consumers' views on preferable traits of traditional vegetables, favoured species, processing technologies applied, and constraints to production and consumption. Three main research questions have been identified:

1. What are the most important traditional vegetables for farmers in the four research regions in Tanzania?
2. What are beneficial traits and constraints in consumption and production of traditional vegetables in Tanzania?
3. What are the main differences between the four regions in Tanzania in terms of
   - Diversity of traditional vegetables – wild or cultivated;
   - Genetic erosion – loss of traditional vegetables;
   - Responsibility of traditional vegetables in terms of gender;
   - Purposes of traditional vegetables (e.g. subsistence or cash crop);
   - Multiple usage of traditional vegetables (e.g. as food, medicine, cosmetic).

In this study the vegetables examined are called “traditional” vegetables while often the term “local”, “indigenous” or “endemic” is used instead. To clarify the exact meaning of the different terms, definitions are given in the following:

- ENDEMIC – Describes a species, race or variety that has long been associated with a particular region or localised area. (IBPGR, n.d.)
- INDIGENOUS - Refers to an organism existing in, and having originated naturally in, a particular region or environment. (IBPGR, n.d.)
- LOCAL – Like endemic, prevalent in a specific locality.
- TRADITIONAL – Indigenous or exotic species which, due to long use, have become part of the culture of a community (Mary O. Abukutsa Onyango, Senior Lecturer, Department of Horticulture, Maseno University, Kenya).

It should be emphasised that these definitions are possible definitions but not exclusive. However, in the present context the terms are used as defined above. Therefore, target vegetables are called “traditional” since some of them have not evolved in Tanzania but are used for a considerable time in this country. For example, cassava (*Manihot* spp.), which originated in the Americas, is claimed to have at least a "traditional usage" in Tanzania. Cassava is considered not only a tuber but also a leaf vegetable species in Tanzania and it has been introduced in the late 16th century already (TINDALL, 1983). In contrary, the usage of cassava leaves for food is not common in the Americas where cassava was domesticated (BONIERBALE et al., 1997).

2 MATERIAL AND METHODS

2.1 METHODS

2.1.1 METHODOLOGICAL RATIONAL

To reach the project aim and gather information directly from farmers, a baseline survey was carried out in the four research districts. For a survey, either individual interviews or focus groups can be used and both are accepted methods used in the initial stages of valuation research (ARROW et al., 1993; BOYLE et al., 1994; in: KAPLOWITZ & HOEHN, 2001). KAPLOWITZ and HOEHN (2001) concluded from a comparative study that focus groups and individual interviews are not substitutes but complimentary and, therefore, it is suggested to use both. Consequently, within the AVRDC-RCA project it was determined to use both methods - rather quantitative individual interviews as well as rather qualitative focus group meetings. However, for this study only focus group meetings were carried out while individual interviews were performed separately and will be reported elsewhere. While this study will, therefore, concentrate on focus group results only, the whole project will acquire results of both methods and analyse, compare, cross-check and compile all information.

2.1.2 FOCUS GROUPS

Focus groups are group discussions designed to learn about a subject's perception on a defined area of interest (KAPLOWITZ & HOEHN, 2001). Like individual interviews, focus groups allow to gain access to, and understand people's activities and perceptions that cannot be directly observed (KAPLOWITZ & HOEHN, 2001). However, some positive and negative group effects that can influence the data generated within a focus group have to be kept in mind. A positive effect can be that group interaction may facilitate an exchange of ideas and information. Thereby, individual group members may be stimulated to think and can build on each others' ideas (KAPLOWITZ & HOEHN, 2001). It is further possible that information given by one group member is disproved by others and, in the end, one could be sure to have got mainly "exact" and "right" information or a large number of different methods (here, e.g. for preparing a certain vegetable). Nevertheless, a negative effect can be caused by dominant group members who, in this study, were sometimes men, older or more wealthy (according to their clothes) members of a village. Another, more or less disturbing, factor was the fact that individual interviews were taking place at the same time as the focus groups and participants were leaving the group for an individual interview and returning later - or, sometimes, not returning at all.

2.1.3 PARTICIPANTS

It is suggested to involve an optimum of twelve participants in a focus group (KAPLOWITZ & HOEHN, 2001). In a study by LEWIS (2001), the average focus group size was seven. In fact, it was planned to involve six to twelve participants per focus group for this study. However, in the end the group sizes were between six and 30 participants with a mean size of 14.5. This was due to a communication problem when organising the meetings, as the number of desired participants got lost on its way to the farmers. Also, the aim to discuss traditional vegetables with farmers was sometimes altered and some farmer groups expected a lecture or even a discussion about a different topic. It was assumed that these alterations to the message happened to ensure sufficient farmer participation. To join a lecture or seminar seemed to be more appreciated by farmers than to answer questions. Nevertheless, in all cases farmers did co-operate very well in spite of wrong information beforehand.

2.1.4 TIME

One focus group meeting should last about two hours and, in fact, on average exactly 2 hours were spent in each of the 43 meetings. However, individual meetings lasted between 1h 10min and 2h 45min. Thereby meetings on production issues were slightly shorter in two regions (Arumeru and Kongwa) and the same length as meetings on consumption issues in the two other regions (Singida and Muheza).

2.1.5 DESIGN AND PROCEDURE

As AVRDC-RCA as well as HORTI Tengeru are located close to Arusha and in Arumeru region, it was possible for the HORTI Tengeru staff themselves to choose the villages and fix dates for the meetings with the participants in Arumeru region. In two regions, namely Singida and Muheza, agricultural extension workers had to be contacted for these arrangements, while in Kongwa region, the non-governmental organisation (NGO) Helen-Keller-International (HKI) was contacted and asked to arrange dates for focus group meetings with farmers. In each region, the aim and objectives of the project were explained to the district council, to the agricultural extension officers and also to each village leader. When meeting the group, aim and purpose were explained and, especially, future activities within the project and the potential role the village and its members could play. Then, it was especially made sure that everyone understood the term 'traditional vegetables', which can be translated with 'asili' = traditional or 'kienyeji' = local, while there is no translation for 'indigenous' into Swahili. However, for most of the farmers there was no problem to distinguish between local and exotic or newly introduced vegetables, like white cabbage, Chinese cabbage, carrots, onions, tomatoes, etc.

During the discussion, a flip-chart was used to collect all names of traditional vegetables, which were produced by village members and to visualise the answers of participants in general. This was done by one researcher who also asked the questions, lead the discussion, and translated the answers from Swahili to English. A second person took notes in English and asked additional questions, if necessary, or probed for certain issues. After all questions were discussed, some time was given to the participants to raise their questions to the researchers. These were normally questions about the aim of the study and how farmers would benefit from the results, but also about technical and general issues of their interest, e.g. how they could combat certain insect pests, where they could get credit or seeds, and what kind of traditional vegetables were grown in Germany.

2.1.6 ANALYSIS OF RESULTS

Since most traditional vegetables were named only by their English or Swahili names, scientific names of cultivated vegetables were determined according to vegetable descriptions by farmers and compared with SCHIPPERS (2002), MAUNDU et al. (1999a), while wild vegetables were looked up in RUFFO et al. (2002), and further names were found with the help of researchers from HORTI Tengeru.

When ranks of individual vegetable species or types are provided (chapter 6), the median was taken, which is found by arranging all ranks available in order (from lowest to highest) and subsequently selecting the central one. If the total number of values in the sample is even, the median is the arithmetic mean of the two central numbers. The median was taken here to prevent a skewing of data when very large extreme values existed (ANONYMOUS, 2004f).

Long-table approach. To analyse the data received through focus group meetings, the so called long-table approach was applied. The long-table approach is a low-technology option, yet, it has been used in countless analysis projects. It is suitable to identify themes and categorise results (KRUEGER & CASEY, 2000). For this approach the answers of each focus group were printed on a coloured paper, whereby different colours were used for the different villages in one district. The answers were cut apart and reorganised according to vegetables. Finally, all answers concerning e.g. cowpea in Singida district appeared on one piece of paper, but could still be traced back to the focus group through their colour of paper they were printed on.

Sørensen coefficient. To compare the research districts with regard to their availability of traditional vegetables, the Sørensen coefficient was calculated. Each district was compared to all three other districts in terms of vegetable diversity, and the number and percentage of species occurring in pairs of districts were determined. Thereby, vegetables were counted as "units" rather than as species, cultivars or types,

since sometimes only local names were available. However, through its local name farmers distinguished one vegetable from others and it contributed to vegetable diversity. Consequently, for the calculation of the Sørensen- and Shannon-Index, all vegetables mentioned were used as one vegetable "unit". In the following it is only referred to as "vegetable".

To calculate the Sørensen coefficient the number of common vegetables in two districts (c) is doubled and divided by the sum of the number of species occurring only in district one (a), the number of species occurring only in district two (b) and double the number of common species (2c). The result is multiplied by 100 to obtain the coefficient (S_S) in percent (DIERßEN, 1990):

$$S_S = \frac{2c}{a + b + 2c} \times 100$$

Shannon's and Simpson's diversity index. These indices are used to characterise species diversity in a community and they account for both abundance and evenness of the species present (BEALS et al., 1999 and 2000). For the Shannon index *H*, first, the proportion of unit *i* relative to the total number of species (*S*) is calculated (p_i), then multiplied by the natural logarithm of this proportion (ln p_i). The resulting product is summed across all mentioned units, and multiplied by -1 (BEALS et al., 2000):

$$H = -\sum_{i=1}^{s} p_i \ln p_i$$

For Simpson's diversity index *D* also the proportion of species *i* relative to the total number of species (*S*) is calculated (p_i) and squared. The squared proportions for all vegetable units are summed, and the reciprocal is taken (BEALS et al., 1999):

$$D = \frac{1}{\sum_{i=1}^{s} p_i^2}$$

The Shannon equability (E_H) can be calculated by dividing *H* by ln*S*:

$$E_H = H / H_{max} = H / \ln S$$

For the Simpson equability (E_D) Simpson's index *D* is divided by *S*. Equability assumes a value between 0 and 1, whereby 1 demonstrates complete evenness (BEALS et al., 1999):

$$E_D = \frac{D}{D_{max}} = \frac{1}{\sum_{i=1}^{s} p_i^2} \times \frac{1}{S}$$

Tables and figures. To summarise the considerable number of answers given by focus group participants, tables were designed for most of the questions. This should help the reader to find an answer to his or her specific question without reading the whole text. Additionally, answers were visualised through figures and graphs where appropriate.

2.1.7 CONSTRAINTS AND METHODS' REVIEW

While it is acknowledged that through a survey as described above certain data and, especially, indigenous or traditional knowledge can be gained and guide future research, the significance and expressiveness of these data should at the same time, be treated carefully. This is due to circumstances that typically occur in such kind of research. First of all, answers given by focus group participants were translated from Swahili to English language, which was done professionally and by persons skilled in the topic of traditional vegetables. However, some words or phrases might not have been possible to be translated accurately, and certain information might have gone lost. Moreover, it is reckoned that the meaning of individual statements might have been slightly changed due to interpretation. Yet, since most of the information given by farmers was found to be similar in not all but several villages, it was considered plausible (e.g. usage of vegetables as medicine for special illnesses).

Secondly, traditional vegetables and especially different species and types, were usually described by farmers only and not verified by the researchers as grown in gardens or fields. Therefore, some vegetables could not be clearly identified and, for future research, it is suggested to assign a botanist for further analysis of exact species names. Thereby, vegetable diversity can be determined much more precisely.

Thirdly, the four districts selected by the project were, on the one hand, a good choice since they differed to a large extend in environmental and other factors and mirrored the high diversity of Tanzania. On the other hand, the four districts were biased in terms of influence on farmers through research centres. Of course, different districts in terms of infrastructure, degree of urbanisation and climate were chosen intentionally, yet, farmers in Arumeru district were highly influenced by the proximity of AVRDC-RCA as well as the governmental HORTI Tengeru. For example, farmers in Arumeru were knowledgeable on certain preparation methods that they had learned at AVRDC, thus, they told those during the focus group, rather than traditional recipes, which had to be asked for especially.

There is a general worry that farmers in Arumeru district were already too much sensitised for the topic and told what they thought the researchers expected to hear and not what they commonly practised or applied. Further, farmers in Arumeru district

close to Arusha town were regularly visited by many research organisations and were, sometimes, unwilling to spent their time and, deservedly so, for something from which they could not expect any direct benefits. Therefore, it is suggested not to chose districts, where much research is already going on but further districts, where research is badly needed.

2.2 MATERIAL

2.2.1 THE QUESTIONNAIRE

The main task of the questionnaire was to guide the discussion and therefore it was semi-structured, beginning with some closed questions and continuing with open questions. Compared to a fully structured questionnaire, which is normally used for the written interview, the semi-structured questionnaire allows the interviewer to structure the interview by him- or herself (KROMREY, 1995). Thereby, the interviewer can go more into depth at certain topics and intensify individual issues. Therefore, the semi-structured questionnaire is also called framework-questionnaire, interview guide or questionnaire for in-depth interview (KROMREY, 1995).

The questionnaire used for this study consisted of three main parts: a general first part asking for traditional vegetables used by the participants and whether they cultivated them or gathered them from the wild. Then, the five to seven most important traditional vegetables were ranked according to different features like amount cropped and consumed, popularity and availability. In the following, the most important three or four vegetables were discussed in detail. There, it was asked for different varieties of each, their general properties (how can they be distinguished from each other) as well as their positive and negative characteristics.

In a second part, either consumption or production issues on the most important vegetables were considered. In the **production** part, farmers were requested to give details on the cropping pattern, production constraints in a traditional vegetable, and who of the family members was responsible for it or for certain production steps. In the **consumption** part, the participants should first name the vegetable parts they used (e.g. leaves, flowers, roots, tubers) and the harvesting method and frequency (twice a week, uprooting, etc.). Then, preparation and processing methods were debated as well as medicinal values and taboos of a particular traditional vegetable. Finally, in the consumption part it was assessed why and in which time of the year wild vegetables were collected that had been mentioned earlier.

At the end of each production and consumption part, the very last question concerned genetic erosion - if farmers had experienced a loss of certain vegetables and if they could name those and tell possible reasons for this.

2.2.2 REARRANGING THE QUESTIONNAIRE AFTER PRE-TESTS

The questionnaire was supposed to be tested in four focus groups in different villages in the Arumeru region. The first group visited was not able to host us because a funeral took place at that day, which most of the farmers joined. Therefore, the questionnaire was only tested with two mixed (both men and women participating) and one women group. Thus, when organising farmer groups for the questionnaire, in each region ten groups should be considered. If some groups were not available for whatever reason, at least eight questionnaires should be completed per region.

In the beginning, it was decided to discuss both the consumption and the production part with one group. However, during the first meeting it turned out that both parts would take too much time and only the first part, namely the production part, was completed with the first mixed group. Moreover, in the following focus group discussions, about two hours were needed to complete either the production or the consumption part. After two hours, there were clear signs of farmers getting tired and wanting to go back to their farms.

Consequently, it was decided to divide the questionnaire into two parts and discuss either production or consumption issues with a farmer group. Consumption issues should only be discussed with women groups, since women are responsible for preparing and processing traditional vegetables. In fact, we learned already during the pre-tests that some men from Arumeru district would never even touch green leafy vegetables.

The second important modification after the pre-tests was that questions on different issues should not be asked for all identified vegetables one after the other. After ranking the most important traditional vegetables with a farmer group, it would be advantageous to ask all questions for one vegetable and then continue with the next so that there would not be any confusion between different crops. Since there was a time constraint, it was further agreed that only the three or four most important vegetable crops defined by the farmers were considered in the questionnaire and asked for in detail.

During the pre-test with the women group, it was experienced that, after being half through the discussion, participants suddenly mentioned that another important traditional vegetable, namely cowpea, was missing. Therefore, it was decided to probe for names of target crops listed in Table 2.1 at the beginning of each focus group to ensure that farmers mentioned all traditional vegetables the project is particularly interested in. However, some of these vegetables were of minor importance, while other, not identified vegetables by the project, were highly relevant for farmers (Table 2.2).

Tab. 2.1 Target traditional vegetables identified by the project.

English name	Local name	Scientific name	Family name
African eggplant	ngogwe	*Solanum aethiopicum* L., *S. macrocarpon* L.	Solanaceae
African nightshade	mnavu	*Solanum americanum* Mill., *S. scabrum* Mill., *S. villosum* Mill.	Solanaceae
African spiderflower	mgagani	*Gynandropsis gynandra* (L.) Briq., syn. *Cleome gynandra* L.	Capparaceae
amaranth	mchicha	*Amaranthus* spp.	Amaranthaceae
bambara groundnut	njugu mawe	*Vigna subterranea* (L.) Verdc.	Papilionaceae
cowpea	kunde	*Vigna unguiculata* (L.) Walp.	Papilionaceae
crotalaria		*Crotalaria brevidens* Benth., *C. ochroleuca* G. Don	Papilionaceae
Ethiopian mustard	sukuma wiki, loshuu	*Brassica carinata* A. Braun	Brassicaceae
hyacinth bean	fiwi	*Lablab purpureus* (L.) Sweet	Papilionaceae
jute mallow	mlenda	*Corchorus olitorius* L.	Tiliaceae
moringa, drumstick tree	mronge	*Moringa oleifera* Lam.	Moringaceae
okra	bamia	*Abelmoschus caillei* (A. Chev.) Stevels, *A. esculentus* (L.) Moench	Malvaceae
pumpkin	maboga	*Cucurbita pepo* L., *C. moschata* (Duschesne ex Lam.) Poir.	Cucurbitaceae

Tab. 2.2 Additional important traditional vegetables identified by farmers in four research districts of Tanzania.

English name	Local name	Scientific name	Family name
black jack	kishonanguo	*Bidens pilosa* L.	Asteraceae
bur gherkin	maimbe	*Cucumis anguria* L.	Cucurbitaceae
cassava leaves	kisamvu muhogo,	*Manihot esculentus* Crantz	Euphorbiaceae
	kisamvu mpira	*Manihot glaziovii*	Euphorbiaceae
hair/bitter lettuce	mchunga	*Launea cornuta* (Oliv. & Hiern)	Asteraceae
		Sonchus luxurians	Compositae
sweet potato leaves	matembele	*Ipomoea batatas* L. (Lam.)	Convolvulaceae
watercress	saladi	*Rorippa nasturtium-aquaticum* (L.) Hayek	Brassicaceae
	mhilile	*Cleome hirta* (Klotzsch) Oliv.	Capparaceae

Fig. 1 **Mixed focus group in Ambureni/Moivaro village, Arumeru district, Tanzania.**

Fig. 2 **Women farmer group in Iseke villages, Singida district, Tanzania.**

Fig. 3 **Women group in front of the village office (old silo) in Sagara villages, Kongwa district, Tanzania.**

Fig. 4 **Mixed focus group in Mindu village, Muheza district, Tanzania.**

Fig. 5 Mr Mndiga conducting a focus group in Mindu village, Muheza district, Tanzania.

Fig. 6 Flipchart with traditional vegetable names (c = cultivated, w = wild), in Iseke village, Singida district, Tanzania.

3 DIVERSITY IN TANZANIA

3.1 SOCIOCULTURAL DIVERSITY

Tanzania, located in East Africa south of the equator, is diverse from an agricultural point of view, with hunter-gatherers, pastoralists, agro-pastoralists and cultivators or mixed farmers living in the country (RODGERS, 1998).

Beside the main ethnic groups found in each district (Table 3.1), also people from other tribes live in all areas and influence the culture more or less. To receive an impression about the main typical cultural features of each district, only the main ethnic groups are considered (Figure 3.1).

Tab. 3.1 Main ethnic groups in four research districts of Tanzania.

District	Main ethnic groups	Main features/activities	Main crops
Arumeru	Arusha	• sedentary agricultural community founded only in 1830;	banana;
	Maasai	• pastoralists of semi-nomadic kind;	positively reject agriculture;
	Meru	• settled at Mt Meru in 17th century;	
Singida	Nyaturu	• grain growers or mixed farmers, cattle integrated in farming system;	corn, millet and sunflower;
Kongwa	Gogo	• semi-pastoral society or cultivating pastoralists; cattle not closely integrated into agriculture;	grain crops; cassava, legumes; vegetables;
	Kaguru	• cattle owner;	
Muheza	Bondei	• agriculturalists and hunters;	maize; grow and collect vegetables;
	Shambaa	• agriculturalists or agropastoralists; cattle not closely integrated into agriculture; hunters;	banana; grow and collect vegetables;

Arumeru district. The **Arusha** community in Arumeru district was only founded in about 1830, when a few small groups of Maasai-speaking people came to settle on the lower edge of the forested, south-western slopes of Mt Meru (GULLIVER, 1969). They established a new sedentary agricultural community and were a settled and recognisable group. Consequently, their culture of vegetable cropping is not extremely old. They have excellent natural conditions at the Mt Meru slopes with a fairly cool climate, fertile soils, a long growing season, plentiful and reliable rainfall and

opportunities for irrigation. The staple crop of the Arusha agriculturists are bananas (GULLIVER, 1969).

The **Meru**, who live on the south-eastern slopes of Mt Meru were largely subjugated by the Arusha in former times. In fact, the Arusha community augmented by refugees and captives from the Meru as well as from Chaga refugees endemic to the slopes of Kilimanjaro, some fifty miles away to the east (GULLIVER, 1969). The Meru people settled at Mt Meru likewise only sometime in the seventeenth century and they were Chaga speakers from western Kilimanjaro who expanded towards the west (SPEAR, 1997).

Even if cultural features and organisations of both Arusha and Maasai are similar, the **Maasai** are markedly different from their neighbours: They are purely pastoralists of a semi-nomadic kind and positively reject agriculture, despising both the people who practise it and the activity itself (GULLIVER, 1969). Furthermore, trade relations between the Maasai and their neighbours depend essentially on the amount of cattle among the latter, i.e. the less cattle a trade partner has the less possible is a peaceful, trade-based relation (KOPONEN, 1988).

Nowadays, in Arumeru district mostly agriculturists are found, practising vegetable cropping all year round among others. However, the culture of vegetable cropping is only about 170 years old.

Singida district. Nyaturu farmers inhabit the land of Singida district and their livelihood depends to a great extent on the cultivation of corn, millet and sunflowers (ANONYMOUS, 2003b). Thus, the Nyaturu are classified as grain growers but also as mixed farmers who practice primarily agriculture, with cattle effectively integrated into the farming system, mainly through large scale manuring (KOPONEN, 1988). In fact, a special feature among the Nyaturu is that they apply cattle manure widely and regularly in food crops. In contrary, other peoples only apply manure in non-food crops such as tobacco (KOPONEN, 1988). Being agriculturists already for a long time, the Nyaturu grow vegetables but only during the rainy season or if there is a possibility for irrigation.

Kongwa district. The Gogo in Kongwa district are sociologically very different from the Kaguru in Kongwa district but linguistically closely related to them (RIGBY, 1969). The **Gogo** are referred to as a semi-pastoral society. Though, the rather dry Kongwa is a good area for livestock husbandry, it also provides the possibility of quite extensive agricultural activity. In fact, the Gogo economy relies heavily upon the production of food crops and therefore a correct description for the Gogo might be “cultivating pastoralists” (RIGBY, 1969). They are also called agro-pastoralists in whose economy both agriculture and cattle is essential but not closely integrated (KOPONEN, 1988).

Besides grain crops and so-called subsidiary food crops like cassava, groundnuts, bambara groundnuts and cowpeas, further traditional crops are grown exclusively for household consumption which include cucumbers, pumpkins and watermelons (RIGBY, 1969). Furthermore, it was found that uncultivated plants grow up with the crops in Gogo fields and are left during cultivation and spared from weeding, to be picked and utilised later (RIGBY, 1969). In regard to the house in Gogo homesteads, it is said to be the "matricentral unit" or else the food-producing, storing, cooking, and consuming unit. Further, women are not only responsible for food preparation and processing but each married woman plants her various crops in her own set of several different garden plots and fields, "to which she has usufructuary rights at any particular time" (RIGBY, 1969). On the contrary, it is men's work to clear new fields and it is the responsibility of the husband to establish new fields for his wives. Fields are divided into two categories: the "bush fields", which are used for two or three years and then left to fallow; and the fields close to the homestead, which can be manured when necessary (RIGBY, 1969). The **Kaguru** are referred to as a matrilineal ethnic group and migrated to Ugogo (of which Kongwa is one part) mainly because they were in search of safe grazing for cattle (MADDOX et al., 1996).

Muheza district. In the coastal Muheza district most people belong either to the Shambaa or Bondei ethnic group. The **Shambaa** are agriculturists or agro-pastoralists with their main income from farming (ANONYMOUS, 2003a). For agro-pastoralists both cattle and agriculture is essential however, these two production branches are not closely related to each other (KOPONEN, 1988). Consequently, dung is used less for manuring but more for purposes such as building and heating. Furthermore, animal foods are consumed less among agro-pastoralists than among the proper pastoralists (KOPONEN, 1988). The strong cultural identity of the Shambaa is based first, on the particular ecological setting of the West Usambara Mountains, and second, on a common language and common rites (KOPONEN, 1988).

The Shambaa, as a banana-growing and cattle-keeping people, go hunting every now and then. The same is reported about their grain-growing neighbours, the **Bondei**, who consider hunting as a very common occupation or amusement (KOPONEN, 1988). When maize was introduced to Africa from America by the end of the 19th century, it was grown mostly as one among many crops. However, among the Bondei and in a few places elsewhere, maize has become a staple food very promptly (KOPONEN, 1988). Both, Shambaa and Bondei people grow and collect vegetables all year round.

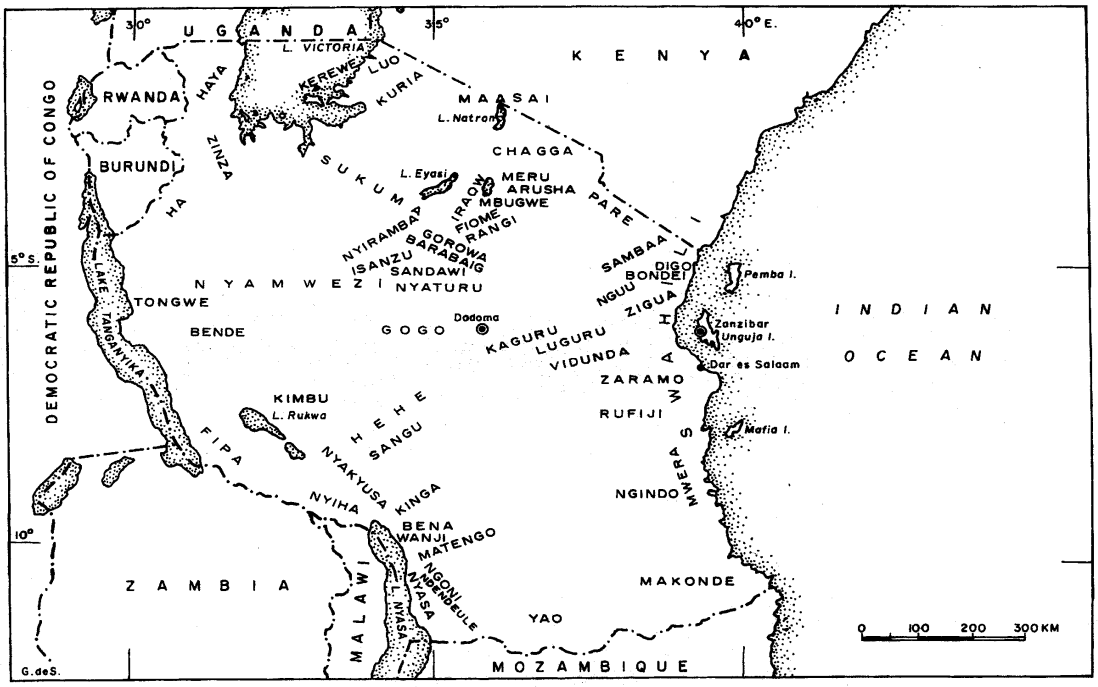

Fig. 3.1 The main ethnic groups of Tanzania. © Ruffo et al. (2002)

3.2 Geographical diversity

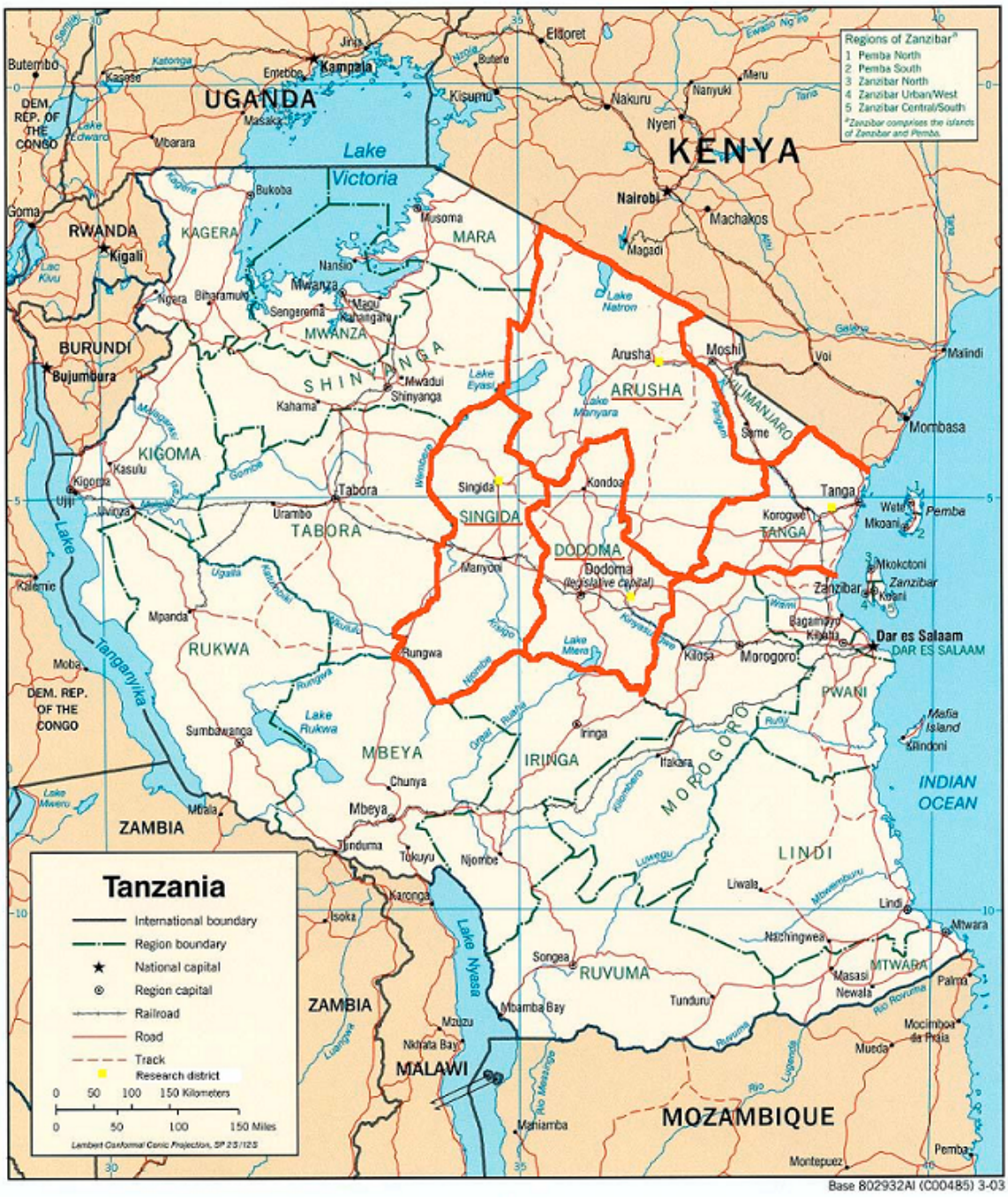

Fig. 3.2 Map of Tanzania showing i.e. the research districts Arumeru (Arusha), Singida, Kongwa (Dodoma) and Muheza (Tanga) (© ANONYMOUS, 2003c).

Geographically in terms of topography, climate, and geology, Tanzania is highly diverse (RODGERS, 1998). Mainland Tanzania is divided into 20 administrative regions (ANONYMOUS, 1998), of which four regions, namely Arusha, Singida, Dodoma and Tanga, located in north-eastern Tanzania, were chosen as research regions for the project (Figure 3.2). In general, regions are further subdivided into districts and for the

project one district in each region was visited. These four districts differed in several factors such as climate, altitude, ethnic groups and distance to urban centres.

Topography. Tanzania has both the highest altitude and the lowest point in Africa which is the summit of Mount Kilimanjaro with 5,950 m asl., and the bottom of Lake Tanganyika (1,470 m deep) (ANONYMOUS, 1998). Thus, a foregone conclusion is a high level of diversity in terms of climate, flora, fauna and, of course, human beings. Most of the country is part of the Central African plateau (1,000–1,500 m asl.) besides the coastal belt and the islands. However, this gently sloping plateau is broken by scattered hills and low-lying wetlands (ANONYMOUS, 1998).

Climate. The country has been subdivided into six **agro-climatic zones**, based on temperatures and rainfall. These are namely the coast, arid lands, semi-arid lands, plateaux, highlands, and alluvial plains (ANONYMOUS, 1998). The districts researched belong to different zones except Singida and Kongwa districts, which both are located in the arid lands (Table 3.2).

The climate in Tanzania is characterised by a long dry season from May to October, followed by a period (November to April) of low to heavy rainfall. The so-called short rains occur from October to December, while heavy rainfall or the long rains take place from March to May (UNDP, 1999). The mean annual rainfall varies from 400 mm in the central regions to over 2,500 mm in the highlands and the western side of Lake Victoria. For example, the research region Kongwa receives only about 560 mm of rain, while Muheza region gets nearly 1,900 mm (ANONYMOUS, 1998) (Fig. 3.3). The hottest months are December to February, while July and August are the cooler months (UNDP, 1999) (Fig. 3.4). However, temperature variations are influenced by altitude, and range from 21°C (mean maximum temperature) in the high montane areas to 29°C (mean maximum temperature) at sea level (ANONYMOUS, 1998).

Geology. Only 9% of Tanzanian **soils** are of medium-high fertility, 23% of low-medium fertility and the rest are generally of lower quality by international standards (ANONYMOUS, 1998). Nevertheless, Arusha region belongs to the four regions in Tanzania classified as suitable for productive agriculture, with volcanic soils consisting mainly of sandy loam with good drainage. Muheza district as part of the coastal zone has deep, sandy to heavy-textured soils, with moderate to high water content (ANONYMOUS, 1998) which results in imperfect drainage. The central plateau areas, where Sindiga and Kongwa are situated, are mantled by sandy loams of low nutrient content and low water-holding capacity (ANONYMOUS, 1998).

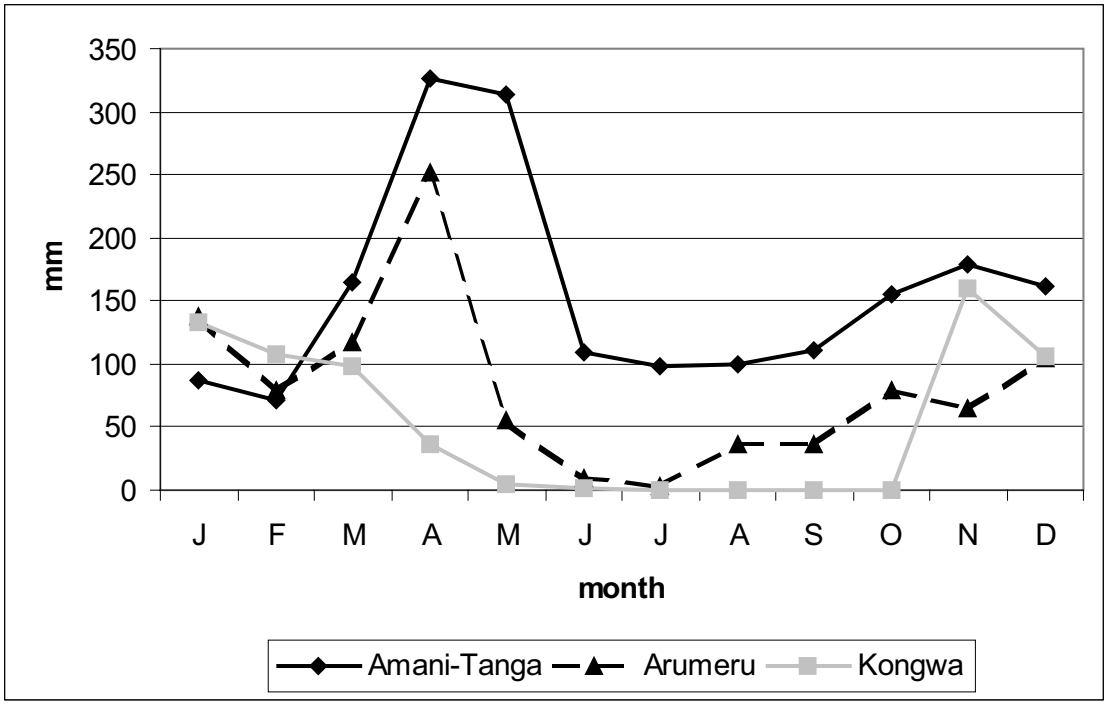

Fig. 3.3 Mean monthly precipitation in Amani-Tanga region, including Muheza district (1988-1991), Arumeru district (2002/2003), and Kongwa district (2000-2002), Tanzania. (Source: ANONYMOUS, 1998; ANONYMOUS, 2004d; ANONYMOUS, 2004e)

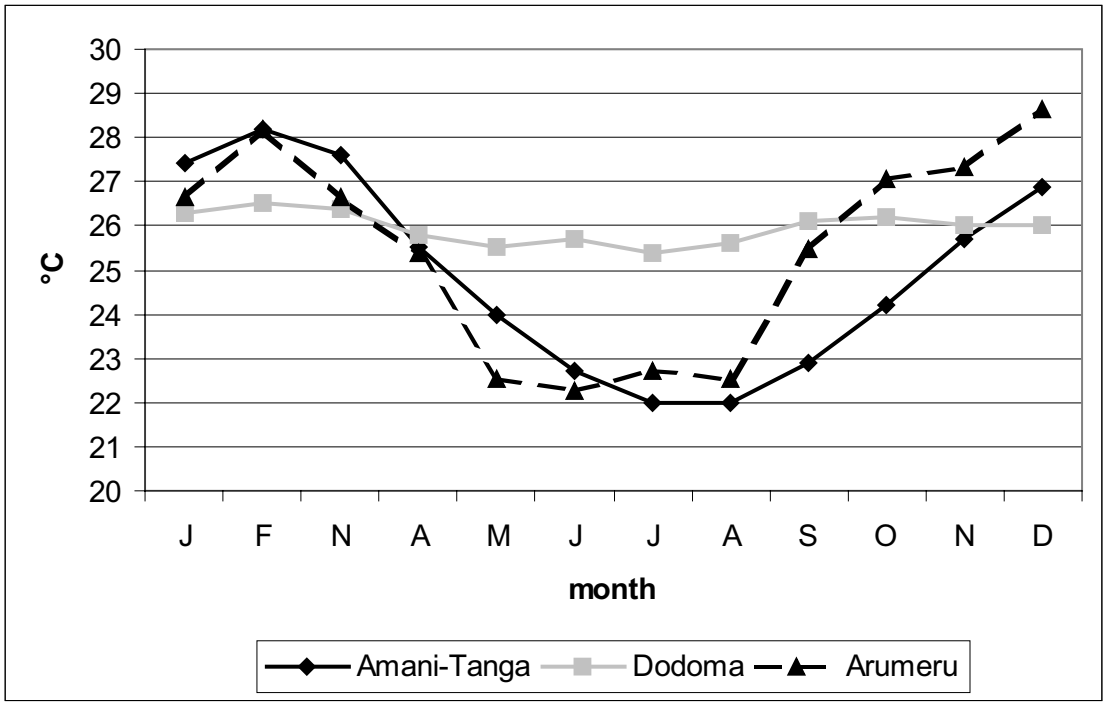

Fig. 3.4 Mean maximum temperature in Amani-Tanga region, including Muheza district, Dodoma region, including Kongwa district (1988-1991), and Arumeru district (2002/2003), Tanzania. (Source: ANONYMOUS, 1998; ANONYMOUS, 2004d)

3.3 BIODIVERSITY

Biological diversity (short: Biodiversity) is understood as the variety of life forms, communities and the ecological processes of which these components form part (ANONYMOUS, 1998). It is used as an umbrella term for the degree of nature's variety, including both the frequency and number of species, genes and ecosystems in a given assemblage (MCNEELY, 1988; in: ANONYMOUS, 1998). Biodiversity is a concept that describes the property of a certain landscape or natural resource, e.g. a forest. Consequently, it is questionable if one can manage biodiversity or only the socio-political environment around that resource so as to maximise the value given to the property labelled biodiversity (RODGERS, 1998).

Tab. 3.2 Characterisation of the four research districts

Region	Arumeru	Singida	Kongwa	Muheza
Location in Tanzania	Northern highlands	Central Tanzania / Central Semi-Arid Lands	Central Tanzania / Southern Maasai Steppe / Arid Lands	Northern coastal areas / Northern Coast
Mean annual rainfall (mm)	1000 (humid)	700 (semi-arid)	500-700 (semi-arid)	1700-1900 (humid)
Altitude	1000 – 1500 m (high)	+/- 1500 m (high)	500 – 1000 m (medium)	200 – 1000 m (low to medium)
Soils	volcanic soils; sandy loam with good drainage	plateau soils; loam with good drainage	red earth; loam with good drainage	loose sands; loamy sand with imperfect drainage
Natural vegetation	brushland and thicket	woodland / brushland	woodland	savannah
Main staple food crops	beans, millet, maize	maize, millet	maize, millet sorghum, groundnut	beans, cassava, maize, banana
Location	urban	urban	rural	rural
Population density	55-99 p / km^2 (dense)	30-49 p / km^2 (medium)	30-49 p / km^2 (medium)	> 100 p / km^2 (very dense)

(Source: HATHOUT, 1983; ANONYMOUS, 1998)

Biological diversity is considered as an intrinsic value and to be important for evolution and maintaining life sustaining systems of the biosphere (ANONYMOUS, 1992). However, due to circumstances such as population pressure and resulting environmental degradation as well as species being irreversibly lost through extinction, biological diversity must be treated more seriously as a global resource, to be indexed,

used, and above all, preserved (Wilson, 1988). Thereby, it is important that the primary cause of loss of biodiversity is not direct human exploitation of spectacular organisms such as black rhinos, elephants or whales, but the habitat destruction that is the consequence from the expansion of human populations and human activities (EHRLICH, 1988)

In the Convention on Biological Diversity, developed by the UNEP Governing Council and signed by 157 governments and the European Community, three main objectives (Article 1) are named: the conservation of biological diversity; the sustainable use of its components; and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources. While, the convention (preamble) assures that states have sovereign rights over their own biological resources, and that they are at the same time responsible for using their biological resources sustainably, obligations within the Convention are restricted with phrases such as "as appropriate" and "as far as possible" (CHABEDA, 1992). Usually, biodiversity is considered at three levels, i.e. “ecosystem diversity”, “species diversity” and "genetic diversity” (ANONYMOUS, 1998). In this study mainly species diversity, i.e. vegetable species diversity, is examined.

In many African farming systems polyculture is the norm, which can be defined as a traditional strategy to achieve yield advantages as well as yield stability, an optimal exploitation of resources, reduction of insect pests and disease occurrence and thereby minimisation of risk, efficient use of labour and diet diversity (LIEBMAN, 1995). Consequently, farmers, by following ancient farming and land use practices, preserve much of the worlds’ biological diversity. As a conclusion it was claimed that “if the world is properly to conserve and use genetic resources [...] the farmers, herbalists, gardeners and pastoralists, must lead us into the next agricultural revolution” (MOONEY, 1992:125; in: WARREN, 1995).

Tanzania covers an area of about 942,800 sq km, of which about 60,000 sq km are covered by inland water bodies (KAIZA-BOSHE et al., 1998). This amplitude, coupled with an enormous variety, uniqueness and superlative attributes of physical features makes Tanzania one of the world’s richest countries in biodiversity. For example, it is the country with the second largest number of plants with 10,000 species of vascular plants alone, about 10% of which are believed to be endemic (MZIRAY, 1998). It further comprises nine different agro-ecological zones (ANONYMOUS, 2004c) and contains one of the 25 biodiversity hot spot areas in the world – the Eastern Arc Mountains (ANONYMOUS, 2004b). Tourism and agriculture, the country’s main economic activities, as well as forestry and fisheries are directly dependent on biodiversity.

While there is a high degree of endemism in Tanzania's biological resources, species and ecosystems are being degraded and lost at rapid rates (KAIZA-BOSHE, 1998). For this unfavourable condition a wide range of interrelated factors are responsible. These include, besides others, high human population densities on fragile ecosystems, limited national capabilities to acquire and utilise new conservation technologies, as well as inappropriate policies, which create disincentives to conserve biodiversity and sustainably use its components (KAIZA-BOSHE, 1998). Especially, wild plants are exploited as sources of food, construction material, medicine, and raw materials for different industrial processes (MZIRAY, 1998). This should not be considered a problem if there was no overexploitation and if efforts to replace the wild plants were available. However, in Tanzania plant genetic resources are being depleted faster than the natural replenishment rate. In fact, some plant species may become extinct even before they are scientifically documented (MZIRAY, 1998).

3.4 VEGETABLE DIVERSITY

In Tanzania, the composition of traditional vegetable species varies to a great extent in the different agro-ecological zones as well as the five different phyto-geographical regions of the country. Furthermore, the importance and number of vegetable species used, are unlike between the zones (RUFFO et al., 2002).

Vegetables can classified as cultivated, semi-cultivated and gathered from the wild (FAO, 2003a). While for cultivated vegetables agricultural practices such as land preparation, sowing, weeding, watering are performed, semi-cultivated vegetables often emerge at the onset of the rains and are allowed to grow between planted crops until ready for consumption (FAO, 2003a). If a vegetable is gathered from the wild, it is mainly found on uncultivated land e.g. in forests. Wild vegetables serve as buffer food supplies during periods of food shortage, which are usually the month of November to February in Tanzania, where extreme drought occurs (FAO, 2003b). In Singida and Kongwa districts, which are located in Central Tanzania and where drought is more extreme than in the other two research regions, wild vegetables can form complete meals where staples (e.g. maize flour) are not available (FAO, 2003b). From March onwards (with the beginning of the rainy season), vegetables from cultivated fields replace wild vegetables.

On the whole, traditional vegetables and especially traditional leafy vegetables have been important ever since to meet the nutritional needs of Tanzanian people (CHWEYA & EYZAGUIRRE, 1999). However, with the modernisation of agriculture and the beginning of market economy, exotic vegetables with a potential for export became more and more important. Furthermore, conventional agronomy has concentrated

mainly on conserving genetic resources of exotic rather than traditional vegetables (CHWEYA & EYZAGUIRRE, 1999). Fruits and vegetables, sometimes even called “wayside” or "roadside" species, are often highly important locally but have received little attention in development and research. Consequently, traditional vegetables have to compete for attention with the more popular exotic ones and are partly threatened with extinction (CHWEYA & EYZAGUIRRE, 1999).

4 TRADITIONAL VEGETABLE DIVERSITY IN TANZANIA

4.1 "PREFERENCES, QUANTITY AND AVAILABILITY OF TRADITIONAL VEGETABLES" - GENERAL VEGETABLE DIVERSITY

Preferences: ranking traditional vegetables. As a variety of different traditional vegetables was commonly used in all districts, a few had to be chosen by farmers in order to discuss them in more detail. Therefore, after focus group participants named all traditional vegetables they produced and/or consumed, they further ranked the six, sometimes seven or even eight traditional vegetables they perceived as most important.

When farmers provided local names for their important vegetables or vegetable varieties or when they named characteristics, they obviously applied their own local classification system, with local names often having a descriptive meaning. The criteria to describe a vegetable referred to different characteristics, such as morphology, place of origin, culinary traits or time until harvest (Table 4.1). However, these criteria do not differ to a great extent from those, utilised to classify different species in conventional science. Nevertheless, a systematic analysis of so-called folk taxonomy, the principles of categorisation of plants in traditional societies, is important and useful to understand the maintenance and use of local varieties (HODEL et al., 1999). Furthermore, through the study of farmers classification system and local knowledge, an insight is gained into what traits and characteristics of varieties farmers consider important (VAN DORP et al., 1993; in: HODEL et al., 1999).

Tab. 4.1 Examples of names referring to different traditional vegetable characteristics as mentioned by farmers in Tanzania.

Characteristics according to	Example
morphology	• 'tambaa' = spreading plant habit; 'wima' = erect plant habit; • 'pamba' = cotton (flower of okra type resembled those of cotton); • 'ngogwe nyeupe ndogo' = African eggplant white and small (regarding the fruits); • 'mchicha mweusi' = amaranth black (regarding the seeds); • with spines/hairs - without spines/hairs;
organoleptic	• 'ngogwe si chungu' = African eggplant not bitter;
place of origin	• 'mnavu wa Kenya' = African nightshade from Kenya; • 'ex-Hai' = vegetable origin in Hai region, Tanzania; • 'kienyeji' = local; 'kisasa' = introduced;
time until harvest	• 'miezi moja uanze kuchuma' = one month until ready for harvest;
culinary	• cooks fast; contains many/few mucilaginous material;

The main traditional vegetables discussed in the four districts are listed in Table 4.2. It was conspicuous that only one traditional vegetable, namely amaranth, was mentioned in all districts as one of the most important six vegetables. Thereby, amaranth ranked second in the humid districts of Arumeru and Muheza and only fourth in the dry Singida and Kongwa districts. Two vegetables were important at least in three districts, namely Okra and Sweet potato leaves, yet, they did not rank first or second. The traditional vegetables, which ranked first were mainly important in one or two districts. For example, African nightshade was the most important vegetable for farmers in Arumeru district, but was only or mainly gathered from the wild in Singida and Muheza district and mentioned in seven out of ten villages in Kongwa district. The same applied to hair or bitter lettuce, the most important vegetable in Muheza district. This wild vegetable was named by farmers in only five out of ten and three out of eleven villages in Kongwa and Singida districts, respectively, and was not mentioned at all in Arumeru district. The most important traditional vegetable in Singida district, jute mallow, was also fairly important in Kongwa district (No. 2), whereas cowpea leaves, ranking No. 1 in Kongwa district, played a certain role as the fifth important vegetable in Arumeru district. The fact that in Kongwa district grain legumes were highly prominent (RIGBY, 1969) was probably the reason for the multipurpose grain and leafy vegetable cowpea being the most important traditional vegetable in this district.

African eggplant was relevant only for farmers in both humid districts Arumeru and Muheza but not in the dry ones, while pumpkin leaves were ranked only in Kongwa and Muheza district. Ethiopian mustard, cassava leaves, local cucumber ('maimbe') as well as African spiderflower / 'mhilile' were mentioned only once in different districts and were, therefore, rather of local relevance.

Tab. 4.2 Rank of most important traditional vegetables in the four research districts in Tanzania, as mentioned by 43 farmer groups of different villages.

Rank	Arumeru	Singida	Kongwa	Muheza
1	African nightshade	jute mallow	cowpea	hair/bitter lettuce
2	amaranth	bur gherkin	jute mallow	amaranth
3	African eggplant	sweet potato leaves	African spiderflower /mhilile	okra
4	Ethiopian mustard	amaranth	amaranth	sweet potato leaves
5	cowpea	okra	pumpkin leaves	African eggplant
6	okra	cassava leaves	sweet potato leaves	pumpkin leaves

A highly interesting fact in Singida district was that the most important vegetable, jute mallow, which was mentioned as No.1 by all focus groups without exception, was not a cultivated but a wild vegetable. The second most important traditional vegetable, a local cucumber, the 'bur gherkin' (*Cucumis anguria*), was also mainly gathered from the wild and, sometimes, cultivated in Singida district but it was not common in any of the other research districts. It can be assumed that these vegetables were very well adapted to the local conditions, which even made care and cultivation by humans unnecessary since they were available from the wild in a sufficient large quantity.

In Table 9.1 all traditional vegetables cultivated and collected in the four districts researched and their rank are compiled as well as in Tables 9.2-9.5, where all vegetables found in one district only are presented. It is indicated if they were cultivated by farmers (c), collected from the wild (w), or if both applied to a traditional vegetable species (c+w). Further, the frequency of ranking is shown. Not every single traditional vegetable mentioned by focus group participants could be identified by its scientific name since only local names were stated and plants were rarely seen. Especially traditional vegetables gathered from the wild were often only known by their local names. Thereby, one can not be sure if an unidentified vegetable eventually was only another type or cultivar of a species already identified.

Constraints in production of traditional vegetables were, certainly, an influencing factor for ranking. When the different constraints were compared, pests and diseases were by far the main restriction for vegetable cropping in all districts (Figures 4.1a-d). Water availability was another crucial factor, while other constraints were rather of local relevance. When the factors were compared to each other (Figures 4.2a-d), it also became clear that the availability of seeds played a decisive role for focus group participants in all districts but Muheza.

Quantity: counting traditional vegetable. The total numbers of traditional vegetables communicated by farmers in the research districts are listed, besides others, in Table 4.3. While overall only 24 and 21 different traditional vegetables were mentioned in Arumeru and Singida districts, respectively, 35 were distinguished in Kongwa and even 74 traditional vegetables, more than double, in the coastal Muheza district. The mean number of traditional vegetables per village in Arumeru district ranged between 11 and 19 which meant a mean of about 14 species in each village.

This was the same number of different traditional vegetable species that were named by farmers in Singida district but less than in Kongwa district (nearly 17 traditional vegetable species per village) and much less than in Muheza district, where focus group participants described, on average, 25 different traditional vegetable species per village (Table 4.3).

These figures suggested a higher vegetable diversity in the latter regions as well as a distinct knowledge on traditional vegetables. The fact that villages in Arumeru and Singida district were situated close to Arusha and Singida town, respectively, and therefore to a centre for marketing but also for purchasing inputs as well as receiving knowledge and training, certainly influenced the diversity of traditional vegetables cultivated and consumed - obviously in a direction of decreasing diversity. In contrary the rather rural Muheza district involves parts of the Eastern Usambara Mountains that are, in turn, part of the Eastern Arc Mountains belonging to the 26 biodiversity hotspots in the world (ANONYMOUS, 2004b) (see also 4.5).

While most of the mentioned traditional vegetables could be identified, a few vegetables in Arumeru and Singida districts, and more than $^1/_3$ in both Kongwa and Muheza districts were only known by their local or Swahili names. However, vegetables were sometimes described if even no Swahili name was available. For example, "melembele gulu" was outlined by farmers in Arumeru district to look like pumpkin leaves, "mnkoswe", "nkoswe" or "mkoswe" was a creeper and only found in valleys in Muheza district and "longwe" or "ongwe" was explained to resemble sweet potato leaves.

Tab. 4.3 Portrait of the four different research districts in Tanzania in terms of traditional vegetable diversity.

	Arumeru	Singida	Kongwa	Muheza
Total no. of TVs (units)	24	21	35	73
Identified TVs (scientific names)	20	15	22	46
Unidentified TVs (local names only)	4	6	13	27
Mean no. of TVs per village	14	14	17	25
Range	11-19	10-17	14-22	18-34
Ratio wild / cultivated TVs	11 / 9 = 1.2	11 / 6 = 1.8	24 / 8 = 3.0	59 / 11 = 5.3
TVs both cultivated and collected	4	4	3	4

Another interesting figure was the ratio between traditional vegetables cultivated and collected from the wild. All vegetables that were not cultivated but collected were regarded as wild even if some of them occurred in cultivated land instead of

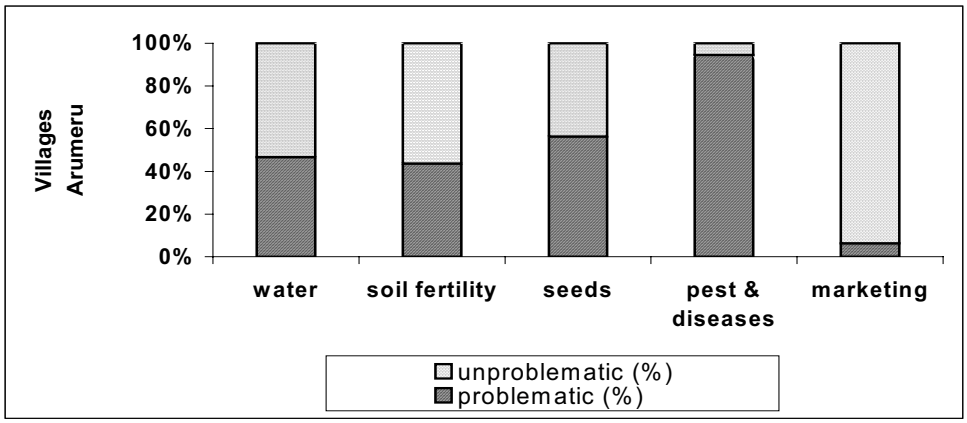

Fig. 4.1a

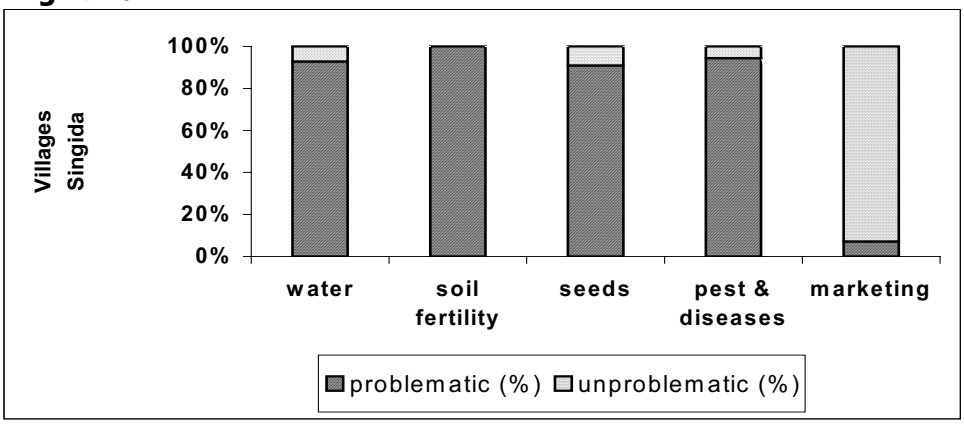

Fig. 4.1b

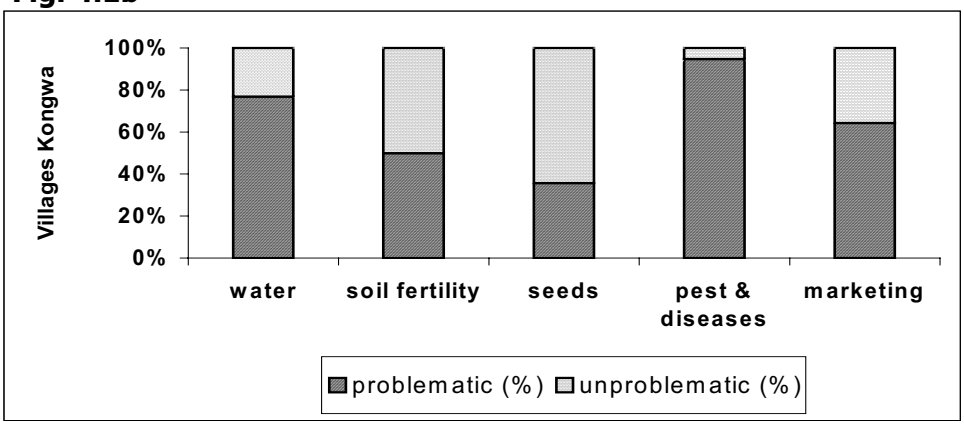

Fig. 4.1c

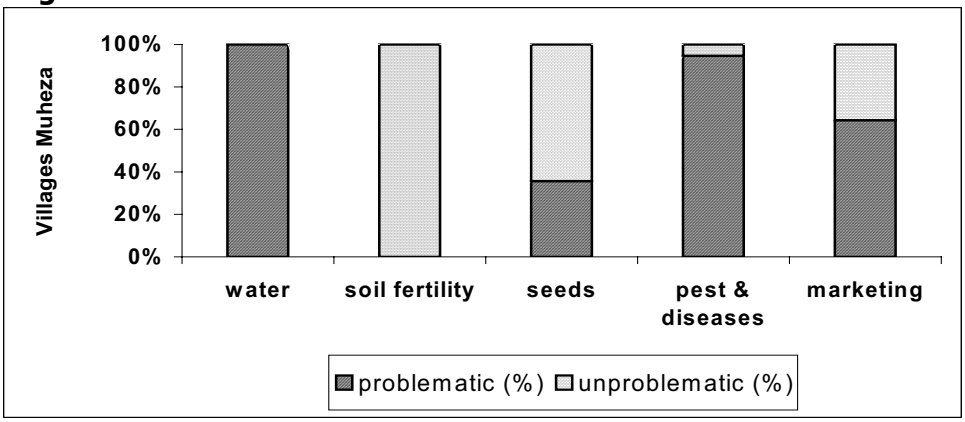

Fig. 4.1d

Fig. 4.1 a-d

Evaluation of production constraints in four research districts of Tanzania (percent of villages valueing a constraint problematic / unproblematic)**.**

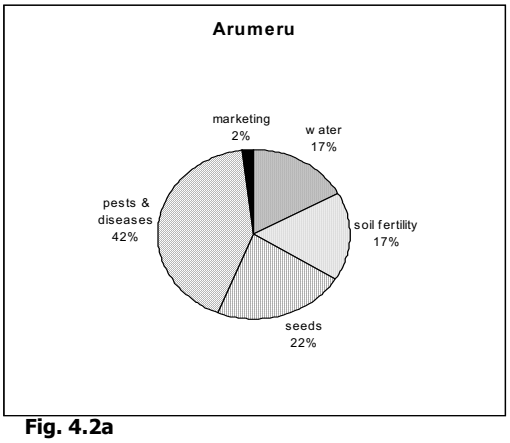

Fig. 4.2a

Fig. 4.2 a-d

Constraints in production of traditional vegetables in four research districts of Tanzania (percent of villages where factors were mentioned as a constraint)**.**

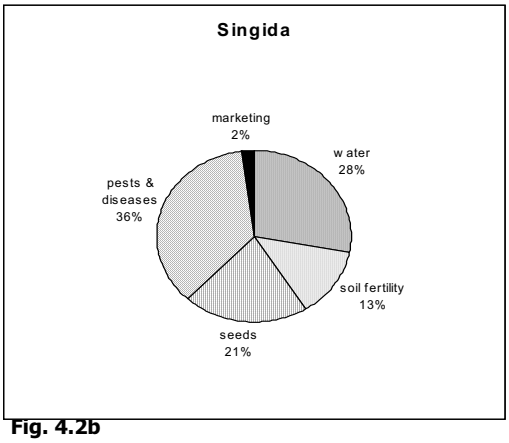

Fig. 4.2b

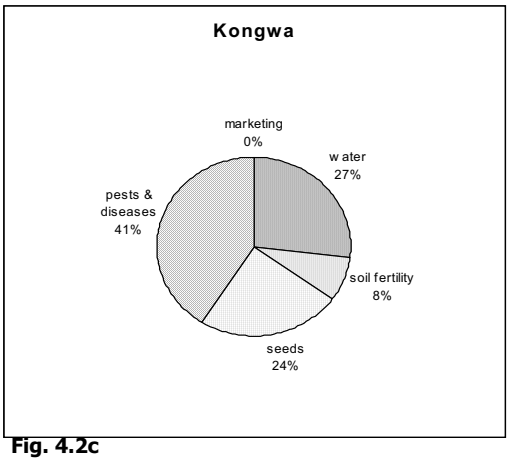

Fig. 4.2c

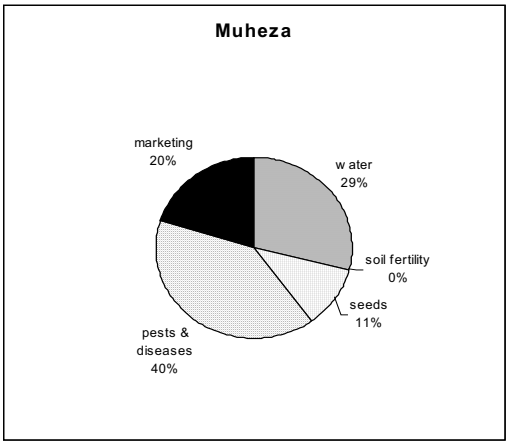

Fig. 4.2d

uncultivated or waste land and should rather be regarded as semi-cultivated. In all four research districts, more wild than cultivated indigenous vegetables were named by focus group participants. This was especially true for Singida district with nearly two times more wild than cultivated vegetables, Kongwa district with exactly three times more and Muheza district with more than five times more wild than cultivated traditional vegetables. Wild vegetables being less known, important and available in Arumeru and also Singida district could be again attributed to the grade of urbanisation and population density, which spared less uncultivated areas as a habitat for wild vegetables. In all districts, only few vegetables were both cultivated and collected from the wild. One of these was amaranth as there were different amaranth cultivars or landraces as well as wild forms of amaranth available in Tanzania.

Sørensen coefficient. First, in Table 4.4 all numbers that are needed to calculate the Sørensen coefficient were listed. Only 12 traditional vegetables were named by focus group participants to be used in all four districts. These were mainly cultivated vegetables and further many non-indigenous vegetables, such as pumpkin, sweet potato or cassava leaves. As it was mentioned before, the highest diversity of traditional vegetables was found in Muheza district, which can not only be seen in the total number of traditional vegetables, but also in the number of traditional vegetables that were found in this district only. This number (bolded) was more than 12 times higher than in Arumeru district, nearly nine times higher than in Singida and about three times higher than in Kongwa district.

Tab. 4.4 Number of traditional vegetables named in the four different districts of Tanzania altogether, in each district alone and overlapping in two or three districts.

No. of vegetables	Arumeru	Singida	Kongwa	Muheza
total	24	21	35	73
Arumeru	**4**	1	0	3
Singida	1	**6**	1	0
Kongwa	0	1	**17**	2
Muheza	3	0	2	**52**
Arumeru + Singida	-	-	0	1
Arumeru + Kongwa	-	0	-	3
Arumeru + Muheza	-	1	3	-
Kongwa + Muheza	3	0	-	-
Singida + Muheza	1	-	0	-
in all four districts	12	12	12	12

The two districts with the most similar traditional vegetables, namely nearly 60%, were Arumeru and Singida district (Table 4.5). Villages of both districts were situated close to a town, which is a centre of education, trade and commerce, and both

districts were situated at similar level of altitude (1000-1600 m asl.). On the other hand, while Arumeru had a rather humid climate Singida district faced a semi-arid climate suitable for fairly different vegetables. Furthermore, while in Arumeru the culture of vegetable cropping was only about 170 years old and people used to be pastoralists in the past (GULLIVER, 1969), in Singida district Nyaturu people practised agriculture with cattle integrated into the farming system since ancient times (KOPONEN, 1988). This would suggest a different preference for vegetable species and types as well. However, urban centres' influence in both Arumeru and Singida district was obviously the overriding decisive factor for diversity and species composition.

Tab. 4.5 Sørensen coefficient for six pairs of research districts in Tanzania concerning the availability of common traditional vegetables.

District	Arumeru/ Singida	Singida/ Kongwa	Arumeru/ Kongwa	Arumeru/ Muheza	Kongwa/ Muheza	Singida/ Muheza
Sørensen [%]	59.6	46.4	46.2	36.2	29.8	27.1

The districts sharing the second most traditional vegetable species and types, namely 46.4%, were Singida and Kongwa. Both districts were situated in Central Tanzania with a similar semi-arid climate, which was responsible for the overlapping of similar traditional vegetables. However, Arumeru and Kongwa districts share in almost the same manner 46.2% of traditional vegetables but were rather different in terms of climate. Furthermore, while Arumeru has an urban centre, Kongwa district is situated about one hour car drive from Dodoma town, with several villages being settled even further away. The reason for using similar traditional vegetables in both districts must be found elsewhere.

Muheza differed most from the other districts in terms of traditional vegetable composition. It shared only about 27% common vegetables with Singida district, nearly 30% with Kongwa and about 36% with Arumeru district (Table 4.5). This was obviously due to Muheza being the only coastal district with a humid climate and light sandy but fertile soils. Moreover, the high natural biodiversity in this region resulted in a high vegetable diversity and, therefore, a high number of traditional vegetables that occurred only in this district. In fact the number of common species was highest for Muheza/Arumeru and Muheza/Kongwa, but this was relativised by the high number of traditional vegetables, which occurred in Muheza district only.

When the four districts were compared in terms of vegetable diversity, not only the overall number of vegetables named per district was important, but also their fre-

quency of mentioning regarding all villages surveyed per district. Since the total number of villages varied per district, the frequency of mentioning a certain vegetable is shown in percent (Table 4.6). Thereby it can been seen that, while 12 traditional vegetables were stated to be used in all four districts only three of them, namely amaranth, cowpea and pumpkin leaves, were named by all villages. Other traditional vegetables, e.g. African spiderflower, were mentioned in all villages of Singida and Kongwa district but only in 70% and 75% of the villages in Arumeru and Muheza district respectively. Contrariwise, an important traditional vegetable for the latter two districts, which farmers named in all villages, was African eggplant, while only in 45% and 50% of the villages in Singida and Kongwa district, respectively, this vegetable was stated to be used.

Availability: Shannon's and Simpson's diversity index. These indices are used to characterise species diversity in a community and they account for both abundance and evenness of the species present (BEALS et al., 2000). Like for the Sørensen coefficient instead of vegetable species the number of vegetable units mentioned by farmers is used.

The results show, that diversity for Singida district was lowest with a Shannon index H = 2.83, while the highest vegetables diversity occurred in Muheza district with H = 3.84. Simpson's diversity index D showed a similar trend in vegetable diversity, with Singida and Arumeru district being quite similar in vegetable diversity but Kongwa and especially Muheza district holding a much greater diversity of traditional vegetables (Table 4.7).

Tab. 4.7 Shannon's and Simpson's diversity index and equitability for four districts researched in Tanzania.

	Singida	Arumeru	Kongwa	Muheza
Total number of different vegetable units mentioned per district	21	24	35	73
Total number of vegetables units mentioned per district (richness) S	152	137	167	293
Shannon's diversity index *H*	2.83	2.93	3.24	3.84
Simpson's diversity index *D*	15.70	16.71	21,87	36.18
Equitability (evenness) E_H	0.56	0.60	0.63	0.68
Equitability (evenness) E_D	0.10	0.12	0,13	0.12

Tab. 4.6 Most important traditional vegetables and frequency of mentioning by focus group participants in four research districts, Tanzania.

English	Swahili	Local	Scientific	Arumeru		Singida		Kongwa		Muheza	
				No.	%	No.	%	No.	%	No.	%
amaranth	mchicha	mgha, mughaa, mugha, mogha (Singida)	*Amaranthus cruentus, A. hybridus, A. dubius, A. spinosus, A. blitum*	10	100	11	100	10	100	12	100
cowpea leaves	majani ya kunde		*Vigna unguiculata* (L.) Walp.	10	100	11	100	10	100	12	100
pumpkin leaves	majani ya maboga	mhuza, mhuja (Kongwa); msusa; manyungu; mimbe (Singida)	*Cucurbita pepo*	10	100	11	100	10	100	12	100
jute mallow	mlenda	kibwando (Muheza); imito (Kongwa); mahonda, nkonda (Singida)	*Corchorus fascicularis, C. tridens, C. trilocularis, C. olitorius*	7	70	11	100	10	100	12	100
okra	bamia		*Abelmoschus esculentus* (L.) Moench	6	60	11	100	10	100	12	100
African nightshade	mnavu	mjimba nkunku (Singida)	*Solanum nigrum, S. scabrum, S. americanum, S. villosum*	10	100	10	100	7	70	12	100
African spiderflower	mgagani	mng'ang'i; mung'ang'i (Singida); mzimwe (Gogo);	*Cleome gynandra* L., *Gynandropsis gynandra* (L) Briq.	7	70	11	100	10	100	9	75
African eggplant	ngogwe		*Solanum aethiopicum, S. macrocarpon, S. anguivi,*	10	100	5	45	5	50	12	100
hyacinth bean (leaves)	fiwi	fili (Kongwa)	*Lablab purpureus* (L.) Sweet	3	30	0	0	9	90	2	17
bambara groundnut	njugu mawe		*Vigna subteranae*	0	0	10	91	10	100	0	0

Shannon's evenness increased from Singida district with the lowest value of E_H = 0.56 up to Muheza district showing the highest evenness of E_H = 0.68. As evenness increased together with species number, a more equal distribution of vegetable units the higher the vegetable diversity is, was indicated. However, evenness for all districts is not very high (1 = complete evenness), which is presumably due to only few vegetables being consumed in most villages, yet, quite a number of vegetables being known and used in individual villages alone.

Simpson's evenness is even lower and not differing between the four districts to a great extent. Surprisingly, Kongwa district shows the highest evenness, which suggests that the number of different vegetable species is rather similar within villages in Kongwa than elsewhere. This is, however, surprising, as in Kongwa district vegetable species differed between villages due to irrigation systems, which were available only in four but not in the other six villages researched.

Altitude and vegetable preferences. The importance of different traditional vegetables seemed to be related to the location of the village, i.e. the altitude in Arumeru district (Table 4.8). There was hardly any difference between villages at high and medium altitudes. Nevertheless, farmers in villages at low altitude preferred considerably different traditional vegetables: while amaranth and Ethiopian mustard played a less prominent role at lower altitudes, okra and African eggplant were mentioned to be of more importance and also watercress was mentioned once. It should be pointed out that focus groups interviewed at lower altitude consisted mainly of women only, while mixed groups were interviewed at medium and higher altitudes. Likewise, this could have influenced the preferences of variable traditional vegetables (see also 5.4). However, altitude varied to such an extent that different climatic conditions, especially water availability, could be assumed and, consequently, different vegetable species would be differently adapted to the particular environment. It was further conspicuous, that in villages at higher and medium altitude only 12 and 13 different vegetables were named, respectively, while at lower altitude 18 were named, which could be also an effect due to gender.

Rainfed vs irrigated vegetable cropping. While in Arumeru, Singida and Muheza districts all villages had rather similar conditions in terms of water availability, in Kongwa district great differences existed. In six villages, where focus group meetings took place, no irrigation was possible but farmers had to rely on the rain, whereas in four villages, which were located in a valley, irrigation of vegetable plots was feasible. Consequently, differences in preferences of traditional vegetables arose (Table 4.9). In villages with irrigation facilities, amaranth ranked No. 1, followed by pumpkin and sweet potato leaves. All three crops usually demanded more water easier affected by drought

than the traditional vegetables preferred in the area without irrigation, namely vegetable cowpea, jute mallow and 'mhilile' (*Cleome hirta*) (SCHIPPERS, 2002; MNZAVA, 2004).

Tab. 4.8 Rank of traditional vegetables in villages at different altitudes in Arumeru district, Tanzania, as mentioned by ten farmer groups.

Rank	Villages at high altitude (> 1500 ft) Kimnyaki & Kiranyi ward (2 villages)	Villages at medium altitude (1200 – 1500 ft) Moshono ward (3 villages)	Villages at low altitude (900 – 1200 ft) Kikwe ward (5 villages)
1	African nightshade	African nightshade	African nightshade
2	amaranth	amaranth	okra
3	Ethiopian mustard	Ethiopian mustard	African eggplant
4	cowpea	cowpea	cowpea
5	African eggplant	African eggplant	amaranth
6	-	watercress	Ethiopian mustard
7	-	-	watercress
No.	12	13	18

Especially the two latter crops were gathered from the wild and were, therefore, rainfed crops anyway. Okra was more valued and cropped in the irrigated area and only to a lesser extend in the dry area. Likewise, Ethiopian kale and African nightshade were of some importance in the area with irrigation, while they did not occur under the most important seven traditional vegetables in the dry area. Thus, farmers adjusted their choice of traditional vegetables to the local conditions, which appeared to be highly different even within one district.

Tab. 4.9 Rank of traditional vegetables in villages with and without irrigation facilities in Kongwa district, Tanzania, as mentioned by ten farmer groups.

Rank	Villages in irrigated area	Villages in dry area
1	**amaranth**	**cowpea**
2	**pumpkin leaves**	**jute mallow**
3	**sweet potato leaves**	**'mhilile'**
4	**Cowpea**	**pumpkin leaves**
5	**okra**	**amaranth**
6	**Ethiopian kale + jute mallow**	**sweet potato leaves + cassava leaves**
7	**African nightshade + 'mhilile'**	**okra**

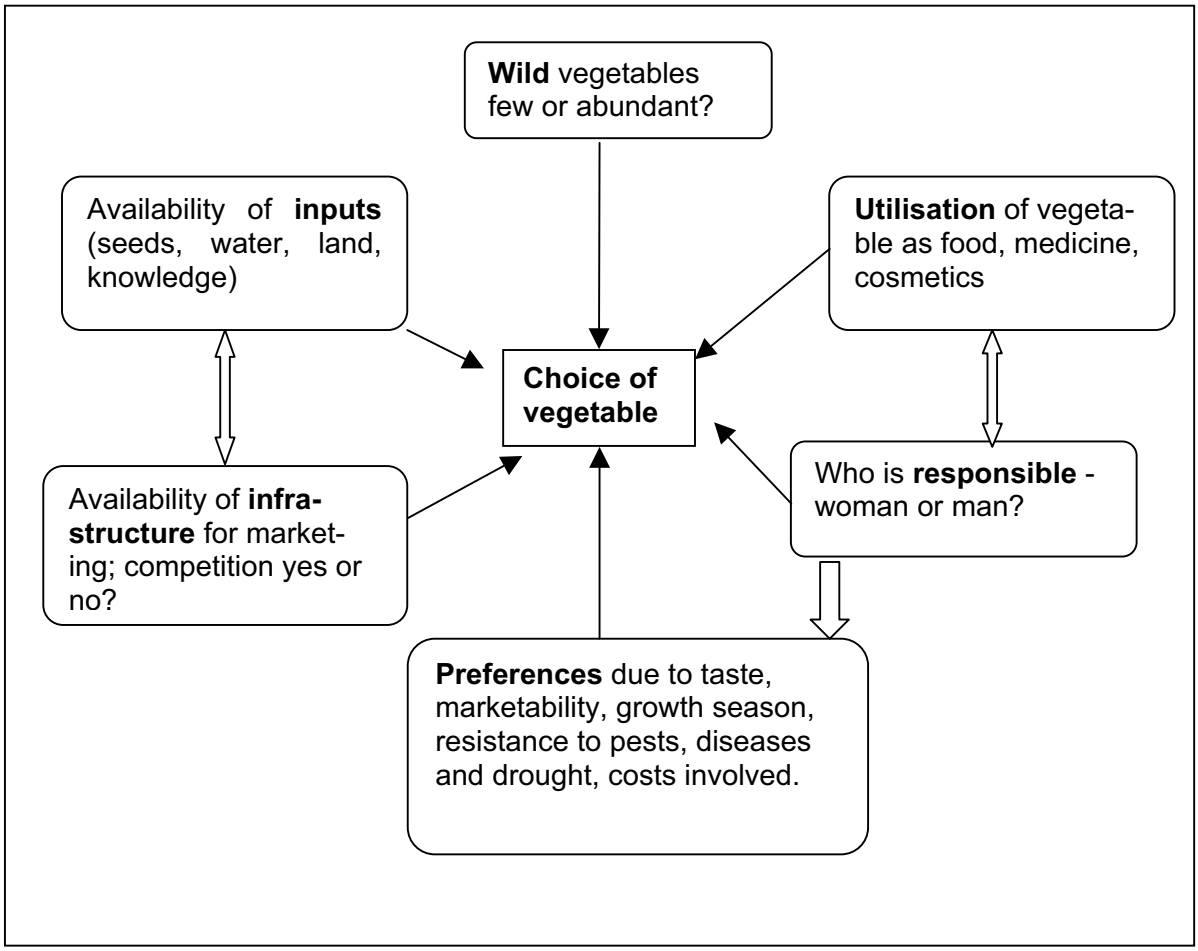

Fig. 4.3 Influences on choice of vegetables consumed and produced in Tanzania.

4.2 "WILD VEGETABLE VALUE" - DIVERSITY OF WILD TRADITIONAL VEGETABLES

The term 'wild' is linked to the word 'wilderness' which refers to an uninhabited or uncultivated section of land (CUNNINGHAM, 2002). However, here the term is only used to distinguish between wild and domesticated, traditional vegetables, not to suggest that the landscapes, where the vegetables occur, were unaffected by human influence or tenure. Consequently, wild vegetables could also occur as spontaneous plants or weeds in cultivated fields and would rather be classified as semi-wild or semi-cultivated.

On the one hand, wild food plants are often used during food shortages and casually. On the other hand, rural communities and especially children depend on wild food for some essential dietary components, such as vitamin C (MAUNDU, 1995). A diverse resource base of traditional plants are a major rural development issue: for resource users it presents a buffer against absolute poverty; edible wild food provides a

cushion against starvation during drought, while economically important species provide a buffer against unemployment during cyclical economic depressions (CUNNINGHAM, 1995). Furthermore, wild plant diversity represents local self-sufficiency for species-specific uses, such as for traditional medicinal plants, which are used by 70–80% of the African population (AKE-ASSI, 1988; in: CUNNINGHAM, 1995).

The questions to focus group participants concerning wild traditional vegetables were "Why do you collect them?" and "When - in which month - do you collect them?". As long as water was available, wild traditional vegetables could be collected throughout the year in all four districts. However, the main time for collection was during the short and long rainy seasons, while some vegetables were gathered during specific times only, which was often according to altitude (Table 9.6). Thus, wild traditional vegetables differed in their needs and habits and represented a great diversity. The reasons for collecting wild traditional vegetables ranged from "it is just a vegetable" and availability to different tastes and medicinal values (Table 9.7).

The wild types of **amaranth (*Amaranthus* spp.)** in Arumeru district grew easy and fast in the rainy season and they were even marketable as a heap (but not as a bundle). Since wild amaranth contained large number of seeds it persisted where it once established as reported in Singida district. Therefore, farmers were of the opinion "You do not have to worry about it, it is just there". Unfortunately, when people show this attitude it is the most difficult situation for improvement, since people cannot understand any reason for effort to change. Wild amaranth was added to bitter vegetables, e.g. African spiderflower, to reduce their bitterness in Kongwa district. In Muheza district, it was stressed that the local and wild amaranth type was sweeter and more resistant to stress than the cultivated amaranth varieties.

A special characteristic of the wild vegetable **black jack *(Bidens pilosa*)** was that it also functioned as a substitute for tea leaves and it further had a medicinal value in Arumeru district. In Muheza district, it was both a vegetable with a very good taste since it was slightly bitter, and a medicine especially to treat wounds.

While **jute mallow (*Corchorus olitorius*)** was mentioned in Arumeru district only two times out of five and was referred to as "just a vegetable", in the much dryer Singida district it was of high importance and ranked number one. It was an easy growing crop and could be harvested throughout the year, thus, there was no need for cultivation. In one village north-east of Singida, the collection of Jute mallow was specified: up to April/May (during rainy season) in cultivated fields, and up to September (during dry season) in the bush. Consequently, to obtain jute mallow during the dry season, uncultivated land was needed where this leafy vegetable could grow (see also chapter 6.4).

African spiderflower (*Cleome gynandra)* was popular due to taste in Arumeru district and was mixed with other vegetables, e.g. amaranth, to improve their taste by increasing bitterness (contrary to amaranth - used to reduce bitterness). However, in one village it was claimed that, because of its bitterness, only few people liked it and that it was unmarketable. In Kongwa district, African spiderflower was appreciated since it grew very fast like most wild vegetables during the rainy season. It was available before any cultivated vegetables could be harvested and, therefore, bridged a gap in terms of fresh vegetables. It was stressed that farmers in Kongwa had learned about this wild vegetable from their ancestors and they would pass their knowledge to their children. In one village of Muheza district, African spiderflower was not popular as a vegetable but it was used as a medicine, especially to treat ear disorders.

Bur gherkin (*Cucumis anguira)* ranked number two in Singida district and was said to be both cultivated and gathered from the wild. The latter was possible between January and May. Yet, as reported in one village, bur gherkin was attacked by insect pests from April onwards. This wild vegetable was stated to be capable to stand even severe drought "because it is a natural crop". Farmers probably thought of the crop not being bred or altered in any way by man but occurring just in nature. It was further explained that, when cultivated fields were weeded, the bur gherkin was not taken out but left to grow. This was a kind of selection or support for the bur gherkin to be left in the field while other "weeds" were removed, thereby some influence of man took place.

Though **hair** or **bitter lettuce (*Launaea cornuta*/Sonchus luxurians)** was explained to have an extremely bitter taste, people liked it in Arumeru district due to its quite different taste to other vegetables. The medicinal value of this wild vegetable was important in Kongwa district since it could treat measles in children under five years of age. In Muheza district, hair lettuce was the third most important vegetable and mentioned in all districts to be collected from the wild. It was named not only as a medicine to treat measles but also to cure malaria and stomach ache, to treat hook worms and to optimise the milk of lactating mothers. The latter was only an external application since, at the same time, a taboo existed for lactating mothers not to eat hair lettuce. Further, small children until they could walk and children with high fever (ndegedege) were not allowed to consume this wild vegetable (see also 5.6).

Different from Arumeru district, in Singida district **African nightshade (*Solanum* spp.)** was not cultivated but only gathered from the wild. However, in four out of six focus groups farmers stated that only few people ate this rather uncommon vegetable while others did not prefer it much. Maybe, this was due to the lack of farmers expertise on how to grow this vegetable, and their general little familiarity with this vegetable. Similarly, in Muheza district farmers in one village reported they do not use much

African nightshade, while in another village its bitter taste was explained to be like that of hair lettuce and appreciated by focus group participants.

Most of the mentioned wild traditional vegetables were said to grow easily and especially after land preparation. Consequently, most of them could be called semi-domesticated since they did not grow on uncultivated land but on cultivated land between the main and staple crops. The focus group participants also stated that most of the wild vegetables had a large number of seeds. Therefore, these wild vegetables would most probably spread easily and continue to grow over the years, thus, there was no need perceived for cultivation.

In a study by MAUNDU (1995) on Kenyan indigenous vegetables, it is assumed that due to clearing of land, over-stocking, over-exploitation and possibly climate change there occured a continual loss of wild food species at the farm and village level. This would mainly concern wild vegetables that grew only in uncultivated land e.g. in forests. However, if on cultivated land weeding would be performed more strictly or herbicides were used, wild traditional vegetables would also diminish. In fact, in Arumeru district cultivated instead of wild traditional vegetables were of high importance and not much attention was given to the latter. Maybe, this was due to the good climatic conditions with water being available nearly all year round and, therefore, the opportunity of cultivating vegetables independent from rainy and dry seasons. If enough cropped vegetables were available there was no need to gather additional vegetables from the wild. Furthermore, since farmers in Arumeru lived close to Arusha town the possibility for marketing of cultivated vegetables was given and, consequently, they gained more value compared to wild vegetables used for subsistence only.

An exception were vegetables, which had a different taste compared to cultivated vegetables and, therefore, would enrich the menu. If the plant grew easily it was a most welcome diversification. Furthermore, most wild traditional vegetables were claimed to have a medicinal value, which could be of high importance.

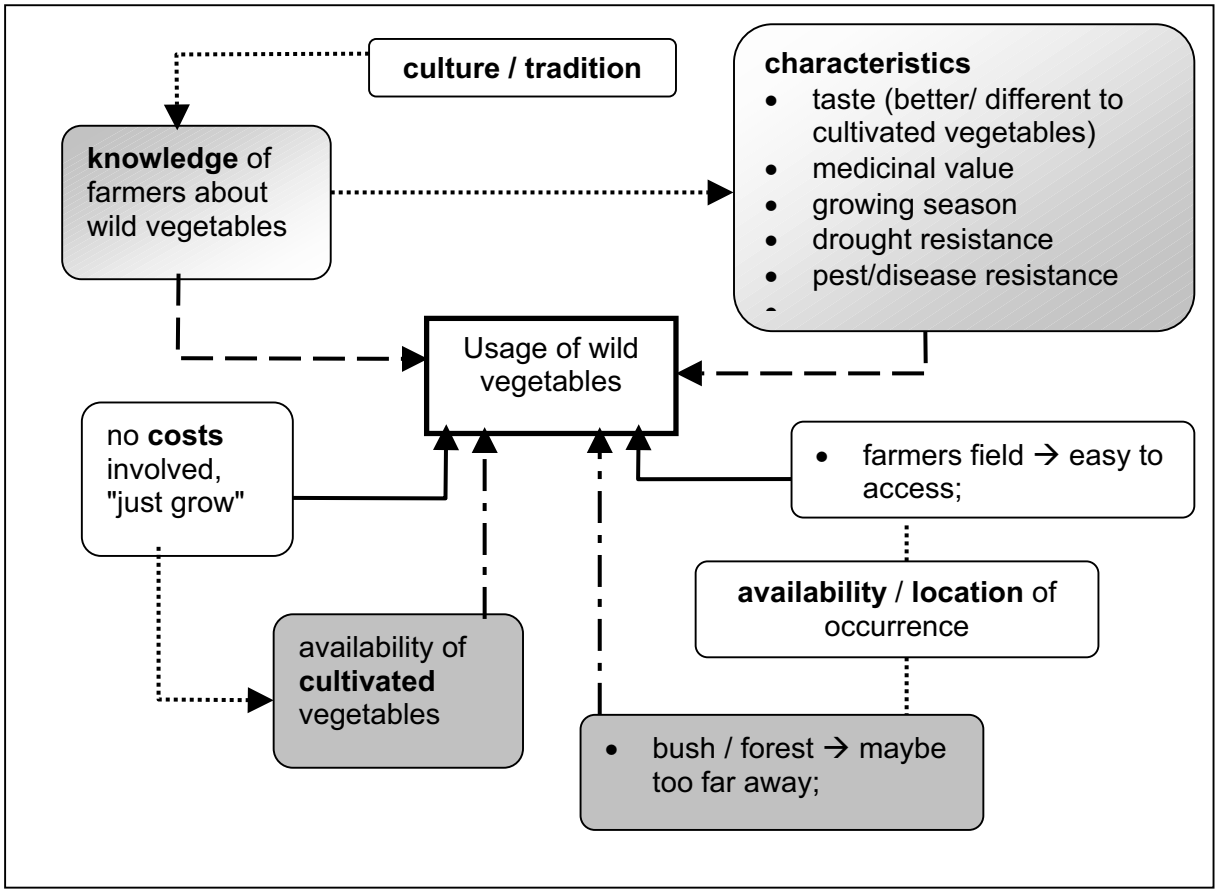

Fig. 4.4 Factors influences on the usage of wild traditional vegetables in Tanzania.

= positive influence

= positive and/or negative influence possible

= negative influence

= indirect influence on other factors

4.3 "LOST VEGETABLES OF TANZANIA" - GENETIC EROSION

To find out about possible genetic erosion, at the end of each focus group meeting farmers were asked about vegetables that were produced and/or consumed in the past but were not available any more. Focus group participants identified several reasons for the disappearance of traditional vegetables (Tables 4.11-4.14).

In nine out of ten focus group meetings (90%) in Arumeru district, farmers named several traditional vegetables that had vanished or were not any more consumed on a regular basis, while five groups in Singida district stated genetic erosion, and only four in Kongwa and Muheza district, each (Table 4.10). Obviously, the level of genetic erosion in terms of vegetables was quite high but not that advanced, or at least not observed and mentioned by farmers, in Singida, Kongwa and Muheza district as it was in Arumeru district.

Tab. 4.10 Loss of biodiversity in four different research districts, Tanzania.

	Arumeru	Singida	Kongwa	Muheza
Recognition of genetic erosion (villages)	9/10 = **90%**	5/11 = **45%**	4/10 = **40%**	4/12 = **33%**
Species lost or decreasing in number	8/(24+2) = **31%**	15/(21+12) = **45%**	7/(35+2) = **20%**	16/(73+1) = **22%**

According to focus group participants, there existed six major threats to vegetable diversity, which included in order of importance

- introduction of new or exotic vegetables, while traditional species were neglected (25%);
- climate change, especially the augmentation of drought (22.5%);
- change in food habits (20%);
- loss of vegetables' habitats (15%);
- lack of systematic transmission of knowledge from one generation to another on indigenous vegetables, resulting in a loss of indigenous knowledge (12.5%);
- politics being responsible, e.g. for farmers resettlement (5%).

Thereby, it is conspicuous how diverse farmers weight these threats in the different districts (Figure 4.5). Moreover, these factors influencing genetic erosion of traditional vegetables also are related to and influence each other (Figure 4.6).

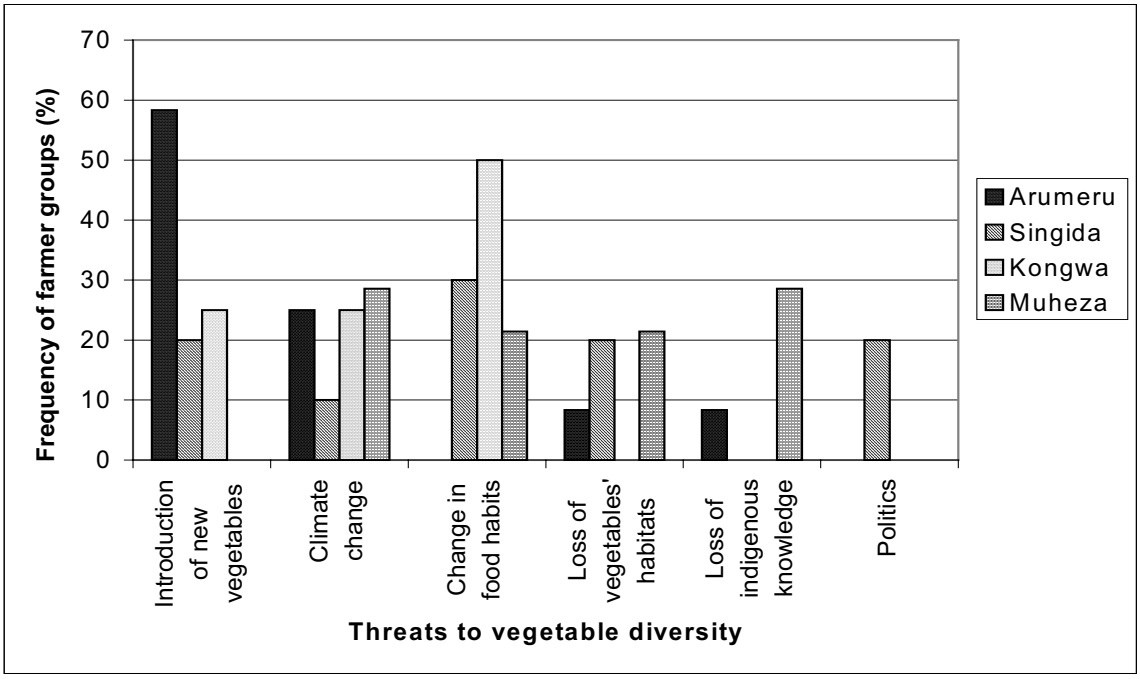

Fig. 4.5 Threats to vegetable diversity as mentioned by farmers (%) in four different research districts, Tanzania.

Tab. 4.11 Indigenous vegetables lost or reduced in number as mentioned by nine farmer groups in Arumeru district, Tanzania.

No	English name	Local name	Latin name	Farmers statements
1		ngoomba	*Brassica* spp.	• Not longer available and not consumed anymore;
2	cowpea	kunde	*Vigna unguiculata*	• Old / traditional varieties not available any more → replaced by new ones; • One old variety used to be collected in the forests, which is not done any more;
3	local kale / mustard		*Brassica carinata*	• Disappeared when Kale with bigger leaves was introduced from Kenya;
4	spiderflower	mgagani	*Cleome gynandra*	• Used to be plenty and now reduced in number; • Neglected because of introduction of new vegetables;
5		songa	*Sonchus luxurians*	• Vanished from one village; • Can still be found in other villages but only during rainy season;
6	African night-shade	shanumbe	*Solanum* sp.	• Collected on uncultivated land; more and more land was cultivated, thus, the vegetable got lost; • Nowadays found only along roadsides;
7		golo	n.d.	• Vanished (from the medium zone).
8	(small cherry tomatoes)		*Lycopersicon* sp.	• Disappeared (in the low zone), grew only in higher elevation.

n.d. = not determined as yet

Tab. 4.12 Indigenous vegetables lost or reduced in number as mentioned by five farmer groups in Singida district, Tanzania.

No	English name	Local name	Latin name	What happened
1	(jute mallow type)	gafuro	*Corchorus* sp.	
2	(jute mallow type)	mntee	*Corchorus* sp.	• Old jute mallow types were not eaten any more, rather prefer new varieties; • New types and new vegetables were introduced, e.g. okra; • Used to collect old types in the bush (uncultivated land) → nowadays settlements were too far from the bush;
3	(jute mallow type)	ngulele	*Corchorus* sp.	
4	(jute mallow type)	trente	*Corchorus* sp.	
5	(Jute mallow type)	mkhala	*Corchorus* sp.	• Many people opened up new land for cultivation because of population pressure; • This lead to deforestation and some wild vegetables only grew in forests; • Eating habits of new generation changed – people did not go to the forest and looked for wild vegetables any more; • Droughts were responsible for genetic erosion;
6	(jute mallow type)	mtae	*Corchorus* sp.	• Got lost;
7	(jute mallow type)	songa	*Corchorus* sp.	• Was close to distinction but they did not prefer it, took it out when weeding;
8	(local cucumber)	matungu	*Cucumis* sp.	• Introduction of new varieties which matured earlier than local ones; • Introduction was backed up by politics (e.g. slogans for new varieties, advertisement) – people were influenced to buy new varieties; • No initiative was taken by farmers themselves to preserve old varieties;
9	(local sweet potato variety) (was sweeter, could stay longer in the field)	matembele viazi	*Ipomea batatas.*	
10	hair lettuce	mchunga	*Launaea cornuta*	• Some farmers used to eat it when they were young; nowadays not consumed any more but they did not know why;
11	cowpea (spreading type)	majani ya kunde	*Vigna unguiculata*	• Like *Cucumis* spp.
12		mamamai	n.d.	• Still available but not consumed by humans any more; • Nowadays used as animal feed;
13		itindimbui	n.d.	• Many people opened up new land for cultivation because of population pressure; • This leads to deforestation and some wild vegetables only grew in forests; • Eating habits of new generation changed – people did not go to the forest and looked for wild vegetables any more; • Droughts were responsible for genetic erosion;
14		kitini	n.d.	
15	(used like local cucumber)	mkayundu	n.d	

Tab. 4.13 Indigenous vegetables lost or reduced in number as mentioned by four farmer groups in Kongwa district, Tanzania.

No	English name	Local name	Latin name	What happened
1	Ethiopian kale	sukuma wiki	*Brassica carinata*	• seeds were not available (general problem for all indigenous vegetables);
2	African night-shade	mnavu	*Solanum* sp.	
3	African spider-flower	mgagani	*Cleome gynandra*	• was introduced but did not adapt to conditions;
4	hair / bitter lettuce	mchunga	*Launaea cornuta*	• not liked due to bitter taste;
5	(evergreen shrub, climber)	mtulu	*Opilia amentacea*	• still available but not eaten any more;
6		mtafuta	n.d.	
7	(green vegetable)	suludia	n.d.	• still available but became fewer, taste was not good, many other green vegetables were available; • food habits changed;

Tab. 4.14 Indigenous vegetables lost or reduced in number as mentioned by four farmer groups in Muheza district, Tanzania.

No	English name	Local name	Latin name	What happened
1	(perennial herb)	tikini	*Asystasia gangetica*	• not lost but not used any more by new generation; only few old people still know how to use them; • found on the farm but not close to homesteads → women did not want to walk long distances to obtain them; • habitat of vegetables (forest, swampy areas) got lost; • eating habits changed: people preferred processed food, e.g. sardines and exotics e.g. tomatoes;
2	(annual herb)	fungum-sanga	*Celosia trigyna*	
3	(annual herb)	nkobo, unkobo	*Justicia heterocarpa*	
4	cape myrtle	zuma	*Myrsine africana*	
5		msangani		
6	African night-shade	mnavu	*Solanum* sp.	
7	(annual herb)	kibwabwa	*Vicandra physaloides*	
8		tee		
9	African night-shade	mnavu	*Solanum* sp.	• a forest species was not used since it was not allowed to farm in the forest any more; • was overgrown when fields in forests were given up;
10	common bean	msangani	*Phaseolus vulgaris*	• availability problematic since rivers became drier;
11	watercress	saladi	*Nasturtium officinale*	• new crop especially for the dry area;
12	hair / bitter lettuce	mchunga	*Launaea cornuta*	• used to eat it but nowadays not any more, new women generation did not know how to prepare (mentioned by a man);
13	(tree)	kiumbu	n.d.	
14		kungujulu	n.d.	• used to eat it when young, nowadays did not prepare it any more, kids got not used to it and did not know about it;

No	English name	Local name	Latin name	What happened
15	(creeper, found in valleys)	mnkoswe	n.d.	• picked it in valleys alongside streams in formers days, due to drought it was not found any more;
16		zinge	n.d.	• grew in forests, got lost with deforestation;

Introduction of new vegetables. In Arumeru district "ngoomba", a *Brassica* species, and certain cowpea types were mentioned to be not available any more. Yet, newly introduced varieties of cowpea were still available but not the local or old ones as farmers called them. The wild vegetable "ngoomba" did not vanish but was reduced in amount, when new crops were introduced in Arumeru district. Newly introduced vegetables were said to be, e.g. amaranth, African nightshades, Ethiopian kale - which are all traditional vegetables but selected or improved varieties - but also white cabbage, Chinese cabbage, spinach and carrots. Two farmer groups reported that they were concentrating nowadays on those crops, "which are consumed in town and with which we can earn money". Farmers became more market-oriented and only few species were favoured as cash crops for this purpose. As a consequent of this specialisation, the diversity of vegetable species cultivated was and would further be reduced.

The introduction of early-maturing, new varieties of vegetable cowpea and sweet potato, which were propagated by the government in Singida district, displaced old varieties. On the one hand, this was an improvement, on the other hand, there was no initiative to preserve the displaced old varieties and, consequently, genetic material got lost. Interestingly, the problem of newly introduced vegetable species replacing old traditional ones was not mentioned in Kongwa and Muheza district at all.

There is little doubt that, through agricultural expansion, biodiversity declined over the past two centuries (LACHER et al., 1999). However, when practices of sustainable agriculture were applied, there was not necessarily a loss of biodiversity when the productivity increased. Likewise, for the subsistence farmer it must be strange that “one would be so foolish as to risk this diversity with the narrow selection of just a few varieties and species” (RHOADES & NAZAREA, 1999). Also, to many agricultural scientists it seems obvious that genetically diverse ecosystems are valuable resources and that genetic diversity has economic value (GOLLIN & SMALE, 1999). In general, it was acknowledged that, when new varieties find their way into traditionally diverse agroecosystems, the number of local landraces as well as associated local knowledge may be diminished (RHOADES & NAZAREA, 1999).

Climate change. In Arumeru, Singida and Muheza districts one reason for traditional vegetables getting lost was assumed to be a change in weather, whereby farmers especially experienced drought to occur more often and more severe. Due to

this, swampy areas as well as rivers, which functioned as a habitat for vegetables such as watercress, were observed to become drier or to disappear (Muheza). Another wild traditional vegetable, 'mnkoswe', used to be present in valleys alongside streams but was not found any more due to drought as farmers suggested (Muheza). In Arumeru district, farmers reported that certain vegetables vanished from their village but could still be found in other areas, e.g. at higher altitude, where conditions were obviously different.

Since the biodiversity of Africa and especially the origin of biodiversity is closely linked to the climatic history of the continent, future biodiversity is seriously threatened by climatic changes. These climatic changes are likely to result from artificial changes in the atmosphere (LIVINGSTONE, 1995). This change also shows the importance for having "potential species" - adapted to different climates - ready for use.

Changing food habits. Farmers reported that eating habits changed with the young generation and, consequently, traditional vegetables and especially wild ones were not valued and used any more, because "young people do not go to the forest and look for wild vegetables" (Singida). A change in preferred taste was also experienced and, for example, one green vegetable was used less due to a bad taste and due to many other green vegetables being available (Kongwa).

Even if some farmers did not experience a loss of traditional vegetable, they often stated that a shift in consumption and eating habits had happened. For example, sardines and meat were preferred instead of vegetables, exotics like tomatoes instead of traditionals, and food already processed was chosen instead of fresh ingredients for a home-made meal (Muheza). Especially, the amount of meat consumed in Muheza district increased recently since one could buy meat in the shop nowadays, while it had to be hunted by men in former times and was a special food item, as reported by one lady farmer.

In fact, MAUNDU (1995) reported that a change in food preference, which was affected by westernised markets, education and urbanisation, tended to reduce the attention for indigenous or traditional plant species. A so-called "nutrition transition", which already occurred in industrialised countries, is now affecting especially urban populations in many developing countries (MILLSTONE & LANG, 2003). This transition is characterised on the one hand by a decline in the consumption of traditional food crops and on the other hand by an increase in intakes of fat, sugar, salt and animal foods, an increase in alcohol consumption and in the consumption of refined and processed foods as well as an overall reduction in dietary diversity. These changes in diet have an impact on health, and will result in an increase in diet-related diseases (MILLSTONE &

LANG, 2003). A change in food habits in Tanzania was further closely linked to loss of indigenous knowledge and the introduction of new vegetable species.

Loss of habitat. In Arumeru district, farmers reported that more and more land was opened up and used as farmland. Consequently, together with uncultivated land, which was the natural habitat for wild vegetable species, the latter were diminished in number or disappeared. For example, a wild *Solanum* species was found only on uncultivated land and vanished when more and more land was cultivated (Arumeru), while an old variety of vegetable cowpea was lost due to deforestation (Arumeru) as well as a wild traditional vegetable called 'zinge' (Muheza). The reason for more land used as farm land and the cutting down of forests was mainly population pressure.

The fact that more and more land close to homesteads was opened up for cultivation was responsible for uncultivated bush land to "move" more and more away from households. For example, farmers in Singida district explained that some old *Corchorus* types used to be collected in the bush which was now too far away from their settlements and, therefore, it was not gathered any more. Male farmers in Muheza district claimed that traditional vegetables were still available but not close to their homesteads and that women were not willing to walk long distances to obtain these vegetables. Again the gender aspect emerge and shows how much vegetable availability and diversity depends on women.

It was acknowledged that deforestation, especially in tropical Africa, may result in species extinction and cultivation was regarded as one of the major causes of deforestation by many people. Besides extinction of some species, deforestation had socio-economic as well as environmental consequences, which included soil erosion, silting, fuelwood shortage, and changes in household labour allocation (KARIUKI, 1995).

A main problem for a developing country like Tanzania was that new technologies and increased economic pressures could cause losses of biological diversity in the early stages of development. Furthermore, agroecosystems simplify the environment and contain fewer species than the native flora did before, and consequently, “habitat loss directly reduces biodiversity” (LACHER et al., 1999).

Loss of indigenous knowledge. In one village of Arumeru district, it was argued that all traditional vegetables were still available but "young people do not know about them". Apparently, there was a lack of systematic transmission of knowledge from one generation to another on traditional vegetables. Similarly, in Muheza district only few old people still had the knowledge how to use traditional vegetables. A male farmer in one village argued that the new generation of women did not know how to prepare traditional vegetables and, therefore, they do not eat them any more. Consequently, children got not used to them and did not learn anything about them. Here,

farmers approved that women were responsible for traditional vegetables and played the greatest role in vegetable cultivation and processing. Consequently, women are the key persons for vegetable conservation and need to be involved in research and development of traditional vegetables.

In Kenya, it was observed that loss of traditional knowledge combined with a loss of indigenous food plants resulted in a decreased utilisation of indigenous food species, which had reduced the variety of foods eaten and food resources in general (MAUNDU, 1995). Likewise, SLIKKERVEER (1995) found that together with the indigenous plants the farmer's knowledge on how to breed, manage and select these resources would be lost. In fact, one of the general issues affecting biological diversity in Tanzania was loss of traditional knowledge (ANONYMOUS, 1998).

Politics. In Singida district, farmers reported that the introduction of new vegetable varieties was backed up by politics, e.g. new varieties were advertised with special slogans. Thereby, farmers were influenced in their choice of vegetable for cultivation. However, focus group participants also maintained that farmers themselves did not take action to preserve old vegetable varieties. For example, a *Solanum* species, which only occurred in the forest, was not used anymore when farmers were no longer allowed to farm in the forest. It was not stated why it was forbidden to cultivate vegetables in the forest, but the species named was overgrown by other forest plants when fields in the forests were given up.

The reason for settlements being too far from the bush was not necessarily only due to more and more land used for cultivation but probably also to the settlement policy in the 1960s. The Arusha Declaration in 1967 set the principles of so-called Ujamaa Villages, whereby farmers were resettled in specific areas for specified types of production (ANONYMOUS, 2004a). Thus, they settled close to each other to share infrastructure. But at the same time they moved far away from their original land and were too far away from the bush or uncultivated land to gather wild traditional vegetables. Additionally, the economical autonomy of women, who were mainly responsible for traditional vegetables, was negatively affected by the Ujamaa-policy, since only few men were empowered over new rights on land-use (BRAIN, 1976).

Besides the mentioned threats to horticultural biodiversity there existed further reasons for traditional vegetables to get lost such as an area-specific consumption of traditional vegetables and a lack of organisation of farmers in terms of marketing and a limited seed supply (ANONYMOUS, 1998). Another possible reason for local food plants to disappear could be modern high-input agriculture, based on monocropping for cash, which replaced traditional systems (SLIKKERVEER, 1995).

No genetic erosion observed. One mixed farmer group from a lower region in Arumeru district argued that no genetic erosion was experienced and all crops were still available. In fact, it was stated by the farmers that the new generation ate vegetables now, while "in former times mainly meat and beans were preferred". This maybe due to the fact that the people interviewed belonged to the Arusha community, which used to be pastoralists and consumed mainly animal products, while the cultivation of plants and especially vegetables was a new culture for them and was only established around 1830 (GULLIVER, 1969).

In Singida district, one farmer group named the traditional vegetables 'bur gherkin' as well as jute mallow, which were used long time ago already, to be still available. Apparently, farmers had been able to conserve these vegetables through consumption and production - conservation through utilisation. In another village, an old and wild amaranth type called 'mughaa' was mentioned to be still available. This type played an important role to overcome famine times, when it was cooked in a different way to cultivated amaranth. Instead of producing a relish, 'mughaa' was cooked together with any type of flour and consumed as a main and not a side dish.

As shown by these positive examples, agricultural genetic diversity is ultimately controlled by the decisions of farmers – they will choose what crop species to exploit and also select their mix of varieties (GOLLIN & SMALE, 1999). For example, when farmers chose to change from cultivating traditional food crops to high-yielding hybrid seeds, indigenous varieties, carefully selected over generations for specific ecosystems, will get lost (SLIKKERVEER, 1995). However, when e.g. credits needed by a farmer come along with the requirement of cropping hybrid seeds it is questionable if their exists a fair choice for farmers (BFDW, 2004). In general, there are several reasons for farmers to grow traditional varieties alongside modern varieties, and this was also practised by the farmers interviewed in all four regions of Tanzania. Motives for this include besides others, farmers' risk aversion, learning behaviour or experimentation and differentiation of varieties seen as different commodities (GOLLIN & SMALE, 1999).

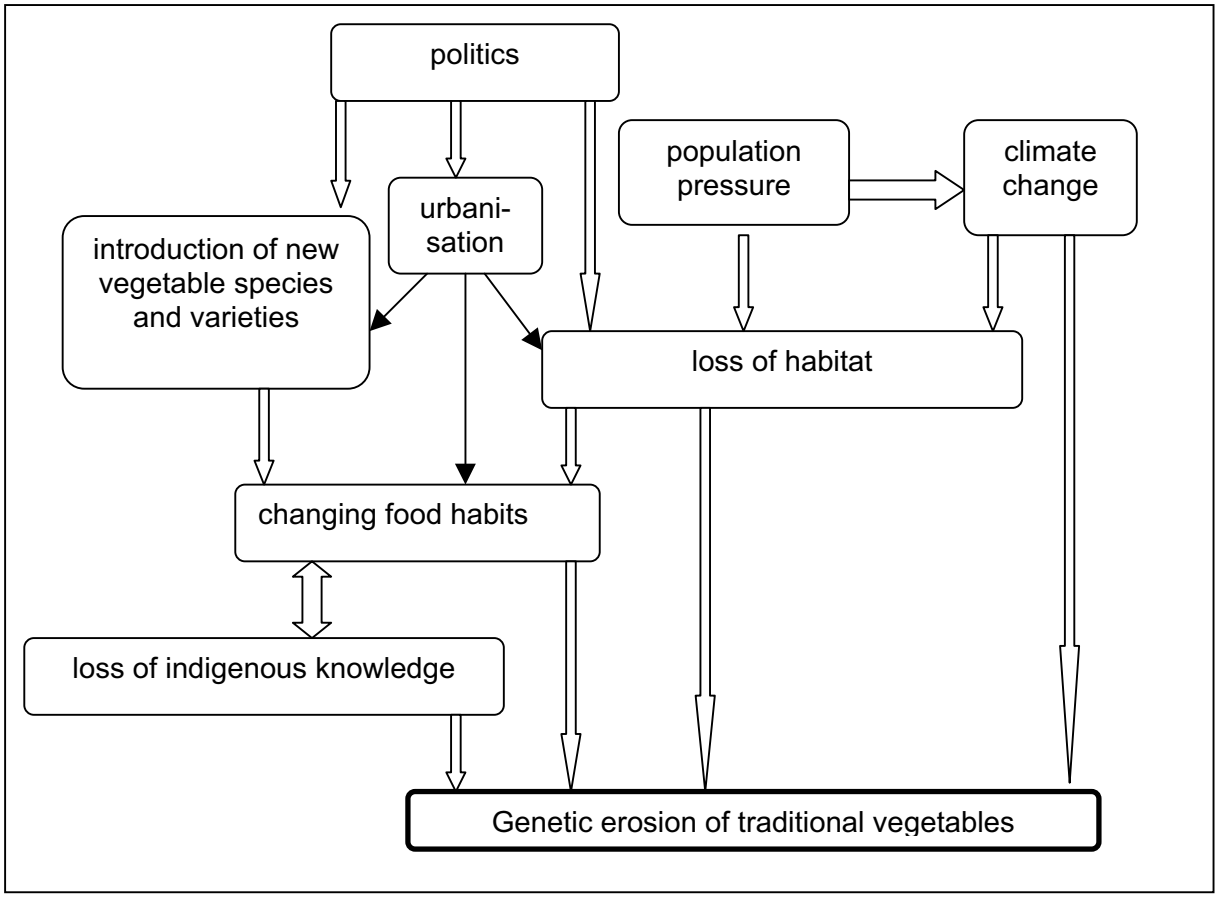

Fig. 4.6 Main factors influencing genetic erosion of traditional vegetables perceived by farmers in Tanzania.

4.4 "RESPONSIBILITY FOR TRADITIONAL VEGETABLES" - GENDER-BASED DIFFERENCES IN VEGETABLE CROPPING

In Tanzania it is well known that women make significant contributions to agriculture, both in food production and post harvest activities (MELLA, 1997). In fact, food insecurity is amplified through women's heavier workload and if involvement of women in decision making and in control of resources is lacking (KAUZENI, 1999). However, little has been done so far to make them more productive and, in fact, the present extension system does not consider much the participation of women in agricultural production (MELLA, 1997).

It is further acknowledged that men and women have different roles to play in the production process of agricultural goods and that households are normally headed by men and, thus, men are responsible for decision-making concerning farming activities. Still, men often lack first hand knowledge of the experiences, constraints and needs of women who are much more involved in agricultural processes like planting, weeding, harvesting, manual threshing and drying, seed selection, hauling of water and

fuel wood, processing and preparation of food (MELLA, 1997). This first hand knowledge is due to a division of labour, where women and men develop and generate specialised knowledge. The latter includes not only the knowledge about the activities mentioned above but also knowledge of the diverse plant species, varieties or types, and the whole agro-ecological system with which women work (FAO, 2003c).

During focus group meetings on production issues farmers were asked "Who is responsible for this traditional vegetable?" (Table 4.15). While farmers answered usually with "women", "both" or - very seldom - "men", in some villages the individual production steps and duties were assigned to either women or men (Table 4.16).

Tab. 4.15 Responsibility for traditional vegetables with regard to gender in four research districts of Tanzania.

Traditional vegetable	Women crop				Women & Men crop			
	A	S	K	M	A	S	K	M
cowpea leaves	X	-	X	X	0	-	0	0
pumpkin leaves	-	X	X	X	-	0	0	0
jute mallow	-	X	X	-	-	0	0	-
African spiderflower	-	-	X	-	-	-	0	-
hair / bitter lettuce	-	-	-	X	-	-	-	0
bur gherkin	-	X	-	-	-	0	-	-
African nightshade	0	-	0	X	X	-	X	0
sweet potato leaves	-	0	0	X	-	X	X	0
amaranth	X	0	0	0	0	X	X	X
African eggplant	0	-	-	0	X	-	-	X
cassava leaves	-	0	-	0	-	X	-	X
Ethiopian mustard	0	-	0	-	X	-	X	-
okra	0	0	0	0	X	X	X	X

X = yes; 0 = no; - = not discussed in this district;

Women crops. Hair lettuce, collected only from the wild, was most important for women focus groups in Muheza district and in fact, only women were responsible for collecting hair lettuce from the wild (Table 4.15). Another wild vegetable, bur gherkin (local cucumber), was preferred by women groups in Singida over sweet potato leaves, while mixed groups ranked these two traditional vegetables vice versa (Table 4.17). Bur gherkin was always declared as a women crop without exception, which was also true for jute mallow, collected from the wild in Singida and Kongwa district by women only. In Kongwa district, African spiderflower gathered from the wild were stated to be women crops only, however, this vegetable ranked No.1 for mixed focus groups and only No.5 for women groups. Women groups in Kongwa rather favoured cowpea and pumpkin leaves, which were named women crops in all four districts (Table 4.15).

Women focus groups in Singida district declared water cress to be more important than pumpkin leaves or vegetable cowpea. In contrary, the two latter traditional

vegetables were outranking water cress in the mixed focus groups where water cress was not ranked at all (Table 4.17). While women alone were responsible for pumpkin and cowpea leaves, both vegetables were used for further plant parts and presented multipurpose crops. The seeds in terms of cowpea and the fruits in terms of pumpkin were crops for the market and were, therefore, interesting as a source of cash income and favoured by men. In contrary, water cress as a leafy vegetable, sometimes cultivated and sometimes collected from the wild, belonged to the women's field of responsibility.

Obviously, if women or men were responsible for one vegetable it was not only due to the purposes of a vegetable but also due to the method how it was obtained - collection, home gardening, small or large-scale farming. Thereby, women were exclusively accountable for vegetables collected from the wild. Moreover, women were the major users and growers of traditional green leafy vegetables and at the same time they were accountable for their preparation, cooking and processing, as well as for their sale on local markets (CHWEYA & EYZAGUIRRE, 1999). In a study by GERSON (1991) it was found that the encouragement of local and traditional vegetable production was essential to enhance the nutritional situation of rural areas in Tanzania. However, agricultural policy neglected the importance of green vegetables and especially traditional vegetable species, and the attention of national agricultural programmes focused only on newly introduced and exotic vegetables cultivated by men for export. It was concluded that, to enhance the cultivation of traditional vegetables, it is necessary to change attitudes, to acknowledge the work carried out by women and especially to value and appreciate their vegetable cropping.

Women and men crops. Though African nightshade was ranked only by mixed groups in Muheza district, yet, women were alone responsible for this crop since it was gathered from the wild. However, in Arumeru and Kongwa districts farmers stated that both women and men cared for this vegetable.

In two villages of Arumeru district, different opinions arose on the whereabouts of the money earned from selling African nightshade by women. According to one village, the money gained belonged to the man and he could decide whether to give little or nothing to the woman, according to her needs. Yet, "according to her needs" was not defined any further and it was not stated if women or men would decide on the amount of money for the woman. In another village, where African nightshade was a women crop, it was common that the sales revenue belonged to women alone, and it was open to her to give some money to her husband or spend everything on household items such as salt and oil. Nevertheless, even if the woman kept all money to herself, she did not spend it on private items but - at least most of the money - for food for her

family. In Tanzania it is recognised, similarly to many other poor countries, that incomes controlled and owned by women are more likely to be spent on improving food and nutrition in their families other than those controlled by men (MSUYA, 1999).

Likewise, women sold Ethiopian mustard on the market in Arumeru district, however, in one village men set the price and collected the money earned by women. Yet, in a second village, men and women shared production and income of Ethiopian mustard since the late 1970s. Moreover, research showed that men's incomes were more often closely related to exotic crops, while women's incomes were more often linked to indigenous or traditional crops, including vegetables (HOWARD, 2003). While Ethiopian mustard was not eaten by old and conservative men in Arumeru district, the labour for cultivating Ethiopian mustard was, however, shared by men and women, and men even had their own garden when it was a commercial crop.

Sweet potato leaves were said to be a women crop when grown in homegardens or planted close to homesteads (Singida). This was in general the non-tuber-producing type, of which only leaves were used. Men were responsible for the tuber-producing sweet potato types, which were planted as food crops in the field. Similarly, both men and women were responsible for the production of cassava in Muheza district, whereby the tuber-producing cassava type ('muhogo', *Manihot esculenta*) was a men's crop, while women cared for the non-tuber-forming cassava types ('mpira', *Manihot glaziovii*) and were also alone accountable for the harvest of leaves.

Actually, in one village of Singida district, men were responsible for okra alone since it was a cash crop, yet, in a second village both women and men shared the production of okra like in all other districts. Amaranth was also stated by most farmer groups to be cultivated by both women and men, only in Arumeru district it was a women crop only. Also in Arumeru, women focus groups decided okra to be the third most important crop, while mixed focus groups claimed Ethiopian mustard to be number three (Table 4.17). It could be assumed that the traditional vegetable okra was more important to women, while Ethiopian mustard had a higher value for men. In one village of Arumeru district, okra was even said to be not consumed by men since it was too slimy and not easy to eat. Furthermore, okra was mainly harvested by women since this was said to be a light kind of work.

African eggplant was favoured rather by mixed groups in Muheza district and, in fact, focus group participants stated that both women and men were responsible in Arumeru as well as Muheza district (Table 4.15). In one village of each district it was distinguished between African eggplant as a homegarden and as a cash crop. However, in Arumeru district, men alone were responsible for the cash crop, while both women and men were responsible for African eggplant as a regional market crop for

Muheza district. Obviously, women in the coastal Muheza district, or at least in the village interviewed, were more involved in agricultural marketing than women in the research village in Arumeru district.

For some traditional vegetables, it was not possible to define them as a clear women or men crop. Still, the function of the vegetable - if it was used for subsistence or marketing - could be combined with gender (Figure 4.7). As long as a traditional vegetable was produced on a small scale for home consumption, women were responsible. As soon as a traditional vegetable became marketable men were responsible for this plant usually partially, seldom outright. This also happened e.g. in rural Mali where, in a farming community, gardening, closely associated with women in former times, had become a commercial venture and a man's affair over the past few decades (WOOTEN, 2003). As a result, women were marginalised from gardening and consequently, their ability to produce traditional foodstuffs was limited. Ironically, male gardeners may be contributing to a decline in the nutritional value of their own meals, by growing and selling garden crops. If this change in local culinary patterns actually takes place, it could lead to nutrient deficiencies and related health problems (WOOTEN, 2003).

Not only nutrition and health of farmers could be affected but also the conservation of plant genetic resources. As it was stated by FAO (2003c), on-farm and *in situ* conservation and use of plant genetic resources begins with women in much of the developing world. While women were responsible for growing and collecting food, men often specialised in producing cash crops for the external market (FAO, 2003c).

All aspects of production and consumption of food in general involved both men and women, with women usually being accountable for the larger share of food-related activities (FIELDHOUSE, 1995). For Tanzania the statement that women did most of agricultural work, including the preparation of food could be applied (LOBULU, 1991). Especially in terms of vegetables, women were mainly responsible and knowledgeable in Tanzania, yet, the production of traditional vegetables was often shared depending on the vegetable and the district (Table 4.16). When different productive tasks are assigned to different family members, there are bound to be ideological and political consequences. Tasks will generate products to which certain values are assigned, and, as a result, to their producers social worth is given. The assignment of social worth will reinforce the power relations within the household and its social structure (WEISMANTEL, 1988; in: FIELDHOUSE, 1995). Consequently, when vegetable-growing for cash is valued higher than vegetable-growing for subsistence, those who are responsible for the latter, usually women, are regarded lower in a society and hold less power and rights. Therefore, it is important to increase the productivity of women who primarily

attend and supply the family and who gain their social recognition mainly through their horticultural activities (CREEVEY, 1996).

Tab. 4.16 Traditional vegetable-related gender division of labour in Tanzania

Traditional vegetable	Women's duties	Men's duties
African eggplant (A)		land preparation
	sowing and transplanting	sowing and transplanting
	irrigation	irrigation
	occasionally application of fertiliser	application of fertiliser
	harvest (+ children if not at school)	harvest
	marketing of small lots	marketing of big lots
African nightshade (A)		land preparation (making ridges)
	planting	planting
	weeding	
	application of farm yard manure	
		irrigation
	harvest	spraying of pesticides
	selling	
African spiderflower (K)	collection from the wild	pick it during weeding in fields or during scarcity
	processing	
amaranth (A)	all production steps	-
amaranth (S)		land preparation
	irrigation	irrigation
	harvest	
	processing	
amaranth (K)	all production steps but irrigation	all production steps but harvest
	collect from the wild	
	processing	
cassava leaves (M)	land preparation	land preparation
	planting	planting
	weeding	weeding
	irrigation	irrigation
	harvest of leaves	
	processing	
cowpea leaves (A)	all production steps	weeding only
	responsible for home consumption	responsible for commercial crop
	harvest for subsistence + market	harvest only for market
cowpea leaves (K)	land preparation	participate in land preparation
	sowing	participate in sowing
	weeding	participate in weeding
	harvest	
	processing	

Traditional vegetable	Women's duties	Men's duties
Ethiopian mustard (A)	sowing and transplanting	sowing and transplanting
		land preparation
	weeding	
		irrigation
		application of fertiliser
		spraying of pesticides
	harvest	
	selling	
	processing	
jute mallow (S, K)	leave it when weeding fields	-
	harvest	
	processing	
pumpkin leaves (K)	land preparation	
	sowing and planting	participate in planting
	weeding	participate in weeding
	harvest	
	processing	
		participate in keeping seeds
sweet potato leaves (S)	leave types only (for homegarden)	tuber and leave types

A = Arumeru district; S = Singida district; K = Kongwa district; M = Muheza district;

Tab. 4.17 Rank of traditional vegetables as mentioned by women and mixed focus groups in four research districts, Tanzania.

Traditional vegetable	Arumeru		Singida		Kongwa		Muheza	
	Women groups (3)	Mixed groups (7)	Women groups (5)	Mixed groups (6)	Women groups (5)	Mixed groups (5)	Women groups (6)	Mixed groups (6)
African eggplant	5	5	-	-	-	-	7	6
African nightshade	**1**	**1**	-	-	-	-	-	-
Amaranth	2	2	5	4	4	3	2	**1**
bur gherkin	-	-	2	3	-	-	-	-
cassava leaves	-	-	6	6	7	-	5	7
cowpea	4	4	-	-	**1**	2	6	-
Ethiopian mustard	6	3	-	-	-	-	-	-
hair/bitter lettuce	-	-	-	-	-	-	**1**	2
jute mallow	-	-	**1**	**1**	3	4	-	-
spiderflower/mhilile	-	-	-	-	5	**1**	-	-
okra	3	6	4	5	-	7	3	3
pumpkin leaves	-	-	-	7	2	5	-	5
sweet potato leaves	-	-	3	2	6	6	4	4
watercress	7	7	7	-	-	-	-	-

- = not ranked

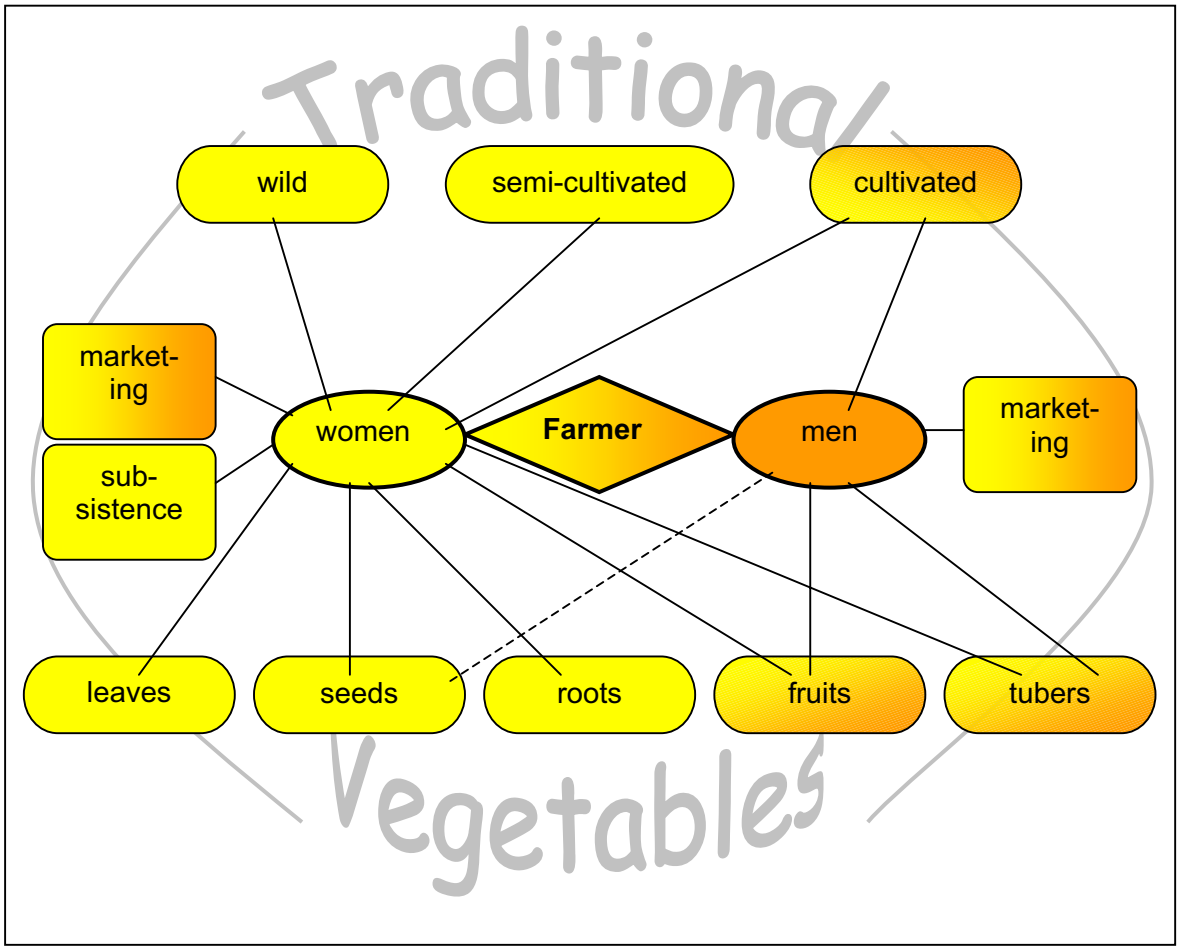

Fig. 4.7 Responsibilities according to gender for traditional vegetables in Tanzania.

4.5 "GROWING FOR SUBSISTENCE OR CASH?" - INTENTION FOR VEGETABLE CROPPING

Traditional vegetables were grown mostly on small but also on large scale in Tanzanian villages. Different motives and circumstances prompted farmers to decide for the one or the other (Fig. 4.8). Usually, farmers distinguished themselves between cultivating for subsistence and for the market.

Vegetables as subsistence crops. Vegetables for own use were usually produced in home gardens, and home gardening is acknowledge to hold an important potential as a food security strategy and, in particular, as a strategy for meeting micronutrient needs (MELLA, 2000). Especially for rural families with limited purchasing power, access to home-grown fruits and vegetables ensures a more balanced diet and increases their self-reliance. Besides cultivated fruits and vegetables, certain leaves and fruits that grow wild or spontaneously are consumed in rural areas and are good sources of micronutrients like their cultivated relatives (MELLA, 2000). In addition to

healthy food, home gardens contain high levels of biodiversity and are normally managed by women. In their home gardens as well as in fields and common property resources (e.g. forests, wetlands) where women gather traditional vegetables, rural women practice *in situ* conservation FAO, 2003c).

In the rural districts of Kongwa and Muheza, many traditional vegetables that were of high importance to farmers were not sold on the market but cultivated for subsistence only (Table 4.18). In Kongwa district, about five vegetables out of nine had a good market while in Muheza district only one vegetable, namely amaranth, was possible to market, with all the other vegetable, either having a non-reliable market or not being sold. Mainly cultivated vegetables were sold in Kongwa district, whereas wild vegetables such as jute mallow and African spiderflower were only collected for home consumption. However, there arose different opinions on marketability between different villages in one district. In two villages of Kongwa district, amaranth generally had a good market, in a third only *A. hypocondriacus* was possible to sell, while *A. cruentus* was not popular in town but in the village, and in a fourth village amaranth was not sold at all. Similarly, cowpea leaves were not sold in some villages but had a good market in other villages of both Kongwa and Muheza district. Where they were not sold, cowpea leaves were preserved and served as a food for home consumption during dry spell.

Different marketing possibilities also arose in terms of African eggplant, which achieved 100 TSH (approx. 0.10 US $) for a 5-l-bucket of fruits in one village of Muheza district only, and farmers claimed that the market was not organised. Yet, focus group participants from another village sold African eggplant two days a week on a market within their village as well as in Muheza and some fruits were even taken to markets in Tanga and Dar es Salaam.

There was no market for cassava leaves in Muheza district and even selling of tubers was problematic. The reason for a bad market of okra was an oversupply as well as no organisation of the market and no functioning market chain. Pumpkin and sweet potato leaves and amaranth in one village were also not marketable due to an oversupply and no sales potential. Additional factors that influenced the choice for subsistence cropping rather than for cultivating for the market are shown in Figure 4.7.

Vegetables as cash crops. From a conventional view, cash crops compete with subsistent food crops for land and labour. However, there is also a potential for cash crops to make available resources such as credit or training for farmers, which can contribute to food crop productivity (GOVEREH & JAYNE, 2002). On the other hand, when markets expand, there is a shift from horticulture as a traditional domain of women towards an intensified and commercialised field of action dominated by men (HOWARD, 2003). Through this shift, women loose the basis for feeding their children

and family if men will not take into consideration that women need money now to purchase food since they can not produce it by themselves any more.

Since Arumeru has a relatively high population density, and Arusha is one of the largest towns in Tanzania (ANONYMOUS, 2002) with a high demand for food items, marketing of traditional vegetables was not of a problem. Singida town is smaller in size and population but still provided similarly good conditions as Arumeru for marketing vegetables. In fact, farmers in Arumeru often explained that they sold to middlemen whole plots, e.g. with amaranth ready for harvest. These collecting wholesalers played a significant role in marketing of horticultural products to bridge the gap between small-scale farmers, who live in rather isolated rural areas and distributing wholesalers, who were situated in large urban centres. Collecting wholesalers, who contributed to the efficiency in marketing channels to the benefit of both farmers and distributing wholesalers (DIJKSTRA, 1999), obviously missed in Kongwa and Muheza districts, where the opportunity for marketing vegetables was hardly given.

Farmers in two villages of Arumeru's Moshono ward (medium altitude) explained that it was no problem to sell vegetable cowpea. Still, in one village in Kikwe ward (lower altitude), farmers claimed marketing of vegetable cowpea to be of a problem during the long rains. This was due to the great offer of cowpea leaves during that time since nearly everybody cultivated them. Similarly, from April to July amaranth could be collected fresh from the wild in Arumeru district and was, therefore, abundant and not marketable. Furthermore, a mixed farmer group explained that nowadays rather Chinese cabbage than amaranth was cultivated because it fetched a better price on the market.

Marketing of sweet potato leaves was usually no problem in Singida district but in one village. There, the leaves of a rare type of non-tuber-forming sweet potato were marketable, while the leaves of a common tuber-forming type were not marketable since everybody produced it. Apparently, an organised marketing group or union was missing so that farmers did not know what types and/or quantities of vegetables other farmers produced, and how the demand developed in certain areas or times. Consequently, oversupplies especially during the rainy seasons occurred, and farmers could not or hardly earn cash during that time. Actually, it was found that farmers' organisations were very weak in tropical Africa, and publications on agricultural marketing in tropical Africa was very fragmentary. Furthermore, marketing channels for subsistence crops were argued to be either not existent or only intra-household, while local domestic cash crops were marketed within one culture, tribe or language and national domestic cash crops could be sold within more cultures, tribes or languages (VAN DER LAAN et al., 1999).

One village of Arumeru district distinguished two types of amaranth, namely 'mchicha mweusi' (*Amaranthus dubius*) and 'mchicha wa unga' (*A. hypocondriacus*), which fetched good prices on the market, while 'mchicha mweupe' (*A. cruentus*) and 'mchicha mwekundu' (collected from the wild, *A. spinosus*) did not obtain a good price. In a second village, farmers stated that they even could not fulfil the general demand for amaranth.

In terms of Ethiopian mustard, farmers in Arumeru differentiated between a type called 'saro', which was tasty and, therefore, had a good market and another type called 'sukuma wiki' (Kenyan type), which was stated to be not tasty and to have no soft leaves and, therefore, the market was rather bad. The positive characteristics of the non-marketable Ethiopian mustard type were a prolonged harvest and that it was resistant to pests, diseases and drought. Presumably, this type was used in famine times, when the other better-tasting type was not available due to unfavourable environmental conditions.

One farmer group in Singida district distinguished between two okra types. One type without spines was easy to harvest and they called it a commercial crop. The other type was spiny and, therefore, not easy to harvest. Although the taste of both types was said to be alike and very good, the spiny type was not marketed. While jute mallow was solely and bur gherkin (local cucumber) partially gathered from the wild and, therefore, were accessible by everybody, there was the opportunity to sell both vegetables on a market, where non-farmers were buying.

In general, in both districts, Arumeru and Singida, the marketing of the most important traditional vegetables as defined by farmers, was possible and good. Nevertheless, there was a difference between the two districts concerning the type of traditional vegetables. While in Arumeru district only cultivated vegetables were marketed, in Singida district besides cultivated also two vegetables collected from the wild were sold on the market. Wild vegetables were of much more significance for people in Singida district, they were a part of their culture and played such an important role that they were even demanded on the market by people, who had no opportunity to gather them from the wild.

Tab. 4.18 Farmers' assessment of marketing possibilities for traditional vegetables in four different districts of Tanzania.

Traditional vegetable	Marketing in			
	Arumeru	Singida	Kongwa	Muheza
amaranth	good	good	good / not sold	good
okra	good	good	good	bad
Ethiopian mustard	good	-	good	-
African nightshade	good	-	good	not sold
African eggplant	good	-	-	medium
bur gherkin	-	good	-	-
cowpea leaves	good	-	not sold / good	not sold / good
sweet potato leaves	-	good	good	bad / not sold
cassava leaves	-	good	-	not sold
jute mallow	-	good	not sold	-
pumpkin leaves	-	good	not sold	not sold
African spiderflower	-	-	not sold	-
hair / bitter lettuce	-	-	-	not sold

- = not discussed in terms of marketing in this district

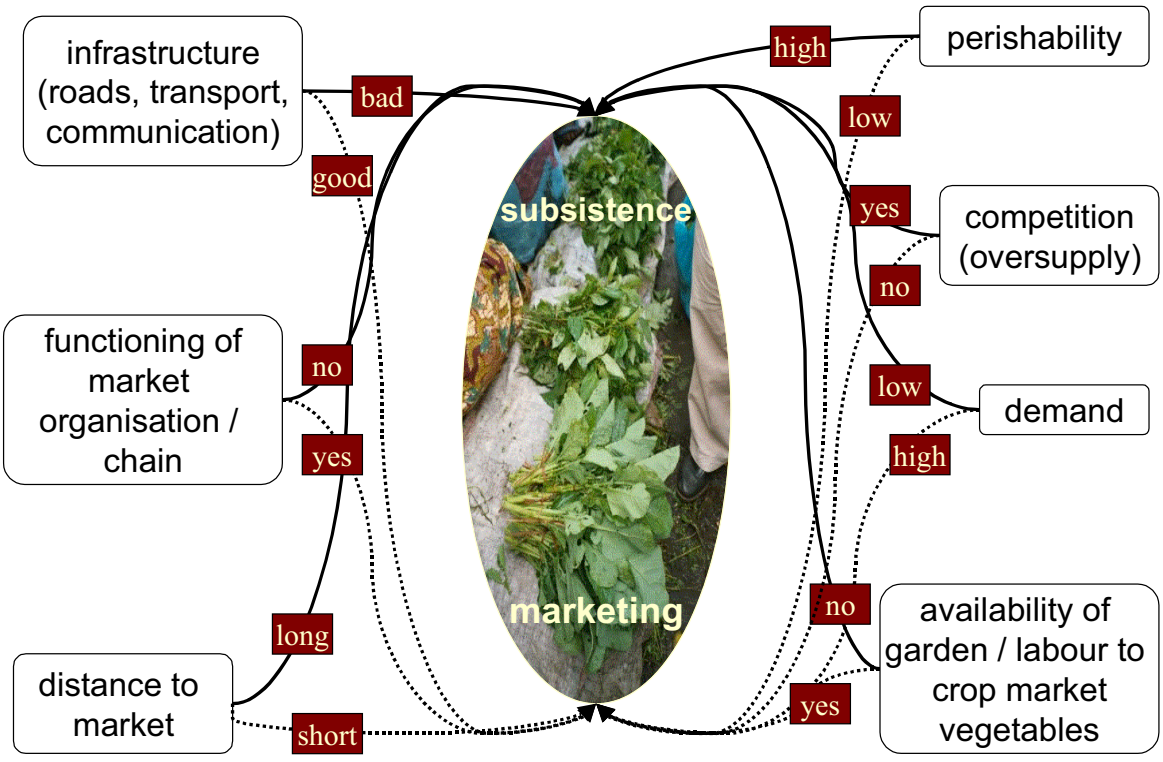

Fig. 4.8 Factors influencing the choice of traditional vegetable production for either subsistence or the market in Tanzania.

4.6 "MEDICINE, COSMETICS, AND FOOD AT ONCE" - MULTIPLE USAGE OF TRADITIONAL VEGETABLES

Besides the diversity of vegetable species, there also existed a diverse usage of traditional vegetables and some could, therefore, be called multipurpose crops. Of almost all vegetables mentioned by farmers, not only leaves but also other parts were used (Table 4.19). Besides African eggplant, of which leaves were consumed from one species (*Solanum anguivi*) only, leaves of all traditional vegetables were used. Thereby, only three vegetables were used for their leaves alone, while at least two plant parts were used from all the others. Besides being consumed by humans, some traditional vegetables were also fed to animals (e.g. stems of African nightshade in Arumeru) or known to be eaten by free ranging animals since they occurred in the wild (e.g. jute mallow in Singida). Which factors influenced the different usage of traditional vegetables is demonstrated in Figure 11.

Tab. 4.19 Plant parts used of traditional vegetables in four different districts of Tanzania.

Traditional vegetables	Plant part used								Location
	leave	stem	root	tuber	fruit	flower	pod	seed	
pumpkin leaves	X				X			X	S
	X				X	X		X	K
	X				X				M
African nightshade	X	X			X**				A
cowpea	X						X	X	A, M
	X							X	S, K
African eggplant	X*				X				A
					X				M
amaranth	X	X							A, S, K, M
bur gherkin	X				X				S
hair / bitter lettuce	X	X							M
jute mallow	X		X						S
	X								K
okra	X				X				A, S, M
sweet potato leaves	X			X					S, K, M
African spiderflower	X								K
cassava	X								S, K, M
Ethiopian mustard	X								A

Districts: A = Arumeru; S = Singida; K = Kongwa; M = Muheza;

* Leaves were only used from *Solanum anguivi*.

** Ripe yellow fruits only of *Solanum villosum* were eaten especially by children.

Food preparation. At first glance, traditional vegetables seemed to serve as food only, as a component in meals besides starch and protein, as important suppliers of vitamins and minerals and as taste improvers. There existed different methods to consume especially leafy vegetables, which OOMEN and GRUBBEN (1978) summarised.

Side dishes were prepared out of leaves to supplement the main food and, thereby, it was made sure that fair quantities of vegetables per meal were consumed. Leaves could also be processed to soups and sauces, whereby the quantities eaten were rather small since leaves were mainly used to improve the taste. A third method was to prepare vegetables as part of the main food, i.e. to mix leaves with the starch component before cooking. Thereby, one problem was that the colour of the whole meal was not very much accepted (OOMEN & GRUBBEN, 1978), furthermore, the cooking time for leaves was extended since e.g. tubers needed more time until they were done and, consequently, more nutrients were lost. A fourth method, which did not occur in the research districts of Tanzania, was edible packing material, whereby e.g. meat dishes were packed and steamed in vine, nightshade or cabbage leaves which increased the carotene intake considerably (OOMEN & GRUBBEN, 1978).

Common preparation methods for traditional vegetables in Tanzania were boiling, steaming or frying for all vegetables, and also roasting of African eggplant in Muheza district (Table 4.20). While in Arumeru district a recipe, whereby vegetables were fried in oil, existed for each vegetable type, in Muheza district it was more often suggested to boil or steam the vegetables in water. However, it was not clear if farmers in Muheza district did not use oil on a regular base since it was not available or rather because it was not part of their culture. Anyway, the ingredients used by farmers were very much adapted to what was locally available. For example, coconut milk was used mainly and often in the coastal Muheza district, where coconut palms were growing, while groundnuts were a common ingredient in Singida and Kongwa districts which were abundant there. In Arumeru district, recipes were characterised by exotic ingredients such as carrots, sweet pepper, tomatoes and onions as well as meat, fish or fresh milk, which was available due to animal husbandry in this area. In fact, frying vegetables with oil and onion was the most popular way of improving food flavour, while in coastal Tanzania, where the use of coconut as a flavouring was widespread, preparations were more complex and time-consuming (MAUNDU & IMBUMI, 2003). The number of different recipes for one vegetable species was lowest in Arumeru district, where not more than three recipes per vegetable were available, while in the other districts sometimes four or even five (Singida) dishes were named (Figures 4.9a-d). Some more data on preparation methods are given in chapters 6.1 to 6.6.

Tab. 4.20 Methods of preparing traditional vegetables and consumption of the meals in four different districts of Tanzania.

Traditional vegetable	Preparation method	Consumption/Avoidance
African eggplant	boiling and frying (A); boiling, frying and roasting (M);	• not consumed by people with peptic ulcers and asthma (M);
African nightshade	boiling, steaming and frying (A); mixed with green maize, banana and milk (A);	• not consumed by old and conservative men in former times (A); • lactating women (A);
African spiderflower	boiling (K);	• everyone;
amaranth	boiling, steaming or frying (A, S, K, M);	• not consumed by old and conservative men (A); • not consumed by some children (S);
bur gherkin	boiling and frying (S);	• everyone;
cassava leaves	boiling and frying (S); boiling (K, M);	• not consumed by people with skin infection (K); • not consumed by people who fear to get head aches due to cyanides (M);
cowpea leaves	boiling, steaming and frying (A); boiling and frying (S, K); boiling and steaming (M);	• not consumed by old and conservative men (A);
Ethiopian mustard	steaming and frying (A);	• everyone;
hair / bitter lettuce	boiling (M);	• not consumed by lactating women, babies and children with high fever (ndegedege) (M);
jute mallow	boiling and frying (S); boiling (K);	• not consumed by people with 'stomach' problems, esp. women after giving birth (S); • type 'ng´honjera' not consumed by men → reduced reproductive ability (K);
okra	boiling and frying (A, S); boiling and steaming (M);	• chopped fruits not consumed by men → too mucilaginous (A); • not consumed by women after giving birth and by powerful men (M);
pumpkin leaves	steaming and frying (S); boiling and steaming (K, M);	• not consumed by women after giving birth → will cause 'stomach' problems (K, M);
sweet potato leaves	boiling and frying (S, K, M);	• not consumed by people with hernia (M);

Districts: A = Arumeru; S = Singida; K = Kongwa; M = Muheza;

Preservation. Drying of traditional vegetables, was not carried out at all in Arumeru district, since fresh vegetables were available throughout the year (Figure 4.9a). In Muheza district only amaranth and cowpea leaves were conserved, while in Singida and Kongwa district all traditional vegetables were preserved for the dry season and often even two preservation methods existed (Figures 4.9b-d). A drawback with preservation was that all focus group participants suggested to dry vegetables in

the direct sun for one or two days depending on the light intensity. Only in one village of Singida district it was stated that a solar drier was used for drying jute mallow leaves.

In Tanzania, the potential of preservation by solar-dehydration of food is not sufficiently recognised (MGOBA et al., 1993). On the one hand, preserving of vegetables is highly necessary in Singida and Kongwa to ensure a year-round supply of vegetables, especially in regions with long dry periods and further to reduce the waste of these highly perishable foods during the seasonal surplus. On the other hand, open drying methods did not ensure against re-wetting of the drying material by rain, contamination by dust and dirt, and attacks by birds, rodents and insects. However, the latter would be ensured by a covered solar drier and, furthermore, higher temperatures speeded up the drying process, thereby eliminating the possibility of microbial spoilage or mould. Another important fact was that the amount of beta-carotene in the final product was appreciably higher than if conventionally dried (MGOBA et al., 1993). In a trial with leafy vegetable grown near Dar es Salaam it was found that, after being dried photo-protected using black plastic sheet, the final moisture content was more than 10% higher and the beta-carotene content was 2-4 times higher than when dried photo-exposed (MGOBA et al., 1993).

Especially leafy vegetables are among the most nutritive vegetables both on a fresh weight basis and when prepared. Of course, some nutritive constituents are lost during cooking, but they still provide significant amounts of pro-vitamins A and C and several minerals after the cooking process. Moreover, leafy vegetables grow rapidly and allow several harvests per season and are, therefore, among the world's most productive plants in terms of nutritional value per unit. For example 1.5 cups of cooked spinach, which is comparable to amaranth in its constituents (only the contents of vitamin A is higher in spinach), has 40 calories and provides 70% of the recommended daily allowance (RDA) for adults of vitamin A, 25% of the RDA of vitamin C, and 20% of the RDA of iron (BOSLAND, 2003).

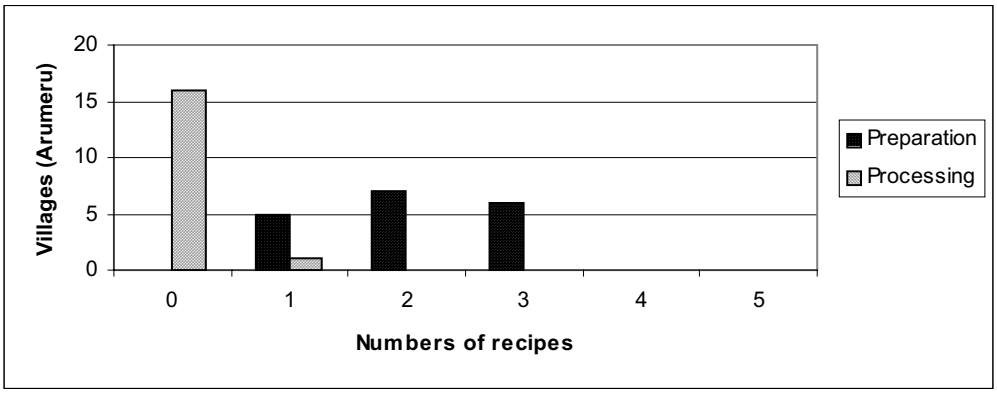

Fig. 4.9a Number of villages and quantity of recipes farmers possess for one vegetable in Arumeru district.

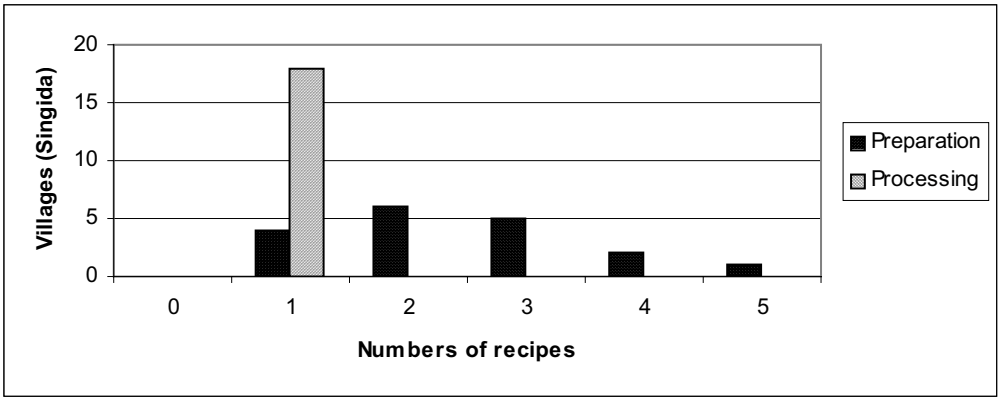

Fig. 4.9b Number of villages and quantity of recipes farmers possess for one vegetable in Singida district.

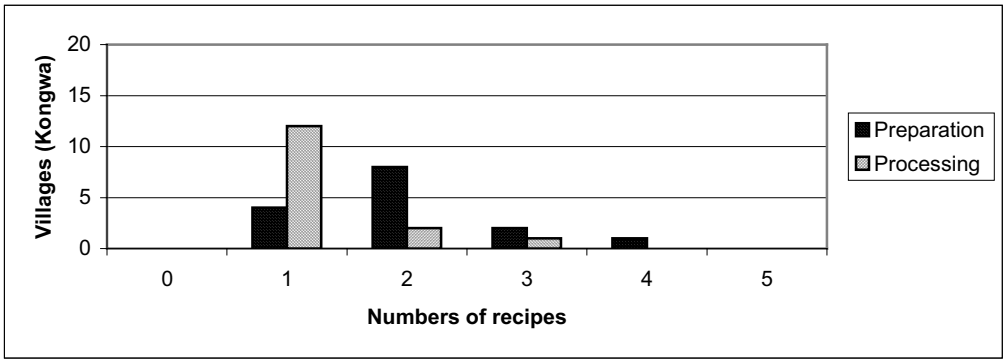

Fig. 4.9c Number of villages and quantity of recipes farmers possess for one vegetable in Kongwa district.

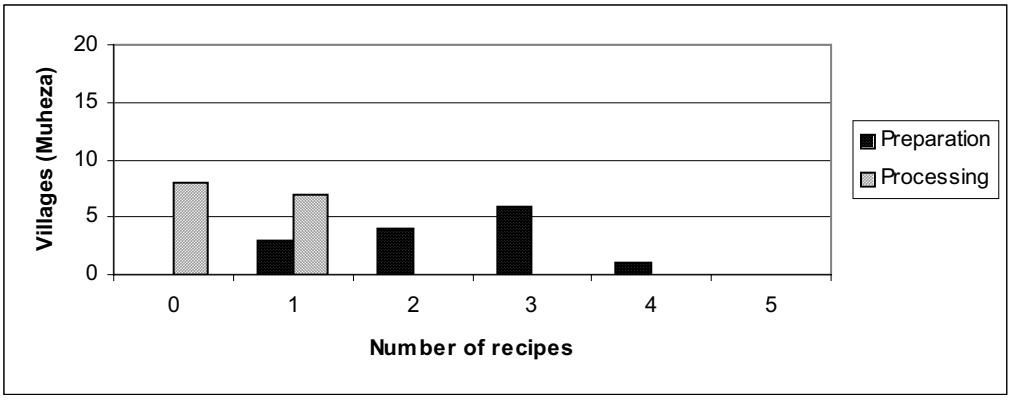

Fig. 4.9d Number of villages and quantity of recipes farmers possess for one vegetable in Kongwa district.

Food taboos. Food taboos or restrictions were named by farmers in Tanzania and are summarised in Table 4.20. While some vegetables were eaten by everyone, the most vegetable taboos concerned people with certain diseases, pregnant or lactating women or men in general. The fact that men would not eat green leafy vegetables in Arumeru district could be traced back to their history as pastoralists. For most pastoralists, besides meat, fresh blood mixed with milk was an important food item (MAUNDU & IMBUMI, 2003), whereas green plants were only regarded as animal fodder

and not suitable for humans. Other taboos were probably created by trial and error or were advised by the doctor, when for example pumpkin leaves created 'stomach' problems in women directly after giving birth. Hereby, it is important to carefully distinguish between the concept of taboo from that of simple avoidance, whereby the latter is usually based on empirical common sense (FIELDHOUSE, 1995). In general, most food taboos or restrictions were mentioned in Muheza district, while only view were explained by farmers in Singida district (Figures 4.10a-d).

It could be assumed that, due to food prohibitions, people and especially vulnerable groups of a community such as women and children could become malnourished. However, MAGANDI (1997) reported that in Iramba district, which is located north of Singida district, it was found that the nutritional status of children and women was not seriously affected by believes and taboos. Yet, community habits, e.g. that husbands or males in general will receive the best, the most and the first part of the food and have priority over females and small children, could still influence nutritional statues of especially the latter groups in a community (MAGANDI, 1997).

The concept of food and consequently that of food taboos is determined by the three factors biology, geography, and culture. Thereby, cultural reasons for food taboos often have a geographical origin, i.e. exotic or unknown foods will often not be accepted for consumption. While only few taboos are related to food of vegetable origin, whereof a prominent example is the prohibition against alcohol for Muslims and some Christian denominations, food avoidance most frequently relates to animal meat (DEN HARTOG, 2003).

In general, food prohibitions can be classified according to their length (permanent or temporary prohibitions) or to the size of the human group they interest (individuals, a masculine or feminine part of the society, a social class, a socioprofessional group, a total society) (FIELDHOUSE, 1995). Permanent food taboos normally include religious, cultural and hygienic reasons such as the prohibition against pork for Jews and Muslims, whereas temporary food avoidance often apply to women and relate to the reproduction cycle and, in fact, in a number of African countries it is common that pregnant women avoid green vegetables (DEN HARTOG, 2003). While there may often be an unnoticed logic behind a food taboo, at the same time one could think of women ingesting insufficient nutrients during the crucial times of pregnancy or lactation. However, in a large number of countries nutrition and health education have reduced the temporary food avoidance of vulnerable groups (DEN HARTOG, 2003).

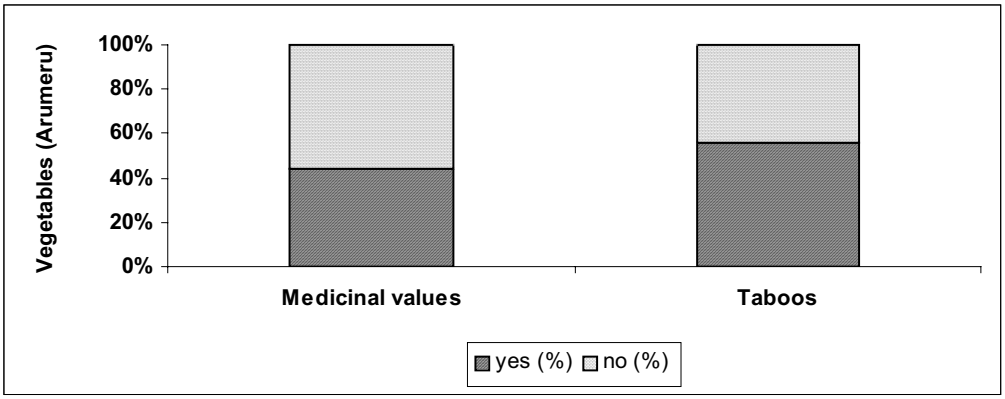

Fig. 4.10a Amount of vegetables with and without medicinal values and consumption taboos in Arumeru district, Tanzania.

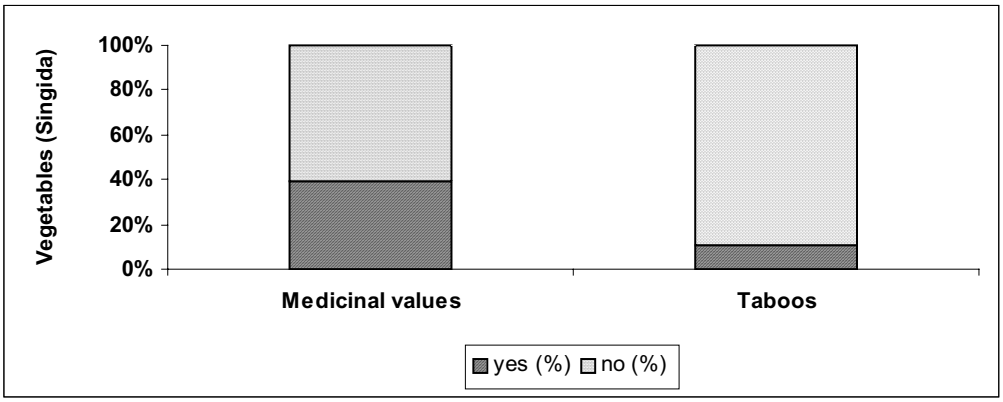

Fig. 4.10b Amount of vegetables with and without medicinal values and consumption taboos in Singida district, Tanzania.

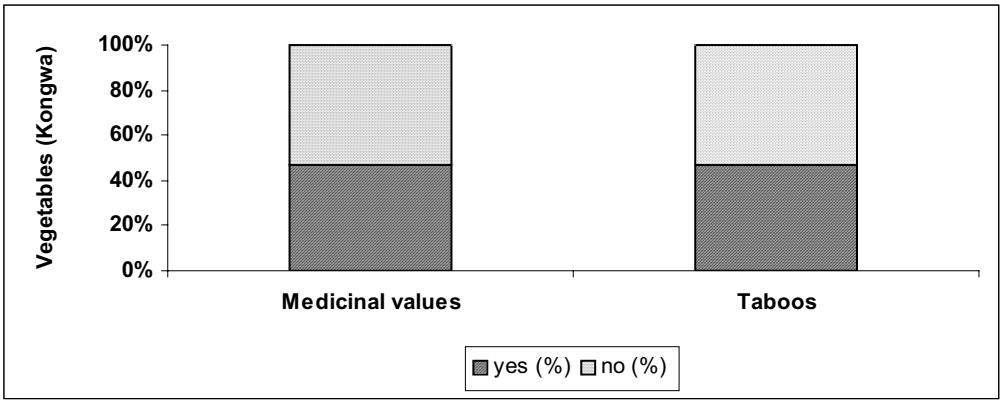

Fig. 4.10c Amount of vegetables with and without medicinal values and consumption taboos in Kongwa district, Tanzania.

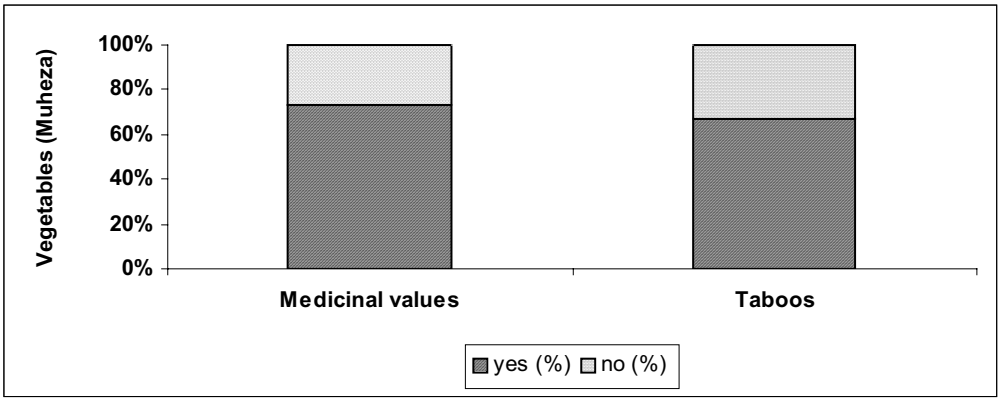

Fig. 4.10d Amount of vegetables with and without medicinal values and consumption taboos in Muheza district, Tanzania.

Medicine and cosmetic. Most traditional vegetables in Tanzania, besides being used for food, had further usages especially as medicines for a range of different illnesses (Table 4.22). Moreover, traditional vegetables were stated to be eaten to prevent the body from diseases in general, such as amaranth (Arumeru) and pumpkin leaves (Kongwa), because they provided vitamin A or were "good for eyes when eaten" such as jute mallow, amaranth (Kongwa), African nightshade and okra (Arumeru). Moreover, according to farmers, traditional vegetables contained vitamins in general, such as cassava leaves (Muheza), or they "increased blood" and therefore could help anaemic people. Most medicinal values of traditional vegetables were available in Muheza district, whereas less were stated in the other three districts (Figures 4.10a-d).

Anaemia can be classified into two major groups according to causes, that is loss of red blood cells (haemorrhagic and maemolytic types) and failure of production of red blood cells (nutritional anaemia and anaemia due to bone marrow diseases). Nutritional anaemia, the most common anaemia in most parts of the world, is mainly due to deficiencies of iron, folate and B12, whereby iron deficiency itself is caused by insufficient dietary intake of iron, infections and chronic bleeding of the gastro-intestinal tract, especially caused by hookworm. In Tanzania, the most common nutritional problem is iron deficiency anaemia (IDA). which is prevalent in both pregnant women and children under five years. Occurrence range from 80% in the coastal zone (including Muheza) to 20-54% in the plateau areas (including Singida) of Tanzania (TATALA, 1996).

The nutrient composition of some traditional vegetables is listed in Table 4.21. To compare these figures with those from exotic vegetables the composition of white cabbage (*Brassica oleracea* var. *capitata*) and tomato (*Lycopersicon lycopersicum*) is shown as well. Though the given figures are drawn from different sources and show only average amounts it is striking that the exotic vegetables have noticeable lower

amounts of all given nutrients compared to traditional ones. Only for amaranth spp. data on raw and cooked leaves are given while there is nothing known about the length and style of cooking. Yet, after the cooking process amaranth leaves contain still more nutrients than the exotic vegetable do in a raw condition.

Tab. 4.21 Nutrient composition of selected traditional and exotic (shaded) vegetables in Tanzania (per 100g edible portion).

Traditional vegetable	Protein (g)	Calcium (mg)	Iron (mg)	b-carotene (mg)	Vitamin C (mg)
Abelmoschus esculentus (raw leaves)*	4.4	530.0	0.7	730	59
Abelmoschus esculentus (raw pods)*	2.1	84.0	1.2	190	47
*Adansonia digitata**	3.8	400.0	1.1	-	52
Amaranthus graecizans	4.8	246.3	3.0	-	46.3
Amaranthus hybridus	4.8	246.8	2.9	-	58.1
Amaranthus spinosus	4.6	43.2	3.8	-	249.0
Amaranthus spp. (raw leaves)*	4.6	410.0	8.9	2300	50.0
Amaranthus spp. (cooked leaves)*	4.0	360.0	7.7	1700	34.0
Bidens spp.	1.7	80.3	2.7	-	79.3
Brassica oleracea var. *capitata***	1.6	55.0	0.8	280	46.0
Corchorus olitorius	1.8	240.3	7.7	-	205.4
Cucurbita pepo (raw leaves)*	4.0	475.0	0.8	1000	80.0
Gynandropsis gynandra	1.5	40.5	0.8	-	89.6
Ipomea batatas (raw leaves)*	4.6	160.0	6.2	2620	70.0
Launaea cornuta	4.6	256.2	2.7	-	15.9
Lycopersicon lycopersicum (raw)*	1.0	10.0	0.6	380	26.0
Manihot spp. (leaves)*	7.0	300.0	7.6	3000	310.0
Solanum macrocarpon (raw)*	1.0	14.0	1.3	17	9
Solanum nigrum	1.0	66.8	2.5	-	234.5
Vigna unguiculata (fresh + raw leaves)*	4.7	255.0	5.7	700	56.0
Vigna unguiculata (dried + raw leaves)*	28.0	1500.0	35.0	3600	-

Source: LYIMO et al. (2003) (values on dry weight basis)

* FAO (2001)

** FAO (1972); in: TINDALL (1983)

An especially multifunctional vegetable was jute mallow because it was not only used as food and as a medicine for three illnesses, but leaves were moreover used as Vaseline and as soap for hairs (Singida) or even for hairs and body (Kongwa). Furthermore, farmers pointed out that jute mallow was easy to eat even for sick people because of the high amount of mucilaginous material (Kongwa). Another wild vegetable, hair lettuce, had besides several medicinal usages the ability to help lactating women when their milk was "watery". Leaves had to be burned and pounded into pow-

der, the skin on the upper top of the breast was cut and the ash-powder was put into these cuts (Muheza). An interesting fact was that especially wild vegetables, such as the two mentioned and also African spiderflower had the most different medicinal usages and obviously contained more useful ingredients in terms of medicinal value than cultivated vegetables.

A key element for the reason how and why plants are selected by humans are allelochemicals, which serve a variety of functions, such as repellents of herbivores and competitors, or attractants of pollinators or seed dispersers. It is assumed that these compounds have been eliminated from most domesticated plants by human action (ETKIN, 1994), which would explain wild vegetables to have more different medicinal applications.

Tab. 4.22 Measures to treat certain illnesses with traditional vegetables perceived by farmers in four districts of Tanzania.

Traditional vegetable	Illness	Measure
African eggplant	• 'machiningi' (skin disease on head of children) (A); • scabies (A); • malaria (A);	• rub leaves between hands and squeeze juice on the skin / external application (A); • like for 'machiningi'; • boil leaves and add little salt, eat leaves and drink boiled water (A);
African nightshade	• anaemia (A); • high blood pressure (A); • diabetes (A); • problems of sight (A); • peptic ulcers (A);	• just eat (A); • eat fresh or boiled fruit without any further ingredients (A); • like for high blood pressure; • like for high blood pressure; • eat boiled fruits with little salt (A);
African spiderflower	• ear problems (A, K, M); • head aches (A, S); • easy conception (S); • cold (K); • continuous lactation (K); • stomach pain (M); • high fever ('degedege') (M);	• rub leaves and put liquid into ears (A, K, M); or use flowers and leaves (M); • rub leaves between fingers and smell (A); • just eat the prepared vegetable (K); • just eat the prepared vegetable to stop permanent milk flow(K); • squeeze leaves and drink liquid (especially for children); • squeeze leaves and drink liquid (especially for children);
Amaranth	• anaemia (K, M);	• boil leaves and drink boiled water (K, M);
black jack	• anaemia (M); • prevention of growing of "false" teeth (A);	• boil leaves and drink boiled water (M); • rub leaves and put on teeth/in mouth of children (A);

Traditional vegetable	Illness	Measure
	• wounds (M);	• rub leaves between hands and squeeze liquid into wound → accelerate healing process (M);
cassava leaves	• anaemia (K, M); • diarrhoea (K); • nosebleed ('kambaku') (M); • snake bites (M);	• just eat (K, M); • pound fresh leaves, add little soda and water, stir, leave particles to settle, drink the water (K); • rub leaves and smell; • chew leaves and swallow liquid → only first aid, e.g. when in the field (M);
cowpea leaves	• anaemia (M); • skin irritation /abscesses (bottoms, 'gipu') (A, M);	• boil leaves and drink boiled water to increase the haemoglobin level (M); • cover skin for 1-2 days with a paste from crushed and pounded cowpea grains soaked in water;
hair / bitter lettuce	• stomach ache (M); • malaria (M); • measles (A, M); • hookworms (M); • 'ascaris', 'safura' (A);	• squeeze leaves and drink the liquid (M); • like for stomach ache, or boil leaves and drink boiled water, 1 cup in the morning, 1 cup in the evening (M) or 1/2 glass 3 times a day (A), or eat the leaves after boiling (M); • boil leaves for 15 min. and drink boiled water and bathe in the water (A, K, M); • boil leaves and drink boiled water (M); • boil the leaves, drink boiled water and eat as a vegetable, must be bitter (A);
jute mallow	• cough (S); • eye diseases (S); • stomach upsets (S);	• chew roots (S); • treat with juice of roots or leaves roots in water overnight and treat with water (S); • chew roots or boil roots and drink the water (S);
okra	• stomach upset (A)	• eat one bowl of a meal with boiled okra fruit, pumpkin leaves, onions and tomatoes (A);
sweet potato leaves	• anaemia (M); • burns (S); • wounds that occur due to worms under the skin (S); • asthma (M);	• boil leaves and drink boiled water (M); • rub soft leaves between hands and put on the skin/wound (S); • wilt broad leaves over fire and put on affected skin (S); • rub the leaves between hands, add water → water becomes slimy, sieve and drink the water, or squeeze leaves and mix the liquid with water and drink (M);
tikini (*Asystasia gangetica, A. mysorensis*)	• bleeding wounds (M);	• flick leaves between fingers and put them on wound → can stop bleeding (M);

Districts: A = Arumeru; S = Singida; K = Kongwa; M = Muheza;
See appendix (Table 9.12) for list of measures according to illnesses (in alphabetical order).

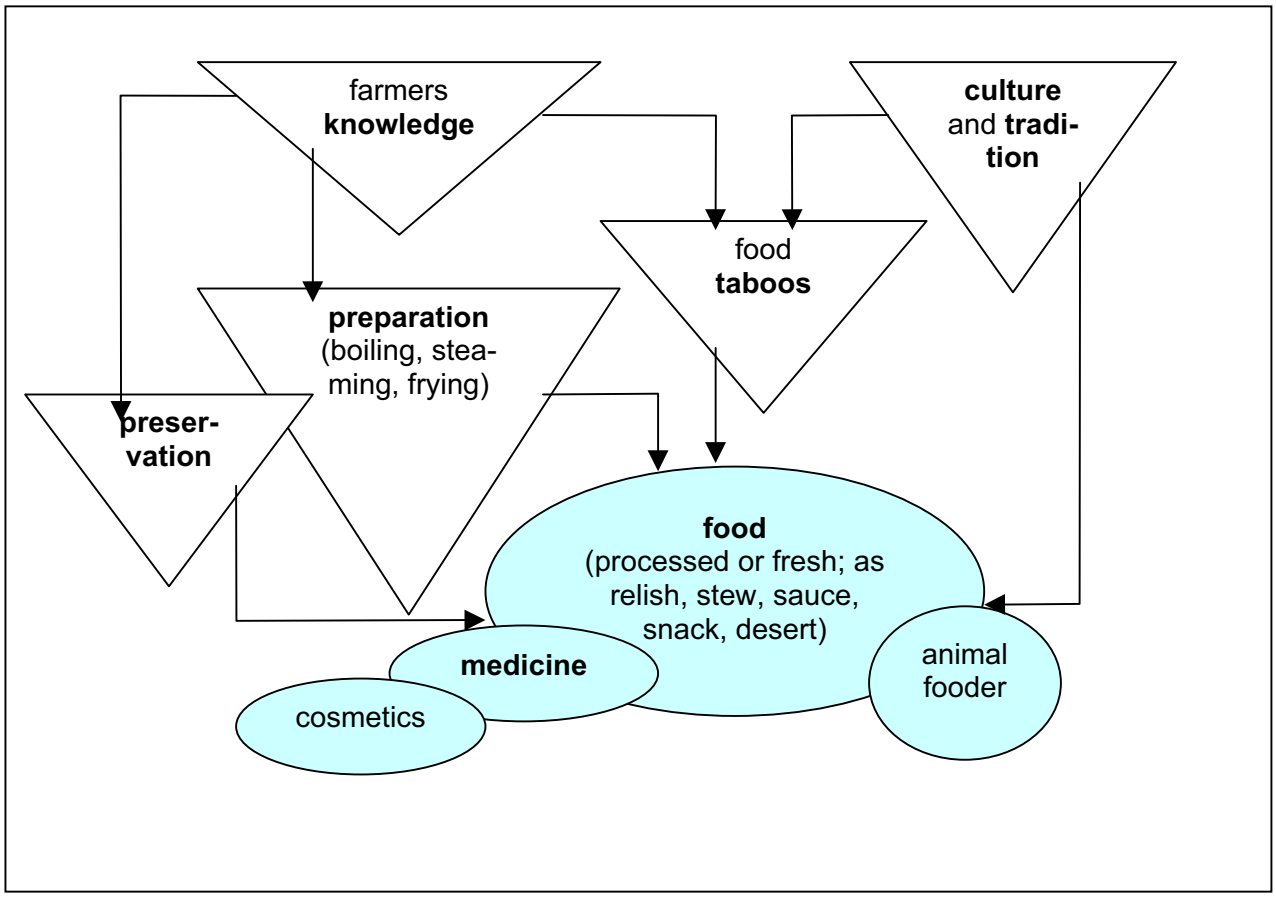

Fig. 4.11 Multiple usage of traditional vegetables and main factors influencing their use in Tanzania.

Fig. 1 **African eggplants (left) and okra fruits on Tengeru market, Arumeru district, Tanzania.**

Fig. 2 **African eggplants (right), okra fruits (middle) and common bean sold in heaps on Tengeru market, Arumeru district, Tanzania.**

Fig. 3 Ethiopian mustard (front) and African nightshade leaves on Tengeru market, Arumeru district, Tanzania.

Fig. 4 Market lady dipping African nightshade leaves into water to prevent wilting, Tengeru market, Arumeru district, Tanzania.

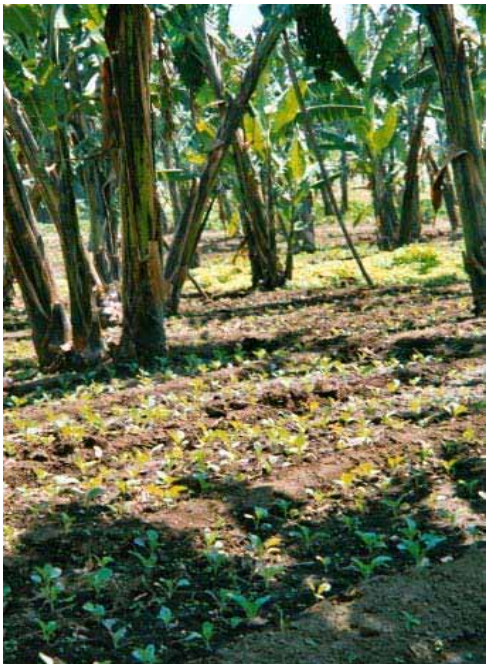

Fig. 5 Vegetables instead of coffee intercropped with banana trees, Arumeru district, Tanzania.

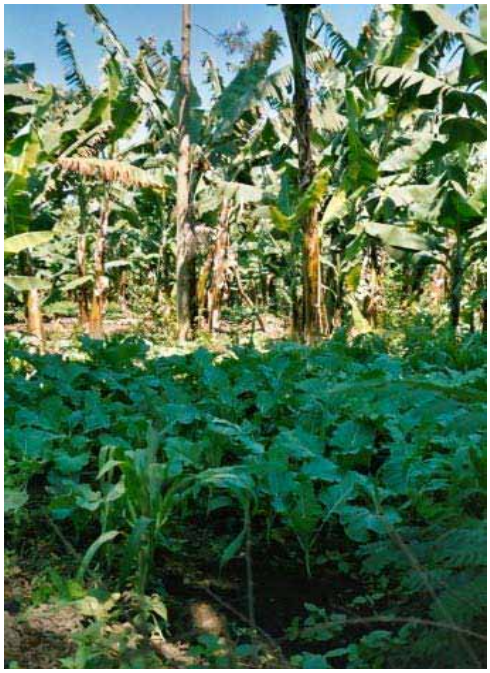

Fig. 6 Ethiopian mustard intercropped with banana trees, Arumeru district, Tanzania.

Fig. 7 Farmer in her home garden in Iseke village, Singida district, Tanzania.

Fig. 8 Home garden in Mlali-Bondeni village, Arumeru district, Tanzania.

Fig. 8 Home garden close to a river in Zambarauni village, Muheza district, Tanzania.

5 THE MOST IMPORTANT TRADITIONAL VEGETABLES IN NORTH -EASTERN TANZANIA

To discuss some traditional vegetables in detail, six of those named by focus group participants to be of high importance are highlighted in terms of their characteristics (literature review), species and types available in Tanzania, as well as production, consumption and issues on processing and utilisation.

In the following scientific names will be assigned to local names, which is done according to farmers descriptions, however, sometimes only partially. Only if it appeared most likely an assignment was done, however, it can not be assured that the correct scientific names are attributed to the respective local names. Therefore, farmers description of different vegetable types is cited in some cases, whereby it become apparent that farmers have certain criteria for describing and also selecting their vegetable.

5.1 AMARANTH (*AMARANTHUS SPP.*) - BOTH CULTIVATED AND GATHERED FROM THE WILD

5.1.1 CHARACTERISTICS OF AMARANTH

Taxonomy. The genus *amaranthus* includes about 70 species, of which at least 17 species have edible leaves and 3 are grain amaranths. Unfortunately, taxonomic problems especially within the so-called *Amaranthus hybridus* aggregate, are far from clarified, obviously due to common hybridisation and nomenclatural disorder caused by names being often misapplied (GRUBBEN, 2004a).

The most frequently grown amaranth in Africa is ***Amaranthus cruentus*** L. and in fact it is the main species found along Tanzania's coast (Schippers, 2002). There exists different taxonomies (Table 5.1) and the one suggested by MAUNDU et al. (1999b) is applied for this study.

The African cultivars of *A. cruentus* are originally grain-amaranths with large inflorescences, a high dry matter content in the leaves and long stems (OOMEN & GRUBBEN, 1978). They can further be easily recognised by their leaves that are twice or three times as long as wide and frequently have a pointed leave tip (SCHIPPERS, 2002). The red form of *A. cruentus* is cultivated as an ornamental plant. Moreover, it is not common in high altitudes (MAUNDU et al., 1999b).

Tab. 5.1 Taxonomic views of *Amaranthus cruentus* by different authors.

Authors	TINDALL (1983)	STEVELS (1990); in: SCHIPPERS (2002).	MAUNDU et al. (1999b)	Grubben (2004a)
Taxonomy	*A. cruentus* L. is a • subspecies of *A. hybridus* L.; • synonym of *A. leucocarpus* S. Wats;	*A. cruentus* L. includes • *A. hypochondriacus* L. • *A. hybridus* L.	*A. hybridus* has the subspecies • *A. hypochondriacus* L. (syn. *A. patulus* Bertol.) • *A. cruentus* L. (syn. *A. paniculatus* L.)	*A. hybridus* aggregate combines • *A. cruentus* L. • *A. caudatus* L. • *A. hypochondriacus* L.

Amaranthus hybridus L. is generally described as a black- or cream-seeded form with dark-green stems and leaves, or a form with at least some red colour on the leaves, stems and inflorescences. Commonly, *A. hybridus* is an erect amaranth, which is usually 40-80 cm in height, occasionally reaching 1 m or more (MAUNDU et al., 1999a, b). It is widespread in tropical and sub-tropical regions of the world, mainly as a weed in cultivated fields, in degraded land, along rivers, roadsides and forest edges. Furthermore, the leaves are very tasty as a vegetable and since they are large this species is a highly popular amaranth (MAUNDU et al., 1999a). ***Amaranthus hypocondriacus*** L. often has a prostrate habit, a more "spiny" look than *A. hybridus* and a prominent terminal spike. It is common in higher altitudes compared to *A. cruentus* (MAUNDU et al., 1999a) and has typically white or cream-coloured seeds.

Amaranthus dubius Mart. ex Thell. is an erect annual herb growing up to 1 m or more (MAUNDU et al., 1999b) or up to 1.5 m with slender to stout stems (GRUBBEN, 2004b). It can be recognised by its ovate-elliptic leaves, which are pointed at the tip and sometimes with purple spots (MAUNDU et al., 1999b). Another typical feature are its long clusters of flowers in the leaf axils and a longer apex in the terminal part (SCHIPPERS, 2002).

The spiny amaranth or thorny pigweed, ***Amaranthus spinosus*** L., resembles *A. dubius* but is collected from the wild. It is more tolerant to drought and more bitter in taste than *A. dubius*. The spines of *A. spinosus* found in the leaf axils only become troublesome when the plant gets older, and there are varieties with only few, soft spines or no spines at all (SCHIPPERS, 2002). This amaranth reaches about 1 m or more in height with red or green and usually branched stems (MAUNDU et al., 1999b). The leaves of *A. spinosus* are noted for their medicinal value and therefore the plant is rather known as a medicine than as a vegetable (SCHIPPERS, 2002).

Amaranthus blitum L. can be described as a branched, erect or postrate herb, which only grows up to 50 cm in height. Leaves have long petioles (MAUNDU et al., 1999b) and plants are spineless (TINDALL, 1983). The taxonomy is again controversial

(Table 5.2). *A. blitum*, together with *A. thunbergii*, *A. sparganiocephallus*, *and A. graecizans*, are probably the only amaranths indigenous to East-Africa (MAUNDU et al., 1999b).

Tab. 5.2 Taxonomic views of *Amaranthus blitum* by different authors.

Authors	TINDALL (1983)	MAUNDU et al. (1999a)
Taxonomy	*A. blitum* is a synonym of • *A. tricolor* • *A. oleraceus* L. • *A. gangeticus* L.	*A. blitum* is a synonym of / comprises • *A. lividus* • spp. *lividus*, larger, with larger fruits and leaves • spp. *polygonoides*, smaller and normally prostrate

Amaranthus graecizans L. is described as an erect, decumbent or prostrate herb, which is usually strongly branched from the base and rather small with up to 45 cm in height. Leaves as well as seeds are tiny (MAUNDU & GRUBBEN, 2004). It can be found on sand deposits along rivers, at roadsides and forest edges and, in fact, it can be intercropped with trees as it is shade-tolerant. To survive in the arid lands as a wild plant, *A. graecizans* sprouts easily soon after the onset of rains. It grows, seeds and also dries fast (MAUNDU et al., 1999a).

Origin and Ecology. Of the approximately 70 species of amaranth about 40 are assumed native to the Americas (GRUBBEN, 2004a). They originated probably in the Andean region of South America or Mexico but an Indian centre of biodiversity has also been acknowledged by some authorities (TINDALL, 1983). Moreover, there are some species indigenous to Africa (MAUNDU et al., 1999a), however, since the taxonomy especially within the group of cultivated African amaranth species is still confused, it is difficult to state how many different truly African species exist (SCHIPPERS, 2002). Amaranth is also called African spinach in English and 'mchicha' in Swahili.

Vegetable amaranth performs well at temperatures above 25°C during the day and not below 15°C at night. Except in case of drought stress shade is disadvantageous. Amaranth prefers further fertile, well-drained soils with a loose structure and it usually has a very high mineral requirement (GRUBBEN, 2004a, b, c). An exception is *Amaranthus graecizans* L., as it is common in semi-arid and arid regions (MAUNDU et al., 1999a) and performs well on poor soils. In general it is very resistant to adverse climate and soil conditions (MAUNDU & GRUBBEN, 2004).

Cultivation. Most amaranth species are collected from the wild for subsistence, while only few are cultivated (SCHIPPERS, 2002) or occur as protected weeds in backyards and home gardens (MAUNDU & GRUBBEN, 2004). The cultivation method of amaranths is either transplanting from a nursery or sowing directly. The plants are

usually harvested by a single uprooting, or with several harvests by repeated cuttings (OOMEN & GRUBBEN, 1978).

Uses. Different from the Americas and from India, in Africa, grain amaranth was not found to be very popular. However, the leaves of most Amaranth species are appreciated as a vegetable and, in fact, some cultivated amaranth species are amongst the most common grown leafy vegetables of the lowland tropics in Africa (SCHIPPERS, 2002). In fact, amaranths are among the most nutritious leafy vegetables (MAUNDU et al., 1999a) as they contain high levels of micronutrients and especially Vitamin A and C, Calcium and Iron (MAUNDU et al., 1999b). Amaranth is mainly used as a leaf vegetable (GRUBBEN, 2004a, b, c), either consumed as a vegetable dish or as an ingredient in sauces. Thereby it can be cooked or fried in oil and mixed with other vegetables or meat, fish or groundnuts (GRUBBEN, 2004a). Especially leaves and tender shoots of *A. dubius* are occasionally cooked together with more bitter leafy vegetables to improve the taste of the latter (MAUNDU et al., 1999a). Besides the usage as food, *A. c*ruentus and *A. graecizans* are sometimes fed to livestock (GRUBBEN, 2004a; MAUNDU & GRUBBEN, 2004) and both have different medicinal properties like *A. dubius* and *A. blitum* (GRUBBEN, 2004a, b, c).

5.1.2 SPECIES OF AMARANTH GROWN IN NORTH-EASTERN TANZANIA

Amaranth was an important traditional vegetable for focus group participants and, in fact, it was the only traditional vegetable, which ranked under the upper five vegetables in all four research districts. Actually, the cultivated amaranth species are amongst the most common leafy vegetables that are grown in the lowland tropics of Africa (SCHIPPERS, 2002). This may be due to the high diversity of the crop, which can be divided into several species and subspecies. Moreover, farmers favouring this crop because of different positive qualities is likely to be another factor for the popularity of amaranth. Since the taxonomy of amaranth is still confused it was not easy to identify the species described by the farmers. In fact, only for some species a scientific name could be assigned with certainty (Table 5.3).

Focus group participants were asked to name the species by their local name, characterise and rank it compared to other amaranth species. These answers are summarised in Tables 5.3 to 5.11. Table 5.3 gives an overview so that all four districts can be compared, while tables 5.4-5.11 list amaranth species per district.

There might be some confusion, especially with the species *A. hybridus*, *A. hypocondriacus* and *A. cruentus*. and it must be alluded to the fact that local and scientific names are not unequivocally assigned to each other. However, these lists give an idea about the diversity of amaranth species perceived by the farmers in the different districts, which seemed to be larger in Muheza than in the other three districts.

Moreover, it shows that the species *A. graecizans*, which is common especially in dry areas (MAUNDU et al., 1999a), occurs in the dry Singida and Kongwa districts but not in the more humid Arumeru and Muheza districts. In Singida district, *A. graecizans* was mentioned relatively often and was very popular as shown by its rank. This was an interesting finding since this amaranth species was wild and not cultivated by farmers. Some reasons for the higher popularity of this amaranth species are provided in Tables 5.6 and 5.8, where positive and negative characteristics in Singida and Kongwa district are listed.

In contrast, *A. blitum*, which was mainly found in wet areas, on waste ground and in cultivated land (MAUNDU et al., 1999a), was mentioned in Arumeru and Muheza districts but not in the dryer Singida and Kongwa districts. *A. dubius* was named to be both cultivated and gathered from the wild in Arumeru district only. In Kenya, this vegetable is common in most towns and found on cultivated land, roadsides and flood plains (Maundu et al., 1999a). Most villages in Arumeru district were rather close to Arusha town and, therefore, this could be an evidence for the occurrence of *A. dubius*. The species *A. hybridus* ranked between 1 and 2 in all districts, which showed its high popularity with farmers.

The local name "mchicha mwekundu" could not be clearly assigned to one particular species. According to the descriptions farmers gave, both *A. hybridus* and *A. spinosus* could be meant by this name. As "mwekundu" means "red" in Swahili, the amaranth species with this name had at least some red colour on leaves, branches and/or stems. However, both *A. spinosus* and *A. hybridus* could show some red colour and, in fact, *A. spinosus* may easily be confused with *A. hybridus* as well as with *A. dubius* (MAUNDU et al., 1999a).

A. spinosus ranked between 2 and 5 and was obviously preferred less by focus group participants. The spines are a clear drawback during harvest and sorting, and it was already found in Kenya that this species is not much liked and its use is declining (Maundu et al., 1999a). The name "mchicha wa miiba" means amaranth with spines (miiba = spine) and describes the distinguishing feature of this species. Further, the local names "kienyeji" (= local) and "kizungu" (= new, introduced) revealed if the plant was well known and of local origin or if it was introduced from another district or region.

The local name "mchicha mweupe" (mweupe = white) was again used for two different species, namely *A. hypocondriacus* and *A. cruentus*. The colour "white" either referred to the light green leaves or to the white or cream-coloured seeds. However, only in Arumeru district this name was used for both species. Farmers ranked both species between 1 and 2 or 2.5, respectively, so that they seemed to equally favour *A. hybridus*.

Tab. 5.3 Local names and prevalence of amaranth species and types in four research districts of Tanzania.

Scientific name	Arumeru	Singida	Kongwa	Muheza
Amaranthus blitum L.	"mchicha kienyeji" (W);			"mchicha kienyeji"; (C) "mzizima"; "mchicha mweusi"; no name (W);
Times mentioned (no.)	2	0	0	6
Rank	1			1,5
Amaranthus dubius Mart. ex Thell.	"mchicha mweusi" (C+W);			
Times mentioned (no.)	4	0	0	0
Rank	1			
Amaranthus graecizans L. (ssp. *graecizans ?*)		"mugha" (W); "mughaa" (W); "mujhaa" (W); "asili" (W);	"fene "/ "ifene" (W); "mpana";	
Times mentioned (no.)	0	5	5	0
Rank		1	3	
Amaranthus graecizans L. (ssp. *silvestris ?*)			"chakaya" (W);	
Times mentioned (no.)	0	0	3	0
Rank			3	
Amaranthus hybridus L.	"mchicha kisasa / kizungu" (C);	"mchicha"; "kijani"; "wakupanda"; "wakuotesha" (C);	"mchicha mwekundu" (C);	no name (W); "mchicha kizungu/kigeni" (C); "mchicha mwekundu"; "bwache" (W);
Times mentioned (no.)	1	5	4	6
Rank	2	2	3	2
Amaranthus hypocondriacus L.	"mchicha mweupe" (C); "mchicha wunga / wa unga" (C); "mchicha lishe" (C);	no name;	"mchicha lishe / jeshi" (C);	"magereza" (C);
Times mentioned (no.)	5	1	3	1
Rank	2	1	2	2
Amaranthus cruentus L.	"mchicha mweupe" (C); "mchicha mpana" (C);	"mchicha mweupe / kawauda" (C);	"mchicha mweupe" (C);	" mweupe / magereza" (C); "mchicha mweupe" (C); no name (W); "bwache" (W)
Times mentioned (no.)	6	2	7	4
Rank	2	2.5	1	1

Scientific name	Arumeru	Singida	Kongwa	Muheza
Amaranthus spinosus L.	"mchicha mwekundu" (W); "mabreka" (W);	"mchicha mwekundu" (W);	"mchicha wa miiba" (W); "mchicha damu" (W); "mwekundu" (C);	"kienyeji miiba" (W); "bwache chamiwa" (W); "bwache" (W); no name (W);
Times mentioned (no.)	4	2	3	5
Rank	4	2	5	3
Not identified				"mchicha kulima" (C); (yellow stem)
Times mentioned (no.)				1
Rank				1
Not identified				"bwache buuza" (W); (white flowers)
Times mentioned (no.)				1
Rank				1
Not identified				"bwache" (W); (< 6 inches in height)
Times mentioned (no.)				1
Rank				2
Not identified	no name; (mature seeds turned green)			
Times mentioned (no.)	1			
Rank	2			

W = gathered from the wild; **C** = cultivated;

Tab. 5.4 Amaranth species and their special positive and negative characteristics as perceived by farmers in Arumeru district, Tanzania.

Amaranth species	Positive characteristics	Negative characteristics
***Amaranthus blitum* L.**	• Available during the whole year; • High yield due to a long production period; • Contains many vitamins; • Does not contain a lot of water;	• If over-grown it is not soft and gets bitter → no good taste any more;
***Amaranthus dubius* Mart. ex Thell.**	• Does not require any chemicals; • Repeated harvesting over a long time is possible; • Can be cooked with little oil; • Is liked best, even by children; *	• If over-grown it becomes bitter; • It flowers early and seeds get lost;
***Amaranthus hybridus* L.**	• Fast growth → early maturing (after 21 days uprooting could be done);	• Contains a lot of water; • Short production period;
***Amaranthus hypocondriacus* L.**	• Early maturing /fast growing → early harvest; • Fast cooking; • Softer than black seeded species;	• Early seed production → looses its seeds; • Causes stomach upsets; • Produces a lot of water when cooked;
***Amaranthus cruentus* L.**	• Sweet taste and dark colour of leaves = sign for many nutrients; ** • Takes longer for maturity → prolonged harvest; • Ready for harvest 21 days after sowing; • Less work required: just sown, not transplanted like African nightshade;	• Does not germinate fast; • If over-grown it gets a poor taste and can not be sold any more; • A lot of oil has to be used for cooking;
***Amaranthus spinosus* L.**	→ ranked only No. 4; normally only the best two or three species were discussed in terms of positive and negative characteristics;	

* One farmer telling Mr Swai (translator): ”If you had eaten a lot of "mchicha mweusi" as a child you would not need your glasses now.”

** “We do not know anything about nutrients, we taste or look at the colour ... ; information about nutrients in food comes from children who go to school, from the radio and from seminars.”

Tab. 5.5 Valuation of major characteristics of amaranth species by farmers in Arumeru district, Tanzania.

Amaranth species	Taste	Market	Availability	Yield	Drought resistant	Pest + Dis resistant	Nutrient content	Prepara-tion	Seed availability
***Amaranthus blitum* L.**	XXXXX	XXXX	XXXXX	XXXXX	XXXXX	XXXX	XXXX	XXXX	0
***Amaranthus dubius* Mart. ex Thell.**	XXXXX	XXXX	0	XXXXX	XXXXX	XXXXX	XXXXX	XXXX	X
***Amaranthus hybridus* L.**	XXXX	XXXX	XX	XX	XX	XX	0	X	0
***Amaranthus hypocondriacus* L.**	XXX	XXXX		XX	X	XXXX	0	XXXX	X
***Amaranthus cruentus* L.**	XXX	XXX	XX	X	X	X	XXXXX	XX	

0 = no comment; X = very poor; XX = poor; XXX = average; XXXX = good; XXXXX = very good;

Tab. 5.6 Amaranth species and their special positive and negative characteristics perceived by farmers in Singida district, Tanzania.

Amaranth species	Positive characteristics	Negative characteristics
***Amaranthus graecizans* L.**	• grows easily; • when dried it is still good, get not fed up, can eat it for a very long period of time; • does not cost anything (collected from the wild); • sweeter taste than *A. hybridus*;	• available only during rainy season; • better taste when mixed with jute mallow or fresh milk; • harvest takes time since plant is very short;
***Amaranthus hybridus* L.**	• fast growth (3 wks); keeps on producing when harvested; • harvest is easier than that of *A. graecizans*; • preserved it has the same quality like fresh; • short cooking time;	• nothing bad; farmers have different opinions; • has to be nursed with fertilizer, water etc. in comparison to wild types; • flowers early → quality of leaves goes down when flowering;
***Amaranthus hypocondriacus* L.**	• fast growth - ready for harvest after 3 wks;	• farmers have different opinions;
***Amaranthus cruentus* L.**	• does not produce seeds early - stays longer in the field;	• farmers have different opinions; • you need to be skilled to raise it: requires a lot of water and fertility - otherwise it will turn yellow;
***Amaranthus spinosus* L.**	• fast growth - ready for harvest after 3 wks; • short cooking time;	• seeds are produced very early; • will stunt when there is water scarcity; • demands a lot of manure / fertility;

Tab. 5.7 Valuation of major characteristics of amaranth species by farmers in Singida district, Tanzania.

Amaranth species	Taste	Market	Availability	Yield	Drought resistant	Pest + Dis resistant	Nutrient content	Prepara-tion	Seed availability
***Amaranthus graecizans* L.**	XXXX	0	XXX	0	X	0	0	0	0
***Amaranthus hybridus* L.**	XXXX	XXXX	0	0	XXXXX	0	0	XXXX	XXXX
***Amaranthus hypocondriacus* L.**	0	XXXX	XXXX	0	0	0	0	0	XXXX
***Amaranthus cruentus* L.**	0	0	XXX	XXXX	X	0	0	0	0
***Amaranthus spinosus* L.**	XXXX	XXXX	0	0	X	0	0	XXXX	XX

0 = no comment; X = ver poor; XX = poor; XXX = satisfactory; XXXX = good; XXXXX = very good;

Tab. 5.8 Amaranth species and their special positive and negative characteristics perceived by farmers in Kongwa district, Tanzania.

Amaranth species	Positive characteristics	Negative characteristics
***Amaranthus graecizans* L. (ssp. *graecizans* ?)**	• is mixed with Mhilile to reduce its bitterness; • very soft leaves → reduces cooking time of other leaves and helps to tenderise them;	• has a lot of seeds but not many leaves if not plugged frequently;
***Amaranthus graecizans* L. (ssp. *silvestris* ?)**	• no need to add any ingredients - just boil and eat;	• available only during the long rainy season;
***Amaranthus hybridus* L.**	• early maturing, fast growth → uprooting is done after 21 to 30 days;	• short production period; • colour (red) is not attractive;
***Amaranthus hypocondriacus* L.**	• fast growth, harvest starts earlier than that of *A. cruentus*; • after 21 days ready for uprooting; • short cooking time; • contains iodine and increases blood;	• short production period; • will be stunted if water is scarce;
***Amaranthus cruentus* L.**	• fast growth; long production period; • high yield → is not stored, only take it fresh; • leaves are soft and need only a short cooking time; • increases blood;	• short production cycle (early maturing); • demands a lot of manure / fertility; • late maturing and slow growth → harvest is late;
***Amaranthus spinosus* L.**	→ ranked only 4,66; normally only the best two or three species were discussed in terms of positive and negative characteristics;	

Tab. 5.9 Valuation of major characteristics of amaranth species by farmers in Kongwa district, Tanzania.

Amaranth species	Taste	Market	Availability	Yield	Drought resistant	Pest + Dis resistant	Nutrient content	Prepara-tion	Seed availability
***Amaranthus graecizans* L. (ssp. *graecizans* ?)**	XXXXX	0	0	0	XX	XXXXX	0	XXXX	0
***Amaranthus graecizans* L. (ssp. *silvestris* ?)**	XXXXX	0	XXX	0	X	XXXXX	0	XXXX	0
***Amaranthus hybridus* L.**	XXX	XXXX	XXXX	XXXX	XX	X	0	0	0
***Amaranthus hypocondriacus* L.**	XXXX	XXXXX	XXX	XXXX	X	XX	XXXXX	XXXX	0
***Amaranthus cruentus* L.**	XXXXX	XXXXX	XXXX	XXXX	X	XXX	XXXX	XXXX	0

0 = no comment; X = very poor; XX = poor; XXX = satisfactory; XXXX = good; XXXXX = very good;

Tab. 5.10 Amaranth species and their special positive and negative characteristics perceived by farmers in Muheza district, Tanzania.

Amaranth species	Positive characteristics	Negative characteristics
***Amaranthus blitum* L.**	• cooking without any other ingredients was agreeable; • increased blood; • branches fast; • long production period; • did not cost anything (local species, did not had to buy the seeds);	• if over-grown / too old, too young or dry leaves became bitter → quality became bad; • attacked by insect pests during dry spell; • did not grow well under dump conditions;
***Amaranthus hybridus* L.**	• big leaves → little was needed; • long harvest period; • produced more shoots and seeds if topped;	• water got bitter when cooking → one had to throw it away; • further ingredients were needed (e.g. onions, tomatoes) to get an agreeable taste; • high demand of water and manure; • short production period, seeded very early; not many branches; • very pink/red type was not used → did not fetch a good market price;
***Amaranthus hypocondriacus* L.**	• fast growth → ready to harvest in 2-3 wks; • grew well during dry season when water was available;	• costs were involved for seeds; • taste must be improved through other ingredients (e.g. onions, tomatoes) → it did not taste alone;
***Amaranthus cruentus* L.**	• fast growth → ready to harvest in 2-3 wks; • acceptable taste if just boiled; • less problems with diseases; • after topping it produced more shoots → high yield;	• flowered early; • short harvest period if compared to other species; • affected by insect pests;
***Amaranthus spinosus* L.**	→ ranked only 2,6; were not discussed in terms of positive and negative characteristics;	

Tab. 5.11 Valuation of major characteristics of amaranth species by farmers in Muehza district, Tanzania.

Amaranth species	Taste	Market	Availability	Yield	Drought resistant	Pest + Dis resistant	Nutrient content	Prepara-tion	Seed availability
***Amaranthus blitum* L.**	XXXXX	XXXXX	XXXX	XXXX	XXXX	X	XXXX	XXXX	XXXX
***Amaranthus hybridus* L.**	XXX	XXXX	XXX	0	X	X	0	X	XXXX
***Amaranthus hypocondriacus* L.**	XX	XXXX	0	0	X	0	0	X	0
***Amaranthus cruentus* L.**	XXXX	XXXX		XXXX		XXX		XXXX	

0 = no comment; X = very poor; XX = poor; XXX = satisfactory; XXXX = good; XXXXX = very good;

5.1.3 PRODUCTION ISSUES OF AMARANTH

The traditional vegetable amaranth was discussed for production issues in 16 villages out of 21, i.e. in four villages in each of the four districts.

Cropping pattern. Farmers were asked about the cropping pattern usually applied for the crop and their reasons for this choice. Amaranth was not intercropped with other plants in Arumeru, Singida and Muheza districts, because the plants would not grow well, even produce dwarf plants (Singida). Amaranth could not tolerate shade and the plants would get only few leaves (Arumeru). If amaranth was mixed with maize, the colour of amaranth turned yellow and the taste of the leaves became bad. Furthermore, one would get slender and weak amaranth plants, which could even die (Muheza). The reasons why amaranth performs so badly under shade conditions but much better in open areas is its C4 cycle of photosynthesis. Compared to a C3 plant, such as *Celosia* (also an Amaranthaceae), the growth rate of amaranths is optimised by bright light, high temperatures, and adequate water and minerals (SCHIPPERS, 2002).

However, in Kongwa district, where only in one village amaranth was cropped alone due to shade intolerance, amaranth usually grew in mixed stands for home consumption. In general, amaranth was cultivated during the dry season, while it was just picked from maize or other cultivated fields, where it grew wild and spread seeds by itself, during the rainy season. The reason for this was that irrigated land was short and there was not enough space to perform monocropping alone but different crops had to share one field (Kongwa).

In contrary to intercropping, monocropping was most common for a commercial amaranth crop, where seeds were sown in lines, management was easy and one got good quality leaves (Muheza). Another advantage of monocropping perceived was an easier harvest (uprooting) since the crop was raised on beds alone (Singida and Kongwa). Furthermore, the bed was soon free for the next crop (Singida). Seeds could also be broadcasted on special beds with borders so that flooding / irrigation could be done. As a commercial crop, amaranth was either uprooted at one time or the whole plot was sold before harvest (Arumeru). Sometimes even seeds from wild amaranth species were gathered and sown on a plot as a monocrop in Arumeru district. However, if certain traditional vegetables grew in-between amaranth, e.g. African spiderflower, they were just left to grow there (Table 5.12).

Tab. 5.12 Cropping patterns for amaranth in four research districts of Tanzania.

	Arumeru (4 villages)	**Singida** (4 villages)	**Kongwa** (4 villages)	**Muheza** (4 villages)
Inter-cropping	not practised; Reason: would not grow under shade; Exception: wild species grew with coffee and banana;	not practised; Reason: growth would be disturbed, plants would stay small (dwarf plants); Exception: wild species were left in fields as weeds;	practised; Reason: shortage of irrigated land; space used for all crops; picked frequently for home consumption; Exception: monocropping for commercial production;	not practised; Reason: colour turned yellow and taste became bad, when grown with maize; did not perform well, could even die; slender and weak plants; Exception: weedy species were left in fields;
Mono-cropping	mainly practised; even with seeds from wild species; Reason: special fields/beds; easy management (uprooting, selling the whole plot); Exception: other favoured wild vegetables were left to grow in the field;	mainly practised; Reason: easier for harvest (uprooting); field was soon free for next crop; better performance of plants; Exception: *A. cruentus* was monocropped while *A.hybridus* was intercropped;	practised; Reason: not shade-tolerate; to uproot whole plants; a habit; Exception: weedy species left in maize fields; in one village, amaranth only collected from the wild;	mainly practised; Reason: easy irrigation; good quality leaves for commercial crop; easy management; Exception: for home consumption left in maize fields; spread seeds by itself;

Harvest. Uprooting was normally done 21 to 30 days after sowing, e.g. with 'mchicha mweupe' (*A. cruentus*), 'mchicha kisasa / kizungu (*A. hybridus*) and *A. hypocondriacus*. If the plant was still young and tender, it was cut close to the ground, if it was older it was cut half way. Another harvest method was to pick young leaves two to three times a week which was done e.g. with 'kienyeji' (*A. blitum*), a local species, as reported in one village. Time of harvest was throughout the year if water was available (Table 5.13).

Leaves of 'mugha', a wild type of *A. graecizans*, were harvested repeatedly once a week, while 'mchicha kawauda / mweupe' (*A. cruentus*) was uprooted three to four weeks after sowing (Singida). The time of harvest depended on the onset of the rain - only when water was available plants would start to grow (Table 5.13).

In Kongwa district, harvest frequency was according to utilisation, i.e. either for home consumption or for marketing (Table 5.14). For marketing 'mchicha lishe' (*A. hypocondriacus*) and 'mchicha mwekundu' (*A. hybridus*) were uprooted 21 days after sowing and 'mchicha mweupe' (*A. cruentus*) one month after sowing. In another village the leaves of A. cruentus were picked continuously twice a week for home consumption or once a week for marketing. In general amaranth was planted continuously so that

uprooting could be done every three to four days for the market. Planting normally took place end of June and harvest started accordingly mid July.

Harvest took place three times per week on a big plot and if used commercially, while amaranth was harvested daily for home consumption (Muheza). Two to three weeks after sowing harvest could start, whereby the first harvest was just a lopping of tips, so that the plant could sprout. In an interval of 1 to 1.5 weeks harvest was repeated up to three times before flowering started.

In all districts amaranth could be harvested throughout the year as stated in some villages (Table 5.13). However, this was only possible if irrigation was available during the dry season (Kongwa) or in the valleys, where enough water was available (Muheza). From March/April to July, that is during the rainy and cold season, the growth rate of amaranth was affected (Arumeru).

Tab. 5.14 Harvest frequency of amaranth and time of harvest in four research districts in Tanzania.

	Arumeru (3 villages)	**Singida** (2 villages)	**Kongwa** (3 villages)	**Muheza** (2 villages)
Harvest frequency	*A. cruentus*: uprooting after 21 to 30 days; local species: 2-3 times per week leaves were picked;	*A. cruentus* (?): uprooting after 3-4 weeks; Local species: once a week leaves were picked;	home consumption: frequently, 2-3 times a week or every day; marketing: uprooting whole plants once or twice a week;	home consumption: daily; marketing: three times a week; first harvest 2-3 weeks after sowing;
Time of harvest	mainly Aug - Dec/Mar; throughout the year;	June - Nov; depends on onset of rain;	mid July - Nov; end Dec - early Jun; throughout the year with irrigation;	throughout the year in valleys; Jul - Feb;

Constraints. Within each focus group, constraints in producing a certain traditional vegetable were examined. Thereby, eight categories were asked for, namely

- labour availability,
- water,
- soil fertility,
- seeds,
- weeds,
- pests,
- diseases, and
- marketing.

Labour availability was no problem in Arumeru district and no comment was given on this topic in the other three districts. In terms of labour, technical know-how was rather a problem, e.g. sometimes over-sowing was done or too much water was applied so that the leaves turned yellow (Singida).

Tab. 5.13 Seasonal calendar (time of harvest) for amaranth in four research districts of Tanzania.

Month	J	F	M	A	M	J	J	A	S	O	N	D
Season	Dry + hot season		Long rainy season				Dry + cold season			Short rainy season		
Arumeru												
A	ø ø ø ø ø ø ø ø ø							ø ø ø ø ø ø ø ø ø ø ø ø				
B								ø ø ø ø ø ø ø ø ø ø ø ø				
C	ø ø											
Singida						ø ø						
Kongwa												
A	ø ø											
B	ø ø ø ø ø ø ø ø ø ø ø ø ø ø ø ø ø											ø ø
C							ø ø						
Muheza												
A	ø ø											
B	ø ø ø ø ø ø						ø ø						

- Arumeru district: **A** = Ambureni/Moivaro village (medium altitude) **B** = Olevolos village (higher altitude) **C** = Nambala village (lower altitude)
- Kongwa district: **A** = Mlali-Iyegu and Tubugwe A villages **B** = Tubugwe A village **C** = Sagara B village
- Muheza district: **A** = Mbambakofi village **B** = Potwe village

Water was no problem in three out of four villages in Arumeru district, where water for irrigation was available and amaranth was not a high demander anyway. However, in one village at lower altitude (Arumeru) and all villages in Singida district, water was scarce especially during the dry season (Table 5.15). Consequently, the distances from field plots to dwells were crucial (Kongwa). If affected by drought, all amaranth varieties flowered early and stayed small (Muheza). Nevertheless, in Singida district farmers stated that *A. cruentus* would stunt when water was scarce, while *A. hybridus* would not suffer.

Only in one village at lower altitude of Arumeru district farmers claimed that soils were not fertile enough to grow amaranth. More problems with soil fertility were found in Singida district, where the rather sandy soils were not fertile enough for growing amaranth and farm yard manure was required. Similarly, in Kongwa district amaranth was described as a high manure demander.

Self-produced amaranth seeds were mainly used in Arumeru district and only sometimes seeds were bought from shops or the market. They were not easily available for certain species, e.g. 'mchicha mweusi' a wild type of *A. dubius* but not cultivated by many farmers. In one village of Singida district, farmers specified that it was not easy to get improved seeds. In the villages of Kongwa district, where irrigation was possible, the availability of amaranth seeds was no problem, farmers used their own seeds which were plenty. Only for one species called 'lishe' (*A. hypocondriacus*), availability of seeds was a problem. Moreover, in a village without irrigation possibilities, farmers argued that seeds for amaranth were not adequate and they had to buy seeds in Kongwa. In one village of Muheza district, own seeds were available for *A. blitum*, while there were not available for *A. hypocondriacus*. This was due to the fact that the latter species was harvested before maturity and therefore no seeds could develop.

Weeds were no problem in any of the districts. As we learned before, weeding is done and obviously necessary. Thus, as traditional vegetables occur sometimes as weeds in cultivated fields the activity 'weeding' is not only done to get rid of weeds but at the same time to collect or harvest food plants. Therefore, it was obviously not regarded as troublesome work or a constraint.

'Mchicha mweusi' (*Amaranthus dubius*) was not affected by pests and diseases as reported in one village in Arumeru district. In other villages, insects in general were of a problem and especially aphids in the rainy and cold (Table 13). Leave eating insects as well as insects entering into the stem were harming amaranth crops, while grass hopper affected amaranth especially during the dry season (Singida). In Kongwa district, besides others, stem borers were affecting *A. cruentus* and *A. hybridus* in one

village while an amaranth type called 'fene' (*Amaranthus graecizans*) was not susceptible to insect pests.

The possibility of marketing amaranth was very good in Arumeru, Singida and Kongwa district. In Arumeru, especially 'Mchicha mweusi (*A. dubius*) and 'Mchicha wa unga' (*A. hypocrondriacus*) could fetch good prices. Since from April to June amaranth could be collected from the wild, marketing was of a problem during that time. However, during the rest of the year farmers were even not able to fulfil the markets demands.

Tab. 5.15 Constrains in producing amaranth in four research districts of Tanzania.

	Arumeru (4 villages)	**Singida** (4 villages)	**Kongwa** (4 villages)	**Muheza** (4 villages)
Labour availability	no problem;	-	-	-
Water	no problem; irrigation was possible; did not demand much water; problem only during dry season in the lower areas;	water stress; some species would stunt with water deficiency; problem esp. during dry season;	problem for all species; highly affected by drought; in some villages irrigation water was not available;	affected by drought → flowered early and stayed small; water availability during drought was problematic; distance from plots to dwell was crucial;
Soil fertility	no problem; soils were not fertile in lower areas;	soils were sandy and not fertile enough; farm yard manure was required;	needed a lot of farm yard manure;	no problem;
Seeds	used own seeds or bought in shops; for some species no seeds were available (e.g. if not many people were cultivating it);	generally no problem; problematic to get improved seeds;	own seeds were plenty and used; for some species no seeds were available; quality was not good → buy seeds;	used own seeds and bought in shops; some species were not let mature and no seeds could develop;
Weeds	no problem;	-	-	-
Pests & Diseases	no problem for some species; insects in general and aphids in particular, esp. from April to July (rainy season)	grass hopper during dry season; leave eating insects; insects entering into stem;	susceptible to insect pests in general; grasshopper and aphids were main problem; stem borer affected some species;	leave eating insects; aphids;

	Arumeru (4 villages)	**Singida** (4 villages)	**Kongwa** (4 villages)	**Muheza** (4 villages)
Marketing	no problem; could even not fulfil market needs; oversupply from April to July;	no problem;	either not selling (if gathered from the wild) or no problem;	no problem in one village; overproduction in another village → everyone was producing + could be picked every-where in the wild;

"-" = issue not raised during focus group meeting

Amaranth was not sold in one village of Kongwa district, since it was only collected from the wild for home consumption and not cultivated. In Muheza, traditional vegetables were abundant, could be picked everywhere in the wild and an overproduction existed since everyone was producing traditional vegetables. Consequently, marketing was problematic.

Responsibility. Amaranth was traditionally a typical women crop and women and sometimes children were responsible for everything in the production of this traditional vegetable in Arumeru district. This was still true for today as stated in two villages. However, in two other villages farmers explained that nowadays both men and women are responsible. This was due to the fact that there was a good market for amaranth and men also grew and sold this crop. However, as long as plots were small, e.g. in home gardens, and only little money could be gained mainly women dealt with this crop.

In Singida and Kongwa district both women and men were responsible for amaranth, whereby different tasks were taken over by men and women (Table 5.16). Only in one village of Singida district it was reported that amaranth was a women crop but when it was marketed men were responsible. In one village of Kongwa district, focus group participants were not in complete agreement and women argued that amaranth was a women crop while men claimed that both women and men were responsible. In Muheza district farmers in one village declared both women and men to be responsible for amaranth, while in two other villages women were doing all production steps. Moreover, in another village women were accountable for amaranth as a subsistence crop in home gardens and men for amaranth as a commercial crop.

Tab. 5.16 Responsibility for the production of amaranth in four research districts of Tanzania.

	Arumeru (4 villages)	**Singida** (4 villages)	**Kongwa** (4 villages)	**Muheza** (4 villages)
Women	traditionally everything; assisted by children;	for home consumption; irrigation, harvesting and processing;	harvesting;	mainly responsible; for home gardening;
Men	grew and sold when there was a market;	when crop was marketed; land preparation and irrigation;	irrigation;	for commercial crop;

5.1.4 CONSUMPTION ISSUES OF AMARANTH

Since the questionnaire for consumption issues was slightly longer only two to four vegetables were discussed during the focus groups on consumption (instead of four to five like in the focus groups on production issues). Therefore, amaranth was debated in only ten villages out of 22, i.e. two and three times, respectively, in each of the four research districts.

Plant parts used. The whole plant, i.e. all aerial parts, namely leaves, young shoots and tender stems were used as a vegetable. Leaves with part of the stem or only leaves were used in Singida district. Leaves sometimes with, sometimes without tender stems were harvested in Kongwa district. In Muheza district it was more differentiated which parts of amaranth were used. In one village leaves were only taken when big and the stem was only harvested when still young and immature. In another village leaves and tender shoots of 'kienyeji' (*A. blitum*), a local amaranth species, were used, while the whole plant was harvested and used of 'mchicha kizungu' (*A. hybridus*), a new introduced species.

Taboos. While in one village in Arumeru district everyone was consuming amaranth, in two villages some men and especially old and conservative ones were not consuming amaranth. There were no taboos on consuming amaranth or only on an individual basis in Singida district. The same was stated in Kongwa district and further, that some children did not feel good when eating amaranth and therefore would not consume it. In Muheza district there were no taboos for consuming amaranth and everyone was eating it.

5.1.5 PROCESSING AND UTILISATION

Preparation. Focus group participants reported three different main dishes that could be prepared out of amaranth in Arumeru district, while four recipes in Singida, Kongwa and Muheza district each were named. For all dishes the leaves were picked,

sorted and cleaned which meant removing unwanted things e.g. insects (Arumeru). Some people washed the leaves and some did not (Singida), and in one village it was suggested to drain the water after washing and therefore put the leaves into the sun for 15 minutes or dry them optional in the shade (Arumeru). In Kongwa and Muheza district, all farmers told that leaves had to be sorted, washed and cut at first. The leaves were either cut or used as a whole (Arumeru and Singida) but there was no specific reason for doing the one or the other.

In Arumeru district, the simplest method was to boil or rather steam the uncut leaves with salt for five minutes without any water but just the water which remained after washing. For the "frying method", the preferred treatment in one village, onions were first fried for about two minutes, tomatoes were added and fried for another three minutes and finally other vegetables such as carrots, eggplants, and/or sweet pepper and finally amaranth were thrown in and fried for another 5-15 minutes. Usually, it was continued to stir for another five to ten minutes until the dish was ready to eat (Table 5.17).

The "frying method" was also a preferred treatment in Singida district, but if available, milk could be added before amaranth was given into the pan. Another possibility is to cut onions, tomatoes and amaranth leaves and put everything together in a pot at once with water and salt. It was boiled with a lid for five to ten minutes and the whole process was less time consuming and could be used when one was in a hurry. The so called "boiling method" - which was actually rather a "steaming method" - started with cleaning the leaves in water, putting them into a pan, adding salt and steaming for five minutes but without any additional water. Only the water which was left from washing was used and farmers explained, that leaves were more nutritious if steamed without water. However, after that treatment leaves were further fried like in the first recipe but only for five minutes.

For the "frying-method" in Kongwa district grounded groundnuts instead of oil could be used. Chopped amaranth leaves, onions and tomatoes were put into a pod with water and salt for the "boiling-method" and everything was boiled for three minutes only. A third recipe combined steaming of leaves for three minutes and frying with further ingredients for another five minutes.

In Muheza district, the local amaranth species 'mchicha kienyeji' (*A. blitum*) as well as 'mchicha kizungu' (*A. hybridus*) were put into a wide container in the sun after washing so that the water could evaporate. Than leaves were fried, whereby no lid was used since there would arise to much water. Another preparation method was to simply cook both amaranth species in the 1st coconut milk together with chopped onions and salt for about 15 minutes and without a lid. It was further possible to first heat chopped

onions and tomatoes plus salt in little 1st coconut milk and afterwards add amaranth leaves and boil for 10 to 15 minutes with a lid. Also the 2nd coconut milk could be used which was boiled together with chopped onions for about two minutes. Amaranth was given into the pot as well and boiled for another three minutes. Finally the 1st coconut milk was added.

Dried amaranth leaves were first cleaned (Singida) or soaked (Kongwa) in warm water to become soft and then treated like in the "frying method" (Singida). Little water and grounded groundnuts were get to boil and soaked leaves and salt were added and cooked for three to five minutes (Kongwa). In Muheza district dried amaranth leaves were boiled in little water plus salt for 15 minutes. Afterwards they were put into cold water. Meanwhile onions and tomatoes were fried in oil or coconut milk. The squeezed amaranth leaves were added and fried for two minutes.

Tab. 5.17 Preparation of amaranth in four research districts of Tanzania.

	Arumeru (3 villages)	**Singida** (2 villages)	**Kongwa** (3 villages)	**Muheza** (2 villages)
Ingre-dients	• uncut leaves; • salt;	• onions; • tomatoes; • leaves; • salt; • oil;	• onions; • tomatoes; • salt; • leaves; • oil;	• onions; • tomatoes; • leaves; • oil; • salt;
Method **Time**	boiling; 5 min.	frying; 5 min. for onions and tomatoes; 5 - 10 min. for amaranth;	frying; 5 min. for onions and tomatoes; 5 min. for amaranth;	frying; 2 min for onions; 3 min. for tomatoes; 3 or up to 15 min. for amaranth;
Impor-tant	only the water which remained after washing is used;	if available milk could be added before amaranth;	grounded groundnuts could be used instead of oil;	no lid; tomatoes are optional;
Ingre-dients	• onions; • tomatoes; • carrots, African eggplants, sweet pepper if available; • cut leaves; • oil;	• onions; • tomatoes; • cut leaves;	• onions; • tomatoes; • cut leaves;	• 1st coconut milk; • leaves; • salt; • onions and tomatoes (optional);
Method **Time**	frying; 5 min. for other vegetables; 15 minutes amaranth;	boiling; 5 - 10 min.	boiling; 3 min.	boiling; 15 min. only leaves; 5 min. for onions and tomatoes + 10 - 15 min. for leaves;
Impor-tant	preferred treatment;	everything is cooked at once in a pod with a lid;	everything is cooked at once;	no lid for leaves alone; with lid for leaves + further vegetables;

	Arumeru (3 villages)	**Singida** (2 villages)	**Kongwa** (3 villages)	**Muheza** (2 villages)
Ingre-dients	• onions; • wilted leaves; • oil;	• leaves; • salt;	• little water; • salt; • leaves; • onions; • tomatoes;	• 1st and 2nd coconut milk; • onions; • leaves;
Method **Time**	frying; 3 min. for onions; 5 min. for amaranth;	boiling; 5 min.	boiling + frying; 3 min. for boiling leaves in water; 5 min. for frying onions and tomatoes; 5 min. for frying amaranth;	boiling; 2 min. for onions in 2nd coconut milk; 3 min. for leaves;
Impor-tant	leaves were wilted / dried in sun or shade for 15 min.	only the water which remained after washing is used;	leaves could also be boiled with water which remained from washing;	add 1st coconut milk at the end;
Ingre-dients		• dried leaves; • onions; • tomatoes; • oil;	• dried leaves; • little water; • grounded groundnuts; • salt;	• dried leaves; • little water; • salt; • onions; • tomatoes; • oil or coconut milk;
Method **Time**		frying; 5 min. for onions and tomatoes; 10 min. for amaranth;	boiling; 3 - 5 min.	boiling + frying 15 for leaves in water + salt; 5 min. for onions and tomatoes; 2 min. for squeezed leaves;
Impor-tant		like first recipe but first cleaned dried leaves in warm water;	first soaked dried leaves in water to become soft;	first boiled leaves, then fried together with other vegetables;

Preservation. Amaranth as a traditional vegetable being available almost the whole year in Arumeru and Muheza district was not conserved in any way. However, in Singida district dried leaves were used during the dry season when hardly no fresh leaves were available. Therefore, amaranth leaves were sorted but not washed and dried for one or two days in the direct sun. The length of the drying process depended on the light intensity. Leaves could be also wilted in the sun for a few minutes and then rubbed between the fingers. If this process was not done the leaves would break easily when they were dried. These preserved leaves could be stored for up to one year (Singida) or up to two years (Kongwa).

In Kongwa amaranth leaves were either preserved on their own or mixed with cowpea leaves in a ration of cowpea leaves : amaranth = 1 : 0.25 or amaranth was mixed with African spiderflower before preservation. For the first method, boiling water was prepared. Leaves were put into a piece of cloth and dipped into the boiling water

for a few seconds or up to two minutes. Even boiling the leaves for 30 minutes while turning them upside down was suggested. However, the green colour should remain and not turn. After boiling, the leaves were left to cool down and then spread on a clean iron sheet for drying (Table 5.18). For a second preservation method amaranth leaves were not boiled but chopped into pieces and dried in the direct sun for one or two days.

Tab. 5.18 Preservation of amaranth in four research districts of Tanzania.

	Arumeru (3 villages)	**Singida** (2 villages)	**Kongwa** (3 villages)	**Muheza** (2 villages)
Ingre-dients		• leaves;	• leaves alone; • amaranth mixed with cowpea leaves or African spiderflower;	• leaves; • tomatoes;
Method		drying in direct sun;	boiling + drying on iron sheet in direct sun;	boiling + drying in direct sun;
Time		1-2 days (depending on light intensity);	few seconds or 30 min. for boiling; 1-2 days for drying;	few minutes for boiling; 2-3 days for drying;
Impor-tant	was not practised;	leaves were sorted but not washed;	during boiling green colour should remain; storage for up to 2 years possible;	preservation was normally not practised;
Ingre-dients		• leaves;	• leaves alone; • amaranth mixed with cowpea leaves or African spiderflower;	
Method		wilting, rubbing and drying in direct sun;	drying in direct sun;	
Time		few minutes for wilting; 1-2 days for drying;	one or two days;	
Impor-tant		leaves would break when dried if not rubbed between fingers;	leaves were chopped in pieces;	

One farmer in Muheza district knew a recipe for preservation but she moved to this area from a drier region and confirmed that she was not using it here since it was not necessary. For this method amaranth leaves and tomatoes were boiled together for a few minutes. Afterwards they were dried in the direct sun for two or three days.

Medicinal value. Amaranth should be boiled and given to children to improve their health in general (Table 5.19). This was in information given by the clinic doctors to the farmers (Arumeru). In Kongwa and Muheza district, farmers believed amaranth to be highly nutritious and to increase blood and it was therefore an important food for anaemic people. In one village of Kongwa district, focus group participants even knew

that amaranth contained many iodine and vitamin A "which is good for the eyes", and the doctor was encouraging people to give amaranth especially to their children.

Tab. 5.19 Medicinal value of amaranth in four research districts of Tanzania.

Arumeru (3 villages)	**Singida** (2 villages)	**Kongwa** (3 villages)	**Muheza** (2 villages)
No medicinal value; leaves should be boiled and the water given to children to improve their health in general;	No medicinal value;	Increased blood; contained many iodine and vitamin A which was good for eyes; gave it especially to children;	Nutritious; increased blood; good for persons who were anaemic;

5.2 VEGETABLE COWPEA (*VIGNA UNGUICULATA*) - A MULTIPURPOSE CROP FOR SUBSISTENCE AND MARKETING

5.2.1 CHARACTERISTICS OF COWPEA

Taxonomy. Cowpea belongs to the family Leguminosae, subfamily Papilionoideae, tribe Phaseoleae and genus Vigna (Ng & Singh, 1997). Maundu et al. (1999a) suggested *Vigna unguiculata* (L.) Walp. a synonym of *Vigna sinensis* (L.) Hassk. However, Tindall (1983) stated that *Vigna unguiculata* was a relatively primitive form of cowpea, particularly cultivated in Asia but also in Africa. Furthermore, *Vigna sinensis* was a species, mostly comprising cultivars of the common cowpea grown in Africa. A third species mentioned by Tindall (1983), is *Vigna sesquipedalis* (L.) Fruhw., which is also called the Asparagus pea or Yardlong bean and is widely grown in the Far East but less commonly cultivated in Africa. Different authors classified three subspecies or cultigroups for the species *Vigna unguiculata* (Table 5.20), whereby most cowpea breeders seem to have adopted Marchal et al.'s (1978) cultigroup scheme for classification of cultivated V. unguiculata taxa (Fery, 2002). The classification and nomenclature of wild *V. unguiculata*, which for sure occurs in Tanzania, is highly complex, with more than 20 epithet names being used for the wild taxa (Ng & Singh, 1997). Likely, in Tanzania the cultivated species farmers are cropping is *Vigna unguiculata* (L.) Walp spp. *unguiculata* (= V. *sinensis* (L.) Walp.).

Tab. 5.20 Taxonomic view of *Vigna unguiculata* by different authors.

Verdcourt (1970) in: Fery (2002)	Marechal et al. (1978) in: Fery (2002)	Tindall (1983)	Rehm (1989) in: Schuster (1998)
Vigna unguiculata (L.) Walp. • cowpea (spp. *unguiculata*) • catjang (spp. *catjang*) • yardlong bean (spp. *sesquipedalis*)	*Vigna unguiculata* (L.) Walp. ssp. *unguiculata* consists of cultigroups • Unguiculata • Biflora • Sesquipedalis	• *Vigna unguiculata* (L.) Walp. **=** primitive form of cowpea; • *Vigna sinensis* (L.) Hassk. **=** comprises cultivars of common cowpea in Africa;	*Vigna unguiculata* (L.) Walp. • spp. *unguiculata* = spp. *sinensis*; • spp. *sesquipendalis*; • spp. *cylindrica*.

Origin and Ecology. *Vigna unguiculata*, called cowpea in English and kunde in Swahili, likely originated in Africa (Fery, 2002). While Vavilov mentioned a centre of origin in Ethiopia and a second in Hindustan (Schuster, 1998), another probable origin could be the Niger River basin which contains large diversity of this species and is home to many wild forms (Schippers, 2002). Cowpea is the most important pulse crop in tropical Africa even though it ranks second after groundnut in a few places (Schip-

pers, 2002). However, it is a multipurpose crop grown for tender leaves as well as dry seeds, green pods and green seeds. It is further utilised as a cover crop and for fodder (Ng & Padulosi, 1988). Cowpea is contributing to soil fertility with the ability of fixing up to 250 kg/ha N through rhizobial nodulation (Schuster, 1998). As a predominately hot weather crop, cowpea is more tolerant to drought but also to waterlogging, infertile soils, and acid stress than, for example, the common bean (Fery, 2002).

Description. Cowpea is an annual herbaceous plant of which the creeping or spreading type will reach about 30 to 40 cm in height, whereas the erect type can become 80 to 100 cm high (Schuster, 1998). The vigorous taproot is deep-reaching so that water can be obtained even from lower soil layers and, therefore, it is drought-resistant to a certain extent (Schuster, 1998). Additionally, several well-nodulated, lateral roots are spreading in the surface soil (Ng & Singh, 1997). Leaves consist of three leaflets, which are between 6 and 16 cm long and 4 to 11 cm in width. The flowers can have various colours from greyish-white and pale green to yellow, red, light blue and purple (Schuster, 1998; Schippers, 2002). Pods are 8-18 cm long (Schuster, 1998), straight and usually hanging (Maundu et al., 1999a). The seeds are longish, quadratic or round (6-8 mm x 4-6 mm) but the size is highly variable. The seed colour is again various and can range from light to dark, in white, black, red or purple colour while a mixture of two colours and a mosaic pattern is also possible (Schuster, 1998).

Cultivation. Cowpea is often grown intercropped with taller crops such as cassava, maize, sorghum, pearl millet or okra, where it can climb the crop but it can also cover the ground. Spacing is much wider (about 75 x 75 cm) for the creeping type compared to the erect cowpea type (about 15 x 35 cm) (Schippers, 2002). Cultivation often takes place on a large scale and extensive research results and literature is readily available for cowpea as a pulse crop (J. Smartt, 1990). Yet, only few studies have been made on varieties, which are primarily grown for their leaves, their immature pods or young seeds (Schippers, 2002).

Vegetable uses. Cowpea leaves are often dried in the sun to conserve them for later use. In Zimbabwe, for example, they are either first boiled for a short time and then dried or directly dried with being turned over once or twice to ensure a uniform drying (Schippers, 2002). Young tender leaves are preferred for direct consumption and are either picked repeatedly or 3 to 4 weeks old plants are cut close to the ground or uprooted. The latter are not solely used for home consumption but also tied in bundles and sold in markets (Maundu et al., 1999a). Besides young leaves, young pods and green grain are also consumed as vegetable. The dry grain is cooked, steamed or fried in oil or grind to flour (Schuster, 1998).

5.2.2 TYPES OF VEGETABLE COWPEA GROWN IN NORTH-EASTERN TANZANIA

Types. Many different cowpea types of were found in the four research districts. Since it was not assured that the different cowpea crops described by farmers were different cultivars, the term 'type' is used in the following.

In Arumeru, Singida and Kongwa districts two types were distinguished by farmers according to growth habit. A spreading or postrate cowpea type "tambaa" (= spreading) or "soko" (= market) was reported to be drought-resistant (Arumeru and Singida) and was explicitly called "vegetable cowpea" and, therefore, obviously grown especially for its leaves (Arumeru). It was further found to produce seeds for a longer period of time (Singida).

The second cowpea type called 'wima' (= erect) or 'dakawa', was a variety developed at Dakawa research station of the Ministry of Agriculture and Food Security in Morogoro region. It had an erect plant habit and further distinguishing features (Table 2). In one village of Arumeru district it was reported that this type was mainly used as a leaf vegetable, whereas it was normally rather used for grains. It was further reported to be not drought resistant, to have a high yield but only one harvest was possible (Singida).

In Kongwa district where cowpea was also called "safwe", both the spreading and the erect type were mentioned to have either narrow, small leaves and at the same time small seeds or broad leaves and simultaneously big seeds. The seed colour was various and could be the same for both types as well as the colour of flowers which was purple, while the only difference was the plant height (Table 5.21). As mentioned earlier, Schuster (1998) suggested larger heights for the two different cowpea types, namely 30-40 cm for the spreading and 80-100 cm for the erect type. However, these heights were apparently measured under more favourable conditions than in Kongwa district and further, at more improved varieties.

Tab. 5.21 Characteristics of two different cowpea types as mentioned by farmers in variable districts of Tanzania.

	Spreading cowpea type	Erect cowpea type
Leaves	• broad, dark green (Arumeru);	• narrow, small, light green (Arumeru);
Seeds	• big, white, cream or yellow (Arumeru); • big, black or red (Singida);	• brown, dark green, red, grey or black and white (Arumeru); • small, pink (Singida);
Height	• about 30 cm (Arumeru); • 15-30 cm (Kongwa);	• about 30 cm (Arumeru); • 30-60 cm (Kongwa);

Different from the other three districts, in Muheza district more than two cowpea types were distinguished by different local names. Farmers mentioned about four different spreading plant types which they distinguished according to seed colour (e.g. white and big ("nyeupe") or red/brown and small ("tambaa")), pod shape (long and slender ("nyeupe") or short ("katumbo nginda")) or according to the colour of the plant (light green ("pamba")). Five different erect plant types were classified also by appearance of seeds, pods, leaves or preparation behaviour (cooks fast ("bahau")). Two types, namely "pamba" and "bahau", were mentioned in several villages, yet, their characterisation was sometimes different. "Pamba" were described to have a spreading plant habit in three villages, while farmers in one village claimed this type to have an erect plant habit. Similarly, "bahau" was said to have an erect plant habit in one village and to be a spreading type in another village. Consequently, local names were used for different plant types in different villages. Positive and negative characteristics of all different types are summarised in Tables 5.22 and 5.23 (see also Figures 5.1 and 5.2). Thereby, variable characteristics were emphasised in different villages and sometimes a feature of cowpea regarded as positive in one village were seen negative in another. Thus, some characteristics seem to be contradictory since they are mentioned two times as a positive and as a negative one.

Ranking. In **Arumeru** district both the spreading and the erect cowpea type were accepted, with the erect type being slightly more preferred. The reason for this were the positive characteristics of the erect type to mature uniformly, to have soft leaves, which cooked faster, and to be uprooted for harvest which was easier than repeated picking of leaves. Further, the erect type was washed during rain, which alleviated the cleaning process before preparation. For the spreading type, the opposite to these characteristics applied, and moreover, it was mentioned to be drought-resistant and to have a prolonged harvest period. However, the softness of leaves and the ease of harvesting was more important to farmers than the latter issues.

In Singida, Kongwa and Muheza districts, clearly spreading types were preferred by farmers. This was due the feature of being drought-resistant while the erect type was rather prone to drought. Furthermore, the production period of the spreading type was longer and therefore more yield could be obtained and it was available fresh for a longer period of time. This is more in accord to Schippers' (2002) view, who consider prostrate, indeterminate cowpea types to be mainly grown for leafs, while erect, determinate and low-branching cowpea types for grain production. Moreover, the spreading or prostrate types could have a maturity period for up to 140 days and leaves could be picked repeatedly, while the grain yield was hardly affected by this as suggested by farmers. In contrary, the erect types could mature in about 80 days and

would not produce leaves for a long time, but would give a grain crop relatively early. The grain yield of this types, however, would be clearly affected by leaf picking, which would delay flowering and, therefore, delay the seed harvest, while spreading types were less affected (Schippers, 2002). It is also known that the yield of dry beans will be seriously affected, when a considerable portion of more than 4 t/ha of the leaves is taken away (Oome & Grubben, 1978).

In some villages of Muheza district it was possible for farmers to rank cowpea types two times, in terms of grains and in terms of leaves (Table 5.24). However, ranking of leaves was not easy or even not possible in some villages of all four districts. Repeatedly, all cowpea types were preferred for their leaves without drawing a distinction, whereas it was possible for farmers to rank the same cowpea types according to their grains. In one village of Muheza district farmers argued that they could not differentiate between the leaves of various cowpea types and therefore all leaves were preferred. This was possibly due to the fact that cowpea was more important to farmers for their grains and rather improved for their seed yielding capacity than for their yield and quality of leaves. Especially international research focused mainly on cowpeas for seed production (Schippers, 2002) and it was reported by Oomen & Grubben (1978) that it is not known whether special leaf types occur. Yet, it is acknowledged that most farmers would like a multipurpose cowpea crop (Schippers, 2002) and, therefore, much more research on types and varieties that are also grown for their leaves is needed.

Tab. 5.22 Cowpea types and their special positive and negative characteristics perceived by farmers in four research districts of Tanzania.

District	Cowpea type	Positive characteristics	Negative characteristics
Arumeru	**Tambaa / Soko** (spreading)	• repeated harvesting (leaves and grains) possible; • preferred as a leafy vegetable; seeds also used;	• pods matured not uniformly; • not as soft as "wima"; did not cook fast (slightly tough leaves); • late maturity - takes a long time in the field (occupies it); • no easy harvest (repeated picking of leaves)
	Wima / Dakawa (erect)	• soft leaves; mainly leaves used as a vegetable; • matured uniformly; matured early; • preferred as a grain, not for leaves; • fast growth; easy seed production; had many seeds; • easier to harvest (uprooting); • washed clean during rain compared to "tambaa";	• short production period; • leaves harvested only once - afterwards started flowering → lower yield; • problem with aphids during cold period;
Singida	**Tambaa** (spreading)	• bigger seeds, which swell very well and fill the pods; • long production period of leaves;	• early maturing; • preferred/needed fertile soil;
	Wima (erect)	• could be grown under all soil fertility conditions;	
Kongwa	**Tambaa** (spreading)	• long production period;	• late maturing; • susceptible to aphids and "ootheca"
	Wima (erect)	• fast growth - early maturing - harvest earlier than "tambaa"; • can grow even in low fertility soils;	• early maturing → short production period → less yield;
Muheza	**Tambaa** (spreading)	• long production period;	
	Pamba (spreading)	• leaves abundant and very soft; • harvest of leaves stimulate production of pods; • cooks fast;	• once infested by aphids, quality of leaves and grains became bad;
	Nyeupe (spreading)	• high production of leaves → could harvest several times;	• nothing;

District	Cowpea type	Positive characteristics	Negative characteristics
	Wima (erect)	• fast growth → harvest started earlier than "tambaa"; • high production;	• short production period → less yield than "tambaa";
	Bahau (erect)	• two harvests possible; • still yields under stress conditions, e.g. heavy rain or drought;	• nothing
	Gomesi	• cooks fast (leaves and grains); • good taste of leaves and grains;	• once infested by aphids quality of leaves and grains became bad;

Tab. 5.23 Evaluation of major characteristics of cowpea types by farmers in two research districts of Tanzania.

District	Cowpea types	Taste	Market	Availability	Yield	Drought resistant	Pest + Dis resistant	Nutrient content	Prepara-tion	Seed avail-ability
Singida	**Tambaa** (spreading)	0	0	XXXX	XX	XXXXX	X	0	0	0
	Wima (erect)	0	0	0	0	X	X	0	0	0
Muheza	**Tambaa** (spreading)	XXXX	XXXX	XXXX	XXXX	XXXX	X	0	0	0
	Nyeupe (spreading)	XXXX	0	0	XXXX	0	0	0	0	0
	Pamba (spreading)	XXXX	0	0	XXXX	0	X	0	XXXX	0
	Wima (erect)	XXXX	XXXX	XX	XXX	X	X			
	Bahau (erect)	XXXX	0	0	XXXX	XXXX	0	0	0	0
	Gomesi	XXXX	0	0	XXXX	0	X	0	XXXX	0

0 = no comment; X = very poor; XX = poor; XXX = average; XXXX = good; XXXXX = very good;

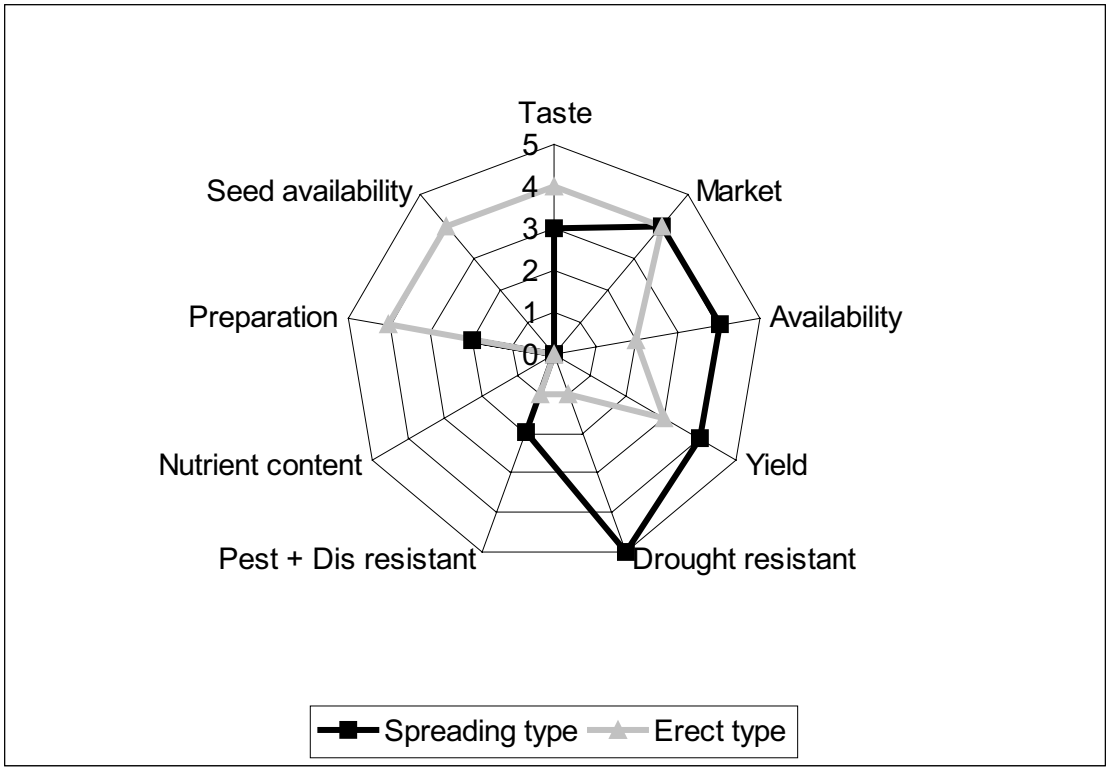

Fig. 5.1 **Farmers valuation of characteristics of cowpea types in Arumeru district, Tanzania.**
0 = no comment; 1 = very poor; 2 = poor;
3 = average; 4 = good; 5 = very good;

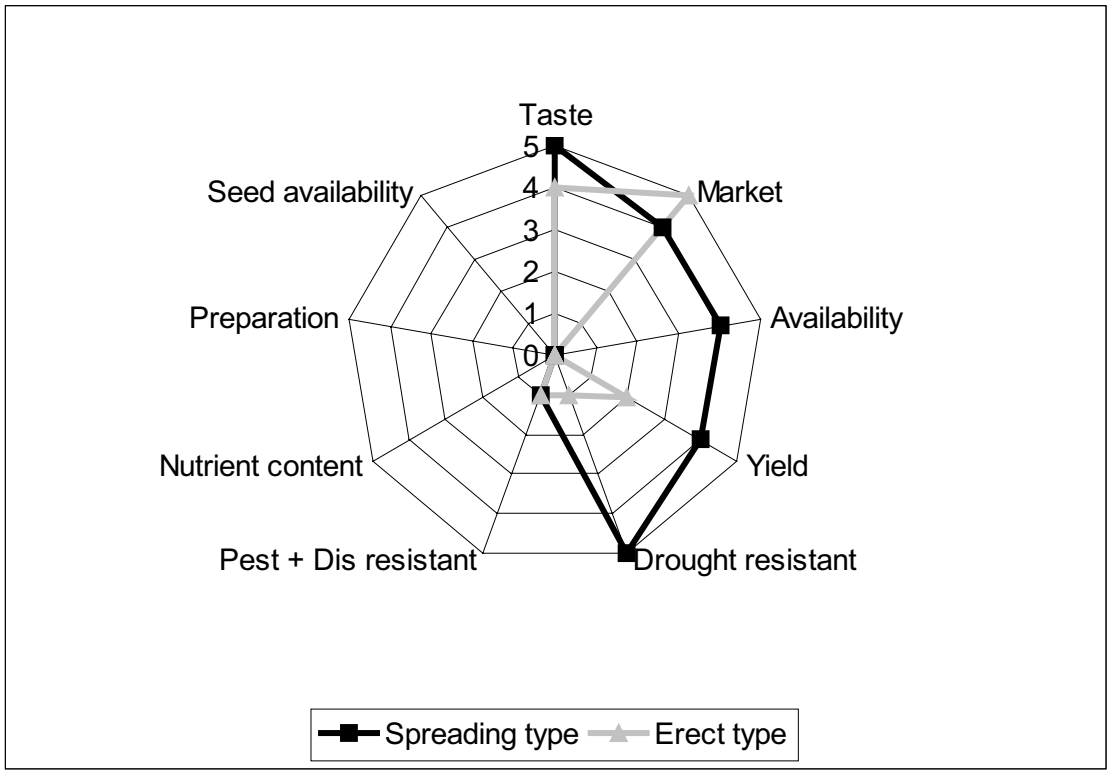

Fig. 5.2 **Farmers valuation of characteristics of cowpea types in Kongwa district, Tanzania.**

Tab. 5.24 Ranking of cowpea types according to farmers in four research district of Tanzania.

District	Cowpea types	Plant habit	Rank	
			grain	leaves
Arumeru	**Wima / dakawa**	erect	1	
	Tambaa / Soko	spreading	2	
Singida	**Tambaa**	spreading	1	
	Wima	erect	2	
Kongwa	**Tambaa**	spreading	1	
	Wima	erect	2	
Muheza	**Tambaa**	spreading	1	1
	Nyeupe	spreading	1	1
	Pamba	spreading	2	3
	Katumbo ndinga	spreading	-	4
	(no name)	erect	2	2
	Wima	erect	2	2.5
	Kazongoo	erect	3	-
	Bahau	erect	4	3
	(no name)	erect	5	5
	Gomesi		1	2

5.2.3 PRODUCTION ISSUES OF VEGETABLE COWPEA

Vegetable cowpea was a favoured traditional vegetable in three of the four districts, namely in Arumeru, Kongwa and Muheza district. It ranked only No. 8 in Singida district and was, therefore, discussed with farmers only for consumption but not for production issues. However, in Arumeru and Muheza districts production issues of vegetable cowpea were talked over in three villages each and in Kongwa even in four villages.

Cropping pattern. Vegetable cowpea was intercropped with maize during the long rains from March to May, while it was also monocropped during the dry season in one village of Arumeru district. The reason for intercropping cowpea with maize, sorghum, sunflowers or even with groundnuts and bambara groundnuts (Kongwa) was, i.a. that cowpea caused no problems to other crops but increased soil fertility (Arumeru). Furthermore, it was just a habit and it saved labour and time, e.g. weeding was done for two crops at once (Kongwa). Intercropping was done with maize or cassave in Muheza district, however, as cowpea would climb these crops and create shade to them there will be a loss in yield. Consequently, in Muheza district, monocropping was the preferred cropping method for cowpea and it was argued that the performance of cowpea was better and the yield higher (Table 5.25).

In Arumeru district, monocropping was rather done on an individual basis but also if cowpea was cultivated for commercial purpose. Moreover, when cowpea was grown for its leaves only, it was monocropped since harvest already started three weeks after sowing. Oomen & Grubben (1978) also reported that 3-week old plants were either uprooted or cut at ground level for either home consumption or marketing.

In one village of Kongwa district, the spreading cowpea type ('tambaa'), which could tolerate shade, was distinguished from the erect cowpea type ('wima'), which was not shade tolerant and, therefore, cropped alone.

Tab. 5.25 Cropping patterns for vegetable cowpea in three different research districts of Tanzania.

	Arumeru (3 villages)	**Kongwa** (4 villages)	**Muheza** (3 villages)
Inter-cropping	practised during rainy season; reason: cowpea caused no problems to other crops but increased soil fertility;	practised (spreading type); reason: local custom; labour and time-saving; cowpea did not affect other crops; spreading type was shade-tolerant;	practised; reason: with maize and cassava; no reason given;
Mono-cropping	practised during dry season; reason: easy harvest, when grown for leaves; for commercial purpose; on individual basis;	practised (erect type); reason: erect cowpea type not shade tolerant; if there was enough time;	practised, preferred method; reason: better performance and higher yield; cowpea climbed on other crops and created shade;

Harvest. Cowpea leaves were either harvested by uprooting after 3 weeks of growth or they were picked frequently, which started 1-1.5 month after sowing and lasted for up to three month for the spreading cowpea type (Arumeru). Time of sowing and planting cowpea depended on the onset of the rain in Muheza district, while 30 to 40 days after planting the first harvest was possible. The interval between the picking of leaves was different for all districts (Table 5.26). However, it was maintained that three harvests per week were only possible in the absent of drought (Arumeru and Muheza).

Vegetable cowpea was grown and available almost throughout the year, while the main cropping season was different for variable villages in Arumeru district (Table 5.27). The growth rate was affected during the rainy season, i.e. plant growth was slower, as reported in one village. In Kongwa and Muheza districts, time of harvest was different for the erect and the spreading cowpea type. The erect type had a short harvesting period of about one month only (Kongwa) or was harvested only during the short rains (end of September to end of December) (Muheza), whereas the spreading cowpea type was harvested for 5-7 month (Kongwa) or even cultivated throughout the year (Muheza) (Table 5.27). In another village of Muheza district cowpea was planted in June, harvest started in July and ended already in August when plants started flowering. In the latter case, picking of leaves was probably stopped to allow cowpea seeds to develop.

Tab. 5.26 Harvest frequency of vegetable cowpea and time of harvest in four research districts of Tanzania.

	Arumeru (4 villages)	**Singida** (1 village)	**Kongwa** (3 villages)	**Muheza** (2 villages)
Harvest frequency	every 3-4 days; every 2 weeks; spreading type for 3 month;	once a week;	2-3 times per week;	1-3 times per week;
Time of harvest	Feb - Aug; Mar - May; throughout the year under irrigation;	Apr - Jun;	spreading type: Dec - Jun; Jan/Feb - Mar/Apr; erect type: Jan - Feb;	Jun - Aug; spreading type: throughout the year; erect type: Sep - Dec

Constraints. When the constraints in producing vegetable cowpea were discussed in the three districts, water was explained to be no problem in Arumeru district and especially not for cowpea which was described to be more drought tolerant than other crops, e.g. lablab (*Lablab purpureus*). However, the erect cowpea type "wima" was not drought tolerant while the spreading cowpea type "tambaa" could tolerate drought and its growth was only restricted if rain was insufficient (Kongwa).

An important constraint perceived in the production of vegetable cowpeas was the availability of seeds (Table 5.28). Due to storage insect pests, especially those that bore the grain, cowpea seeds were not easily available in Arumeru district. Furthermore, farmers mentioned aphids as a reason, why it was difficult to produce their own cowpea seeds. In Kongwa district, the availability of seeds was problematic due to lack of rain. In Muheza district farmers explained that seeds from the previous crop or from the market were usually mixed seeds of different cowpea types, and therefore they had mixed stands on their fields.

Tab. 5.27 Seasonal calendar (time of harvest) for vegetable cowpea (leaves) in four research districts of Tanzania.

Month	J	F	M	A	M	J	J	A	S	O	N	D
Season	Dry + hot season		Long rainy season				Dry + cold season			Short rainy season		
Arumeru												
A			ø ø ø ø ø ø ø ø ø ø ø ø ø ø ø ø ø ø ø ø									
B			ø ø ø ø ø ø ø ø ø ø									
C	ø ø											
Singida				ø ø ø ø ø ø ø ø ø ø								
Kongwa												
Spreading type												
A	ø ø ø ø ø ø ø ø ø ø ø ø ø ø ø ø ø ø ø ø											ø ø ø
B	ø ø ø ø ø ø ø ø ø ø ø ø											
Erect type												
A	ø ø ø											ø ø
B	ø ø ø ø											
Muheza												
Spreading type												
	ø ø											
Erect type												
									ø ø ø ø ø ø ø ø ø ø ø ø ø ø				

- Arumeru district: **A** = Karangai village (lower altitude) **B** = Olevolos village (higher altitude)
  C = Nambala (lower altitude) and Ambureni/Moivaro (medium altitude) villages
- Kongwa district: **A** = Chamae village **B** = Mbande and Sagara B village

A major problem, was the susceptibility of cowpea to pests and diseases in all three districts. In Arumeru district farmers reported aphids *(Aphis spp.)* to be a slight problem as well as bollworms (*Helicoverpa* spp.). In Kongwa district, farmers mentioned insects sucking on leaves, making holes in leaves and others boring the pods. Further, aphids and insects inside the stem were reported to be a hazard. Aphids and other insects eating on the leaves were said to attack the leaves of cowpea in Muheza district, so that they did not taste any more. Besides, insects sucking the pods and insects cutting the growing tip of cowpea were reported by farmers. The beanfly (Scientific name) was mentioned to affect the stem just about ground level. Additional, monkeys were very fond of cowpea and therefore represented competitors for the farmers.

Marketing was not of a problem in Arumeru district, except in one where farmers reported that they could not sell vegetable cowpea during the long rainy season (Oct - Dec) since, during that time, leafy vegetables were abundant. In one village of Kongwa and Muheza districts each, marketing was reported to be good. However, in the other villages farmers explained that cowpea leaves were not sold but preserved for own consumption (Kongwa). In another village it was explained that prices for cowpea grains were unstable and cowpea leaves were not sold at all (Muheza). It was conspicuous that the possibility for marketing cowpea was not only different for the variable districts but even differences between villages within one district occurred.

Tab. 5.28 Constrains in producing vegetable cowpea in three research districts of Tanzania.

Constraints	Arumeru (3 villages)	Kongwa (4 villages)	Muheza (3 villages)
Labour availability	no problem;	-	-
Water	no problem; cowpea was more drought tolerant than other crops; main problem in one village at lower altitude;	Problem especially for erect type; no problem for spreading type if rain sufficient;	No problem in general; drought problematic for cowpea in one village;
Soil fertility	No problem for cowpea; no fertiliser applied;	No problem for cowpea;	-
Seeds	Problematic due to storage insect pests (boring the pods) and aphids;	Problematic due to lack of rain, especially for erect, not for spreading type;	No problem; available on the market or from own previous crop;
Weeds	No problem;	-	-

Constraints	Arumeru (3 villages)	Kongwa (4 villages)	Muheza (3 villages)
Pests & Diseases	Insect pest in general, aphids and bollworms in particular a slight problem;	Insect pests main problem, especially aphids, insects sucking on leaves, inside the stem, making holes in leaves, boring the pods;	Insect pests main problem, especially aphids and other insects eating leaves; insects sucking pods and cutting growing tip; beanfly; monkeys;
Marketing	No problem; only during long rainy season → plenty leafy vegetables available;	No problem; most cowpea leaves not sold but preserved for own consumption;	No problem; prices for grains unstable; leaves not sold;

"-" = issue not raised during focus group meeting

Responsibility. Though vegetables were in general acknowledge to fall in women's field of activity, in several villages there were sharp divisions over the responsibility of vegetable cowpea. It was declared as a women crop in two villages of Arumeru, Kongwa and Muheza districts, each, and women farmers argued that men did not know much about cropping this traditional vegetable. In fact, men performed the weeding but otherwise were not involved in cropping vegetable cowpea (Table 5.29). This was said to be typical for the Arusha people were men will not eat leaves but only grains. However, farmers explained that a change in eating habits was taking place due to education.

Farmers in one village of Arumeru and Muheza, each, and in two villages of Kongwa district, claimed that both women and men were responsible for this traditional vegetable. Thereby, women grew for home consumption and the market, while men participated when cowpea was a commercial crop. In Arumeru they even harvested leaves (not only grains) but exclusively for the market. In Kongwa, however, there were no production step done by men alone but they only participate in land preparation, sowing and weeding.

5.29 Responsibility for the production of vegetable cowpea in three research districts of Tanzania.

	Arumeru (3 villages)	Kongwa (4 villages)	Muheza (3 villages)
Women	responsible; grow for subsistence and market;	responsible for harvesting and processing;	responsible;
Men	participated in harvest for market (commercial crop); did not eat leaves;	participated in land preparation, sowing and weeding if commercial crop;	participated;

5.2.4 CONSUMPTION ISSUES OF VEGETABLE COWPEA

Consumption issues of vegetable cowpea were discussed in all four research district but in a different number of villages per district.

Plant parts used. Cowpea leaves and grains when either not yet mature, i.e. directly after filling of pods, or when dried, were consumed in all district. Additionally, in Muheza district also cowpea pods were used as food.

Taboos. Whereas cowpea grains were eaten by everyone, leaves were not consumed by old and conservative men (Arumeru). Moreover, some people did not like the texture and taste of leaves but this was on an individual basis. The meal called "kitalolo" mentioned by Meru people (see preparation) was not eaten by men and farmers explained this to be a special food for women as lunch during harvesting and dry periods. The reason why men did not eat this meal was that "men need meat". There existed no taboos in terms of cowpea mentioned in the other districts of Singida, Kongwa and Muheza.

5.2.5 PROCESSING AND UTILISATION

Preparation. Cowpea leaves were highly important as a relish since it was argued that to eat rice or ugali (maize porridge) alone would be too dry. In general, a typical meal consisted of rice or ugali with a relish made from green leafy vegetables plus beans or - if one could afford it - meat (Arumeru).

There existed two main recipes to prepare fresh cowpea leaves in all districts except Singida, where only one recipe was available. In general, leaves were first of all sorted, cleaned, washed and cut if preferred. A dish where boiling and frying of leaves was combined was popular in Arumeru, Singida and Kongwa district. Thereby, cowpea leaves were first boiled or rather steamed with normal or soda salt and a very little amount of water. This was only done when the leaves were not soft and tender enough (Arumeru). Thereby, the water used for washing the leaves could be used for cooking as well (Kongwa). Afterwards, chopped onions, tomatoes, and carrots or other vegetables if available were fried in oil, the boiled leaves were added and fried. Time for boiling and frying varied between the districts but was especially long in Singida (Table 5.30). Cowpea leaves were said to need more oil than other leafy vegetables and the taste will be not okay when too little oil was used (Arumeru). An option for this recipe was to add coconut milk if available when the cowpea leaves were nearly ready (Arumeru and Kongwa). Furthermore, grounded groundnuts could be added to the cooked leaves instead of onions, tomatoes and oil (Kongwa).

The second recipe in Arumeru district was mentioned only in one village by Meru people and it was called "kitalolo". Thereby, green maize and beans were boiled

and, after a while, cowpea leaves and plantains but no salt were added. Everything had to be mixed to get a uniform consistency before fresh milk and later also sour milk were added. Farmers also mentioned that, if you cooked cowpea leaves today and left them over night, they tasted even better on the next day.

For another method in Kongwa district, which was only mentioned in one village, cowpea leaves were mixed with amaranth leaves, which helped to tenderise cowpea leaves and made them easier to cook. Crushed groundnuts in a ration of groundnuts : leaves = 0.5 : 1 were added as well further vegetables (Table 5.30). It was important to continue stirring or otherwise the vegetables would burn.

Coconut milk played an important role in Muheza district where a very fast and simple preparation method was to boil cowpea leaves in little water until soft for about 15 minutes. The boiled leaves could be further processed and mixed with 2nd coconut milk, chopped onions and salt. They were boiled for another 10 to 15 minutes when finally the 1st concentrated coconut milk was added. Young cowpea pods and leaves together could be processed the same way, with the pods being boiled for a longer time first. It appeared to be that normally there was no remaining water after the boiling process and leaves and pods were rather steamed than boiled, which would be a more sparing process in terms of nutrients.

Tab. 5.30 Preparation of vegetable cowpea in four research districts in Tanzania.

	Arumeru (4 villages)	**Singida** (1 village)	**Kongwa** (3 villages)	**Muheza** (2 villages)
Ingredients	• fresh leaves; • little water; • salt; • oil; • onions; • tomatoes; • carrots (optional) • coconut milk (optional);	• uncut leaves; • water; • soda salt; • table salt; • oil; • onions; • tomatoes;	• fresh leaves; • water; • salt; • onions; • tomatoes; • oil; • coconut milk (optional)	• fresh leaves; • little water;
Method Time	boiling + frying; 2-10 min. for boiling leaves + salt; 10-15 min. for frying everything in oil;	boiling + frying; 15 min. for boiling leaves + soda salt; 30 min. for boiling leaves + table salt; 5 min. for frying onions + tomatoes; 5 min. for frying leaves;	boiling + frying 10-15 min. for boiling leaves + salt; 5 min. for frying onions and tomatoes; 10 min. for frying leaves;	boiling; 15 min.
Important	carrots and coconut milk were added when available and liked;			boil until leaves were soft

	Arumeru (4 villages)	**Singida** (1 village)	**Kongwa** (3 villages)	**Muheza** (2 villages)
Ingredients	• green maize; • green beans; • cowpea leaves; • plantains; • fresh + sour milk;		• fresh leaves; • salt; • grounded groundnuts;	• fresh leaves (and pods); • water; • onions; • tomatoes; • salt; • coconut milk;
Method **Time**	boiling; boil green maize + green beans first; add leaves + plantains → mix to get a uniform consistence;		boiling; 15 min. for boiling leaves + salt; 15 min. for boiling leaves + ground-nuts;	boiling; 30 min. for boiling pods; 30 min for boiling pods + leaves; 10-15 min. for all ingredients;
Important	no salt was added; special lunch for women during harvest and dry periods;			drain water after boiling of leaves and pods;
Ingredients			• cowpea leaves; • amaranth leaves; • onions; • tomatoes; • grounded groundnuts; • salt;	• dried leaves; • little water; • onions; • tomatoes; • salt; • coconut milk;
Method **Time**			boiling; 30 min. for boiling leaves; 10 min. for boiling all ingredientes;	boiling; 10-15 min. for boiling leaves; 10-15 min. for cooking all ingredients;
Important			mix cowpea with amaranth leaves to tenderise them;	drain water after boiling of leaves and pods;
Ingredients			• dried leaves; • little water; • oil; • onions; • tomatoes; • groundnuts OR coconut milk;	
Method **Time**			boiling + frying; 10-15 min. for boiling leaves in little water; + frying everything	
Important			do not throw away boiling water;	

Dried leaves were prepared similar to fresh leaves by boiling and frying, whereby the boiling process was usually shorter (Kongwa and Muheza). In Kongwa

district, the boiled water, which was cleaned from possible residues e.g. sand, was not thrown away but used for the further process.

Preservation. Since water was available nearly throughout the year and, therefore, cropping of cowpea was possible all year round, cowpea leaves were not preserved in Arumeru district. Farmers in one village explained that they had the knowledge about preserving cowpea leaves but they only practised it when leaves were plenty. However, in the drier Singida and Kongwa districts, cowpea leaves were preserved for the dry season (Table 5.31). Leaves were wilted in the sun for a few minutes before being rubbed between the fingers (Singida). This was done to facilitate the drying process since water could evaporate easier after rubbing. If they were dried straight away, leaves would break into pieces after drying. After rubbing, leaves were dried in the sun for about two days depending on the light intensity.

One drying process in Kongwa and Muheza district started with the cowpea leaves to be boiled in water either for 5 minutes only or even for 10 to 15 minutes. After that they were put e.g. on a polythene sheet or a clean mat, and dried in the direct sun for one or two days. They could also be dried directly without cooking before. However, it was argued that the taste would not be good if the leaves were not boiled before drying (Kongwa and Muheza) and the dried leaves would not cook very well after wards (Muheza). Moreover, leaves without being cooked before drying were too light and would be removed by the wind, when lying outside in the sun (Kongwa). Dried leaves could be kept in polythene bags for up to two years (Kongwa) or for only three month up to one year as long as there was no moisture within the storage container (Muheza).

Medicinal value. Farmers in three villages of Arumeru district negated that cowpeas had medicinal values, whereas in one villages a medicinal benefit of cowpeas was named. Crushed and pounded cowpea grains were used to nurse skin irritations like bumps or swellings for which the skin was treated with the prepared grains. Likewise, in Muheza district, immature cowpea grains were grounded, water was added if they were too dry, and abscesses on the skin were covered with the paste for one or two days. The paste of cowpea grains would make the abscess burst. While cowpea leaves had no medicinal function in Arumeru district, they were used for the same treatment for which they were rubbed between the hands and put onto the skin for one day. Leaves were also boiled and the water was drunk to increase blood, i.e. to increase the haemoglobin level. In Singida as well as in Kongwa district no medicinal values were mentioned for vegetable cowpea.

Tab. 5.31 Preservation of vegetable cowpea in four research districts of Tanzania.

	Arumeru (4 villages)	**Singida** (1 village)	**Kongwa** (3 villages)	**Muheza** (2 villages)
Ingredients		• leaves;	• leaves; • little water;	• leaves; • water; • salt;
Method		drying in direct sun;	boiling + drying in direct sun;	boiling + drying in direct sun;
Time		2 days - depending on light intensity;	5-15 min. for boiling leaves in water; 1-2 days for drying;	10-15 min. for boiling; 1-2 days for drying;
Important	not done; but knowledge available about preservation; only practised when leaves were plenty;	wilt leaves for few minutes + rub between fingers → to facilitate drying process, water can easier evaporate;	no additives (e.g. salt); put on polythene sheet for drying; taste will not be good if not boiled; storage in polythene bags for 2 years possible;	storage in plastic containers for 3-12 months possible; squeeze water before drying;
Ingredients			• leaves;	
Method			drying in direct sun;	
Time			1-2 days;	
Important			storage in polythene bags for 2 years;	

5.3 OKRA (*ABELMOSCHUS ESCULENTUS*) - A FRUIT AND LEAFY VEGETABLE

5.3.1 CHARACTERISTICS OF OKRA

In Africa, okra is a widely cultivated vegetable and can be found in almost every market. It is especially popular in West Africa where, e.g. in Cameroon it is the second and in Ghana the fourth most important vegetable (SCHIPPERS, 2002).

Taxonomy. Okra belongs to the tribe Hibisceae of the family Malvaceae, which is classified into five genera: *Hibiscus*, *Abelmoschus*, *Kosteletzkya*, *Thespesia* and *Gossypium*. Many *Abelmoschus* species used to be classified within the genus *Hibiscus*, but since 1787 Abelmoschus is treated as a separate genus (PRESTON, 1998). *Abelmoschus* is determined to consist of nine or ten species of which five occur in Africa: *A. moschatus* and *A. manihot* as well as *A. caillei*, *A. esculentus* and *A. ficulneus* (SCHIPPERS, 2002). Within these species, numerous cultivars exist that vary in leaf colour, fruit shape, stem length, time to maturity and other characters (TINDALL, 1983).

A. ficulentus, found in tropical lowland areas with a long dry season, is one of the two ancestors of the common okra (*A. esculentus*) (SCHIPPERS, 2002), whereas *A. caillei* was recognised only recently in 1988 as a new species of cultivated okra found only in West and Central Africa (PRESTON, 1998). While the common okra has benefited from worldwide research over many years, the West African okra (*A. caillei*) has not experienced much genetic enhancement and, due to a lack of combination of desirable characteristics in one or more uniform varieties, it will hardly win any recognition (SCHIPPERS, 2002).

Origin and Ecology. The genus *Abelmoschus* originated in South-East Asia (SIEMONSMA & HAMON, 2004). Nontheless, *A. caillei*, *A. esculentus* as well as *A. ficulneus* are considered to be indigenous to Africa, while *A. moschatus* and *A. manihot* were introduced from Asia to Africa in the distant past (SCHIPPERS, 2002).

In fact, A. caillei is a cultigen, which occurs mainly in West and Central Africa (SIEMONSMA & HAMON, 2004). For *A. esculentus*, an origin in the Sahara region is favoured as well as a northern Indian origin. In Africa, however, there exists a far greater diversity in *A. esculentus* than in Asia (SCHIPPERS, 2002). Similarly, SIEMONSMA & PILUEK (1994) states *A. esculentus* to be a cultigen of uncertain origin.

The two most important okra species in Africa are *A. esculentus* and *A. caillei*, whereby the latter is mainly found in the humid coastal zones of West and Central Africa as well as in an area, which extents from southern Senegal to southern Democratic Republic of Congo and up to Uganda (SCHIPPERS, 2002). Thus, its distribution is restricted to humid and perhumid climates in Africa, while *A. esculentus* besides occurring throughout the distribution area of *A. caillei*, can be found worldwide throughout

warm temperate regions, the tropics and subtropics (SIEMONSMA & HAMON, 2004). One reason for this distribution is that many types of West African okra show qualitative and quantitative short-day responses and are, therefore, not suitable for semi-arid and arid regions beyond latitudes of 12°N and 12°S, while the common okra is much more day-length-neutral (SIEMONSMA & HAMON, 2004).

A. caillei is highly valued since it continues fruiting during the dry season when only few other vegetables are available. Moreover, West African okra plants remain green during drought periods and, consequently, fresh leaves are always available. In contrary, the common okra sets fruit only under irrigation or during the rainy season (SCHIPPERS, 2002).

Though, being susceptible to drought, *A. esculentus* originated in a semi-arid environment where the salt level in soils is often high and, therefore, it is moderately tolerant to salinity, unlike *A. caillei*, which is rather prominent in the humid forest belt. Furthermore, *A. esculentus* does not perform well in the shade but prefers plenty of sunshine. Generally, okra does not grow well at temperatures below 20°C but can tolerate high temperatures (SCHIPPERS, 2002).

While TINDALL (1983) states that soil types appear not to influence development and growth of okra noteworthy and the crop can grow on a range of different soil types, SCHIPPERS (2002) specifies that a well-drained sandy loam with a pH of 6-6.8 is perfect for cultivating okra and that it does not perform well on acid or clay soils or in swampy areas.

Discription. While *A. esculentus* is cultivated as an annual herb of up to 2 m in height (TINDALL, 1983), *A. caillei* is an annual or bi-annual crop, which may also survive for three years and can reach 4 m or more in height as a shrub. However, mutations of *A. esculentus* found in coastal Tanzania can also grow 3 to 4 m in height with strong branches at the base (SCHIPPERS, 2002).

The main differences between *A. esculentus* and *A. caillei* is the width of the epicalyx segments as well as the length of the pedicels (Table 5.32). Both species can have various fruit colours ranging from purple-red to reddish-green, and from light-green to yellow (SCHIPPERS, 2002). Furthermore, flowers of both types are usually yellow with a dark-purple centre and between 5 and 8 cm long (BLANCKE, 2000). On the whole, both *A. esculentus* and *A. caillei* are highly polymorphic species and not all characteristics are consistent, thus, a combination of characters should always be used to distinguish between the two species (SCHIPPERS, 2002).

Tab. 5.32 Characteristics of two different *Abelmoschus* species according to SIEMONSMA (2004).

Species	Epicalyx segments	Pedicels	Fruit	
			colour	surface
A. esculentus (L.) Moench	narrow; up to 18;	shorter → upright fruit;	general lighter;	smooth;
A. caillei (A. Chev.) Stevels	broader; 5-10;	longer → pendant fruit;	general darker;	can be hairy or somewhat spiny;

Similarly, *A. ficulneus* can appear with different characteristics, e.g. either strongly branched and short or tall-growing up to 2 m in height with few branches, such as in southern Tanzania. Flowers are usually pink, fruit hairy with a rather round than pointed apex, and leaves are divided and fig-shaped (SCHIPPERS, 2002).

Cultivation. It is suggested to soak okra seeds for 24 hours before directly sowing on prepared ridges or beds with a spacing of 60-80 cm x 20-30 cm (TINDALL, 1983). To perform well, okra requires many nutrients, which should be incorporated into the soil prior to sowing. In addition, especially *A. caillei* requires more nutrients during the vegetative phase since it takes a longer time to flowering (SCHIPPERS, 2002). If there is no rain, irrigation is highly important for *A. esculentus* since the crop that suffer from water stress will drop its young fruit which will reduce total yield (SCHIPPERS, 2002). About 5 to 10 days after flowering and 60 to 180 days from sowing, young okra fruit may be harvested, depending on the species and cultivar grown. It is suggested to do repeated harvesting of young fruit because mature pods become fibrous (TINDALL, 1983).

Uses. While the West African okra is mainly grown for subsistence, the common okra is predominantly grown for market gardening (SCHIPPERS, 2002). Immature okra fruits of both types are used as a fried or boiled vegetable and they may also be dried and powdered for use as a flavouring. Due to their mucilaginous consistency, mature pods are often used in soups or sauces, and they are an ideal meal for dyspeptic people (BLANCKE, 2000). Further, young shoots and leaves are prepared and eaten like spinach (TINDALL, 1983). While most okras are eaten in a processed form, young fruits may also be eaten fresh as a salad. Because of its relatively long and more tender fruit, common okra is often preferred to West African okra. In fact, the fruits, of *A. caillei* are supposed to be rather solid, yet, they are also considered to have more flavour (SCHIPPERS, 2002).

Besides fruits, leaves and shoots, the seeds are of interest from a nutritional point of view since they contain about 20% of edible oil (TINDALL, 1983). In fact, amino acids found in seeds of *A. caillei* appear favourably, when compared with those in soya beans, eggs and poultry (SCHIPPERS, 2002). Seeds are also roasted and used as a

substitute for coffee (BLANCKE, 2000). Okra fruit and leaves are especially a good source of calcium (90mg / 100g edible portion in fruit and 70mg / 100g edible portion in leaves) (GRUBBEN, 1977; in: SCHIPPERS, 2002).

5.3.2 SPECIES OF OKRA GROWN IN NORTH-EASTERN TANZANIA

In general, okra types grown in traditional agriculture were often determined as landraces, which consisted of a mixture of *A. caillei* and *A. esculentus* (SIEMONSMA & HAMON, 2004). Therefore, scientific names of local crops were assumed rather than properly identified. Since *A. caillei* was mainly found in West and Central Africa (PRESTON, 1998) it was assumed that the different okra types described by farmers in Tanzania were primarily types of the species *A. esculentus*. However, some types had rather typical characteristics of *A. caillei* and were, therefore, assumed to belong to the latter. The different okra types and their characteristics are summarised in Table 5.33.
Five different okra types were mentioned by farmers, but two of them were not described in detail in Arumeru district, while six different types were distinguished in Singida district, three in Kongwa, and ten in Muheza district, where diversity of okra types was most significant. Since most okra types had no local name, characteristics to distinguish them were listed. Thereby, the availability of spines was a decisive trait, and to have no spines was usually named as a positive characteristic by farmers.

An *A. esculentus* type called "Pusa sawani" and also "Miezi moja uanze kuchuma" (= "one month until beginning of harvest") was ranked No.1 in Arumeru and Kongwa districts and, according to SIEMONSMA & PILUEK (1994), Pusa sawani is an Indian cultivar which had been introduced to East Africa, where it had become highly popular (SCHIPPERS, 2002). In Singida and Muheza district, an *A. esculentus* type ranked No. 1 as well. Qualities of okra preferred by farmers were early maturing and fast growing, whereas late maturing and a consequently late harvest was a negative characteristic in Arumeru district, which e.g. applied to the okra type 'miezi nne uanze kuchuma' (= four months until beginning of harvest) (*A. caillei*). The latter okra type was not marketable when 'Pusa sawani' was available. Nevertheless, since it yielded later than the other types it provided fruits and leaves when no other okra type was available and, therefore, bridged a gap in the market.

A positive characteristic of an okra type in Singida district was to contain not much mucilaginous material, which was not preferred by consumers as it occurred in other districts. Moreover, a red okra type was not liked by farmers since the colour was not attractive. An important characteristic in Kongwa district was fruits remaining soft as long as they were in the field and, consequently, an *A. caillei* type whose fruit became coarse at an early stage, additionally, spines were irritating during harvest and plants were late-maturing, was disliked by farmers (Table 5.34).

'Pamba' meaning 'cotton' was the name for two *A. esculentus* and one unidentified type in Muheza district, and farmers explained that their flowers resembled those of cotton plants. A desirable plant height of okra was rather long and a preferred fruit size rather big, so that only few fruits were needed for a meal. Furthermore, okra fruits compatible to be mixed with other vegetables, such as amaranth or African eggplant, were favoured in Muheza district.

5.3.3 PRODUCTION ISSUES OF OKRA

The traditional vegetable okra (*A. esculentus*, *A. caillei*) was especially important in the districts of Muheza and Singida, where it ranked second and fifth, respectively. In Kongwa, it was the seventh most important traditional vegetable while it ranked only No.13 in Arumeru district. Consequently, it was discussed with focus group participants for production issues only once in Arumeru and Kongwa district each, twice in Singida district, however, in four villages of Muheza district.

Cropping pattern. Okra was cropped as a monocrop only in Arumeru district, while in all other districts both intercropping and monocropping was applied (Table 5.35). Focus group participants argued that, if intercropped, okra would not get enough light and consequently would not bear nice fruits, but they would become slender and, as a result, yield would be low (Arumeru).

Okra was cropped alone during the dry season since it required frequent irrigation (Kongwa). In fact, a full-grown crop will consume about 8 mm of water per day under humid tropical conditions (SIEMONSMA & HAMON, 2004). Moreover, monocropping was preferred because it secured a better yield since the plant could spread and had not to compete for light. Especially, if okra was grown for a commercial purpose it was grown alone (Muheza). Of course, adequate space and light rather depended on plant spacing than on the cropping type (inter or sole). However, it was found that most commercial okra growers practise sole-cropping and, moreover, prefer the homogeneous, early and introduced cultivars of *A. esculentus* (SIEMONSMA & HAMON, 2004).
Still, intercropping was practised since it was more convenient to harvest, e.g. okra and local cucumber 'maimbe', at once for home consumption because these vegetables were usually prepared together (Singida). Another reason for intercropping was to save labour because e.g. weeding could be done for two crops at once (Kongwa). It is acknowledged that farmers practising traditional agriculture usually grow their okra landraces in home gardens or in fields together with other food crops (SIEMONSMA & HAMON, 2004).

Tab. 5.33 Okra types and their special positive and negative characteristics perceived by farmers in the four research districts of Tanzania.

District	Okra types	Positive characteristics	Negative characteristics
Arumeru	Pusa sawani / miezi 1 uanze kuchuma (*A. esculentus*)	• fast growth / early maturing → early harvest; • no spines;	• fast growth → short production period; • before mature, high mortality rate of plants;
	bamia ya Moshi (*A. esculentus*)	• fast growth → early harvest; • no spines, no hairs; • start production close to the ground;	• early maturing;
	miezi 4 uanze kuchuma (*A. caillei*)	• extended harvest → very good market when other types did not produce any more; • not susceptible to insect pests like "Pusa sawani";	• spiny → irritated during harvest; • late harvest; • marketing only good when 'Pusa sawani' not available;
	bamia ya magugu (*A. esculentus*)	• ranked only No.3 → no information;	
	(red fruit, stem, leaves, robust, tall) (?)	• ranked only No.3 → no information;	
Singida	(fruit long, slender, green, no ribs, no spines) (*A. esculentus*)	• contained not much mucilaginous material; • no spines;	• nothing;
	(fruit long, slender, green, ribbed, no spines) (*A. esculentus*)	• contained not much mucilaginous material; • no spines → easier harvest and cooking; • soft and palatable leaves; • stayed for a long time in the field while still producing; • long fruits → only few needed for a meal;	• susceptible to pests and diseases (insects on flowers and fruits, powdery mildew on leaves);
	(fruit short, broad, green, blunt end, with spines) (*A. esculentus*)	• produces many fruits (high yield);	• spines → no easy harvest and preparation; • lasted only for a short period in the field;

District	Okra types	Positive characteristics	Negative characteristics
Singida (continued)	(fruit short, broad, red, no spines) (*A. caillei*)	• long production period;	• nothing;
	(fruit short, red, ribbed, with spines) (*A. esculentus* ?)	• early maturing;	• spines on the whole plant → irritated during harvest; • less mucilaginous; colour not attractive;
	(fruit long, slender, green, with spines) *(A. caillei*)	• long production period;	• spines;
Kongwa	Pusa sawani (*A. esculentus*)	• fast growth / early maturing; • soft fruit as long as in the field;	
	(light green fruits, no ribs) (*A. esculentus*)	• early maturing; • soft fruit as long as in the field;	
	(ribbed fruits with spines) (*A. caillei*)	• big and long fruit;	• soft fruit for a short time only; • spines irritated during harvest; late maturing;
Muheza	Mshumaa (= candle) (*A. esculentus*)	• average amount of mucilaginous material; • no spines; • big fruits preferred by customers, few sufficient for a meal;	• nothing;
	(fruits long, slender, light green, no spines, no ribs) (*A. caillei*)	• repeated harvest after 3-4 days possible; • no spines;	• late maturing;
	(fruits long, slender, with spines, no ribs) (*A. caillei*)	• cooks fast, compatible with other vegetables for cooking; • long production period → fruit took longer to get over-mature;	• susceptible to insect pests (pollen beetles)

District	Okra types	Positive characteristics	Negative characteristics
	(fruit long, slender, green, no ribs, no spines) (*A. esculentus* ?)	• early maturing / fruiting; • no spines;	• nothing;
Muheza (continued)	Pampa jekundu (= red cotton) (?)	• no information;	
	Pampa nyeupe (= white cotton) (*A. esculentus*)	• matured early; no spines; • contained not much mucilaginous material;	• short production period;
	Pamba (= cotton) (*A. esculentus*)	• matured early	• short production period; • short in height;
	(fruit red, stout, short, ribbed, with spines) (*A. caillei*)	• big fruits → only few needed for a meal; • preferred to mix with amaranth and African eggplant;	• few spines;
	(fruit short, stout, green, ribbed, with spines) (*A. esculentus* ?)		• short production period → plant died soon; • spines;
	(fruit purple, grew in a curve, no spines)	• no information;	

Tab. 5.34 Evaluation of major characteristics of okra types by farmers in four research districts of Tanzania.

District	Okra types	Rank	Taste	Market	Availability	Yield	Drought resistant	Pest + Dis resistant	Nutrient content	Preparation	Seed availability
Arumeru	Pusa sawani (*A. esculentus*)	1	XXXXX	XXXXX	XXX	XXXXX	0	X	0	0	0
	bamia ya Moshi (*A. esculentus*)	2	XXXXX	XXXXX	0	0	X	X	0	0	X
	"miezi 4 uanze kuchuma" (*A. caillei*)	3	0	XXXX	0	0	0	XXXXX	0	0	0
Singida	(no ribs, no spines) (*A. esculentus*)	1	XXXX	0	0	0	0	0	0	0	0
	(ribbed, no spines) (*A. esculentus*)	1	XXXX	XXXX	XXXXX	XXXX	0	X	0	XXXX	0
	(blunt end, with spines) (*A. esculentus*)	2	XXXX	X	XX	XX	0	X	0	0	0
Singida (continued)	(red, no spines) (*A. caillei*)	2	0	0	XXXX	0	XXXX	0	0	0	0
	(red, ribbed, with spines) (*A. esculentus* ?)	2.5	X	0	0	0	0	XXXX	0	0	0
	(slender, with spines) (*A. caillei*)	3	0	0	XXXX	0	0	0	0	0	0
Kongwa	Pusa sawani (*A. esculentus*)	1	XXXXX	XXXXX	0	0	X	X	0	0	0
	(light green fruits, no ribs) (*A. esculentus*)	2	XXXX	XXXX	0	XXXX	0	X	0	0	0
	(ribbed fruits with spines) (*A. caillei*)	3	XXXX	XXXX	0	X	XXXX	0	0	0	0
Muheza	Mshumaa (*A. esculentus*)	1	0	XXXX	XXXX	XXXX	0	0	0	0	0
	(no spines, no ribs) (*A. caillei*)	1	XXXX	0	XXXX	XXXX	XXXX	0	0	0	0
	(with spines, no ribs) (*A. caillei*)	1	XXXX	0	XXXX	XXXX	0	0	0	XXXX	0

District	Okra types	Rank	Taste	Market	Avail-ability	Yield	Drought resistant	Pest + Dis resistant	Nutrient content	Pre-para-tion	Seed avail-ability
	(no ribs, no spines) (*A. esculentus* ?)	2	XXXX	XXXX	XXXX	XXXX	0	0	0	0	0
	Pampa jekundu (?)	2.5	0	0	0	0	0	0	0	0	0
	Pamba nyeupe (*A. esculentus*)	2.5	XXXX	0	XX	0	0	0	0	0	0
	Pamba (*A. esculentus*)	3	0	0	XX	0	0	0	0	0	0
	(red, ribbed, with spines) (*A. caillei*)	3	0	0	XXXX	XXXX	0	0	0	0	0

0 = no comment; X = very poor; XX = poor; XXX = average; XXXX = good; XXXXX = very good;

Tab. 5.35 Cropping patterns for okra in four research districts of Tanzania.

	Arumeru (1 village)	**Singida** (2 villages)	**Kongwa** (1 village)	**Muheza** (4 villages)
Inter-cropping	Not practised; Reason: fruit became slender;	Practised with tomato, African eggplant, pumpkin, bananas, "maimbe"; Reason: to harvest both crops at once;	Practised with maize; Reason: during rainy season to save labour, e.g. do weeding for 2 crops at once;	Practised with maize (random pattern); Reason: for home consumption;
Mono-cropping	Practised only; Reason: to give enough light to the plants;	Also practised;	Practised; Reason: during dry season with irrigation;	Practised; Reason: as commercial crop; higher yield; no competition for light; plant could spread;

Harvest. About 45 (Arumeru) to 60 days (Singida) after sowing harvest of okra fruit started. The earliest types of *A. caillei* are normally ready for the first harvest after 8 weeks or 56 days (SIEMONSMA & HAMON, 2004), while *A. esculentus* requires shorter time from seed emergence until flowering and fruit setting (SCHIPPERS, 2002). Thus, in Arumeru district early cultivars of common okra seemed to be available, while in Singida district rather late West African okra types or landraces with a greater portion of *A. caillei* were used.

Mature fruit had to be harvested within two or three days, since from the 4th day onwards they would be overgrown as farmers suggested in one village of Arumeru district. While over-aged fruits become fibrous, developing fruits should be harvested when 7-8 days old according to SIEMONSMA & HAMONS (2004), since picking too early results in low fruit weight and depressed yield. An economic production of fruits from the same plant could be expected only for two months, for home consumption fruits could be harvested for a three-months period (Arumeru). Repeated harvesting of fruits after every 3-4 days was possible (Singida and Muheza), whereas tender leaves were normally harvested once (Singida) or twice (Arumeru and Muheza) per week (Table 5.36). When leaves were picked too often, the life-span of the okra plant was shortened (Muheza). Apparently, it was not easy to achieve a high yield of leaves and fruits at the same time.

Since okra was a warm season crop, cultivation was problematic in cold or dry periods (Arumeru). It was either planted from December to March (Singida) and during the long or short rains (Muheza). According to water availability, harvest was possible from January to March in areas of higher altitude and between May and August in lower areas (Singida) (Table 5.37). The duration of harvest depended also on the okra

type or cultivar and, in one village of Arumeru district, okra was explained to be harvested even throughout the entire year.

Tab. 5.36 Harvest frequency of okra and time of harvest in three research districts of Tanzania.

	Arumeru (2 villages)	Singida (2 villages)	Muheza (2 villages)
Harvest frequency	fruit: for 2 months (economic production); for 3 months (home consumption); leaves: twice a week;	fruit: every 3-4 days; leaves: once a week;	fruit: every 3-4 days; leaves: every 3-4 days:
Time of harvest	May to July (warm season); throughout the year;	Jan-Mar in higher areas; May-Aug in lower areas;	June-Sep

Constraints. Like for African eggplant, water was perceived as a limiting factor for okra, especially between August and February in Arumeru district and during the dry seasons in Singida and Muheza district (Table 5.38). To maintain vigorous growth, supplementary irrigation up to the fruiting period of okra was suggested (TINDALL, 1983). On the other hand, excessive rain was responsible for a bad germination of okra seeds and for no setting of fruit (Muheza).

Seed availability was a problem stated in Kongwa district as well as in two villages of Muheza district. While in one village of Muheza district, seed quality was described to be bad, in another village insect pests were made responsible for okra seeds being not available. However, most farmers harvested seeds from their own local cultivars or landraces for the next season, and seeds were usually kept in the pods. While chemical control of insects would be risky because of frequent harvest of fruit and leave (SIEMONSMA & HAMON, 2004), control options of storage pests for small scale farmers were not discussed in the literature so far.

Pests were named in all districts as a production constraint. Pollen beetles (*Meligethes* spp.) were mentioned in Arumeru and Muheza district to attack okra. Furthermore, a cotton insect pest, which damaged the flowers and laid eggs in the fruit (Arumeru) as well as insects boring the seeds and sucking the fruits so that they turn yellow, flower beetles during the dry season and snails which ate the growing tip after fertilisation, constituted a major problem (Muheza). Powdery mildew (*Oidium abelmoschii*) was a problematic fungus for a red type of *A. caillei* (Singida). Furthermore, wilt (*Fusarium* spp.) was a drawback but the observed symptoms could be also due to an insect pest or nematodes, probably root-knot nematodes of the genus *Meloidogyne*, since roots of Okra were affected as well (Muheza).

Tab. 5.37 Seasonal calendar (time of harvest) fo r okra in three research districts of Tanzania.

Month		J	F	M	A	M	J	J	A	S	O	N	D
Season		Dry + hot season			Long rainy season			Dry + cold season			Short rainy season		
Arumeru	A	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
	B					Ø	Ø	Ø	Ø				
Singida		⊘	⊘	⊘		Ø	Ø	Ø	Ø				
Muheza							Ø	Ø	Ø	Ø			

- Arumeru district: **A** = Maweni village **B** = Karangai village
- Singida district: Ø = at lower altitude; ⊘ = at higher altitude;

As mentioned before, chemical control was difficult because of the short period between fruit formation and harvest. Additionally, chemical control was often more expensive than the loss of a few fruits. However, okra is a host to a range of pests that were also found on other members of the Malvaceae family such as roselle (*Hibiscus sabdariffa*), cotton (*Gossypium* spp.) and kenaf (*Hibiscus cannabinus*). It is, therefore, important to maintain a proper crop rotation, weed out other members of the Malvaceae family and avoid okra production near these other crops (SCHIPPERS, 2002).

Marketing was acceptable in one village of Muheza district, where only sometimes a surplus of okra existed. However, in two other villages it was not easy to market okra because the supply was abundant. Further, one male farmer claimed that organisation of the market was poor and no real market chain existed. Obviously, there were differences in marketing possibilities within one district and no general marketing strategy for one district but rather for individual villages existed.

Tab. 5.38 Constrains in producing okra in four research districts of Tanzania.

Constraints	Arumeru (1 village)	Singida (2 villages)	Kongwa (1 village)	Muheza (4 villages)
Labour availability	Labour hired for big plots;	-	-	-
Water	Limiting factor especially from Aug to Feb;	Problematic during dry season;	-	Affected during dry spell and excessive rain;
Soil fertility	-	-	-	No problem, no fertiliser applied;
Seeds	-	No problem, own seeds produced;	Not available;	Own seeds available (2 villages); poor seed quality (1 village); no seeds due to insect pests (1 village);
Weeds	-	-	-	-
Pests & Diseases	Pollen beetles; cotton insect pests;	Insect pests; powdery mildew;	Insect pests;	Pollen beetles; insects sucking fruit, boring seeds; snails; nematodes; wilting;
Marketing	No problem;	No problem for *A. esculentus*;	Good;	Problematic due to surplus, poor organisation of market chain;

"-" = issue not raised during focus group meeting

Responsibility. In general, all production steps of okra were carried out by both women and men, except harvesting, which was done by women alone (Arumeru), since it was argued that harvesting was a rather light kind of work and men could do further work in the meantime (Table 5.39). Moreover, okra was marketed by women solely (Singida) as well as the whole production of okra as a home-garden crop (Muheza). When okra became a cash crop, either both women and men were involved in all production steps (Muheza) or men were responsible for cropping it (Singida). Thus, while cash crop production was shared in Muheza, it was a sole men task in Singida, which was probably due to the different ethnic groups in the two districts and more patriarchic structures in Singida than in Muheza district as noticed during own observations and conversation to local people.

Tab. 5.39 Responsibility for the production of okra in four research districts of Tanzania.

Responsible	Arumeru (1 village)	Singida (2 villages)	Kongwa (1 village)	Muheza (4 villages)
Women	All activities; especially harvest;	All activities; especially marketing;	All activities;	All activities for home gardening (alone) and cash crop;
Men	All activities besides harvest;	all activities for cash crop;	All activities;	All activities for cash crop;

5.3.4 CONSUMPTION ISSUES OF OKRA

In Kongwa district, where okra was not very popular, consumption issues of this vegetable were not discussed. Yet, in two villages in each of the other three districts, focus group participants were reporting about the following facts.

Plant parts used. Fruit and leaves of okra were used for food in Arumeru and Singida district, while leaves were hardly used in Muheza district. Besides okra fruits only the young, immature leaves were harvested when there was no alternative.

Taboos. In general okra fruits and leaves were eaten by everyone in Arumeru and Singida district and if not there was no specific reason for this. Still, meals with okra fruits chopped into small pieces (see preparation, second recipe, Arumeru district) were not eaten or at least not preferred by men of Arumeru district because the consistency was highly mucilaginous and not easy to eat. Likewise, old and conservative men of the Arusha ethnic group refused to eat leaves of amaranth and African nightshade, which was due to their history as pastoralists and subsequent way of nutrition.

Several reasons for not consuming okra were suggested by farmers in Muheza district. Women who had just given birth did not eat okra, since it could cause stomach

pain within the first 40 days after delivery. It was assumed that "stomach pain" was not necessarily gastric pain but describing general pain in the abdomen. Additionally, when a person was using traditional healing to combat a snake bite, he or she should also not consume okra. It was further believed that tough and powerful men should not eat okra since they would loose their power when doing so.

5.3.5 PROCESSSING AND UTILISATION OF OKRA

Preparation. In general, more diverse recipes for the preparation of okra fruits existed, while okra leaves were usually mixed with pumpkin leaves and okra fruits when cooked (Arumeru), and especially young, immature leaves were preferred (Muheza). While in Arumeru and Singida district different methods of frying and boiling okra fruit and leaves were mentioned, in Muheza district only the boiling of okra was suggested by focus group participants (Table 5.40). To prepare okra only by boiling could be either due to taste or, otherwise, due to the availability of oil, which was used for frying.

Okra fruit. If spiny okra fruits were used, spines were first of all removed by scratching (Singida). After sorting and washing, it was of great importance if either only one or both ends of okra fruit were cut off, or if fruits were cut lengthwise or even chopped into small pieces. When the okra fruit was kept as a whole, the meal was less mucilaginous, since the slimy material inside the fruit would only leak from it when okra was chopped. A trick was to add lemon to the dish to prevent the consistency of being too mucilaginous (Arumeru). However, in Singida district okra fruits were always cut because people preferred the mucilaginous consistency.

For the first recipe in Arumeru and Singida district, the frying method, chopped onions were fried in oil until brown, chopped tomatoes were added as well as salt. Finally, okra was added and fried until tender, which took about 8 to 10 (Arumeru) or even 15 minutes (Singida). Thereby, a lid was used to keep the steam. An option of this recipe was to add milk or coconut milk or groundnuts at the end of the frying process (Arumeru). Additional ingredients could be chopped carrots and sweet pepper if available and liked, which were added before okra was added (Arumeru).

For the boiling method, usually chopped okra fruits were cooked in salted water together with further ingredients, such as leaves of okra or pumpkin (Arumeru), local cucumber, tomatoes (Singida), African eggplant fruit, mature mango or coconut milk (Muheza). Chopped cherry tomatoes were added in Muheza district to improve the taste, hence, they were utilised rather as a spice than as a vegetable. The meal with chopped okra fruit was not preferred by men in Arumeru district but eaten by women especially to treat stomach aches (see medicinal values). Preparation methods ap-

peared to be fairly similar in all districts, yet, different ingredients were used with okra according to what was locally available.

Okra leaves. Only the soft parts of the leaves were used and ribs and veins were sorted out (Singida). Usually, okra leaves were added into boiling water together with further leafy and fruit vegetables and boiled for 15 minutes as suggested in all three districts. Since okra leaves were never prepared alone, it might be assumed that their taste was not appreciated but had to be enhanced by additional vegetables.

In all districts, an important process after cooking and taking the pot of the fire was to keep on stirring the mixture for about 5 minutes to achieve a good consistency. The vegetable stew of either okra fruit or leaves could be mixed with beef and served with rice or cooking bananas (Arumeru) or ugali (maize porridge) like it was suggested in all districts.

Preservation. Neither okra fruit nor leaves were processed in Arumeru and Muheza district. Farmers explained that vegetables were available throughout the year and, therefore, there was no need for preserving them. Yet, farmers had been taught how to preserve okra but they did not practise it at the moment (Arumeru). Farmers had knowledge about preservation though it was not necessary in this area and obviously not their local knowledge. As farmers in Arumeru district lived close to the HORTI Tengeru as well as AVRDC-RCA, they benefited from education, advanced training and seminars.

However, in one village of Singida district farmers explained that okra was not preserved since it was not possible to keep the mucilaginous consistency during the drying process. Because the sliminess was highly important and demanded, people did rather without okra during the time when it was not freshly available than eating non-mucilaginous dried ones. Nevertheless, in the other village of Singida district, okra fruits were sliced into small pieces, put onto a plate and dried in the sun for 3-7 days depending on the light intensity. Obviously, even within the same district (here Singida) highly different tastes and preferences existed, and customs that were standard in one village could be downright unusual in the next village.

Medicinal value. In one village of Arumeru district, no medicinal values of okra were mentioned, while in the other village focus group participants reported that okra provided vitamin A. Apparently, different education levels in different villages of one district existed.

Furthermore, it could treat stomach upsets and stomach pains and it was suggested to eat one bowl of the second dish explained in Arumeru district (see preparation). However, mainly women ate this meal to treat stomach aches and it might be

concluded that this dish could treat women's specific disorders e.g. menstrual pains. Medicinal values of okra were neither named in Singida nor in Muheza district.

Tab. 5.40 Preparation of okra in three research districts of Tanzania.

	Arumeru (2 villages)	**Singida** (2 villages)	**Muheza** (2 villages)
Ingredients	• okra fruit; • oil; • onions; • tomatoes; • lemon (optional); • milk or coconut milk or groundnuts (optional); • carrots and sweet pepper (optional);	• okra fruit; • oil; • onions; • tomatoes; • little water (optional); • salt (optional);	• okra fruit; • pumpkin leaves; • African eggplants; • water; • soda salt; • local cherry tomato;
Method	frying;	frying;	boiling;
Time	8-10 min.;	15 min.;	15 min.;
Important	cut only ends of okra; use a lid while frying okra;	cut ends of okra and optional lengthwise;	cut okra fruit into small pieces; keep on stirring after boiling;
Ingredients	• okra fruit; • okra or pumpkin leaves; • water; • salt;	• okra fruit; • local cucumber; • tomatoes (optional); • water; • soda salt;	• okra fruit; • mature mango; • onions; • salt; • little water; • coconut milk;
Method	boiling;	boiling;	boiling;
Time	7-10 min.	15 min.;	15 min.;
Important	cut okra fruit into small pieces; eaten by women only; medicinal value;	cut okra fruit into small pieces; stir the mixture;	cut only ends of okra;
Ingredients	• 5-6 tender okra leaves; • handful of pumpkin leaves; • 10 okra fruits; • 1 tomato; • 1/2 onion; • 1-1.5 l water; • soda and table salt;	• okra leaves; • pumpkin or local cucumber leaves; • water; • salt;	• okra fruit; • pumpkin leaves or African eggplant; • little water; • salt;
Method	boiling;	boiling;	boiling;
Time	15 min.;	15 min.	15 min.;
Important	add everything at once; stir after cooking for 5 min.;	only soft part of leaves taken, ribs and veins sorted out;	cut okra fruit into small pieces;
Ingredients		• okra leaves; • okra fruit; • little water; • salt;	• okra leaves; • pumpkin leaves; • little water; • salt;
Method		boiling;	boiling;
Time		15 min.;	15 minutes;
Important		only soft part of leaves taken; stir while boiling;	stir while boiling;

5.4 JUTE MALLOW (*CORCHORUS OLITORIUS*) - A TRADITIONAL WILD VEGETABLE

5.4.1 CHARACTERISTICS OF JUTE MALLOW

Corchorus species are mainly known for their sturdy fibre product jute, while it is seldomly realised that special types of jute mallow are widely cultivated as a leafy vegetable (PALADA & CHANG, 2003). This vegetable is known under many different names such as 'Jew's mallow', 'jute mallow' or 'bush okra' in English, 'corète patagère' in French and 'mlenda' in kiswahili (PALADA & CHANG, 2003; SCHIPPERS, 2002).

Taxonomy. *Corchorus*, a member of the Tiliaceae (Jute) family, consists of some 50 to 60 species. Of the about 30 *Corchorus* species found in Africa, *Corchorus olitorius* is the most common and most frequently cultivated one besides *C. tridens* and *C. trilocularis* (SCHIPPERS, 2002). However, in Tanzania *C. tridens* as well as *C. trilocularis* are both only collected from the wild, whereby the latter is sometimes propagated by seeds (RUFFO et al., 2002). Species that are also commonly used as a wild vegetable in Tanzania are *C. fascicularis* L. as well as *C. pseudocapsularis* (RUFFO et al., 2002). Furthermore, *C. aestuans* L. (syn. *C. acutangulus* Lam.) as well as *C. asplenifolius* Burch. are mainly weedy and occasionally semi-domesticated species in Africa, which are frequently collected from the wild and only rarely cultivated (SCHIPPERS, 2002).

Origin and Ecology. The origin of *C. olitorius* is most likely Africa since there exist a much wider diversity within this species in Africa than in China or India, where *C. olitorius* is also cultivated since ancient times. North India, Myanmar and Bangladesh are, therefore, considered as secondary centres of diversity (SCHIPPERS, 2002). *C. olitorius* grows in most of Africa in a range of climatic zones and in places up to 1500 m asl. whereby it prefers alluvial soils or sandy loam (MAUNDU et al., 1999a). It is susceptible to cool weather and does not perform well under drought, thus, the ideal conditions are temperatures between 25 and 32°C and an annual rainfall of between 600 and 2000 mm in general (FONDIO & GRUBBEN, 2004; SCHIPPERS, 2002), and of between 1000 and 1800 mm in Tanzania (RUFFO et al., 2002).

C. trilocularis is also found in most parts of Africa but in contrary to *C. olitorius* it can grow in areas up to 2100 m asl. (RUFFO et al., 2002) or even up to 2400 m asl. (MAUNDU et al., 1999a). *C. trilocularis* further appreciates high temperatures as long as there is adequate moisture in the rooting zone (SCHIPPERS, 2004). It occurs in disturbed grassland or as a secondary re-growth after cultivation whereby it prefers black-cotton soil and brown clay-loam (RUFFO et al., 2002). C. tridens thrives in moist deep

red and brown soils and is common as a weed in cultivated areas, as secondary re-growth in disturbed areas, thickets, and forest edges (RUFFO et al., 2002). It is a rather drought resistant crop (MNZAVA, 2004).

Discription. Jute mallow is an annual herb or short-lived perennial with different growth habits. While *C. olitorius* is an erect and woody herb which grows 0.5 to 1.2 m and can reach up to 2.5 m in cultivation (MAUNDU, 1999a), *C. trilocularis* and *C. tridens* are shorter in height and do not exceed 1 m (SCHIPPERS, 2002). In fact, *C. trilocularis* grows up to 90 cm and is a much branched herbaceous or woody annual, whereas *C. tridens*, an erect or low-growing branched annual herb, will reach only about 45 cm (RUFFO et al., 2002). The wild jute mallow species, *C. fascicularis* is a sub-erect herb which grows up to 40 cm in height, while *C. pseudocapsularis* can be described as an annual herb, about 60 cm high (RUFFO et al., 2002) (Table 5.41). Furthermore, the wild species *C. aestuans* is growing close to the ground and reaching only about 30 cm in height and, similarly, the horizontal branches of *C. asplenifolius* can be mainly found at ground level (SCHIPPERS, 2002).

Tab. 5.41 Main differences between five *Corchorus* species grown in Tanzania according to MAUNDU et al. (1999), RUFFO et al. (2002) and SCHIPPERS (2002).

Characteristics	*Corchorus olitorius*	*Corchorus tridens*	*Corchorus trilocularis*	*Corchorus fascicularis*	*Corchorus pseudocapsularis*
Status	cultivated;	wild, occasion-ally cultivated;	wild, occasion-ally cultivated;	wild	wild
Height	0.5 - 1.2 m; 2.5 m in cultivation;	0.45 m;	0.9 m;	0.4 m	0.6 m
Leaves	dark-green, glossy;	light to yellowish-green; long oval; about 7 cm;	light to yellowish-green; oblong to narrow-oval; 11cm;	elliptic;	(bright yellow flowers);
Capsules	5-7-valved; straight beak;	3-valved; long; green-brown; smooth; 4 cm; 3 small and spreading horns;	3-4-valved; smooth; 8.5 cm; short pointed tip; no horns;	2-5 small capsules in a group;	-

The stem of jute mallow contains abundant fibres in the phloem tissues (TINDALL, 1983), while the leaves hold mucilaginous material (YAMAGUCHI, 1983). Leaves are normally glossy and dark-green of *C. olitorius* and light to yellowish-green as well as oblong and non-shiny of *C. tridens* and *C. trilocularis*. Furthermore, *Corcho-*

rus species are distinguished by the number of valves of their capsules as well as beak length and availability of horns at the end of the capsules.

Cultivation. *C. trilocularis* is collected from the wild or from fields, where it is left untouched during weeding. If cultivated, a similar technology may be applied as for *C. tridens* and *C. olitorius*. These latter are usually grown as rainfed crops without much care (FONDIO & GRUBBEN, 2004; MNZAVA, 2004). In most places of Africa, Jute mallow is cultivated in mixed-cropping systems for subsistence, thereby, being mainly compatible for planting with staple crops rather than with other vegetables, where it shows a low competitive ability. Yet, in some areas, e.g. in Cameroon, monocropping is practised because *C. olitorius* is grown as a cash crop (SCHIPPERS, 2002).

Seeds can be sown directly on raised beds or ridges, or they are sown in a seedbed and transplanted later (TINDALL, 1983) with a spacing of 30 to 50 cm between rows and about 20 cm within rows, depending on the type or variety chosen (Schippers, 2002). Direct sowing is usually done during the dry season, when flooding is not a problem, seed is abundant, and labour is limited as well as when it is aimed at a singular harvest. On the other hand, transplanting is suggested during the wet season, when heavy rain occurs which could wash out the seeds, when there is plenty of labour and limited supply of seed and, moreover, when the crop should be harvested multiple times (PALADA & CHANG, 2003).

The vegetative yield of *Corchorus* has been significantly influenced, when manure or fertiliser was applied to the crop (SCHIPPERS, 2002). 30 to 60 days, or even 20 to 40 days after planting if the variety is sensitive to short daylengths, jute mallow is harvested. Either whole plants are uprooted when 20 to 30 cm tall, or young leaves and shoots are picked repeatedly every two to three WEEKS (PALADA & CHANG, 2003). In fact, breaking of small branches encourages the growth of new shoots (MAUNDU et al., 1999a), it further prolongs the harvest period since it delays flowering and harvest of one plant may be repeated three or four times (PALADA & CHANG, 2003).

Uses. The tender and mucilaginous leaves are prepared like spinach (YAMAGUCHI, 1983), often together with other coarse vegetables, such as *Gynandropsis gynandra*, *Crotalaria brevidens*, *Crotalaria ochroleuca* or *Vigna unguiculata* to reduce the sliminess (MAUNDU et al., 1999a). Besides being used fresh, leaves are also preserved by steam-blanching, followed by drying in the sun whereby most ascorbic acid is retained, even after 6 months (SCHIPPERS, 2002). Besides Vitamin C, jute mallow leaves are further rich in nutrients such as folic acid, iron, calcium and protein (PALADA & CHANG, 2003).

5.4.2 SPECIES OF JUTE MALLOW GROWN IN NORTH-EASTERN TANZANIA

Jute mallow was not prominent in all research districts, but in Singida and Kongwa located in the rather dry Central Tanzania. In fact, in Singida district jute mallow, though gathered from the wild, was the most important traditional vegetable, which ranked No. 1 in all villages without exception. Farmers distinguished mainly between two types of jute mallow, namely an erect type called "wima" (= erect) or also "ikugha" (presumably *Corchorus trilocularis* or *C. olitorius*), and a type with spreading plant habit called either "mbarta", "mbaata", "mbata" or "mbara" (presumably *Corchorus tridens*). The different names of the latter were possibly due to distinct pronunciation in different villages and the researchers being not familiar with these names and their spelling. A third jute mallow type called "nguleli" was described in one village, the type "kifuo" was even mentioned in two villages but it was suggested that this type was not common, neither were "mnkhara" and "mtae" types. In fact, type "mtae" as well as five other types got lost or were not used any more due to different reasons (see also chapter 4.3).

The main difference between the erect and the spreading jute mallow type in Singida district was that the former was drought-resistant and, therefore, available throughout the year, while the spreading type was only available during the rainy season. Furthermore, the taste of the erect type was slightly better and preparation a little easier, i.e. cooking-time was shorter. However, in different villages opposed characteristics of the same growth type were mentioned. Especially, the amount of mucilaginous material was often a subject of discussion even within one village: while especially older men maintained that the mucilaginous substance was often insufficient and that jute mallow had to be slimy, young people complained about too much mucilage, which complicated eating of jute mallow.

An advantage of the spreading type was that it was available close to homesteads in the cultivated fields, while the erect type grew also in uncultivated land far away from houses. Moreover, the spreading type did not turn bitter after preservation and after a certain time of storage, like the erect type would do. Further positive and negative characteristics of both jute mallow types can be viewed in tables 5.42 and 5.43.

In Kongwa district, farmers also distinguished between erect and spreading jute mallow types but there was a greater diversity, namely three erect (presumably *Corchorus trilocularis*, *C. tridens* or *C. olitorius*), and two spreading types (most likely *Corchorus tridens*) were differentiated. In contrary to Singida district, the spreading types were suggested to be drought-resistant and in one village one of the spreading types was even marketed, while all other types were usually not sold on the market. The spreading jute mallow types were further more preferred due to a better taste if com-

pared with the erect types. Only one erect type, namely "ng'honjera" (possibly *Corchorus trilocularis* or *C. olitorius*), was stated to be somewhat drought-resistant. The erect types could further tolerate excessive rain, while the spreading types could not, which was obviously relevant in Kongwa district, while it was not mentioned in Singida district.

5.4.3 PRODUCTION ISSUES OF JUTE MALLOW

As a traditional vegetable collected only from the wild in the research regions of Tanzania, jute mallow played a major role in the semi-arid district of Singida where it was the most important vegetable as well as in Kongwa district, where it ranked No. 4. It was less important in the humid districts of Arumeru and Muheza, where it ranked only No. 12. Consequently, production as well as consumption issues of jute mallow were only discussed in five villages of Singida and three villages of Kongwa district and not at all in the other two districts.

Habitat. Since jute mallow was gathered from the wild in all villages studied, cropping patterns were not mentioned. However, farmers explained in what kind of habitat they usually found jute mallow plants. In Singida district, they even distinguished between the habitat of the erect and the spreading jute mallow types (Table 5.44). Since the spreading types occurred in cultivated fields only, it could be called rather semi-domesticated than wild. Likely, the treatments for the actual crop such as manuring, watering or weeding were a benefit for jute mallow and the plants probably already adapted to these more preferable conditions in contrary to uncultivated land. In contrary, the erect jute mallow type in Singida district was a real wild type since it appeared only in uncultivated land. Consequently, when more and more open or wild land was taken into cultivation, the habitat of the erect type decreased. In Kongwa district, farmers did not separate the different types of jute mallow in terms of habitat.

Tab. 5.44 Habitat where jute mallow was usually collected as mentioned by farmers in two research districts of Tanzania.

	Singida (5 villages)	**Kongwa** (3 villages)
Spreading types	in cultivated fields of maize, millet sorghum, cowpea, amaranth, sweet potato, pumpkin, local cucumber (maimbe);	both types in cultivated fields of maize, sorghum, groundnut; also in uncultivated land;
Erect types	in uncultivated land, open land, bush, forest;	

Tab. 5.42 Jute mallow types and their special positive and negative characteristics perceived by farmers in two research districts of Tanzania.

District	Jute mallow type	Positive characteristics	Negative characteristics
Singida	wima (= erect); ikugha; (*C. trilocularis* / *C. olitorius* ?);	• matures early; • short cooking time, not many ingredients / no oil needed; • can be mixed with all vegetables when cooking; • amount of mucilaginous material just right / only little; • easy eating: no chewing necessary, just swallow; • no costs → pick from the wild; • storage for one year after processing; not bitter when stored; • part of the culture ("asili"), known since many generations; • "when you eat it you become tough" (stated by a man); • supplementary food for kids under five;	• complicated harvest during dry season → scratch the ground, open soil with a stick to find and obtain leaves; plants grew far apart from each other → had to search; • competition with animals during dry season; • necessary to add soda salt to reduce cooking time; • bitter after 3-4 month of storage; • too slimy - had to mix with maize or other food; • colour when processed (pale green) not attractive - people preferred dark green colour; • available throughout the year → got tired of it; • dry season: sand contaminate leaves close to the ground; • rainy season: elasticity (important for cooking) got lost;
	mbata; mbarta; mbaata; mbara; (tambaa = spreading); (*C. tridens* ?)	• available during rainy season in the field, close to home; • amount of mucilaginous material abundant but less after cooking; • short cooking time; no oil needed for cooking; • no costs → pick from the wild / grows in cultivated fields; • storage for a long time after processing → not bitter;	• not enough mucilaginous material (mentioned by old man); • too much mucilaginous material, esp. during rainy season; • dirty through sand when it rained → had to harvest before rain started; • inconvenient harvest: small plant, had to bend;
	nguleli (?);		• available only during rainy season;
	kifuo (?);		• not common;

District	Jute mallow type	Positive characteristics	Negative characteristics
Kongwa	ng'honjera, mkonjera, (wima = erect); (*C. trilocularis* / *C. olitorius* ?);	• good / intermediate taste, flavour, aroma; • available throughout the year / long production cycle; • short cooking time, not many ingredients needed; • easy to swallow for sick people; • fast growth; • rain tolerant;	• no good taste, aroma and smell; • taboo for (young) men: decreased reproductive ability; • long cooking time, soda salt and groundnuts needed (→ to soften leaves and shorten cooking time); • not available during dry season → low yield; • early maturing → little yield;
District	**Jute mallow type**	**Positive characteristics**	**Negative characteristics**
Kongwa (continued)	ng'hundagwa, imana, mzole, (wima = erect); (*C. trilocularis ?*);	• better taste than Ng'honjera; • short cooking time; • excessive rain tolerant; • contained not much water during rainy season;	• not available during dry season → low yield;
	mlikwi, nzole, (wima = erect); (*C. tridens* ?);	• short cooking time; • rain tolerant; • easy to swallow for sick people;	• not available during dry season → low yield;
	tambaa, (= spreading); (*C. tridens* ?);	• good taste, flavour, aroma; • short cooking time; • high yield; • long production period (drought resistant);	• early maturing → had to harvest early; • contained much water;
	mgalu, mbaata, mbata, (tambaa = spreading); (*C. tridens* ?);	• storage for one year possible; • short cooking time; • easy to swallow for sick people; • fast growth;	• susceptible to excessive rain; • stomach disorders through eating possible;

Tab. 5.43 Evaluation of major characteristics of African eggplant types by farmers in two research districts of Tanzania.

District	Jute mallow type	Rank	Taste	Market	Availability	Yield	Drought resistant	Pest + Dis resistant	Nutrient content	Preparation	Seed availability
Singida	Erect type	1.0	XXXXX	0	XXXXX	0	XXXX	0	0	XXXXX	0
	Spreading type	2.0	XXXX	0	XXX	0	X	0	0	XXXX	0
Kongwa	Spreading type (mgalu)	1.0	XXXXX	XXXX	XXXX	XXXX	XXXX	XXX	0	XXXX	0
	Spreading type (tambaa)	1.0	XXXX	0	0	XXXX	XXXX	XXXX	0	XXXX	0
	Erect type (ng'hundagwa)	2.5	XXX	0	0	XX	X	XXX	0	XXXX	0
	Erect type (ng'honjera)	3.0	XXX	0	XXXXX	XXXX	XXX	XXXX	0	XXX	0
	Erect type (mlikwi, nzole)	3.0	XXX	0	0	0	X	XXXX	0	0	0

0 = no comment; X = very poor; XX = poor; XXX = average; XXXX = good; XXXXX = very good;

Harvest. Farmers suggested to collect leaves of both jute mallow types once a week, though, the spreading jute mallow types was stated to grow faster than the erect type (Singida). In Kongwa district, farmers explained that there was no specific interval of harvesting since leaves were collected from the wild and different people harvest probably from the same plants. With the onset of rain, jute mallow started to germinate and was ready to harvest after two to three weeks later.

Time of harvest was very different, not only between the two districts but also between individual villages of one district (Table 5.46). The non-drought resistant spreading type, for example, could be collected for four months only, with a specifically good harvest in February, however, it was affected by insect pests and would drop its leaves from April onwards (Singida). Quite contrary to this, it was possible to gather from this growth type for the whole year in two villages of Kongwa district. The erect jute mallow type, however, which was characterised as drought-resistant in Singida district, was affected by drought and only harvested during certain months in Kongwa district. Nevertheless, in one village of Kongwa district both jute mallow growth types were collected throughout the year.

The property 'drought resistance' was obviously not connected with the plant habit since there occurred both spreading and erect jute mallow types with both characteristics 'drought-resistant' and 'non-drought-resistant'. This would suggest a high genetic diversity since there might be more physiological types within one particular growth type. To be available throughout the year was dependent also on further factors such as the pressure of pests and diseases, soil fertility and degree of land disturbance.

"Do not pick leaves before March - or the rain will stop!"

In one village of Kongwa district it was believed that if jute mallow leaves to be used for preservation were picked already in January and February, the rain would stop. Only leaves that were consumed fresh could be picked at the beginning of the year already, but otherwise it was not allowed to start picking jute mallow leaves before March.

Constraints. Since jute mallow was wild and not under cultivation, farmers mentioned only few problems of this vegetable, which attracted their attention (Table 5.45). Water scarcity was a problem, especially for the erect jute mallow type but less for the spreading type, (Kongwa). If rain was insufficient, jute mallow was not available (Kongwa) or severely affected (Singida). All three *Corchorus* species thrived best during the rainy season, and only *C. tridens* was rather drought-resistant, however, could tolerate only about a month without rainfall (Mnzava, 2004).

Especially the spreading jute mallow type was highly affected by insects and there was competition with free-ranging animals that preferred this plant as fodder

(Singida). In contrary, farmers in Kongwa district mentioned the erect type to be highly affected by insect pests, while the spreading type was not susceptible. In general, jute mallow was known to be rather resistant to pests and diseases. However, some damaging pests were different types of mites (*Tetranychus* spp.), beetles (*Podagrica* spp.) and caterpillars (*Acrea* spp.), and especially *C. olitorius* is highly susceptible to root-knot nematodes (*Meloidogyne* spp.).

Though being a wild vegetable, which could be collected by everyone, jute mallow was obviously demanded on the market by non-farming people in Singida district. Also in Singida, farmers stated repeatedly that no costs were involved to obtain jute mallow, which was one of the positive characteristics. To obtain it, little input was required and, therefore, the profit margin was quite high when it was sold for cash.

Tab. 5.45 Constraints in producing jute mallow in two research districts of Tanzania.

Constraints	**Singida** (5 villages)	**Kongwa** (3 villages)
Labour availability	-	-
Water	Affected in extreme drought periods;	No growth with insufficient rain; problem for erect not for spreading type;
Soil fertility	-	-
Seeds	-	-
Weeds	-	-
Pests & Diseases	Spreading type highly affected; competition with free ranging animals;	Erect type highly affected; leaf-rolling insects and leaf blight during heavy rains;
Marketing	no problem;	-

"-" = issue not raised during focus group meeting

Responsibility. The only production steps for this crop were harvest and preparation, exclusively carried out by women in both Singida and Kongwa district. When cultivated fields were weeded, jute mallow was left to grow there - also by men. Though, jute mallow was sold on the market in two villages of Singida district, it was mainly collected for own consumption. Like home-gardening, which was also mainly performed for subsistence and where no cash was obtained, collecting of jute mallow was a sole women task.

Tab. 4.46 Seasonal calendar (time of harvest) for jute mallow in two research districts of Tanzania.

Month		J	F	M	A	M	J	J	A	S	O	N	D
Season		Dry + hot season			Long rainy season			Dry + cold season			Short rainy season		
Singida													
Spreading type	**A**	ø ø ø ø ø ø ø ø ø ø ø ø											
	B		ø ø ø ø ø ø ø ø ø ø ø ø										
	C	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø										
Erect type		ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø
Kongwa													
Spreading type		ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø
Erect type	**A**	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø	ø ø ø ø ø ø ø ø ø ø ø ø
	B	ø ø ø ø ø ø ø ø ø ø											
	C	ø ø ø ø ø ø ø ø											ø ø

- Singida district: **A** = Ilongero and Itamka I village; **B** = Iseke village; **C** = Itamka II village;
- Kongwa district: **A** = Mlali-Iyegu village; **B** = Mbande village; **C** = Chamae village;

5.4.4 CONSUMPTION ISSUES OF JUTE MALLOW

As mentioned before, consumption issues of jute mallow were only discussed in Singida and Kongwa district, in five and three villages, respectively. Leaves of jute mallow were the only plant parts harvested and used for consumption in both districts.

Taboos. While in three villages of Singida district no general reasons for not consuming jute mallow leaves were indicated but individual ones, in one village, farmers stated that dried jute mallow leaves were not eaten by people with stomach aches. Furthermore, the local medicine men in another village advised especially women who had stomach or abdomen problems due to child birth not to eat jute mallow leaves for a certain time. Interestingly, while roots of jute mallow could treat stomach pains, leaves of the same plant were taboo when problems with the stomach were troubling a person.

There was one main taboo mentioned in all villages of Kongwa district concerning the erect jute mallow type called "ng´honjera". Men were not allowed to eat this type since it would reduce their reproductive ability. This information was first paraphrased in one village, explaining that men when eating "ng´honjera" would have no good fortune and e.g. would fall from a house while building or be bitten by a snake when in the field.

5.4.5 PROCESSING AND UTILISATION OF JUTE MALLOW

Preparation. Farmers applied different methods for preparing fresh and dried jute mallow leaves. Boiling as well as frying was used to prepare the leaves in Singida district, whereas only boiling methods were common in Kongwa district. Usually, jute mallow leaves were usually mixed with leaves of local cucumber ('maimbe') (Singida), pumpkin leaves or groundnuts (Kongwa). Furthermore, leaves were sorted, cleaned and shaken to remove branches, dust and sand, but they were not washed. Washing of leaves would increase the mucilaginous consistency (Singida and Kongwa) or, as explained in another village, leaves would loose water through washing. Leaves were either not cut because they were already small enough (Singida) or according to individual preferences (Kongwa).

Fresh jute mallow leaves. One main dish called "mapishi" (pishi = 2 litre measure) plus several options was explained in Singida district, while there were two different recipes for boiling fresh jute mallow leaves in Kongwa district (Table 5.47). The amount of water used for cooking depended on the amount of leaves, but it would evaporate so that there was no water left afterwards and the process could rather be called steaming than boiling (Singida). Through this preparation method important nutrients were conserved, which was a great advantage in terms of nutrition. Mixing and

stirring ("pekecha") was important to get a good consistency and in Kongwa district, a special mixing-stick or blender was used for this purpose.

One option for the first dish was to first boil crushed groundnuts in water until soft for 5 minutes before adding cold water and, finally, jute mallow leaves because they would form lumps in hot water. Cooking was started again for about 5 minutes. Nevertheless, it was often suggested to add leaves directly to boiling water and the described lumps were probably only troubling the focus group participants in one village.

Local 'soda salt' or 'soda ash'

The local 'soda salt' containing soda or bicarbonate was used to shorten the cooking time of jute mallow leaves. At the same time, leaves were softened which was important if no young and tender leaves were available. Table salt was added since it was the ingredient, which enhanced the flavour.

On the other hand, mixing of leaves during and after the cooking process was frequently stressed and it could be assumed that through stirring the lumps of leaves were avoided.

Pumpkin leaves were said to reduce the mucilaginous habit of jute mallow and were therefore, mixed with jute mallow leaves in a ratio of jute mallow : pumpkin = 2:1 (Kongwa).

Dried jute mallow leaves. Dried leaves were always used in a mixture with a little flour (maize, sorghum or millet) and this mixture was carefully ground and sieved (Singida). Dried jute mallow leaves could also be mixed with groundnuts in a ratio of leaves : groundnuts = 1:1.5 and pounded and sieved to obtain a very fine powder. Optional a mixture of different leaves, e.g. jute mallow and pumpkin, was grounded and sieved together (Kongwa). The time for frying or boiling was considerably shorter for dried than for fresh leaves and amounted only to (2)3-5(10) minutes.

For a dish called "kukausha" in one village of Singida district, the mixture of dried leaves and flour was added to warm but not boiling water, which already contained either milk or crushed groundnuts or tomatoes. For ten minutes, the mixture was stirred until ready. Dried, pounded and sieved leaves of jute mallow and local cucumber were also prepared like fresh leaves (Singida).

Tab. 5.47 Preparation of jute mallow in two research districts of Tanzania.

	Singida (5 villages)	**Kongwa** (3 villages)
Ingredients	• fresh jute mallow leaves; • local cucumber (maimbe) leaves • water; • soda salt + table salt; • tomatoes (option); OR • mature cowpeas (option); OR • grounded groundnuts (option);	• fresh jute mallow leaves; • little water; • soda salt + table salt; • grounded groundnuts (option);
Method	boiling;	boiling;
Time	10-15 min. for both leaves; OR 10-15 min. for cucumber leaves; 10-15 min. after adding jute mallow leaves;	15 min.
Important	washing of leaves would increase mucilaginous material; water was evaporated when dish was ready;	washing of leaves would increase mucilaginous material;
Ingredients	• dried jute mallow leaves; • dried local cucumber (maimbe) leaves; • flour (maize, sorghum or millet); • oil (or water); • salt; • tomatoes (option); AND/OR • onions (option); • little water or milk (option);	• fresh jute mallow leaves; • fresh pumpkin or local cucumber ('maimbe') leaves; • little water; • soda salt; • grounded groundnuts; • table salt;
Method	pounding and frying;	boiling;
Time	3-5 min.	5 min. for leaves; 5 min. when groundnuts were added;
Important	pound leaves and flour before frying; keep on stirring while frying;	pumpkin leaves reduced sliminess; mix ("pekecha") well with a mixing-stick;
Ingredients	• dried jute mallow leaves; • dried local cucumber (maimbe) leaves; • flour (maize, sorghum or millet); • tomatoes (option); OR • grounded groundnuts (option); OR • milk (option);	• dried leaves; • groundnuts; • little water; • salt;
Method	boiling;	pounding and boiling;
Time	10 min.	2 min. / 5-7 min.
Important	lumps would occur when dried leaves were added to boiling water - use warm water; keep on stirring while boiling;	pound leaves and nuts and sieve before cooking; leaves : nuts = 1:1.5;
Ingredients		• dried jute mallow leaves; • dried pumpkin leaves; • little water; • salt; • tomatoes (option);
Method		pounding and boiling;
Time		5 min.
Important		pound and sieve leaves before cooking;

Preservation. Jute mallow leaves were preserved in all villages of both districts. Leaves were normally dried in the direct sun on different underlays and time for drying depended on the light intensity (Table 5.48). Only in one village of Singida district, a solar drier for drying leaves was mentioned, which would take longer than drying leaves in the direct sun (e.g. one day in direct sun, two days in solar drier).

In Kongwa district, jute mallow leaves were either dried alone or in a mixture with pumpkin or local cucumber leaves (ratio jute mallow : pumpkin = 1:1 or 2:1) and especially tender jute mallow leaves were preferred for drying. In one village of Kongwa district, it was additionally suggested to rub leaves after drying between the hands and winnow them to remove e.g. sand. The latter was probably only necessary when leaves were dried on the bare ground without an underlay.

The dried leaves were stored in containers for 6 to 7 months when leaves were harvested during the dry season and only for 3 months when leaves were picked in the rainy season (Singida). Obviously, it was not possible to dry leaves properly in rather humid conditions during the rainy season. However, this was probably not too necessary, since during the rainy season vegetable was abundant. In other villages farmers stated that dried jute mallow leaves could be stored for up to one year (Singida) or even for up to two years (Kongwa). While a storage period for dried and pounded *C. olitorius* leaves of at least half a year (FONDIO & GRUBBEN, 2004), and for C. trilocularis of up to one year was acknowledged (SCHIPPERS, 2004), the questions arose about the level of nutrients left after a storage period of two years.

Tab. 5.48 Preservation of jute mallow in two research districts of Tanzania.

	Singida (5 villages)	**Kongwa** (3 villages)
Ingredients	• jute mallow leaves;	• jute mallow leaves; • pumpkin or local cucumber leaves;
Method	drying in direct sun;	drying in direct sun;
Time	1-2 days;	1-3 days;
Important	dry on bare ground, mat or iron sheet; store in containers for 3 to 12 months;	dry on bare ground, polythene sheet or banana leave mat; rub between hand and winnow after drying; store for 2 years;
Ingredients	• jute mallow leaves;	
Method	drying in solar drier;	
Time	two days (longer than in direct sun);	
Important	-	

The reason stated for preserving leaves was that no fresh material was available during the long dry period (Singida and Kongwa). Furthermore, jute mallow leaves could not be stored fresh for a long time, only when constantly kept wet and cool

(FONDIO & GRUBBEN, 2004), while drying of leaves allowed to create a supply of food so that no daily collecting activities were necessary.

Medicinal and nutritional values. Jute mallow leaves as well as roots had several medicinal values as maintained by farmers in Singida district. **Leaves** were rubbed between hands to squeeze the mucilaginous material out, which was used like Vaseline e.g. for baby bottoms. Whole leaves, especially of the erect jute mallow type, were rubbed into the hair, which was washed afterwards. The women explained that this served to soften the hairs. In one village of Kongwa district, focus group participants stated that jute mallow had no medicinal value but it was easy to eat even for sick people since it could be just swallowed and no chewing was necessary due to the mucilaginous consistency. In another village, jute mallow was known to be good for the eyes if eaten, and in the third village it was formerly used as soap for body and hair because it contained a high amount of mucilaginous material. Here, in three different villages, three different approaches to jute mallow were available, which showed a high diversity of knowledge on the one hand and a slow or not established information system between villages on the other hand.

In Singida district **roots** of jute mallow were simply chewed and the juice swallowed to treat coughs and stomach ache. Any kind of stomach pain was also treated with the drinking of water, in which jute mallow roots had been boiled. Moreover, the roots were used to nurse eyes of both humans, especially children, and domestic cows. Thereby, either roots were chewed and afterwards parts of the root or the juice was given into the eye, or roots were left in water overnight and eyes were treated with the water on the next day. This treatment was done if the eyes had problems like pain or were red in colour due to dust or insects.

5.5 AFRICAN NIGHTSHADE (*SOLANUM AMERICANUM, S. ´ELDORETII`, S. SCABRUM, S. VILLOSUM*) - VEGETABLE AND MEDICINE

5.5.1 CHARACTERISTICS OF AFRICAN NIGHTSHADE

On the African continent, African nightshades are probably the second most important group of traditional leafy vegetables after amaranths. In some places they even surpass non-traditional cabbages and kales, being the most important leaf crop (SCHIPPERS, 2002).

Taxonomy. The correct taxonomic classification of most of the species of African nightshade is still debated and often most species are lumped together and named *Solanum nigrum* (MAUNDU et al., 1999a). However, according to SCHIPPERS (2002) this scientific name or the English name black nightshade is incorrect since it is associated with the deadly nightshade, a poisonous plant species found in Europe. This real *Solanum nigrum* is also found in the cooler parts of Africa but as a wild species, not cultivated and only rarely collected for its leaves. This confusion of names also be a potential reason for the neglect of these vegetables have been neglected in research and development. However, as suggested again by SCHIPPERS (2002), there are four main cultivated species in Africa and several wild species that belong to the *Solanum nigrum* complex, which are referred to as 'African nightshades'. Different approaches to the taxonomy of the *Solanum nigrum* complex can be viewed in Table 5.49.

Tab. 5.49 Taxonomic views of *Solanum nigrum* by different authors.

Authors	Maundu et al. (1999a)	Schippers (2002)
Taxonomy	*Solanum nigrum* complex: • *Solanum americanum* Miller • *Solanum nigrum* L. • *Solanum scabrum* Miller • *Solanum villosum* Miller • *Solanum physalifolium* (not used for food)	*Solanum nigrum* complex: • *Solanum americanum* Miller • *Solanum 'eldoretii'* nom.nud. • *Solanum scabrum* Miller • *Solanum villosum* Miller + several wild relatives

Origin. According to TINDALL (1983), West Africa is assumed to be the centre of origin of the *Solanum nigrum* complex, while African nightshades grow nowadays in all warmer and humid zones of Africa (SCHIPPERS, 2002). Since there is much confusion about names within the section of *Solanum* and there exist more than 30 related 'weedy' species, it is very difficult to establish the exact origin of the species that are cultivated in Africa (SCHIPPERS, 2002). The closest relatives of *S. americanum* are found in South America, which is also the supposed origin of this species. However,

few authors have also considered an Australian origin and others that it originated from southern Europe (MANOKO & VAN DER WEERDEN, 2004a). *S. scabrum* is very common in both the highland and lowland regions of West and East Africa and its origin is likely to be in the warm humid forest belt of West and Central Africa (FONTEM & SCHIPPERS, 2004). In contrast, *S. villosum* is supposed to have its origin in Eurasia, while it is sometimes speculated to have originated from southern Europe (MANOKO & VAN DER WEERDEN, 2004b). *S. 'eldoretii'* is mainly known from Kenya and adjacent areas of Tanzania (SCHIPPERS, 2002).

Ecology. African nightshades are commonly found as weeds e.g. in cultivated fields, under trees and in shaded areas near buildings (MAUNDU et al., 1999a). While *S. americanum* is mainly found at low altitudes and in coastal areas (MANOKO & VAN DER WEERDEN, 2004a), *S. scabrum* grows from sea level to well over 2000 m asl. (FONTEM & SCHIPPERS, 2004), and *S. villosum* even up to 2400 m asl., but all species do not tolerate night frost (MANOKO & VAN DER WEERDEN, 2004b). TINDALL (1983) as well as SCHIPPERS (2002) state, that nightshades grow well in soils rich in organic matter, since they require large quantities of nitrogen and other nutrients. This is especially true for *S. scabrum* and *S. villosum*, which prefer fertile soils with high nitrogen content and rich in organic matter (FONTEM & SCHIPPERS, 2004; MANOKO & VAN DER WEERDEN, 2004b), while *S. americanum* can grow on various soil types (MANOKO & VAN DER WEERDEN, 2004a). African nightshade is not drought-tolerant and all species need more than 500 mm of rain per year (MAUNDU et al., 1999a).

Discription. Crops belonging to the *Solanum nigrum* complex are erect herbaceous plants with green or purple stems, which are usually soft, ridged and sometimes feature tiny and soft prickles (MAUNDU et al., 1999a). Leaves are born horizontally, have long petioles and are ovate or elliptic with acute tips (TINDALL, 1983). The leave size varies between the species as well as the fruit size (Table 5.50). Flowers are usually white, small and born on a branched inflorescence (MAUNDU et al., 1999a).

Tab. 5.50 Characteristics of four different *Solanum* species according to Seo (2004).

Species	Height	Fruit
S. 'eldoretii'	40 cm	7-9 mm; dull, mainly green, sometimes purple;
S. americanum	50-70 cm	4-7 mm; shiny black, occasionally dark green;
S. villosum	50-70 cm	7-9 mm; orange;
S. scabrum	60-120 cm	11-17 mm; dark purple;

Cultivation. As mentioned before, soils with high organic matter content are preferred by African nightshades as well as sufficient water (SCHIPPERS, 2002). In fact, the root system of African nightshades is sensitive to low soil moisture levels (TINDALL,

1983) and, therefore, daily irrigation is suggested for the first week after transplanting and can be reduced to three times per week, depending on possible rain, cloud cover and temperatures (SCHIPPERS, 2002). In fact, a minimum rainfall of 500 mm for *S. scabrum* (FONTEM & SCHIPPERS, 2004) and of 500-1200 mm for *S. villosum* is suggested, and frequent irrigation especially during the dry season is necessary (MANOKO & VAN DER WEERDEN, 2004b). Plants are propagated by either seeds or cuttings, whereby the seeds are usually first sown in nursery beds and transplanted later (TINDALL, 1983). The first young leaves and shoots may be harvested 4-5 weeks after transplanting, whereby stems are cut down to about 15 cm from the ground. This allows new side shoots to develop which can be harvested in 7-14 day intervals (FONTEM & SCHIPPERS, 2004). Moreover, complete harvesting by uprooting the whole plant is also practised, either as a form of thinning or if a close spacing of plants is chosen and enough suitable land is available, the entire crop is uprooted (SCHIPPERS, 2002).

Uses. While OOMEN and GRUBBEN (1978) as well as TINDALL (1983) state that African nightshade is only used as a leafy vegetable and only leaves and young shoots are used in soups, MAUNDU et al. (1999a) and SCHIPPERS (2002) point out that besides fresh or dried leaves and young shoots also the green or purple fruit from *S. `eldoretii´* are much appreciated and the orange berries of *S. villosum* are especially liked by children. In most regions, *S. americanum* fruit are believed to be inedible, but in some eastern and southern African areas, ripe and sweet fruit of local varieties are much appreciated (MANOKO & VAN DER WEERDEN, 2004a). As the leaves are bitter sometimes no salt is used or the leaves are mixed with less bitter vegetables such as amaranth (MAUNDU et al., 1999a; MANOKO & VAN DER WEERDEN, 2004a). However, especially elderly people are fond of a higher degree of bitterness and will prepare flowers and young fruits together with leaves and shoots (MANOKO & VAN DER WEERDEN, 2004a). Several medicinal values were recognised e.g. in Kenya, where unripe fruits of *S. villosum* are applied to aching teeth, leaves are used for stomach-ache, an extract from pounded leaves and fruits used to treat tonsillitis, and even roots are boiled in milk and given to children as tonic (MAUNDU et al., 1999a). Furthermore, in Tanzania the juice extracted from *S. americanum* leaves is used to treat chronic conjunctivitis (MANOKO & VAN DER WEERDEN, 2004a).

5.5.2 SPECIES OF AFRICAN NIGHTSHADE GROWN IN NORTH-EASTERN TANZANIA

For the identification of African nightshade species occurring in north-eastern Tanzania the taxonomy according to SCHIPPERS (2002) was applied. In Table 5.51 species of African eggplant occurring in different districts researched have been listed. The assignment from local names to scientific names is not assured, yet, according to plant descriptions by farmers and due to identification of some plants by Tanzanian fellow

researchers, it is very likely that the correct scientific names are given, as far as SCHIPPERS' (2002) approach is concerned.

In Arumeru district *S. villosum* was the most important African nightshade due to a good taste, beneficial market and also a high nutrient content. Farmers gave contradictory statements concerning length of production period as well as susceptibility to pests and diseases. Nevertheless, it was stated twice that this species grew especially well under the given conditions in this district. *Solanum scabrum* which was called "introduced" or "Kenyan" variety in local language, ranked second because taste and marketability were not as favourable as for *S. villosum*. The third species *S. `eldoretii´* was not favoured by farmers because of coarse leaves, no bitter fruit (bitterness was preferred) and hairs or spines on the stems (Table 5.52).

In Kongwa district the most preferred African nightshade species was *S. americanum*, which was adapted to rather low altitudes and e.g. not available in Arumeru district. This species was newly introduced and not yet accepted by all people but very much favoured because of its slightly bitter taste. Furthermore, it was not much affected by insect pests and easy and fast to prepare. It was not stated why the yellow-fruited *S. villosum* was preferred by farmers in this village. However, it was acknowledged that this species was rather common in the northern highlands and less so in the southern highlands of Tanzania (SCHIPPERS, 2002). *S. scabrum* did not occur in the dry Kongwa district, possibly due to the fact that it was normally found in high rainfall areas (SCHIPPERS, 2002).

Tab. 5.51 Local names of African nightshade species and types in three research districts of Tanzania.

Scientific name	Arumeru	Kongwa	Muheza
Solanum villosum	"mwembamba" (=narrow); "mnavu wa kienyeji / kawaida" (=introduced nightshade); "inyafu" (= nightshade in maasai language);	no name;	not available;
Solanum scabrum	"mpana" (=broad); "kisasa" (=introduced); mnavu wa Kenya / kisasa" (nightshade from Kenya / introduced); "inyafu" (= nightshade in kimaasai);	not available;	not available;
Solanum americanum	not available;	no name;	"zinge";
Solanum `eldoretii´	"Ex-Kenya"; "Ex-Hai" (= formerly in Kenya or Hai district, Tanzania);	no name;	"puche"
Not identified	-	-	"mnavu kiau / gana"

S. americanum, common in coastal areas, ranked No.1 in Muheza district since it was said to contain plenty of vitamin C, to increase the appetite as well as to be able to cure malaria. *S. `eldoretii´* (No.2) was earlier maturing and, therefore, earlier available than *S. americanum*, but its taste was less acceptable. The valuation of major characteristics can be viewed in Figures 5.3-5.5.

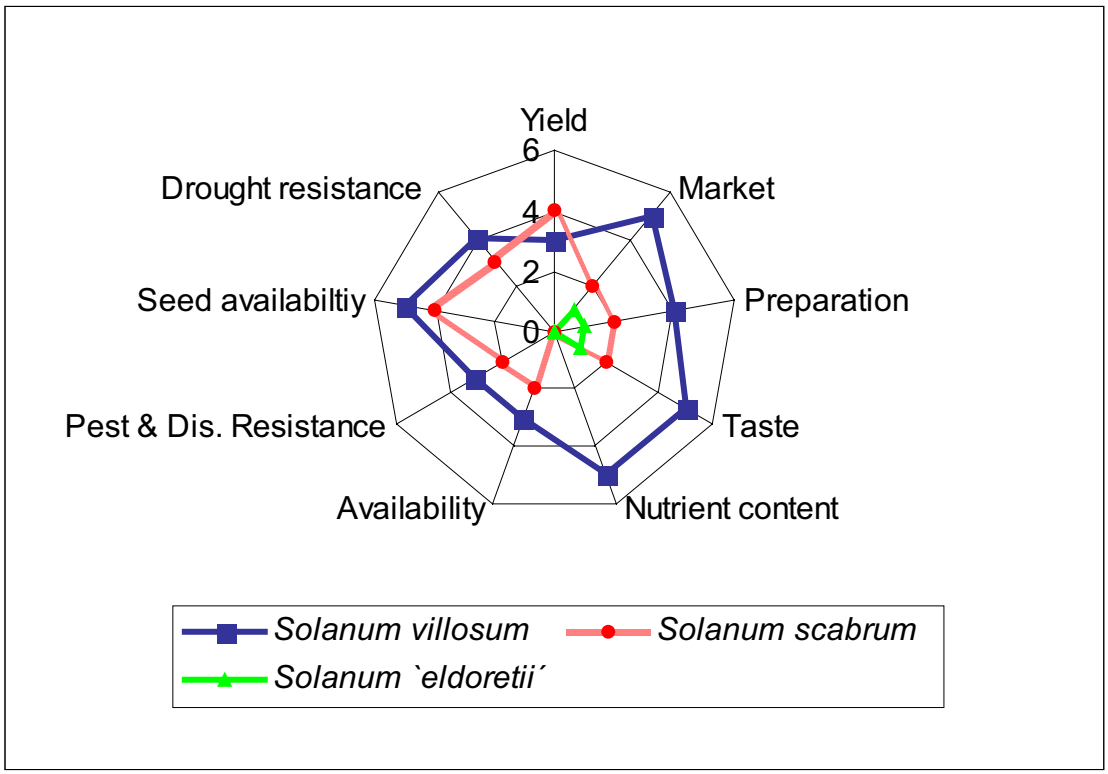

Fig. 5.3 Farmers valuation of major characteristics of African nightshade types in Arumeru district, Tanzania.

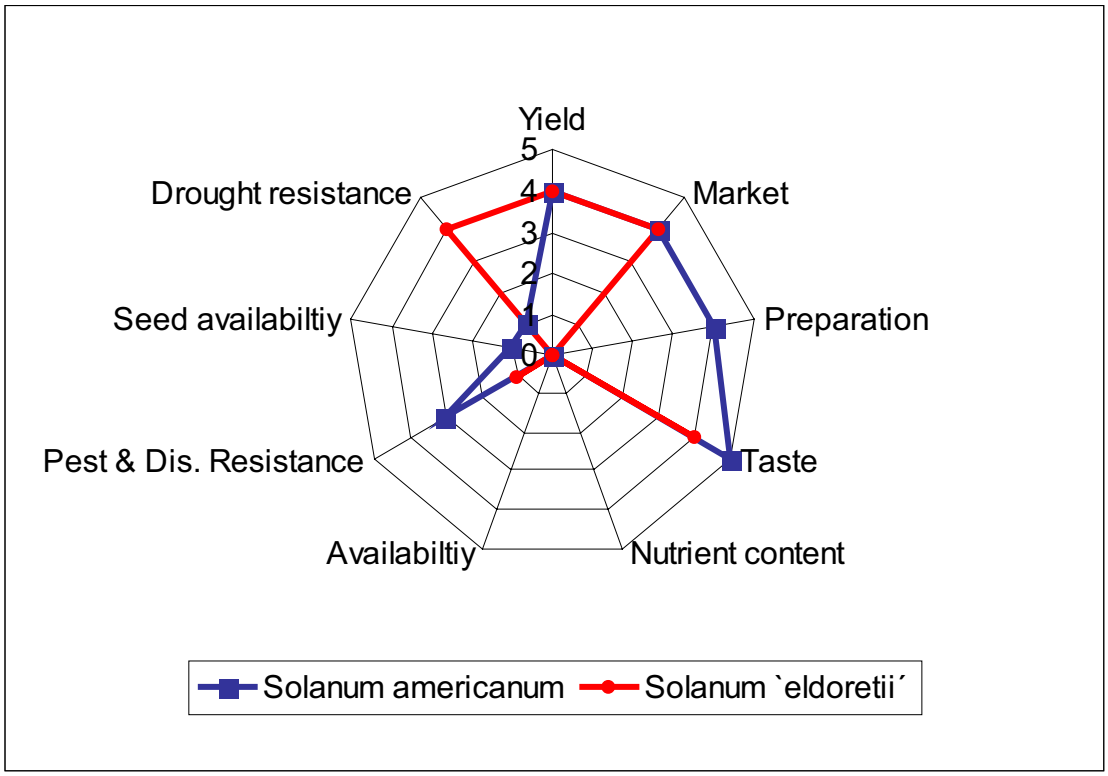

Fig. 5.4 Farmers valuation of major characteristics of African nightshade types in Kongwa district, Tanzania.

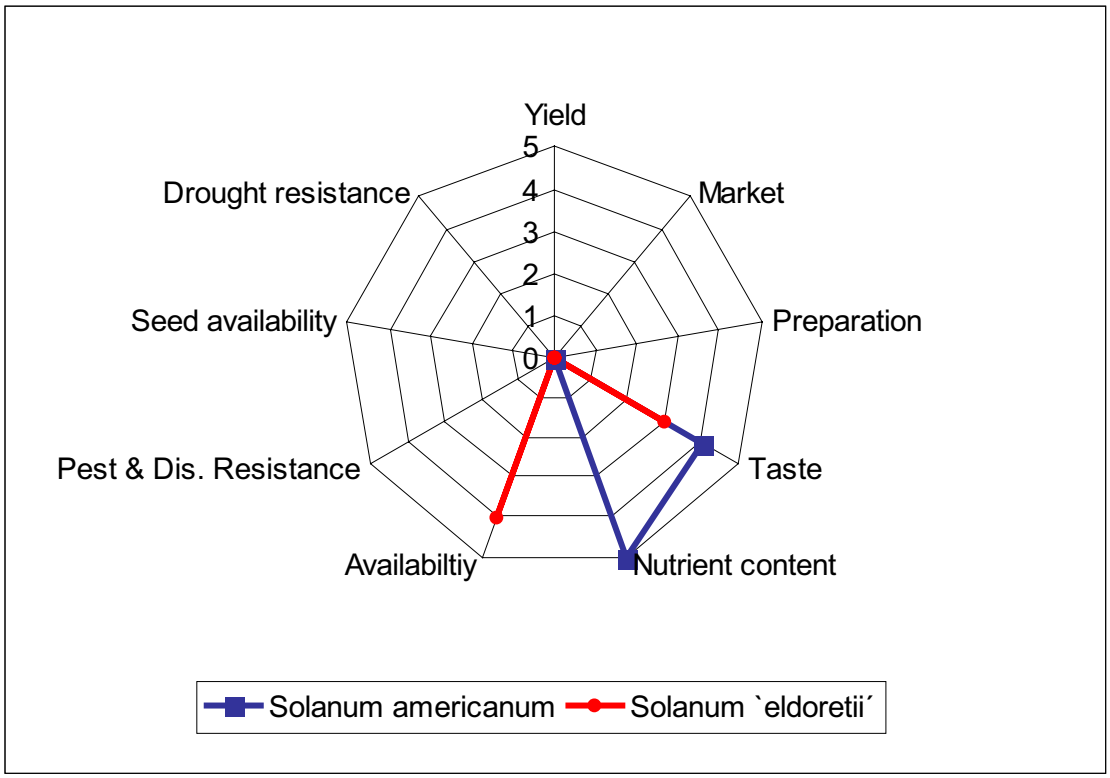

Fig. 5.5 Farmers valuation of major characteristics of African nightshade types in Muheza district, Tanzania.

0 = no comment; 1 = very poor; 2 = poor;
3 = average; 4 = good; 5 = very good;

Tab. 5.52 African nightshade types and their special positive and negative characteristics perceived by farmers in three research districts of Tanzania.

District	African nightshade type	Positive characteristics	Negative characteristics
Arumeru	*Solanum villosum*	• slightly bitter taste which was preferred; • short cooking time, easy cooking, not watery; • medicinal value; • nutritious, contains many vitamins, esp. vitamin A; • long harvest period; • seeds germinated easily; • management costs to combat pests small; • not attacked by diseases; • grew very well under local conditions;	• susceptible to aphids and wilting, attacked by insect pests; • exhausted the soil - needed much fertility; • could not compete with weeds; • no easy harvest; • not drought tolerant → required regular watering every week; • early seed production → short harvest period; • affected by diseases;
	Solanum scabrum	• easy harvest because of bigger leaves; • after cutting it kept sprouting; • fast growth; • intermediate to long harvest period; • if over-mature it did not become bitter → still liked by kids;	• not very bitter and soft leaves → taste not appetising, therefore mixed with meat; • longer cooking time, soft when cooked, contained a lot of water; • exhausted the soil + required watering every week; • only few number of harvests;
	Solanum `eldoretii´	• fast growth;	• not bitter, no soft leaves, no market, not wanted by people;
Kongwa	*Solanum americanum*	• fast growth; • slightly bitter; soft → cooking fast;	• newly introduced, not very popular; • not easy to get the seeds;
	Solanum `eldoretii´	• fast growth + long production period;	
Muheza	*Solanum americanum*	• cured malaria; increased appetite; rich in vitamin C;	• very bitter → some people do not like it;
	Solanum `eldoretii´	• earlier available;	• nothing;

5.5.3 PRODUCTION ISSUES OF AFRICAN NIGHTSHADE

The traditional vegetable African nightshade was highly important in Arumeru district where it ranked No. 1 and was discussed in all ten villages, where focus group meetings took place. In Singida district, it was placed No. 11 and was not discussed in detail with focus group participants. However, African eggplant ranked No. 10 in Kongwa and No. 9 in Muheza district, respectively, and was reviewed in one village of each of the two districts in terms of production issues.

Cropping pattern. In all villages of Arumeru district, farmers explained that African nightshade was not intercropped with other plants since it was not shade-tolerant. Especially, *S. villosum* would not grow very tall and would be easily shaded out by other crops. Therefore, African nightshade was sown in rows in nurseries and transplanted either randomly or in rows as a monocrop. Farmers named different advantages of monocropping (Table 5.53) whereby one reason mentioned by a farmer was rather unconvincing since he maintained that through monocropping insect pests were avoided. When e.g. aphids contaminated the field, they would affect all crops, also the intercropped plants. However, it was acknowledged that intercropping is often applied for risk reduction or risk spreading and if e.g. one crop is affected by insect pests at least the other will yield since it is often affected by different insect pests (VANDERMEER, 1989). African nightshade were intercropped together with maize or beans, whereby African nightshade was planted in ridges between the other crops. The reason for intercropping was limited land and presented only a temporary and provisional solution to farmers.

Tab. 5.53 Cropping patterns for African nightshade in three research districts of Tanzania.

	Arumeru (5 villages)	**Kongwa** (1 village)	**Muheza** (1 village)
Inter-cropping	Hardly ever practised, sometimes with maize or beans; Reason: limited land;	Not practised but left in maize and sunflower fields;	Gathered from the wild;
Mono-cropping	Mainly practised; Reason: not shade-tolerant; strong competitor, needed many nutrients, other plants would not perform well; want to sell whole plots, to avoid insect pests;	Practised;	

In Kongwa district, monocropping was practised as well. Yet, if African nightshade was found in fields of sunflowers or maize as a weed it was left to grow there. Farmers explained that African nightshade was rather drought-resistant and, therefore, it could stay in fields of other crops for a long time. In Muheza district African night-

shade was gathered from the wild and, therefore, no cropping pattern was applied. On the one hand, African nightshade was preferred as much as other vegetables, on the other hand, it was probably so abundant in the wild that there was no need for farmers to cultivate it.

Harvest. After 21 to 30 days in the nursery, African nightshade were transplanted and after another 21 to 30 days harvest started as suggested in villages at medium and high altitude. For both *S. scabrum* and *S. villosum* the first harvest was expected 4-5 weeks after transplanting (FONTEM & SCHIPPERS, 2003; MANOKO & VAN DER WEERDEN, 2004b), which was about one week later than farmers reported. Plants were harvested about 1-3 times per week, however, this depended on plot size and not the same plants were picked three times a week. Harvest of the same plant once a week was possible for up to seven weeks. This was also due to additional manure or fertiliser used. For *S. scabrum*, for example, plants were harvested 3-5 times on average without manure or fertiliser, while it was possible for large scale commercial farmers to harvest up to 10 times (FONTEM & SCHIPPERS, 2004). Harvest frequency, however, was different for all altitudes, and plants were harvested for a longer time the higher they grew (Table 5.54). Time of harvest was equal for the medium and high but totally different for the low altitude. When African nightshade was irrigated and additionally collected from the wild, it was available throughout the year at medium altitude.

Though, during focus group meetings on production issues it was stated by farmers that African nightshade was not shade-tolerant, at medium altitude in Arumeru district focus group participants experienced that African nightshade performed best when grown under shade and with sufficient water available. This might be true for different local species or landraces which were not named by farmers in this context. In fact, *S. americanum* occured as a weedy plant both in the open or in lightly shaded localities e.g. under trees (MANOKO & VAN DER WEERDEN, 2004a). Yet, *S. scabrum* could tolerate some shade but preferred full sun as long as water was sufficiently accessable (FONTEM & SCHIPPERS, 2004).

Tab. 5.54 Harvest of African nightshade in five villages of Arumeru district, Tanzania.

	Low altitude	Medium altitude	High altitude
Harvest frequency	Once a week; during four weeks;	Once to thrice a week; during up to seven weeks;	Every second week; 3-5 times;
Time of harvest	Aug - Oct; Oct - Mar possible;	End of Mar - May; May - Aug; throughout the year with irrigation;	May - Sept/Nov; Feb - Mar;

Constraints. Only in Arumeru and Kongwa districts, constraints of producing African nightshade were discussed, since it was not cultivated in Muheza district. Water was a main problem for *S. americanum* in Kongwa district, as well as in two villages of Arumeru district since African nightshade required watering every week as farmers suggested. Soil fertility was also a main problem in three villages of Arumeru district since African nightshade was explained to exhaust the soil and needed large amounts of farm yard manure. All African nightshade species required large amounts of nitrogen and further nutrients as reported by FONTEM & SCHIPPERS (2004) and MANOKO & VAN DER WEERDEN (2004a, b). If manure was available the crop responded well to it. Nevertheless, transport for manure was lacking in one village and manure had to be carried on the head instead of wheelbarrows (Table 5.55).

Another limiting factor in four villages of Arumeru district was the availability of African nightshade seeds since there existed no organised seed production for African nightshade to the farmers knowledge. Each farmer propagated his or her own seeds but only few people sold seeds on the market. The own produced seeds could not be kept too long, since they would not germinate any more after a certain storage period. Furthermore, birds ate the ripe fruits of African nightshade and were, therefore, competitors for seeds. It was surprising that farmers in Arumeru district, living close to Arusha where several shops offer vegetable seeds and, further, close to HORTI Tengeru and AVRDC where seeds were propagated, were not aware or had no access to these seed supply sources. It could be assumed that it was not easy to get seeds of traditional vegetables, since mainly seeds of exotic vegetables like tomatoes and cabbages were sold in shops.

As aphids were a problem for African nightshade, in one village of Arumeru district farmers suggested to sprinkle ash over the plants to avoid them. According to the farmers experience, this method was absolutely sufficient and no chemicals were needed. FONTEM & SCHIPPERS (2004) also stated to spread wood ash over African nightshade leaves as a traditional cure for pests. In general, many pests and pathogens of tomato also occur in African nightshades, whereby a major disease in tropical highlands was late blight, caused by *Phytophtora infestans* (MANOKO & VAN DER WEERDEN, 2004b).

Tab. 5.55 Constrains in producing African nightshade in two research districts of Tanzania.

Constraints	**Arumeru** (5 villages)	**Kongwa** (1 village)
Labour availability	No problem, sometimes hired labour;	-
Water	Limiting factor, watering every week required;	Problem for *S. americanum*;
Soil fertility	Exhausted the soil; lot of manure needed; transport of manure problem;	-
Seeds	Limiting factor; no organised seed production; short storage life of own seeds; birds ate ripe fruits (+ seeds);	Own seeds used and available;
Weeds	No problem;	-
Pests & Diseases	Insect pests attacked *S. americanum*; aphids and other insects; blight during cold season;	Problem for *S. 'eldoretii'*;
Marketing	No problem, good market;	No problem;

"-" = issue not raised during focus group meeting

Responsibility. While in three villages of Arumeru district farmers stated that both women and men shared the production of African nightshade as in Kongwa district, in two villages of Arumeru district it was stated that only women were responsible for this traditional vegetable. This also applied to Muheza district, where only women were responsible for gathering the wild African nightshade species (Table 5.56).

However, in the villages where it was named a women crop, land preparation and spraying of pesticides was performed by men (Arumeru). Selling was always a task for women, however, different opinions on the whereabout of the earned money were stated by focus group participants (see chapter 4.4). In general, wherever there was money to gain men became involved in the production of African nightshade.

Tab. 5.56 Responsibility for the production of African nightshade in three research districts of Tanzania.

	Arumeru (5 villages)	**Kongwa** (1 village)	**Muheza** (1 village)
Women	Planting (both); homegarden irrigation; application of manure; weeding; harvesting; selling;	Generally responsible;	Responsible alone;
Men	Planting (both); sowing; land preparation; irrigation; pesticide application;	Generally responsible;	Not involved;

5.5.4 CONSUMPTION ISSUES OF AFRICAN NIGHTSHADE

Only in all five villages of Arumeru district, where African nightshade was highly popular, consumption issues for this traditional vegetable were discussed with focus group participants. Unfortunately, no comparison between the different research districts could be made in this case. However, the five villages in low (about 1100 m), medium (about 1400 m) and high (about 1600 m) altitudes of Arumeru district will be compared instead. Of course, differences between villages did not occur only due to altitude but also due to other circumstances such as education of farmers and infrastructure but information about the latter factors was not available.

Plant parts used. While only leaves were used at lower altitude, additionally young shoots of African nightshade and ripe fruit of *S. villosum* were consumed at medium altitude, whereas at high altitude, leaves were consumed by humans and stems of African nightshade sometimes fed to livestock.

Taboos. While farmers in three villages (at medium and low altitude) stated that everybody consumed African nightshade and only on an individual basis it was refused, focus group participants from two villages (at low and high altitude) explained that in former times African nightshade leaves were not eaten by old men of the Arusha ethnic group. These people used to be pastoralists and believed that green leaves were food for livestock only. Still today, a meal prepared with green maize, bananas, nightshade and milk was not consumed by men but was a special meal for lactating women (see preparation).

5.5.5 PROCESSING AND UTILISATION OF AFRICAN NIGHTSHADE

Preparation. Four different recipes for African nightshade could be distinguished, whereby one preparation method occurred at all altitudes, namely the frying of leaves with onions and tomatoes. Usually, African nightshade leaves were first sorted (bad parts and things such as insects and sand were taken out), cleaned, washed and cut either into pieces or left as a whole (Table 5.57).

For the first dish chopped onions were first fried in oil, then tomatoes and, finally, nightshade leaves were added as well as salt, or everything was fried at once for about 5 to 10 minutes. Thereby, it was important that the time for frying depended on the intensity of the fire. Furthermore, in one village it was suggested to use a lid to cover the pot after nightshade was added since it was believed that vitamins will got lost through evaporation if the pot was not covered. On the one hand, focus group participants had some knowledge about vitamins, their importance, and that they can get lost somehow. On the other hand, they were not aware that vitamins can not evaporate with steam but will get simply lost due to excessive boiling and, in fact, no

leaves should be exposed to boiling temperatures for more than a quarter of an hour. Especially, vitamin C was affected and its losses were increased when potash (local soda salt) was used (OOMEN & GRUBBEN, 1978). In contrary, steaming reduced loss of vitamins, e.g. vitamin C (GOODE, 1989; in: BUKENYA & CARASCO, 1999).

There were several options for this dish, e.g. sardines or meat could be added but the cooking time would be extended for another 20 minutes. If not very soft leaves of African nightshade were used, they were boiled first in little water for about 5 minutes before the usual process was carried out. Coconut milk or fresh milk could also be added to the dish if preferred.

A recipe named only in one village at medium level was similar to the first one but instead of oil for frying, coconut milk was used or optional oil and coconut milk half and half. Special items were carrots and sweet pepper if available. African nightshade leaves were washed two or three times before thrown into the pot. The reason for this was unclear, presumably, the bitterness, which is a sign for alkaloids, could haven been reduced by this process. However, alkaloids can not be totally removed even by cooking or frying the leaves, however, to dispose the cooking water can at least reduce them (SCHIPPERS, 2002).

An easy and fast preparation method was to chop onions, tomatoes and nightshade leaves and steam everything in a pot together with salt but without water for about 5 minutes. This recipe appeared to be rather sparing in terms of nutrients.

A special meal for lactating women was mentioned in the village at high altitude. First, green maize was boiled, banana was added, nightshade roughly chopped into pieces was given into the pot and everything boiled for 5 minutes. About 1l of water, 1/2 l of fresh milk and salt were added finally. It was believed that by eating this meal women would have enough milk to breastfeed their children. In fact, milk or in general dairy products are one of the richest sources of calcium, and calcium is important for the formation of breast milk (WHO, 2001). Therefore, the milk played probably the most important role for breast-feeding mothers, rather than the vegetables. However, the special mixture could be of importance as well.

Tab. 5.57 Preparation of African nightshade in five villages of Arumeru district, Tanzania.

	Recipe 1	Recipe 2	Recipe 3	Recipe 4
Ingredients	• leaves; • oil; • onions; • tomatoes; • salt • sardines or meat (optional); • coconut or fresh milk (optional);	• leaves; • oil and / or coconut milk; • onions; • tomatoes; • carrots; • sweet pepper;	• leaves; • onions; • tomatoes; • salt;	• green maize; • banana; • leaves; • 1l of water; • 0.5 l of fresh milk; • salt;
Method	frying;	frying;	steaming;	boiling;
Time	5 min. for sorting; 2 min. for washing; 5 min. for cutting; 5-10min. for frying; 30 min. for frying if sardines or meat was added;	15 - 20 min. for frying of leaves;	5 min. for steaming everything at once;	10 min. for boiling green maize; 5 min. for boiling leaves;
Important	cover pod with a lid to prevent vitamins from evaporating;	order in which vegetables were added was arbitrarily;	no water was added;	special meal for lactating women; men did not eat it;

Preservation. In general, African nightshade leaves were not preserved in Arumeru district. As a reason, farmers explained that plenty of water was available throughout the whole year so that the vegetable could grow during all seasons. If African nightshade was not available other vegetables were consumed and at least some kind of vegetables if not all were available throughout the year. Only in one village one woman was preserving African nightshade, yet, she was the only one who had the experience. After sorting, washing and cutting of leaves they were put into a piece of cloth and dipped into boiling water for about two minutes. Afterwards leaves were dried in the direct sun on a piece of so called "kiroba". In a "kiroba" bag leaves could be stored for three month and longer.

Medicinal value. Besides others, a recipe to treat scabies was described by farmers in villages at all altitudes (Table 5.58). The same treatment could help against a skin disease called 'Mchiningi' in Swahili and only appeared on heads of children. Farmers in one village maintained that, to take effect as a medicine, only plants that were grown without industrial fertiliser could be used because, otherwise there would be no effect. Furthermore, leaves to be used for a treatment must be mature. In fact, plants produced more biomass when fertiliser was applied, while high nitrogen levels reduced the dry matter content of the plant and further increased the level of unwanted nitrates in the leaves (FONTEM & SCHIPPERS, 2004). Consequently, certain components

probably responsible for a medicinal effect, were not available in sufficient quantities any more or possibly inhibited by other nutrients. This happened in another *Solanum* species, namely *S. macrocarpon*, which had ten different uses as a semi-wild or wild plant, whereas the cultivated group of *S. macrocarpon* had only one medicinal usage and was otherwise eaten as a vegetable only (BUKENYA & CARASCO, 1999).

Tab. 5.58 Medicinal value of African nightshade in five villages of Arumeru district, Tanzania.

Illness	Treatment
Scabies	rub leaves between hands and squeeze the juice out of leaves on the skin; external application;
Machiningi (skin disease on heads of children)	like for scabies;
Malaria	boil leaves and add little salt, drink boiled water and eat leaves;
Nutrition deficiency	provided vitamin A; increased blood (= provided iron);

5.6 AFRICAN EGGPLANT (SOLANUM AETHIOPICUM, S. ANGUIVI, S. MACROCARPON) - A PROMISING FRUITY VEGETABLE FOR MARKETING

5.6.1 CHARACTERISTICS OF AFRICAN EGGPLANT

Taxonomy. In Tanzania, African eggplant in general and garden eggs in particular are called "ngogwe" or "nyanya chungu" whereby the latter means bitter tomatoes (AVRDC, 2003). As for African nightshades there has been a fair confusion on the taxonomy of African eggplants. The two most important African eggplants are the scarlet eggplant (*Solanum aethiopicum*), of which the so-called garden eggs are the best-known representatives, and gboma eggplant (*Solanum macrocarpon*). Furthermore, two other African eggplant species are *Solanum anguivi*, which most likely is the wild progenitor of *Solanum aethiopicum* (BUKENYA & CARASCO, 1995), and the brinjal eggplant (*Solanum melongena*) which is also called aubergine (Schippers, 2002).

According to SCHIPPERS (2002) recent research led to the conclusion that there is one pluriform diploid species of the scarlet eggplant only, namely *Solanum aethiopicum*, comprising many different forms. The latter can be divided into four cultivar groups that adapted to a range of climatic zones during the domestication process:

- Shum group (nakati) - found in wetter areas of Africa; East Africa, esp. Uganda, mainly used as a leafy vegetable;
- Kumba group (jakatu) - found in semi-arid zones of the western Sahel up to northern Nigeria; frequently used for both leaves and immature fruit;
- Gilo group (garden eggs) - found in zones with a more average rainfall; humid zones of West Africa; mainly grown for its immature fruit;
- Aculeatum group - not normally found in Africa and non-edible, however, used as rootstock for plants such as brinjal eggplant and tomatoes because representatives of the aculeatum group are resistant to a number of soil-borne diseases (SCHIPPERS, 2002; LESTER & SECK, 2004).

Origin & Ecology. While the gboma eggplant (*S. macrocarpon*) as well as the scarlet eggplant (*S. aethiopicum*) are native to Africa (BUKENYA & CARASCO, 1995), the brinjal eggplant (*S. melongena*) probably originated in India (TINDALL, 1983).

The African eggplant is clearly a tropical crop, with optimal day temperatures between 25°C and 35°C and night temperatures between 20°C and 27°C. However, the different types of *S. aethiopicum* have different humidity requirements related to the climatic zones they are adapted to (SCHIPPERS, 2002; LESTER & SECK, 2004). Local cultivars and types of *S. macrocarpon*, which are mainly grown for their fruits are mostly restricted to humid coastal and high-rainfall zones of West Africa, whereas leafy

types of this species are common throughout West and Central Africa (BUKENYA-ZIRABA & BONSU, 2004).

While *S. aethiopicum* is one of the five most important vegetables in West and Central Africa, *S. macrocarpon* is generally considered to be a minor crop in most African countries and virtually no research, for example on agronomic requirements, has been carried out yet (SCHIPPERS, 2002).

Discription. The Gilo group of *S. aethiopicum* is by far the most commonly cultivated group of cultivars and, depending on local selection criteria, many different forms can be found (SCHIPPERS, 2002). One of the main characteristics that distinguishes *S. aethiopicum* from *S. macrocarpon* are the flowers, which are always white with free petals in *S. aethiopicum*, while flowers of *S. macrocarpon* are mainly light purple with fused petals. Further characteristics to differentiate between the African eggplant species are listed in Table 5.59.

Tab. 5.59 Characteristics of four different *Solanum* species according to BUKENYA & CARSON (1999)* and SEBERRY (2002).

Species	Height	Leaves	Fruit size	colour	shape/surface
S. aethiopicum - Gilo group	shrub; 1-2 m;*	hairy and not or slightly prickly leaves;	2-12 cm;	white or green, sometimes purple when immature; orange, dark-red or shiny-brown when mature;	oval to round, less often somewhat flattened;
S. aethiopicum - Shum group		glabrous;	1.5-3.5 cm;*	green with dark green stripes when immature; shiny red when mature;*	globose;*
S. anguivi	shrub; 0.7-1.5 m; or 1.5-3 m;*	highly prickly if growing wild;	0.7-1.5 cm;	green or white when immature; red when ripe;* or striped when immature and light orange when mature;	globose, smooth;*
S. macrocarpon - fruity group	0.5-1.5 m;*	hairy when young; glabrous when mature;*	5-12 cm;	white, green or purple when immature; yellow when mature;	mainly oblate/flattened; smooth surface;
S. macrocarpon - leafy group			3-6 cm;	yellow, brown or orange brown when mature;	cracked surface;

Cultivation. African eggplants prefer fertile and well-manured but also rather light soils (TERRA, 1966) and, in fact, they do not perform well on clay (SCHIPPERS, 2002). Seeds are suggested to be first sown in nursery beds and transplanted when 12

to 15 cm high, which is about 5 weeks after sowing. Plants are often topped and the axillary shoots are cut out in order to promote an early bearing. Usually, the first fruits come after three months (TERRA, 1966). When the crop remains in the field for a long time, supplementary fertilisation is suggested especially at the flowering stage and after the first harvest (AVRDC, 2003). Moreover, sufficient moisture in the soil is needed for an ideal growth and yield, and especially after fruit setting, irrigation frequency should be increased (SCHIPPERS, 2002).

Uses. African eggplant is used both for young leaves and immature fruit. Yet, the fruit and leafy types already mentioned are mainly used for the one or the other purpose. For example, leaves of the fruity group of *S. macrocarpon* frequently have prickles or hairs and are eaten at a young stage only. Fruit of the leafy group are bitter and, therefore, not popular (Schippers, 2002). Leaves, fruit and roots have several medicinal uses and, moreover, *S. macrocarpon* as well as *S. aethiopicum* are occasionally grown as ornamentals (BUKENYA-ZIRABA & BONSU, 2004).

The hairy leaves of the Gilo group (*S. aethiopicum*) are usually not eaten, whereas the glabrous leaves of the Shum group of this species are consumed together with shoots, but small fruit are disdained (SCHIPPERS, 2002). Immature fruit of the Gilo group are either cooked in stews or sometimes eaten raw. Especially fruit of bitter cultivars as well as roots and leaf juice are applied as medicine, e.g. to treat high blood pressure (LESTER & SECK, 2004).

African eggplant leaves are especially rich in calcium and further, leaves of *S. aethiopicum* and *S. macrocarpon* provide all the nutritionally important amino acids in adequate quantities (SCHIPPERS, 2002). A drawback for all *Solanum* species is that they contain a number of spirosolane alkaloids, including solanine and solanidine, which are bitter-tasting. These substances are potentially poisonous when eaten frequently, but especially when eaten raw or not properly cooked but merely blanched or steamed. Therefore, leaves should not be eaten raw as a salad. Unfortunately, these alkaloids can not be totally removed by cooking or frying the leaves, however, to dispose the cooking water can, at least, reduce them (SCHIPPERS, 2002).

5.6.2 SPECIES OF AFRICAN EGGPLANT GROWN IN NORTH-EASTERN TANZANIA

Four and five different types of African eggplant were distinguished by farmers in Arumeru and Muheza district, respectively. Tanzania's main variety was suggested to be 'Tengeru white' (SCHIPPERS, 2002) which was a garden egg (Gilo group/*S. aethiopicum*). In fact, 'Tengeru white', also called 'ngogwe si chungu' (= not bitter eggplant) or 'mviringo kubwa' (= round and big), was cultivated in both districts by farmers but ranked No.1 in Arumeru district only, while it was second after 'mshumaa' (also Gilo group/*S. aethiopicum*) in Muheza district (Table 2 and 3).

In Arumeru district, 'Tengeru white' was preferred due to several positive characteristics such as to have a high demand on the market. Other varieties, e.g. 'Manyere green' or 'ngogwe mshumaa', were reported to have no chance to be sold on the market when 'Tengeru white' was available. Thus, farmers even stopped growing these varieties when they got 'Tengeru white' and further, they uprooted these varieties when they grew in the field by accident to prevent them from crossing with 'Tengeru white'. However, 'Manyere green', for example, was less attacked by insect pests than 'Tengeru white' and 'mshumaa'. A fourth *S. aethiopicum* type called 'ngogwe nyeupe ndogo' (= white and small eggplant) or only 'ndogo' (= small) was also inferior to 'Tengeru white', e.g. concerning the price it received on the market. Yet, it matured earlier and could, therefore, be sold on the market when 'Tengeru white' was not ready to be sold, thus, bridging a market gap.

In Muheza district, the garden egg 'mshumaa' was preferred by middlemen who bought vegetables directly from farmers (sometimes even a non-harvested plot) and sold it to marketers. 'Tengeru white' ranked only No.2, possibly due to its short production period. Yet, focus group participants also stated that 'Tengeru white' performed better in general than other types. The type 'mviringo' (= round) had a higher yield and also bigger fruits than 'mshumaa', still marketability was less favourable (Table 5.60 and 5-61).

Tab. 5.60 African eggplant types and their special positive and negative characteristics perceived by farmers in two research districts of Tanzania.

District	African eggplant type	Positive characteristics	Negative characteristics
Arumeru	Tengeru white / Ngogwe si chungu (*S. aethiopicum* - Gilo group)	• early flowering, long production period; • big fruits; • slightly bitter → preferred;	• susceptible to rust, wilt, spider mites, thrips; • late-maturing;
	Manyere green (*S. aethiopicum*)	• less attacked by insect pests; early maturing; • medicinal value, appetiser; • good market → some people preferred bitter types;	• very bitter → no market → not grown by farmers; • susceptible to rust, wilt, spider mites, thrips;
	Ngogwe mshumaa (*S. aethiopicum* - Gilo group)	• long production period; • very attractive shape (but less than Tengeru white);	• early-maturing;
	Ngogwe nyeupe ndogo / ndogo (*S. aethiopicum*)	• earlier maturing earlier than Tengeru white → market niche ;	• fetched lower price than Tengeru white;
Muheza	Mshumaa (*S. aethiopicum* - Gilo group)	• sweet not bitter taste; • big fruit, attractive colour; • preferred by middlemen;	• nothing;
	Mviringo kubwa (= Tengeru white) (*S. aethiopicum*)	• big fruit, not bitter; • better performance than other types;	• short production period;
	Mviringo (*S. aethiopicum*)	• not / slightly bitter; • marketability good but less sold than other types; • fruit bigger than mshumaa; • higher yield than mshumaa;	• nothing;

District	African eggplant type	Positive characteristics	Negative characteristics
	Nyeupe (*S. macrocarpon* ?)	• no information (ranked No.3);	
	(fruit bitter, very small, green, ribbed) (*S. anguivi* ?)	• no information (ranked No.3);	

Tab. 5.61 Evaluation of major characteristics of African eggplant types by farmers in two research districts of Tanzania.

District	African eggplant type	Rank	Taste	Market	Availability	Yield	Drought resistant	Pest + Dis resistant	Nutrient content	Prepara-tion	Seed availability
Arumeru	Tengeru white / Ngogwe si chungu (*S. aethiopicum*)	1	XXXX	XXXXX	XXXX	XXXXX	XXXX	X	0	0	0
	Manyere green (*S. aethiopicum*)	2	XX	XXX	0	XX	0	XXX	0	0	0
	Ngogwe mshumaa (*S. aethiopicum* - Gilo group)	2.5	XXX	XXX	XXXX	XXXX	XXXX	X	0	0	0
	Ngogwe nyeupe ndogo / ndogo (*S. aethiopicum*)	3	0	XXX	0	0	0	0	0	0	0
Muheza	Mshumaa (*S. aethiopicum* - Gilo group)	1	XXXX	XXXXX	XXXX	XXXX	XXXX	X	0	0	0
	Mviringo kubwa (= Tengeru white) (*S. aethiopicum*)	1.5	XXXXX	XXXX	XXX	XXXXX	0	XXX	0	0	0

District	African eggplant type	Rank	Taste	Market	Availability	Yield	Drought resistant	Pest + Dis resistant	Nutrient content	Prepara-tion	Seed availability
	Mviringo (*S. aethiopicum*)	2.5	XXXX	XXX	0	XXXXX	0	0	0	0	0

0 = no comment; X = very poor; XX = poor; XXX = average; XXXX = good; XXXXX = very good;

5.6.3 PRODUCTION ISSUES OF AFRICAN EGGPLANT

African eggplant was important in Arumeru district, where it ranked third after African nightshade and amaranth, whereas it was the fifth most important traditional vegetable in Muheza district. In the dry districts of Singida and Kongwa, African eggplant did not rank under the most important traditional vegetables (Singida No. 13, Kongwa No. 16) and was, therefore, not discussed in detail with focus group participants. However, results from the discussions on production issues in two villages each of Arumeru and Muheza district shall be provided in the following.

Cropping pattern. In general, as suggested in Muheza district, African eggplant seedlings were first raised in a nursery before being transplanted. Intercropping was hardly ever done with African eggplant in Arumeru and Muheza districts mainly because of shade (Table 5.62). On the one hand, African eggplant could be shaded by e.g. taller maize plants and, additionally, pollen of maize would fall on the eggplant fruits which was disliked by farmers. On the other hand, eggplant could overshadow other smaller plants (Arumeru). It would further suppress other crops with its spreading tendency. Yet, it was also suggested that African eggplant would grow upright for light when intercropped, thereby producing less branches and less yield (Muheza). Moreover, monocropping was especially done during the wet season from April to August in Arumeru district to avoid pests which occur together with the rain. Actually, soil-borne diseases were of a serious problem for *S. aethiopicum*, which can be controlled by adequate drainage, crop rotation and a good soil structure (LESTER & SECK, 2004). From August onwards, it was possible to intercrop African eggplant with banana as it was suggested in one village of Arumeru district.

Tab. 5.62 Cropping patterns for African eggplant in two research districts of Tanzania.

	Arumeru (2 villages)	**Muheza** (2 villages)
Inter-cropping	hardly practised but with bananas from August onwards; reason: shaded by and shaded other crops; strong competitor, suppressed other crops;	not practised; reason: spreading plant habit, suppressed other crops; grew upright for light and produced less;
Mono-cropping	mainly practised; reason: especially from Apr - Aug (wet season) to avoid pests which occurred with rain;	solely practised; reason: better performance, higher yield;

Harvest. African eggplants were nursed for 30 to 40 days before transplanting. Another 60 days after transplanting, harvest could start, which lasted for 60 days under

normal conditions, with a harvest interval of one week. Under superior conditions concerning water and nutrients, African eggplant could even be harvested for up to 90 days. Farmers in Muheza district even stated that one plant could be harvested for one or two years depending on the moisture, though, with age yield was declining. Cropping of African eggplant was possible throughout the year, while there existed certain times for the main harvest period (Table 5.63). During April and May, the crop was not producing in Arumeru district due to rainy and cold weather.

Tab. 5.63 African eggplant parts used and time of harvest in two research districts of Tanzania.

	Arumeru (2 villages)	**Muheza** (2 villages)
Harvest frequency	Fruit once a week; no experience with leaves;	Once a week;
Time of harvest	Throughout the year; mainly Jun - Mar;	Throughout the year; mainly Jun/Jul - Dec;

Constraints. A limiting factor for the production of African eggplant in Arumeru district was soil fertility. Farmers in one village argued that the soil was poor, fertiliser expensive, and African eggplant exhausted the soil to their knowledge. However, farmers had experienced that they could harvest one plant once a week during two weeks, and only from the third week onwards fertiliser was necessary. Application of fertiliser was suggested ten days after transplanting, at first flowering, and then at monthly intervals, whereby plants grown as leaf vegetables (Kumba and Shum groups of *S. aethiopicum*) require extra nitrogen (LESTER & SECK, 2004). In Muheza district, no chemical fertiliser was used but leaves were left to rot on the ground and provided nutrients to the soil. Here, obviously only the fruits of African eggplant and not the leaves were used as a vegetable (Table 5.64).

Pests and diseases were mentioned as a constraint in both districts. Farmers claimed that insecticides were too expensive and, since there were no credit facilities, they could not afford to buy them (Arumeru). Besides insects, wilting and some kind of fruit worm, monkeys were troublesome because they ate and destroyed the crop (Muheza). This was also reported from Uganda, where especially leaves of the Shum group (*S. aethiopicum*) were sometimes eaten by monkeys. In Tanzania, considerable damage was reported due to the chilli veinal mosaic virus (ChiVMV) spread by the green peach aphid (*Myzus persicae*) (LESTER & SECK, 2004). In general, both *S. macrocarpon* and *S. aethiopicum* were rather resistant to pests and diseases compared to exotic vegetables like tomatoes and the brinjal eggplant (BUKENYA-ZIRABA & BONSU, 2003; LESTER & SECK, 2004).

Marketing of African eggplant was a constraint in one village of Muheza district since the market was not organised. Farmers claimed that they could earn only 100 Tanzanian Shillings (= ca 0.10 US$) for a 5 l bucket of fruits. In another village, farmers sold their African eggplants two days a week on markets within their village, within Muheza, and some were even taken to the cities of Tanga and Dar es Salaam. Great differences in terms of marketing arose between villages of one district. However, while fresh leaves had to be taken immediately to the market since they were highly perishable, African eggplant fruit could be transported long distances, and stored for several days if they were free of rot or damages (LESTER & SECK, 2004). This was a considerable advantage to solely leafy vegetables and facilitated marketing.

Tab. 5.64 Constrains in producing African eggplant in two research districts of Tanzania.

Constraints	**Arumeru** (2 villages)	**Muheza** (2 villages)
Labour availability	no problem	-
Water	limiting factor especially from Aug to Feb;	-
Soil fertility	crop exhausts the soil; poor soil and expensive fertiliser;	no chem. fertiliser; leaves were left to rot on the ground;
Seeds	no problem; use own seeds;	-
Weeds	no problem;	-
Pests & Diseases	insects boring the fruit; nematodes; wilting; powdery mildew;	insects eating leaves and fruits; fruit worms; monkeys; wilting;
Marketing	no problem; good market;	1st village: no organised market → problem; 2nd village: twice a week market in village and Muheza;

"-" = issue not raised during focus group meeting

Responsibility. In Arumeru as well as Muheza district, both men and women were responsible for the production of African eggplant. While in Muheza district no distinctions between individual production steps were made, women and children, if not at school, were responsible for activities such as weeding and harvesting of small lots (for subsistence) in Arumeru district. On the other hand, field preparation and harvesting of big lots (for marketing) was a task solely for men (Table 5.65). In general, women had the sole responsibility for African eggplant if it was grown in their home gardens, while men were accountable if it was a cash crop.

Tab. 5.65 Responsibility for the production of African eggplant in two research districts of Tanzania.

	Arumeru (2 villages)	**Muheza** (2 villages)
Women	weeding and harvest of small lots; spraying if men not around; sowing, transplanting and watering together with men; cared for home garden crop;	all activities; especially home-gardening;
Men	field preparation and harvest of big lots; spraying; sowing, transplanting and watering together with women; cared for the cash crop;	all activities, no distinction;

5.6.4 CONSUMPTION ISSUES OF AFRICAN EGGPLANT

Consumption issues as well as issues on processing and utilisation were discussed in two villages of Arumeru district as well as in one village of Muheza district considering the following aspects.

Plant parts used. Only fruits of African eggplant were used for consumption in both districts. Yet, in Arumeru district, focus group participants knew that the leaves of *Solanum anguivi* were consumed but this species was not popular in this district.

Taboos. In Arumeru district no reasons were named for not consuming African eggplant, only on an individual basis people would not eat it. Interestingly, in Muheza district farmers explained that people with peptic ulcers refrain to eat African eggplant because it created more acid. However, as mentioned before in Arumeru district it was advised to eat African eggplant to treat peptic ulcers. Presumably, different landraces with different chemical compositions were available in the two districts. Furthermore, in Muheza district asthmatic people were told not to eat African eggplant.

5.6.5 PROCESSING AND UTILISATION

Preparation. Two and three different preparation methods for African eggplant were explained by farmers in Arumeru and Muheza district, respectively. Thereby, one main dish was named in both villages of Arumeru district with several different variations (Table 5.66). The preparation of a meal in Arumeru district started typically with the sorting and washing of vegetables, the ends of African eggplants were cut off, they were pealed and cut in half, while further vegetables where chopped as well. Onions were fried in oil, tomatoes added and finally eggplants, salt and additional vegetables. The frying process took about 15 minutes.

This recipe could be modified when fresh milk was added after the frying process or, optional, coconut milk or groundnuts were already added at the beginning and cooked together with the vegetables. A further variation was to add tomatoes at the

very end and fry them with a lid for two minutes only. Additionally, little water or milk was added to this dish. After the frying process, it was also possible to add Irish potatoes (*Solanum tuberosum*) and beef, and cook everything for another 30 minutes. In doing so, the vegetable was cooked for about 45 minutes whereby the question arose, how many nutrients would remain. It was also not explained why not Irish potatoes and beef were cooked first and later vegetables were added or cooked separately for a short time only.

A different recipe in Arumeru district without frying the vegetable in oil was to put all ingredients into a pot at once and to cook or rather steam them with a little amount of water for 15 minutes. All vegetable dishes were usually served together with ugali (maize porridge).

For one dish called "hombo" in Muheza district, African eggplants were cut in half but not peeled because they would loose their taste when pealed. African eggplant was also prepared as a sauce to fish, beef or chicken in Muheza district. Thereby, all ingredients were either fried one after the other in oil and, when dried, fish (or beef or chicken) was added and everything was cooked. Optional, all ingredients were boiled in coconut milk at once for 10 to 15 minutes. The latter option took only half the time and must, therefore, be much more sparing in terms of nutrients.

A third, totally different method to prepare African eggplant fruit in Muheza district was called "choma". Fruits of African eggplant were put into hot ash and simply roasted. They were ready when the skin burst, yet, it was suggested not to let the skin burst since ash would enter into the fruit and reduce the quality. Therefore, it was looked for blisters and fruit taken out in time. They were eaten along with boiled cassava roots.

Preservation. African eggplant was neither preserved in Arumeru nor in Muheza district. This was due to the vegetable being available throughout the year and, accordingly, there was no need for preservation and storage.

Medicinal value. While in Muheza district African eggplant was declared to have no medicinal value, in Arumeru district focus group participants explained that, by simply eating fruit of bitter African eggplant types (of leafy groups), one could overcome problems of high blood pressure, problems of sight as well as diabetes. Thereby, fruit should be eaten fresh or boiled but without any further ingredients. If fruits were boiled with little salt one could even treat peptic ulcers by eating them (Arumeru). The possibility to treat problems of sight suggested that the fruit contained a significant amount of vitamin A. Furthermore, the fruit contained probably a substance that could e.g. relief the body from surplus salt and water, so that the volume of blood was reduced. How-

ever, this was not tested but LESTER & SECK (2004) suggested also that roots and fruit of *S. aethiopicum* could treat high blood pressure.

Tab. 5.66 Preparation of African eggplant in two research districts of Tanzania.

	Arumeru (2 villages)	**Muheza** (1 village)
Ingredients	• onions; • tomatoes; • oil; • okra fruits (1/2 kg); • eggplant fruits (6-8); • salt; • fresh milk (optional); OR • coconut milk (optional); OR • groundnuts (optional);	• eggplant fruits; • okra fruits; • little water • salt;
Method	frying;	boiling;
Time	10-15 min. for whole process;	5-10 min.;
Important	only one ingredient of fresh milk, coconut milk or groundnuts was added;	"hombo"; mix well to get a uniform consistence;
Ingredients	• like No.1 • Irish potatoes; • beef;	• onions; • oil; • eggplant fruits; • tomatoes; • little water; • dried fish (beef or chicken); • salt;
Method	frying and cooking;	frying and cooking;
Time	10-15 min. for frying process; 30 min. for cooking after adding potatoes and beef;	5-10 min. for frying vegetables; 10-15 min. for cooking (vegetables + fish);
Important		option: use coconut milk instead of oil and boil all ingredients at once for 10-15 min.
Ingredients	• eggplant fruits; • okra fruits; • pumpkin leaves; • groundnuts; • salt; • soda ash;	• eggplant fruits;
Method	boiling;	roasting in hot ash;
Time	15 min.	
Important	boil everything at once;	"choma"; take them out of ash before blisters on the skin burst;

Fig. 1 **Local amaranth types in Sakale village, Muheza district, Tanzania.**

Fig. 2 **Farmer in her home garden with amaranth, Ethiopian mustard and African spiderflower (right), Kikwe village, Arumeru district, Tanzania.**

Fig. 3 Spreading (left) and erect cowpea plants and appendant seeds, Mbala village, Arumeru district, Tanzania.

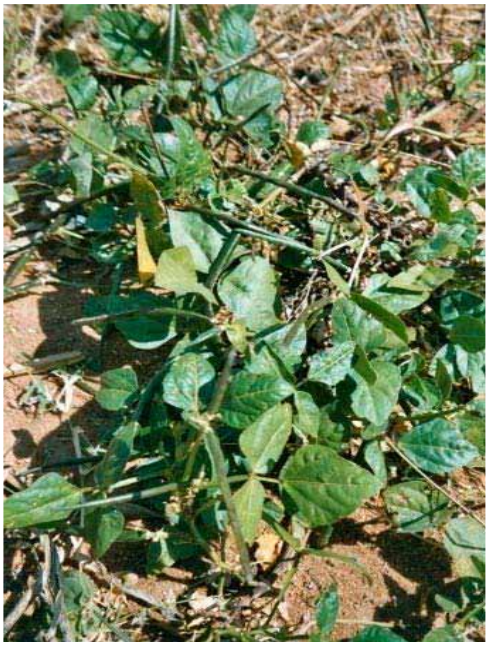

Fig. 4 Vegetable cowpea in Itamka village, Singida district, Tanzania.

Fig. 5 Okra with leaves affected by powdery mildew and insect pests, Ambala village, Arumeru district, Tanzania.

Fig. 6 Okra type 'pamba ekundu' in Tongwe village, Muheza district, Tanzania.

Fig. 7. Jute mallow (*Corchorus* spp.), spreading type, growing wild in Singida district, Tanzania.

Fig. 8. Jute mallow (*Corchorus* spp.), spreading type, growing wild in Singida district, Tanzania.

Fig. 9. Erect/wima' (left) and spreading/tambaa' jute mallow type (*Corchorus* spp.), Singida district, Tanzania.

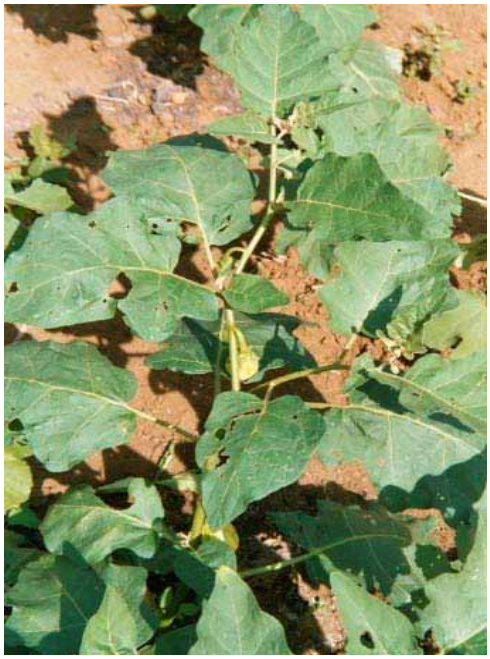

Fig. 10 African eggplant, white and sweet type, Mashewa village, Muheza district, Tanzania.

Fig. 11 African nightshade, Kenya type, leaf size is reduced due to drought, Nambala village, Arumeru district, Tanzania.

Fig. 12 Cassava tree (kisamvu mpira), used for leaves only, Muheza district, Tanzania.

Fig. 13 Local cucumber type in Itamka village, Singida district, Tanzania.

Fig. 14 Local cucumber type in Manungu village, Singida district, Tanzania.

6 PROSPECTS AND CONCLUSIONS

The main research objective of this study, namely to collect baseline information on the current consumption and production status of traditional vegetables in Tanzania, has been achieved for the four districts researched. Farmers named preferable traits of traditional vegetables, favoured species and varieties, explained processing technologies they applied, and voiced main constraints to traditional vegetable production, consumption and utilisation. It must be pointed out that several general findings were not new but only confirmed the knowledge already available on, for example, gender issues in subsistence and marketing of vegetables, constraints such as pests and diseases in vegetable cropping, and genetic erosion of indigenous and traditional vegetables. However, some of these outcomes were not explored before in Tanzania and in the particular districts. Therefore, a contribution in a geographical sense has been achieved. In fact, some new results were made in particular with regard to the value or status of wild traditional vegetables as well as the medicinal values of traditional vegetables in Tanzania.

6.1 DIVERSITY OF TRADITIONAL VEGETABLES IN TANZANIA

Genetic diversity. As Tanzania comprises nine different agro-ecological zones (ANONYMOUS, 2004c) and hosts one of 25 hotspots of biodiversity in the world (ANONYMOUS, 2004b), it was expected to find also a high diversity of traditional vegetables in this country. In fact, it was not a question of vegetables being available but rather which and how many vegetables were indeed used by farmers. Actually, vast differences in number of traditional vegetables used occurred between the different districts of Tanzania investigated. While the overall vegetable diversity with 103 different traditional species and types found in the four districts researched was fairly high, only 12 traditional vegetables were available in all four districts. These were mainly cultivated vegetables, while those gathered from the wild were rather unique to individual districts. It was shown by Shannon's and Simpson's diversity indices that vegetable diversity as well as evenness were different between districts. Thereby, less difference between the urban districts of Arumeru and Singida was observed, while the rural Kongwa and especially the rural and coastal Muheza district showed a much higher vegetable diversity. Moreover, the Sørensen coefficient was rather low and ranged from about 27% of common vegetables only between Singida and Muheza to nearly 60% of common vegetables between Arumeru and Singida districts. The fact that Muheza differed to such an extent from the other districts in terms of vegetable composition can be traced back to its totally distinct coastal climate and its great

biodiversity in general (ANONYMOUS, 2004b). Furthermore, it was by far the most rural district with villages farthest from urban centres and, in general, not easy to access. The equality of Arumeru and Singida districts was contrariwise explained with their urban centres being responsible for a certain degree of infrastructure, resulting especially in terms of marketing and information systems in a similar limited set of vegetable species and types used by farmers. Thereby, climatic conditions as well as soil properties were rather negligible, while the degree of urbanisation and the availability of infrastructure were decisive. This can also be stated for the general shortage of food, which is not due to natural conditions such as drought but to man-made forces (ROSSET, 2001).

Differences also may be due to the variable ethnic groups and their culture present in the four districts. As people in Arumeru district had a much shorter tradition of cultivating crops, i.a. vegetables, while, e.g. the Shambaa in Muheza district were agriculturalist since ancient times, these two groups had a different relationship to vegetable cultivation and usage. Another example from Mara region, Tanzania, showed that edible wild roots and tubers were found to be unrecognised in this area, while at the same time little cultural tradition among the population of the region of eating wild underground portions of plants was available and, thus, explaining the unexploitation of roots and tubers (JOHNS, 1996).

In terms of infrastructure, farmers' knowledge was an important factor in which the information system of each district was reflected. For example, farmers in Arumeru district, living close to HORTI Tengeru and AVRDC-RCA as a source of training and information, were knowledgeable about specific facts, e.g. on nutrient contents of certain vegetables or preservation methods though not common in this district. They further cultivated more exotic vegetables, such as tomatoes, which were a main research and development target of AVRDC-RCA. In contrary, in the rural Kongwa district, focus group participants asked for more information about vegetables since they were reached seldom or never by advanced training programs for these particular crops. Thus, knowledge determined which vegetables were cultivated but also how successful and for what purpose. In this case, knowledge was obviously stimulating exotic vegetable cultivation and reducing traditional vegetable diversity. Likewise, a study in Swaziland has demonstrated that in an economy, which is rapidly becoming market-led and urbanised, processes of agrobiodiversity loss took place extremely fast. Thereby, specific government policies that favoured this process played an important role (MALAZA, 2003). However, agricultural infrastructure and education have to be enhanced in the "right" way, i.e. promotion of local farming practices, diets and

agrobiodiversity as well as approaches on needs of rural women who are the principal food producers and gatherers must be applied (MALAZA, 2003).

Genetic erosion. Besides infrastructure including knowledge from "outside", **indigenous knowledge** on how to collect, cultivate and prepare traditional vegetables and their variable taboos and applications e.g. as medicines, was also of high importance. Unfortunately it was recognised that indigenous knowledge was getting lost in Tanzania. For example, in Muheza district, where vegetable diversity was highest, names of many wild traditional vegetables and their uses were often only known by elderly women, yet, this knowledge was not with the young generation. This was a main factor for genetic erosion of traditional vegetables. Also in Venezuela a continuing loss of knowledge of agrobiodiversity was recognised with the Arawakan people. This knowledge, along with sustainable agriculture, has been abandoned among many families, resulting in instability in food supply (HOFFMANN, 2003). In Mali, however, research in the area of indigenous knowledge on plant biodiversity has progressed and organisations were now giving attention to documenting and conserving local plant genetic resources. Nevertheless, it was found that, due to different ethnicity or mode of livelihood, a substantial degree of differentiation existed within local populations concerning indigenous knowledge on plant biodiversity (WOOTEN, 2003).

Another significant factor for genetic erosion of traditional vegetables in Tanzania was the introduction of exotic vegetables. The introduced new vegetable varieties or species were usually marketable or fetched a better market price They were higher yielding, fast growing and less perishable. In fact, some of them, such as onions and tomatoes, diversified the meals of people and were rather used as spices and mixed with traditional vegetables and were irreplaceable already. However, others, such as kales and cabbages stood in for traditional leafy vegetables, yet, they were often less nutritious and more expensive than traditional ones (IPGRI, 2003). While these qualities, especially nutrient content, were rather "long-term" qualities, and would not influence people directly, the positive qualities of exotic vegetables mentioned above were "short-term" qualities and had a direct impact e.g. on farmers income. If one was in an unfavourable situation, one would of course choose a path with short term impacts to change living standards rapidly. As low living standards are prevalent in Tanzania, with 19% of the population living below the food poverty line and 36% living below the basic needs poverty line (ANONYMOUS, 2001), exotic vegetables creating cash income rapidly became highly popular.

Besides positive long-term effects in terms of nutrition and adapted growth, the usage of traditional vegetables also presents a conservation of genetic material

through utilisation. This is an important key to preserve genetic diversity for future generations and to prevent crop failures due to large-scale monocropping. Plant genetic diversity represents an immense pool of different genetic characteristics such as resistance, taste and nutrient content, adapted to different requirements, cultures, lifestyles and regions. This diversity is needed for different growing conditions and to ensure that new combinations and new ideas can evolve (LACHKOVICS, 2003).

Recommendations. While investment into infrastructure and especially education and advanced training in vegetable cropping and marketing is needed, at the same time indigenous knowledge must not be neglected. For example, in this study it was learned that especially wild traditional vegetables played an important role while others initially identified by the project did not. Thus, to identify farmers' knowledge and needs was absolutely necessary, as it was done in this study.

Genetic erosion in terms of traditional vegetables already occurs in Tanzania and should be focused on if genetic diversity is to be maintained for future generations. While some traditional vegetables may vanish since they are not longer preferred by consumers, others should receive similar attention in research and development as exotic vegetables to get a chance within the competition.

6.2 PRODUCTION ISSUES: CULTIVATING VS COLLECTING TRADITIONAL VEGETABLES IN TANZANIA

Cultivated traditional vegetables. The most important constraints in the production of traditional vegetables were pests and diseases affecting the crops, followed by water stress and lack of irrigation facilities. Additional constraints were weight differently in the various districts and in individual villages some constraints were perceived as burning issues and outstanding while others were not of a problem. Consequently, each district needs its own approach and while e.g. the availability of vegetable seeds must be improved in Singida district, vegetable marketing should be enhanced in Kongwa and Muheza districts. Similar constraints, such as pests and diseases, lack of good market prices, lack of seeds and lack of cash for inputs, were mentioned by farmers to decrease production in a study on Kenyan traditional leafy vegetables (MAUNDU et al., 1999b).

AVRDC-RCA already achieved some research goals and identified, e.g. two lines of African eggplant (*S. aethiopicum*) to be very productive, easy-to-grow and to have minimal pest and disease problems. Furthermore, these lines were stated to be much sweeter in taste than older lines (AVRDC, 2003), however, some farmers of both Arumeru and Muheza districts maintained that slight bitterness of African eggplant fruits was preferred. Therefore, before releasing new lines with benefiting agronomic

traits, farmers must be involved to approve the acceptance of these new lines. Besides, especially women farmers should be comprised in selection of new varieties or types since they are the decision makers and manage and oversee the whole process, with few exceptions, from planting to harvesting of traditional vegetables (MAUNDU et al., 1999b).

In general, vegetables are succulent crops and therefore attractive to pests and disease organisms (SIEMONSMA & PILUEK, 1994). The most common damage in leafy vegetables is caused by leaf eating insects, generally caterpillars. The latter not only disturb growth and development of plants, but they also spoil the leaves for marketing (OOMEN & GRUBBEN, 1978). Furthermore, actively growing leafy vegetables need 6 mm (6 liter per m^2) of water daily, other vegetables 4 mm. Normally, vegetable produce higher yields in the dry season with irrigation than in the rainy season without irrigation (SIEMONSMA & PILUEK, 1994).

Farmers in Tanzania reported problems with purity and storage life of seeds, which is not surprising as the production of seeds is a skilled operation, especially when a high level of purity and trueness to type is wanted (TINDALL, 1983). In fact, seed systems are not well refined, as domestication of most traditional vegetables is rather recent and, consequently, seeds are a common constraint in the cultivation of traditional vegetables (MAUNDU et al., 1999b). Besides constraints in production, traditional vegetables face the problem of being replaced by a few high-yielding commercial varieties (AVRDC, 2003), which can result in loss of plant genetic resources.

Wild traditional vegetables. Many more different traditional vegetables were collected from the wild instead of being cultivated. Moreover, some of these wild plants were even recognised as the most important vegetables for one district, such as jute mallow in Singida. However, the amount of wild vegetables consumed compared to cultivated ones was not explored, nevertheless, it is possible that consumption of cultivated vegetables has a larger share because of easier access as well as availability.

Wild traditional vegetables are advantageous since they are often more resistant to pests, easy growing, and acceptable to local tastes (AVRDC, 2003). Furthermore, it is mainly women who select, propagate, gather, and market these wild food resources (PRICE, 2003). As wild vegetables were seldom marketed in Tanzania they contributed mainly to the daily domestic consumption. This contribution is highly important especially in terms of vitamins and minerals, yet, historically wild food plants, belonging to the women's field of responsibility, were often overlooked since men's activities received much more attention in research (PRICE, 2003).

The fact that wild traditional vegetables were hardly marketed in Tanzania was not surprising, since everybody had access to these wild resources being not only available in cultivated fields but also in uncultivated common land like forests or swampy areas. Nevertheless, in Thailand, it was experienced that women who sold wild foods at market had a higher income than those who did not (PRICE, 2003). Obviously, there is a demand for wild vegetables by people who either have no access to land where they could gather them, or have no time to collect vegetables. Wild vegetables must, therefore, reach markets of urban centres or at least markets where non-farmers are buying. Consequently, scope for developing a market or market chain for wild vegetables is given and requires a follow up.

Besides being a daily food, wild vegetables have been an important source of emergency food, which is used when there is a shortage in other food sources (DANIGGELIS, 2003). As wild vegetables are obviously of enormous importance, it is inappropriate to use the term 'supplementary' or 'minor' food crops, since they are in no way peripheral to the diet (FLEURET, 1979; LINTU, 1995; in: DANIGGELIS, 2003).

Recommendations. Though research on integrated pest management in vegetables is already carried out at HORTI-Tengeru and AVRDC, the knowledge did not yet reach the farmers sufficiently, especially in the districts of Singida, Kongwa and Muheza. As pests and diseases were named as a main constraints, this problem should be examined with a focus on traditional vegetables in particular. Water availability is a general problem for agriculture in Tanzania, with agriculture usually being rainfed. At the same time it is believed that irrigation holds the key to stabilise agricultural production (ANONYMOUS, 2004c), yet, in 1997 only 4% of Tanzania's cropland was irrigated (MILLSTONE & LANG, 2002). As it is not sure how fast this broad challenge on water distribution and availability can be solved, crops should be adapted to their environment and rather drought-resistant varieties and types should be chosen for cultivation. For example, in Kongwa district an introduced okra type (*Abelmoschus esculentus*) was preferred due to its fast growth, early maturing and soft fruits, but it was susceptible to drought. At the same time, a local type (*A. caillei*) was drought-resistant but not liked by people since it was late-maturing, getting coarse fruits very soon and having spines. Consequently, more research is urgently needed for traditional and indigenous crops and, in fact, it is argued that the value for money would be higher when research is invested in indigenous vegetables than in research on already well-established exotic vegetable crops. Furthermore, it is likely that research on traditional vegetables will lead to new findings and contributes not only to science, but also to people's general well-being and food security (SCHIPPERS, 2002).

To maintain wild vegetable resources, it is not only important to save indigenous knowledge but also to preserve the habitats where wild food plants occur. These habitats are e.g. forests or swampy areas but also bush and fallow land. Since many wild vegetables occur alongside staple crops in fields, at field boundaries, along roadsides, in gardens and garden fallows and are sometimes also called 'weeds' (PRICE, 2003), one should carefully think about changing an agricultural system from extensive to intensive, i.e. starting to apply herbicides. In terms of jute mallow (*Corchorus olitorius*), being the most important vegetable in Singida district but collected from the wild only, it is suggested to encourage farmers to cultivate this crop since cultivating techniques as well as improved seeds are already available with AVRDC-RCA and HORTI-Tengeru. A further step is to encourage the marketing of wild vegetables, which can contribute significantly to farmers income.

6.3 CONSUMPTION ISSUES: NUTRITIONAL VALUES OF TRADITIONAL VEGETABLES IN TANZANIA

Consumption of traditional vegetables. In Tanzania, different parts of traditional vegetables were consumed, mostly more than one part, e.g. leaves and fruits or seeds. Between 50 and 60% of vegetables were sometimes not consumed by specific population groups in all districts but in Singida district, where only 10% of vegetables were named to be related to a food taboo. About 40% of traditional vegetables had, besides being consumed as food, a medicinal value in all districts but Muheza, where even 70% of vegetables were used as medicine. Medicinal value was not restricted to the ability of healing an illness but many traditional vegetables were named to increase the health in general, to contain many important nutrients and e.g. to "increase blood" and, therefore, to help anaemic people.

In general, vegetables are not fully acknowledged as an important part of the nutrition by international organisations and in international literature on the global food situation. For example, in 'The atlas of food' by MILLSTONE and LANG (2002), the so-called world tables on consumption show only an average daily calorie supply per person as well as an average daily consumption of animal products per person, while no sources of essential micronutrients are listed. Furthermore, the food poverty line is calculated as the minimum calories necessary for survival (ANONYMOUS, 2001). However, even when a person receives enough calories through energy-rich but nutrient-poor food, she or he still may suffer from micronutrient malnutrition, which is also termed "hidden hunger" (BOUIS & NOVENARIO-REESE, 1997).

For example, vitamin A deficiency is a public health problem especially in Africa, hitting hardest pregnant women and young children in low-income countries (WHO, 2004a). While short-term attempts to combat the deficiency are promotion of breastfeeding and vitamin A supplementation, as long-term attempts first of all food fortification is suggested and then only the encouragement of homegardens to grow fruits and vegetables naturally rich in vitamin A (WHO, 2004a). It is acknowledged that the primary food sources of vitamin A are dark green vegetables, and dark yellow vegetables and fruits (STEYN et al., 2001; TONTISIRIN et al., 2002). Thereby, traditional vegetables were found to contain much more vitamin A and other micronutrients than introduced exotic vegetables. For example, amaranth has 57 times more vitamin A precursor than green cabbage, about 13 times more iron, and nearly 9 times the calcium (Table 6.1) (IPGRI, 2003). In Bangladesh, for example, the key food group with respect to micronutrient consumption is vegetable. There, vegetables provide nearly 95% of vitamin A, 75% of vitmain C, and 25% of iron intake, and are further the least expensive source of all these nutrients (BOUIS & NOVENARIO-REESE, 1997).

Tab. 6.1 Composition per 100 grams of edible portion of amaranth, African spiderflower and African nightshade compared with cabbage.

Vegetable	Iron (mg)	Protein (g)	Calories (cal)	Ascorbic acid (mg)	Calcium (mg)	Phosphorus (mg)	B-Carotene (mg)
Amaranth (*Amaranthus hybridus*)	8.9	4.6	42	64	410	103	5.7
African spiderflower (*Cleome gynandra*)	6.0	4.8	34	13	288	111	n.d.
African nightshade (*Solanum nigrum*)	1.0	4.3	38	20	442	75	3.7
Cabbage (*Brassica* spp.)	0.7	1.7	26	54	47	40	0.1

n.d. = not determined Source: FAO; in IPGRI (2003)

One of Tanzania's main nutritional problems include iron deficiency anemia (IDA) affecting 32% of the general population, especially pregnant women and children under five (KAVISHE, 1993; in: LYIMO et al., 2003). Since some traditional vegetables are a potentially important source of iron, such as jute mallow (*Corchorus tridens*) with content of up to 7.7 mg/100g, consumption of these vegetables in adequate amounts may help to overcome nutritional problems (LYIMO et al., 2003). In general and as a long-term approach, a food-based strategy with emphasis on increasing the variety of

foods consumed, is presumably the best approach to improve micronutrient malnutrition sustainably (TONTISIRIN et al., 2002).

However, even when certain foods to overcome nutritional problems have been identified and are available, reasons, why these foods are consumed in insufficient quantities, must be analysed to solve the complex problem of micronutrient malnutrition. According to BOUIS and NOVERNARIO-REESE (1997), possible reasons can be unpayability of desired non-staple foods, lack of nutritional knowledge as well as cultural factors, which results in low preference to certain non-staple foods and, finally, discrimination against certain family members (e.g. on the basis of gender and age) in the intra-household distribution of certain non-staple foods.

Preparation of traditional vegetables. Preparation methods for traditional vegetables in Tanzania were mostly steaming, boiling or stir-frying in combination with other vegetables such as onions and tomatoes. Especially, the preparation methods of steaming and stir-frying were satisfactorily in terms of nutrient preservation and, in fact, they are desirable for increasing micronutrient bioavailability. To facilitate the absorption of provitamin A, foods containing provitamin A-rich sources should be mixed with appropriate quantities of fat or oil (TONTISIRIN et al., 2002) which was usually done in all districts, whereby fat was used in the form of vegetable cooking oil (Arumeru, Singida), groundnuts (Kongwa) and coconut milk (Muheza). Only few exceptions of cooking too long were experienced in Tanzania, for example the boiling of hair lettuce (*Launea cornuta*) in plenty of water for up to 40 minutes (Muheza).

Sun-drying of leaves can help, on the one hand, as an inexpensive and effective method of preserving surplus micronutrient-rich foods (TONTISIRIN et al., 2002). However, the amount of light-sensitive micronutrients will be significantly reduced through sun-drying, while a photo-protected solar drier could retain a much higher amount of, for example, beta-carotene (MGOBA, 1993). Like in Tanzania, in Burkina Faso, the common drying method is also to spread e.g. surplus vegetables on the roof of a hut or on straw mats on the ground in the direct sun. However, since vegetables are exposed to dust and insect attacks, ABACGERES, a local NGO, has been working on a solar-drying program in the country. Their aim was to utilise seasonal overproduction of vegetable in a sensible way, so that farmers do not have to sell it below cost or even waste it. The promoted solar drier is reliable and assures a sufficiently good quality, so that products even can be sold on the market (LEGAY, 2004).

Recommendations. The pattern of preference for traditional vegetables was fairly unequal between the four districts researched. For example, in Arumeru district some vegetables low in iron content such as African nightshade (No. 1) and African

eggplant (No. 3), were popular, while others rich in iron, such as sweet potato leaves (No. 7) and cassava leaves (No. 9) were less preferred. Similarly, in Muheza district okra (No. 2) and hair lettuce (No. 3), having a low iron content, were favoured, while cassava and cowpea leaves, rich in iron, ranked only No. 7 and No. 8, respectively. Consequently, it is suggested that people should be educated about the nutritional benefit of certain vegetables on the one hand. On the other hand, variability in nutritional quality due to genotypes used and environmental conditions of cultivation sites may require further research.

Though, a number of recipes was named in each district they were fairly similar and mainly differed between the four districts. To make preparation of traditional vegetables more diverse and popular and to provide greater recognition to traditional vegetables, a cookbook for traditional vegetables, as it was supplied by IPGRI in Kenya (WOOMER, 2002), could help to introduce these plants and preparations to a wider audience of consumers and cooks.

7 SUMMARY

Traditional vegetables, though not necessarily indigenous to a country, can be associated with traditional production systems, local knowledge of farmers and, usually, have a long history of local usage and selection. Furthermore, traditional vegetables are widely underutilised and neglected in research and development. In the frame of the project "Promotion of Neglected Indigenous Vegetable Crops for Nutritional Health in Eastern and Southern Africa" led by the World Vegetable Centre (AVRDC) and partners, a study was performed in order to verify the potential of traditional vegetables that might help to fight malnutrition in Tanzania and to diversify income for resource-poor farmers under low-input conditions.

For this study, focus group meetings were conducted in 10-12 villages of four different districts in north-east Tanzania to gather basic information on available traditional vegetables and to explore farmers' knowledge on production and consumption taking gender into consideration. As the questionnaire for focus groups was mainly needed to guide the discussion it was semi-structured, containing both closed and open questions. The four districts researched differed highly in ethnicity as well as in climate, altitude, and soil conditions.

To analyse data received a long-table approach was applied, which is a low-technology option, yet, it is suitable to identify themes and categorise results. To compare the research districts with regard to their availability of traditional vegetables, the Sørensen coefficient was calculated. Furthermore, Shannon's and Simpson's diversity indices were determined, which are used to characterise species diversity in a community. They account for both abundance and evenness of the species present.

Farmers named 10-34 different traditional vegetables per village, summing up to an overall of 102 in all four districts. While 56 of these vegetables could be identified, 46 of them were only known by their local names. Only 12 traditional vegetables were present in all four districts. The number of wild traditional vegetables used was always greater than that of cultivated ones, with a ratio wild:cultivated ranging from 11:9 in an urban highland district to 59:11 in a rural coastal district. The Sørensen coefficient showed a rather low degree of common vegetables in two districts and ranged from about 27% only between Singida and Muheza to nearly 60% of common vegetables between Arumeru and Singida districts. Furthermore, it was shown by Shannon's and Simpson's diversity indices that vegetables diversity as well as evenness were less different between the urban districts of Arumeru and Singida but diversity was much higher in the rural Kongwa district and, especially, in the rural and coastal Muheza district.

Traditional and particularly wild traditional vegetables were threatened with genetic erosion due to change in land use and eating habits. While climate change was suggested by farmers as a possible reason for genetic erosion, it was found that climatic conditions were rather negligible, while the degree of urbanisation and the availability of infrastructure were more decisive. Thereby, training and new knowledge gained apparently stimulated exotic vegetable cultivation, while it reduced traditional vegetable diversity. At the same time, indigenous or traditional knowledge on how and where to collect, cultivate and prepare traditional vegetables was disappearing.

Despite their recognised importance, existing taboos, for example in one district, did not allow men to eat green leafy vegetables. Preservation of traditional vegetables was non-satisfying since leaves were usually dried in the direct sun-light, whereby especially vitamin C is being lost.

As a consequence of this study, it is suggested i.a. to launch an educational program especially on sparing preparation and processing methods as well as to increase awareness of wild traditional vegetables, the conservation of their habitats, and the possibility to save these genetic resources through enhanced utilisation. Thereby, marketing of wild traditional vegetables, which hardly occurred in Tanzania, could be a source of income and is one possibility to enhance preservation through usage of these important food sources.

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9 APPENDIX

Tab. 91 Availability and frequency of occurrence of traditional vegetables mentioned by focus group participants in all four research districts, Tanzania

English	Swahili	Local (district or tribe)	Scientific	Arumeru n = 10		Singida n = 11		Kongwa n = 10		Muheza n = 12	
				No.	%	No.	%	No.	%	No.	%
okra	bamia	n.a.	*Abelmoschus esculentus* (L.) Moench	6	60	11	100	10	100	12	100
baobab (tree)	mbuyu	majani ya mbuyu, Ikui; tebwe (Sambaa); mbuyu (Bondei)	*Adansonia digitata* L.	0	0	0	0	2	20	1	8
(woody herb or shrub)	kinonga	tebwa (Bondei, Sambaa)	*Aerva lanata* (L.) Schultes	0	0	0	0	0	0	5	42
amaranth	mchicha	mgha, mughaa, mugha, mogha (Singida)	*Amaranthus blitum* L., *A. cruentus* L., *A. dubius* L., *A. hybridus* L., *A. spinosus* L., *A. graecizans* L.	10	100	11	100	10	100	12	100
spiny amaranth	mchicha	buuza (Bondei), bwache (Sambaa)	*Amaranthus spinosus* L.							1	8
(perennial herb)	mchicha, mfuchwe, mtikini	tikini	*Asystasia gangetica* (L.) T. Anders., *A. mysorensis* (Roth) T. Anders.	0	0	0	0	0	0	6	50
malabar spinach		nderema, ndeema	*Basella alba* L.	0	0	0	0	0	0	6	50
black jack	kishonanguo	mpangalale, mhangalale (Kongwa); kisamanguo (Muheza)	*Bidens pilosa* L.	3	30	0	0	3	30	12	100

English	Swahili	Local (district or tribe)	Scientific	Arumeru n = 10		Singida n = 11		Kongwa n = 10		Muheza n = 12	
				No.	%	No.	%	No.	%	No.	%
Ethiopian kale / mustard	sukuma wiki, loshuu, figiri	figiri, figili (Muheza); nyaulezi, figili (Kongwa)	*Brassica carinata* A. Braun	10	100	0	0	4	40	5	42
n.a.	ngoomba	n.a.	*Brassica* spp.	3	30	0	0	0	0	0	0
(large tree)	mpafu	muafu, mwafu, mpafu	*Canarium madagascariense**	0	0	0	0	0	0	2	17
(annual herb)	mchicha pori	fungumsanga	*Celosia trigyna**	0	0	0	0	0	0	2	17
(annual herb)	mlenda mbata	mbaata	*Ceratotheca sesamoides**	0	0	1	9	0	0	0	0
African spiderflower	mgagani	mng'ang'i; mung'ang'i (Singida); mzimwe (Gogo);	*Cleome gynandra* L., *Gynandropsis gynandra* (L.) Briq.	7	70	11	100	10	100	9	75
(bushy herb)	n.a.	mhilile	*Cleome hirta* (Klotzsch) Oliv.	0	0	0	0	10	100	0	0
taro	n.a.	majani ya majimbi	*Colocasia esculenta* (L.) Schott	0	0	0	0	0	0	8	67
(like taro)	n.a.	maeze	*Colocasia* sp.	0	0	0	0	0	0	1	8
(like taro)	n.a.	majani ya mayugwa	*Colocasia* sp.	0	0	0	0	0	0	1	8
(type of taro, found in mountainous area)	n.a.	yugwa	*Colocasia* sp.	0	0	0	0	0	0	1	8
n.a.	n.a.	nhongo	*Commelina* sp.	0	0	0	0	1	10	0	0
jute mallow	mlenda	kibwando (Muheza); imito (Kongwa); mahonda, nkonda (Singida)	*Corchorus olitorius* L., *C. tridens* L., *C. trilocularis* L.	7	70	11	100	10	100	12	100

English	Swahili	Local (district or tribe)	Scientific	Arumeru n = 10		Singida n = 11		Kongwa n = 10		Muheza n = 12	
				No.	%	No.	%	No.	%	No.	%
bur gherkin	n.a.	Maimbe = dried; Mahanjo = fresh Matango ya kienyeji;	*Cucumis anguria* L.	0	0	11	100	0	0	0	0
pumpkin leaves	majani ya maboga	mhuza, mhuja (Kongwa); msusa; manyungu; mimbe (Singida)	*Cucurbita pepo* L., *C. moschata (*Duschesne ex Lam.) Poir.	10	100	11	100	10	100	12	100
(annual herb)	kilemba cha bwana, ulimi wa ngombe	limi la ng'ombe, limi ja ng'ombe	*Emilia coccinea* *	0	0	0	0	0	0	1	8
(shrub)	n.a.	mnyembeuwe (Bondei), mnyembeue (Sambaa)	*Erythrococca kirkii**	0	0	0	0	0	0	6	50
gallant soldier	majani ya sungura	n.a.	*Galinsoga parviflora* Cav.	1	10	0	0	0	0	0	0
sweet potato leaves	Matembele	n.a.	*Ipomoea batatas* L. (Lam.)	10	100	11	100	9	90	12	100
beach morning glory	majani ya mwaka, mlakasa	talata, tarata, taata	*Ipomoea pes-caprae* (L.) R. Br.	0	0	0	0	0	0	11	92
n.a.	n.a.	matembele pori	*Ipomoea* sp.	0	0	0	0	1	10	0	0
(annual herb)	n.a.	unkobo	*Justicia heterocarpa**	0	0	0	0	0	0	2	17
hyacinth bean (leaves)	fiwi	fili (Kongwa)	*Lablab purpureus* (L.) Sweet	3	30	0	0	9	90	2	17
sage brush	mvepe	mghaa, mhuuga	*Lantana trifolia* L.	0	0	0	0	0	0	1	8
hair/bitter lettuce	mchunga	suunga (Kongwa); songa (Singida)	*Launaea cornuta* (Oliv. & Hiern) Jeffr., *Sonchus luxurians**	8	80	3	27	5	50	12	100
(annual herb)	kinwale, kisambale, msambali	sambae, shambae	*Lobelia fervens* ssp. *fervens**	0	0	0	0	0	0	5	42

English	Swahili	Local (district or tribe)	Scientific	Arumeru n = 10		Singida n = 11		Kongwa n = 10		Muheza n = 12	
				No.	%	No.	%	No.	%	No.	%
(cherry tomato; indigenous tomato)	nyanya	nyanya pori, mwasege (Muheza)	*Lycopersicon* sp.	2	20	0	0	0	0	3	25
Cassava leaves	Kisamvu	mpira (Kisamvu) muhogo (Cassava)	*Manihot glaziovii** *Manihot esculenta* Crantz	9	90	11	100	9	90	10	83
(climber or creeping herb)	n.a.	ushwe, lushwe	*Momoridca foetida**	0	0	0	0	0	0	2	17
moringa	mlonge, mronge	n.a.	*Moringa oleifera* Lam.	2	20	0	0	0	0	1	8
cape myrtle	n.a.	zuma	*Myrsine africana**	0	0	0	0	0	0	1	8
(evergreen shrub, climber)	n.a.	mtulu	*Opilia amentacea**	0	0	0	0	3	30	0	0
small caterpillar pod	n.a.	kiumbu, kisogo (Zigua), hombo-kiumbu (Bondei), hombo (Sambaa)	*Ormocarpum kirkii**	0	0	0	0	0	0	3	25
common bean (leaves)	majani ya maharage	msangani	*Phaseolus vulgaris* L.	0	0	0	0	0	0	8	67
(annual herb)	kisogo	kisungu, kisugu	*Platostoma africanum**	0	0	0	0	0	0	2	17
(common) purslane	tako la hasani	talco la hassani, tako-da-hasani	*Portulaca oleracea* L.	0	0	0	0	0	0	1	8
water cress	saladi	n.a.	*Rorippa nasturtium-aquaticum* (L.) Hayek	10	100	4	36	0	0	1	8
(shrub, small tree)	msogo	kisogo (mbangwe)	*Rourea orientalis**	0	0	0	0	0	0	9	75
African eggplant	ngogwe	n.a.	*Solanum aethiopicum* L., *S. macrocarpon* L., *S. anguivi* ,	10	100	5	45	5	50	12	100
African eggplant	ngogwe	makunga	*Solanum macrocarpon* L.							1	8

English	Swahili	Local (district or tribe)	Scientific	Arumeru n = 10		Singida n = 11		Kongwa n = 10		Muheza n = 12	
				No.	%	No.	%	No.	%	No.	%
African nightshade	mnavu	mjimba nkunku (Singida)	*Solanum nigrum* L., *S. americanum* Miller, *S. scabrum* Miller, *S. villosum* Miller	10	100	10	100	7	70	12	100
(perennial herb)	mchunga	kwake	*Sonchus luxurians**							1	8
East African arrowroot	mlanga, mwanga	mwange, mwanga	*Tacca leontopetaloides**	0	0	0	0	0	0	1	8
(perennial herb)	mlenda	tonge (Bondei, Sambaa); pumbwiji / pwimbwiji; mbwimbwi (Kaguru)	*Talinum portulacifolium* (Forsk.) Aschers. ex Schweinf.	0	0	0	0	5	50	3	25
caltrops, puncture vine	mbigili, mbigiri	mbigili	*Tribulus terrestris**, *Oxygonum sinuatum* (Meisn.) Dammer	0	0	0	0	2	20	0	0
(erect annual herb)	n.a.	kibwabwa (Bondei), mnavu-zinge (Sambaa)	*Vicandra physaloides'*	0	0	0	0	0	0	2	17
bambara groundnut	njugu mawe	n.a.	*Vigna subterranea* (L.) Verdc.	0	0	10	100	10	90	0	0
cowpea leaves	majani ya kunde	n.a.	*Vigna unguiculata* (L.) Walp.	10	100	11	100	10	100	12	100
knobwood	mjafari, mkunungu; mlenda	mlungulungu (Bondei), hombo-muungu (Sambaa); mrungurungu (Digo, Arusha)	*Zanthoxylum chalybeum* Engl. var. *chalybeum*	1	10	0	0	0	0	4	33
n.a.	n.a.	chagongwe	n.d.	0	0	0	0	3	30	0	0
n.a.	n.a.	gahu	n.d.	0	0	0	0	0	0	1	8
n.a.	n.a.	igongya	n.d.	0	0	0	0	1	10	0	0
n.a.	n.a.	kayoyo mwingeeza	n.d.	0	0	0	0	0	0	1	8
n.a.	n.a.	kifatu matongo	n.d.	0	0	0	0	0	0	1	8

English	Swahili	Local (district or tribe)	Scientific	Arumeru n = 10		Singida n = 11		Kongwa n = 10		Muheza n = 12	
				No.	%	No.	%	No.	%	No.	%
n.a.	n.a.	kikolio (myembena)	n.d.	0	0	0	0	0	0	1	8
n.a.	n.a.	kikungu nzitu, kikungamzitu	n.d.	0	0	0	0	0	0	2	17
n.a.	n.a.	kimavi cha kuku	n.d.	0	0	0	0	0	0	1	8
n.a.	n.a.	kindii	n.d.	0	0	0	0	0	0	1	8
n.a.	n.a.	kinyuki	n.d.	0	0	0	0	0	0	1	8
(tree)	mlenda	kiumbu	n.d.	0	0	0	0	0	0	2	17
n.a.	n.a.	kokomaa	n.d.	0	0	2	18	0	0	0	0
n.a.	n.a.	konanko	n.d.	0	0	0	0	0	0	2	17
n.a.	n.a.	kungujulu	n.d.	0	0	0	0	0	0	2	17
n.a.	n.a.	kuntuagundu	n.d.	0	0	0	0	0	0	1	8
n.a.	n.a.	kwipa	n.d.	2	20	0	0	0	0	0	0
(like sweet potato)	n.a.	longwe, ongwe	n.d.	0	0	0	0	0	0	3	25
(local mushroom)	uyoga	madali (Singida)	n.d.	1	10	5	45	1	10	1	8
n.a.	n.a.	magudegude	n.d.	0	0	1	9	0	0	0	0
n.a.	n.a.	marambate	n.d.	0	0	1	9	0	0	0	0
n.a.	n.a.	matanga (matango pori)	n.d.	0	0	0	0	1	10	0	0
n.a.	n.a.	maweja (tembele mwitu / pori)	n.d.	0	0	0	0	1	10	0	0
(like pumpkin leaves)	n.a.	melembele gulu (iramba)	n.d.	0	1	0	0	0	0	0	0
n.a.	n.a.	mhonga nyeukei	n.d.	0	0	0	0	0	0	1	8
n.a.	n.a.	mkobo	n.d.	0	0	0	0	0	0	1	8
n.a.	n.a.	mkombadole	n.d.	0	0	0	0	1	10	0	0
(creeper, found in valleys)	n.a.	mkoswe, mnkoswe, nkoswe, unkoswe		0	0	0	0	0	0	10	83
n.a.	n.a.	mkukuu	n.d.	0	0	1	9	0	0	0	0
n.a.	n.a.	mkungujulu	n.d.	0	0	0	0	0	0	1	8
n.a.	n.a.	mngereza	n.d.	0	0	0	0	0	0	1	8

English	Swahili	Local (district or tribe)	Scientific	Arumeru n = 10		Singida n = 11		Kongwa n = 10		Muheza n = 12	
				No.	%	No.	%	No.	%	No.	%
n.a.	n.a.	mnyago	n.d.	0	0	0	0	0	0	2	17
(very hot pepper with med. value)	n.a.	mpilipili	n.d.	0	0	0	0	0	0	2	17
(kapok tree, slimy)	n.a.	msufi	n.d.	0	0	0	0	0	0	1	8
n.a.	n.a.	mtanga	n.d.	0	0	0	0	6	60	0	0
n.a.	n.a.	ngazi	n.d.	0	0	0	0	1	10	0	0
n.a.	n.a.	ngwiba kwipa (warangi)	n.d.	0	0	10	90	0	0	0	0
n.a.	n.a.	niewe	n.d.	1	10	0	0	0	0	0	0
n.a.	n.a.	sang'hala	n.d.	0	0	0	0	1	10	0	0
n.a.	n.a.	sawasawa	n.d.	0	0	0	0	3	30	0	0
n.a.	n.a.	tangatumbo (tango pori)	n.d.	0	0	0	0	1	10	0	0
n.a.	n.a.	tee	n.d.	0	0	0	0	0	0	1	8
n.a.	n.a.	tunguja	n.d.	0	0	0	0	0	0	1	8
n.a.	n.a.	tura	n.d.	0	0	0	0	0	0	2	17
n.a.	n.a.	ubi	n.d.	0	0	0	0	0	0	1	8
n.a.	n.a.	yageyage	n.d.	0	0	0	0	1	10	0	0
n.a.	n.a.	yambuyambu	n.d.	0	0	0	0	1	10	0	0

Sum: 102 traditional vegetables; n.a. = not available; n.d. = not determined as yet * no scientific name found

No. = number of villages where traditional vegetable was mentioned;

% = frequency of availability

= vegetable species specifically mentioned only in one district but occurred presumably also in the other districts.

Tab. 92 IV cultivated and collected (times mentioned) and their rank according to farmers of ten villages of Arumeru district, Tanzania.

No	Traditional vegetable (TV) species names				C	W	C+W	Sum	Rank				
	English	Swahili	Local	Scientific					1	2	3	4	5
1	African nightshades	mnavu	n.a.	*Solanum nigrum, S. scabrum, S. americanum, S. villosum*	7		3	10	4	3	3		
2	amaranth	mchicha	n.a.	*Amaranthus cruentus, A. hybridus, A. dubius, A. spinosus, A. blitum*	2		8	10	3	3	1		2
3	African eggplant	ngogwe	n.a.	*Solanum aethiopicum, S. macrocarpon, S. anguivi,*	10			10	1	1	1	1	4
4	Ethiopian kale / mustard	sukuma wiki, loshuu, figiri	n.a.	*Brassica carinata*	10			10	1	1	4		
5	cowpea leaves	majani ya kunde	n.a.	*Vigna unguiculata*	10			10				7	2
6	field pumpkin leaves	majani ya maboga	n.a.	*Cucurbita pepo*	10			10					1
7	sweet potato leaves	matembele	n.a.	*Ipomea batata*	10			10					
8	water cress	saladi	n.a.	*Rorippa nasturtium-aquaticum*	7	3		10				2	
9	cassava leaves	kisamvu	mpira (kisamvu) muhogo (cassava)	*Manihot glaziovii Manihot esculenta*	9			9					
10	hair lettuce	mchunga	n.a.	*Launaea cornuta*		8		8					
11	African spiderflower	mgagani	n.a.	*Cleome gynandra, Gynandropsis gynandra*		7		7					
12	jute mallow	mlenda	n.a.	*Corchorus olitorius*, *C. tridens, C. trilocularis*	1	5	1	7					
13	okra	bamia	n.a.	*Abelmoschus esculentus, A. caillei*	6			6	1	2	1		1
14	black jack, jack weed	kishonanguo	n.a.	*Bidens pilosa*		3		3					
15	Hyacinth bean (leaves)	fiwi	n.a.	*Lablab purpureus*	3			3					
16	n.a.	ngoomba	n.a.	*Brassica sp.*		3		3					

No	Traditional vegetable (TV) species names				C	W	C+W	Sum	Rank				
	English	Swahili	Local	Scientific					1	2	3	4	5
17	moringa	mlonge, mronge	n.a.	*Moringa oleifera*	2			2					
18	n.a.	n.a.	kwipa	n.d.		2		2					
19	(indigenous tomato)	nyanya	n.a.	*Lycopersicon sp.*		2		2					
20	gallant soldier	majani ya sungura	n.a.	*Galinsoga parviflora*		1		1					
21	(like pumpkin leaves)	n.a.	melembele gulu (Iramba tribe)	n.d.		1		1					
22	knobwood	mjafari, mkunungu	mrungurungu	*Zanthoxylum chalybeum* var. *chalybeum*		1		1					
23	n.a.	n.a.	niewe	n.d.		1		1					
24	(local mushroom)	uyoga	n.a.	n.d.		1		1					
25	bambara groundnut (leaves)	njugu mawe	n.a.	*Vigna subterranea*				0					
26	crotalaria	n.a.	n.a.	*Crotalaria brevidens, C. ochroleuca*				0					

n.a. = not available; n.d. = not determined as yet

C = cultivated; **W** = gathered from the wild; Number of female group discussions: **3**; Number of mixed group discussions: **7**;
Number of IVs named in each village: 11, 11, 12, 12, 12, 15, 15, 16, 18, 19 **Ø 14.1**

= not available but asked for in this district

Table 98 IV cultivated and collected (times mentioned) and their rank according to farmers of eleven villages of Singida district, Tanzania.

No	IV Species				C	W	C+W	Sum	Rank						
	English	Swahili	Local	Latin					1	2	3	4	5	6	7
1	jute mallow	mlenda	mahonda; nkonda	*Corchorus olitorius*, *C. tridens*, *C. trilocularis*		11		11	11						
2	bur gherkin	n.a.	maimbe = dried; mahanjo = fresh matango ya kienyeji;	*Cucumis anguria*		4	7	11		6	3				
3	sweet potato leaves	matembele	n.a.	*Ipomoea batatas*	11			11		5	5		1		
4	amaranth	mchicha	mgha; mughaa; mugha; mogha	*Amaranthus cruentus*, *A. hybridus, A. dubius, A. spinosus, A. blitum*			11	11			2	4	3	1	
5	okra	bamia	n.a.	*Abelmoschus esculentus*, *A. caillei*	11			11			2	4	1	1	1
6	cassava leaves	kisamvu	kisamvu mpira kisamvu muhogo	*Manihot glaziovii* *Manihot esculenta*	11			11				3	4	1	1
7	pumpkin leaves	majani ya maboga	msusa; manyungu; mimbe	*Cucurbita pepo*	11			11					1	3	2
8	cowpea leaves	majani ya kunde	nsansa = dried cowpea leaves; nkusa = cowpea; Ihaji	*Vigna unguiculata*	11			11						3	2
9	African spiderflower	mgagani	mng'ang'i; mung'ang'i	*Cleome gynandra*, *Gynandropsis gynandra*		11		11							
10	n.a.		ngwiba kwipa (warangi)	n.d.		10		10							
11	African nightshades	mnavu	mjimba nkunku	*Solanum nigrum, S. scabrum, S. americanum, S. villosum*		10		10							
12	bambara groundnut (leaves)	njugu mawe	n.a.	*Vigna subterranea*	10			10							

No	IV Species				C	W	C+W	Sum	Rank						
	English	Swahili	Local	Latin					1	2	3	4	5	6	7
13	African eggplant	ngogwe	n.a.	*Solanum aethiopicum, S. macrocarpon, S. anguivi,*	4	1		5							
14	(local mushroom)	uyoga	madali	n.d.		5		5							
15	water cress	saladi	n.a.	*Rorippa nasturtium-aquaticum*	3	1		4					1	1	
16	hair lettuce	mchunga	songa	*Launaea cornuta, Sonchus luxurians* (?)		3		3							
17	n.a.	n.a.	kokomaa	n.d.		2		2							
18	n.a.	n.a.	magudegude	n.d.		1		1							
19	(annual herb)	mlenda mbata	mbaata	*Ceratotheca sesamoides*		1		1							
20	n.a.	n.a.	mkukuu	n.d.		1		1							
21	n.a.	n.a.	marambate	n.d.		1		1							
22	crotalaria	n.a.	n.a.	*Crotalaria brevidens, C. ochroleuca*				0							
23	Ethiopian kale / mustard	sukuma wiki, loshuu, figiri	n.a.	*Brassica carinata*				0							
24	hyacinth bean (leaves)	fiwi	n.a.	*Lablab purpureus*				0							
25	moringa	mlonge, mronge	n.a.	*Moringa oleifera*				0							

n.a. = not available; n.d. = not determined as yet

C = cultivated **W** = gathered from the wild Number of women group discussions: **5** Number of mixed group discussions: **6**

Number of IVs found in each village:10, 13, 13, 13, 13, 14, 14, 15, 15, 16, 17 ∅ **13.8**

= not available but asked for in this district

Tab. 94 IV cultivated and collected (times mentioned) and their rank according to farmers of ten villages of Kongwa district, Tanzania.

No	IV Species				C	W	C+W	Sum	Rank						
	English	Swahili	Local	Latin					1	2	3	4	5	6	Σ
1	cowpea leaves	majani ya kunde	n.a.	*Vigna unguiculata*	10			10	2	3	2	2			9
2	amaranth	mchicha	n.a.	*Amaranthus cruentus, A. hybridus, A. dubius, A. spinosus, A. blitum*		3	7	10	2	1	2	1	1		7
3	pumpkin leaves	majani ya maboga	mhuza, Mhuja	*Cucurbita pepo*	9	1		10	1	1	1	1	3		7
4	jute mallow	mlenda	imito	*Corchorus olitorius*		10		10	3	3					6
5	(bushy herb)	n.a.	mhilile	*Cleome hirta*		10		10	1		3	2			6
6	sweet potato leaves	matembele	n.a.	*Ipomea batata*	9			9	1	1		1	3		6
7	okra	bamia	n.a.	*Abelmoschus esculentus, A. caillei*	10			10				1	2		3
8	cassava leaves	kisamvu	n.a.	*Manihot glaziovii, Manihot esculenta*	9			9			1		1	1	3
9	African spiderflower	mgagani	mzimwe (Gogo tribe)	*Cleome gynandra*, *Gynandropsis gynandra*		10		10				2			2
10	African nightshades	mnavu	n.a.	*Solanum nigrum, S. scabrum, S. americanum, S. villosum*	2	3	2	7			1				1
11	Ethiopian kale / mustard	sukuma wiki, loshuu, figiri	nyaulezi, figili	*Brassica carinata*	4			4		1					1
12	bambara groundnut (leaves)	njugu mawe	n.a.	*Vigna subterranea*	10			10							
13	hyacinth bean (leaves)	fiwi	fili	*Lablab purpureus*	9			9							
14	n.a.	n.a.	mtanga	n.d.		6		6							
15	(perennial herb)	mlenda	pumbwiji / pwimbwiji; mbwimbwi (Kaguru tribe)	*Talinum portulacifolium*		5		5							

No	IV Species				C	W	C+W	Sum	Rank						
	English	Swahili	Local	Latin					1	2	3	4	5	6	Σ
16	African eggplant	ngogwe	n.a.	*Solanum aethiopicum, S. macrocarpon, S. anguivi,*	5			5							
17	hair lettuce	mchunga	suunga	*Launaea cornuta, Sonchus luxurians* (?)		5		5							
18	n.a.	n.a.	chagongwe	n.d.		3		3							
19	black jack	kishonanguo	mpangalale, mhangalale	*Bidens pilosa*		3		3							
20	(evergreen shrub, climber)	n.a.	mtulu	*Opilia amentacea*		3		3							
21	n.a.	n.a.	sawasawa	n.d.		3		3							
22	baobab (tree)	mbuyu	majani ya mbuyu, lkui	*Adansonia digitata*		2		2							
23	caltrops, puncture vine	mbigili, mbigiri	mbigili	*Tribulus terrestris, Oxygonum sinuatum* (?)		2		2							
24	n.a.	n.a.	lgongya	n.d.		1		1							
25	n.a.	n.a.	matanga (matango pori)	n.d.		1		1							
26	n.a.	n.a.	matembele pori	*Ipomoea sp.*		1		1							
27	n.a.	n.a.	maweja (tembele mwitu / pori)	n.d.		1		1							
28	n.a.	n.a.	mkombadole	n.d.		1		1							
29	n.a.	n.a.	ngazi	n.d.		1		1							
30	n.a.	n.a.	nhongo	*Commelina sp*.		1		1							
31	n.a.	n.a.	sang'hala	n.d.		1		1							
32	n.a.	n.a.	tangatumbo (tango pori)	n.d.		1		1							
33	(local mushroom)	n.a.	uyoga	n.d.		1		1							
34	n.a.	n.a.	yageyage	n.d.		1		1							
35	n.a.	n.a.	yambuyambu	n.d.		1		1							
36	crotalaria	n.a.	n.a.	*Crotalaria brevidens, C. ochroleuca*				0							
37	moringa	mlonge, mronge	n.a.	*Moringa olifera*				0							

n.a. = not available; n.d. = not determined as yet

C = cultivated **W** = gathered from the wild Number of women group discussions: **5** Number of mixed group discussions: **5**

Number of IVs found in each village:14, 14, 14,16, 17, 17, 17, 17, 18, 22 Ø **16.6**

= not available but asked for in this district

Tab. 95 IVs cultivated and collected (times mentioned) and their rank according to farmers of twelve villages of Muheza district, Tanzania.

No	IV Species				C	W	C+W	Sum	Rank							
	English	Swahili	Local	Latin					1	2	3	4	5	6	7	Σ
1	amaranth	mchicha	n.a.	*Amaranthus cruentus, A. hybridus, A. dubius, A. spinosus, A. blitum*			12	12	2	4	2				1	9
2	okra	bamia	n.a.	*Abelmoschus esculentus*	12			12			5	1	1	2		9
3	hair lettuce	mchunga	n.a.	*Launaea cornuta, Sonchus luxurians,* (?)	2	10		12	6	2						8
4	sweet potato leaves	matembele	n.a.	*Ipomea batata*	12			12	1	1		2	1	1	1	7
5	African eggplant	ngogwe	n.a.	*Solanum aethiopicum, S. macrocarpon, S. anguivi,*	12			12				3	1	2		6
6	pumpkin leaves	majani ya maboga	n.a.	*Cucurbita pepo*	12			12			1		3	1	1	6
7	cassava leaves	kisamvu	n.a.	*Manihot glaziovii Manihot esculenta*	10			10		1	1	1	1	1	1	6
8	cowpea leaves	majani ya kunde	n.a.	*Vigna unguiculata*	12			12				2	2		1	5
9	African nightshades	mnavu	n.a.	*Solanum nigrum, S. scabrum, S. americanum, S. villosum*	1	5	6	12		1					1	2

No	IV Species				C	W	C+W	Sum	Rank							
	English	Swahili	Local	Latin					1	2	3	4	5	6	7	Σ
10	black jack, jack weed	kishonanguo	kisamanguo	*Bidens pilosa*		12		12							1	1
11	jute mallow	mlenda	kibwando	*Corchorus fascicularis, C. tridens, C. trilocularis*		12		12								0
12	(straggling perennial)	majani ya mwaka, mlakasa	talata, tarata, taata	*Ipomoea pes-caprae*		11		11								0
13	(creeper, found in valleys)	n.a.	mkoswe, mnkoswe, nkoswe, unkoswe	n.d.		10		10								0
14	African spiderflower	mgagani	n.a.	*Cleome gynandra*, *Gynandropsis gynandra*		9		9								0
15	(shrub, small tree)	msogo	kisogo (mbangwe)	*Rourea orientalis*		9		9								0
16	taro	n.a.	majani ya majimbi	*Colocasia esculenta*	6	2		8								0
17	common bean (leaves)	majani ya maharage	msangani	*Phaseolus vulgaris*		8		8								0
18	(shrub)	n.a.	mnyembeuwe (Bondei tribe), mnyembeue (Sambaa tribe)	*Erythrococca kirkii*		6		6								0
19	basella	n.a.	nderema, ndeema	*Basella sp.*		6		6								0
20	(perennial herb)	mchicha, mfuchwe, mtikini	tikini	*Asystasia gangetica, A. mysorensis*		6		6								0
21	Ethiopian kale / mustard	sukuma wiki, loshuu, figiri	figiri, figili	*Brassica carinata*	5			5								0
22	(annual herb)	kinwale, kisambale, msambali	sambae, shambae	*Lobelia fervens sp. fervens*		5		5								0

No	IV Species				C	W	C+W	Sum	Rank							
	English	Swahili	Local	Latin					1	2	3	4	5	6	7	Σ
23	baobab (woody herb or shrub)	mbuyu kinonga	tebwe; tabwa, tebwa,	*Adansonia digitata, Aerva lanata*		5		5								0
24	(tree)	mlenda	hombo da mungu / muungu	n.d.		3		3								0
25	small caterpillar pod	n.a.	kiumbu, kisogo (Zigua tribe), hombo-kiumbu (Bondei tribe), hombo (Sambaa tribe)	*Ormocarpum kirkii*		3		3								0
26	(like sweet potato)	n.a.	longwe, ongwe	n.d.		3		3								0
27	(cherry tomato)	n.a.	nyanya pori, mwasege	*Lycopersicon sp.*		3		3								0
28	(perennial herb)	n.a.	tonge	*Talinum portulacifolium*		3		3								0
29	(annual herb)	mchicha pori	fungumsanga	*Celosia trigyna*		2		2								0
30	hyacinth bean (leaves)	fiwi	n.a.	*Lablab purpureus*	2			2								0
31	(erect annual herb)	n.a.	kibwabwa (Bondei tribe), mnavu-zinge (Sambaa tribe)	*Vicandra physaloides*		2		2								0
32	(tree)	mlenda	kiumbu	n.d.		2		2								0
33	n.a.	n.a.	kikungu nzitu, kikungamzitu	n.d.		2		2								0
34	(annual herb)	kisogo	kisungu, kisugu	*Platostoma africanum*		2		2								0
35	n.a.	n.a.	konanko	n.d.		2		2								0
36	n.a.	n.a.	kungujulu	n.d.		2		2								0
37	n.a.	n.a.	mnyago	n.d.		2		2								0
38	(very hot pepper with med. value)	n.a.	mpilipili	n.d.		2		2								0
39	(large tree)	mpafu	muafu, mwafu, mpafu	*Canarium madagascariense*		2		2								0

No	IV Species				C	W	C+W	Sum	Rank							
	English	Swahili	Local	Latin					1	2	3	4	5	6	7	Σ
40	n.a.	n.a.	tura	n.d.		2		2								0
41	(annual herb)	n.a.	unkobo	*Justicia heterocarpa*		2		2								0
42	(climber or creeping herb)	n.a.	ushwe, lushwe	*Momoridca foetida*		2		2								0
43	spiny amaranth	mchicha	buuza	*Amaranthus spinosus*		1		1								0
44	n.a.	n.a.	gahu	n.d.		1		1								0
45	n.a.	n.a.	kayoyo mwingeeza	n.d.		1		1								0
46	n.a.	n.a.	kifatu matongo	n.d.		1		1								0
47	n.a.	n.a.	kikolio (myembena)	n.d.		1		1								0
48	n.a.	n.a.	kimavi cha kuku	n.d.		1		1								0
49	n.a.	n.a.	kindii	n.d.		1		1								0
50	n.a.	n.a.	kinyuki	n.d.		1		1								0
51	n.a.	n.a.	kuntuagundu	n.d.		1		1								0
52	(perennial herb)	mchunga	kwake	*Sonchus luxurians*		1		1								0
53	(annual herb)	kilemba cha bwana, ulimi wa ngombe	limi la ng'ombe, limi ja ng'ombe	*Emilia coccinea*		1		1								0
54	(like taro)	n.a.	maeze	*Colocasia sp.*	1			1								0
55	(like taro)	n.a.	majani ya mayugwa	*Colocasia sp.*	1			1								0
56	African eggplant	ngogwe	makunga	*Solanum macrocarpon*	1			1								0
57	sage brush	mvepe	mghaa, mhuuga	*Lantana trifolia*		1		1								0
58	n.a.	n.a.	mhonga nyeukei	n.d.		1		1								0
59	n.a.	n.a.	mkobo	n.d.		1		1								0
60	knobwood	mjafari, mkunungu	mlungulungu (Bondei tribe), hombo-muungu (Sambaa tribe)	*Zanthoxylum chalybeum* var. *chalybeum*		1		1								0
61	n.a.	n.a.	mngereza	n.d.		1		1								0
62	moringa	mlonge, mronge	n.a.	*Moringa oleifera*		1		1								0
63	East African arrowroot	mlanga, mwanga	mwange, mwanga	*Tacca leontopetaloides*			1	1								0

No	IV Species				C	W	C+W	Sum	Rank							
	English	Swahili	Local	Latin					1	2	3	4	5	6	7	Σ
64	(common) purslane	tako la hasani	talco la hassani, tako-da-hasani	*Portulaca oleracea*		1		1								0
65	n.a.	n.a.	tee	n.d.		1		1								0
66	n.a.	n.a.	tunguja	n.d.		1		1								0
67	n.a.	n.a.	ubi	n.d.		1		1								0
68	(local mushroom)	n.a.	uyoga	n.d.		1		1								0
69	water cress	saladi	n.a.	n.d.		1		1								0
70	(type of taro, found in mountainous area)	n.a.	yugwa	*Colocasia sp.*		1		1								0
71	cape myrtle	n.a.	zuma	*Myrsine africana*		1		1								0
72	n.a.	n.a.	mkungujulu	n.d.		1		1								0
73	(kapok tree, slimy)	n.a.	msufi	n.d.		1		1								0
74	bambara groundnut (leaves)	njugu mawe	n.a.	*Vigna subterranea*				0								0
75	crotalaria	n.a.	n.a.	*Crotalaria brevidens, C. ochroleuca*				0								0

n.a. = not available; n.d. = not determined as yet

C = cultivated **W** = gathered from the wild Number of women group discussions: **6** Number of mixed group discussions: **6**

Number of IVs found in each village:18, 18, 19, 21, 26, 26, 27, 28, 28, 29, 30, 34 ∅ **25.3**

= not available but asked for in this district

Tab. 95 Seasonal calendar (time of harvest) for wild traditio nal vegetables in the four research districts of Tanzania.

Month	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Season	Dry + hot season		Long rainy season				Dry + cold season			Short rainy season		
amaranth (*Amaranthus* spp.)												
	A(h)	A(h)	A(l)	A(l)	A(l)	A(l)						A(h)
	S	S	S	S								
	K	K	K	K	K	K						
			M	M	M	M	M	M	M	M		
			M	M	M					M	M	M
black jack (*Bidens pilosa)*												
			A	A	A	A						
	A / M	A / M	A / M	A / M	A / M	A / M	A / M	A / M	A / M	A / M	A / M	A / M
			M	M	M					M	M	M
jute mallow (*Chorcorus olitorius)*												
			A	A	A	A						
	S	S	S	S	S	S	S	S	S	S	S	S
	K	K	K	K	K	K						K
			M	M	M					M	M	M
African spiderflower (*Cleome gynandra)*												
	A(h)	A(h)	A(l+m)	A(l+m)	A(l+m)	A(l+m)						A(h)
	S	S	S	S	S							
	K	K	K	K	K	K						K
			M	M	M					M	M	M
	M	M	M	M	M	M	M	M	M	M	M	M
bur gherkin (*Cucumis anguira)*												
	S	S	S	S	S							
hair/bitter lettuce (*Launaea cornuta / Sonchus luxurians)*												
	A(h)	A(h)	A(l+h)	A(l)	A(l)	A(l)						A(h)
	K	K	K	K	K	K	K	K	K	K	K	K
			M	M	M	M	M	M	M	M	M	M

Month	J	F	M	A	M	J	J	A	S	O	N	D
Season	Dry + hot season		Long rainy season				Dry + cold season			Short rainy season		
African nightshade *(Solanum* spp.)												
	S	S	S	S								
	K	K	K	K	K	K	K	K	K	K	K	K
	K	K	K	K	K	K						K
			M	M	M	M	M	M				
			M	M	M					M	M	M

A = Arumeru district; S = Singida district; K = Kongwa district; M = Muheza district;
h = high altitude;
m = medium altitude;
l = low altitude

Tab. 97 Names of wild traditional vegetables, reasons for collection, and frequency of availability in villages of four districts, Tanzania.

English name	Local name	Scientific name	Reasons for collection provided				Arumeru		Singida		Kongwa		Muheza	
			Arumeru	Singida	Kongwa	Muheza	No.	%	No.	%	No.	%	No.	%
(woody herb or shrub)	tebwa	*Aerva lanata*	n.a.	n.a.	n.a.	- mixed with pumpkin and tomatoes;	0	0	0	0	0	0	4	80
amaranth	mchicha	*Amaranthus* spp.	- grew easily and fast in rainy season; - marketable;	- grew easily; - plenty during rainy season; - many seeds; - once established it stayed;	- applied to reduce bitterness of spiderflower and mhilile;	- sweeter than cultivated amaranth; - no costs; - highly resistant crop; - "just a vegetable";	3	60	6	100	5	100	5	100

English name	Local name	Scientific name	Reasons for collection provided				Arumeru		Singida		Kongwa		Muheza	
			Arumeru	Singida	Kongwa	Muheza	No.	%	No.	%	No.	%	No.	%
(perennial herb)	tikini	*Asystasia gangetica*	n.a.	n.a.	n.a.	- mixed with okra for better palatability;	0	0	0	0	0	0	5	100
Basella	nderema	*Basella* spp.	n.a.	n.a.	n.a.	-"just a vegetable";	0	0	0	0	0	0	2	40
black jack	mashona nguo, bwem-bwe	*Bidens pilosa*	- medicinal value; - substitute for tea leaves; - knew that it is edible; - tasty; - "just a vegetable";	n.a.	n.a.	- medicinal value; - increased blood; - "just a vegetable"; - tasty (slightly bitter); - substitute for hair lettuce;	2	40	0	0	0	0	3	60
jute mallow	mlenda kibwando	*Chorcorus olitorius*	- grew easily; - knew that it is edible; - tasty; - "just a vegetable";	- grew widely, easily and efficiently; - many seeds; - no need for cultivation;	- fast growth; - availability; - knew that it is a vegetable;	- tasty; - "just a vegetable"; - easy available;	2	40	6	100	5	100	2	40
African spiderflower	mgagani	*Cleome gynandra*	- medicinal value; - grew widely and easily; - tasty (though bitter);	- medicinal value; - grew widely and easily;	- medicinal value; - bitter taste; - knew that it is a vegetable; - availability;	- medicinal value; - bitter taste; - "just a vegetable"; - increased blood;	4	80	6	100	5	100	5	100

English name	Local name	Scientific name	Reasons for collection provided				Arumeru		Singida		Kongwa		Muheza	
			Arumeru	Singida	Kongwa	Muheza	No.	%	No.	%	No.	%	No.	%
n.d.	mhilile	*Cleome hirta*	n.a.	n.a.	- tradition; - for a change in diet; - knew that it is a vegetable;	n.a.	0	0	0	0	5	100	0	0
bur gherkin	maimbe, mahanjo	*Cucumis anguira*	n.a.	- grew easily and widely; - capable to stand even severe drought;	n.a.	n.a.	0	0	6	100	0	0	0	0
(like pumpkin leaves)	malembe le gulu	*Cucurbita sp.*	- "it is just a vegetable"; - mixed with other vegetables (for consumption);	n.a.	n.a.	n.a.	1	20	0	0	0	0	0	0
beach morning-glory	talata	*Ipomoea pes-caprae*	n.a.	n.a.	n.a.	-"just a vegetable";	0	0	0	0	0	0	5	100
hair/bitter lettuce	mchunga	*Launnaea cornuta / Sonchus luxurians* (?)	- medicinal value; - different taste to other vegetables (very bitter); grew easily; - "it is just a vegetable";	n.a.	- medicinal value; - knew that it is a vegetable;	-medicinal value; - grew as weed in (maize) fields;	4	80	0	0	2	40	5	100
cape myrtle	zuma	*Myrsine africana*	n.a.	n.a.	n.a.	- just grew; - used during shortage of vegetable;	0	0	0	0	0	0	1	20

English name	Local name	Scientific name	Reasons for collection provided				Arumeru		Singida		Kongwa		Muheza	
			Arumeru	Singida	Kongwa	Muheza	No.	%	No.	%	No.	%	No.	%
(annual herb)	kisungu	*Platostoma africanum*	n.a.	n.a.	n.a.	-bitter taste like hair lettuce;	0	0	0	0	0	0	2	40
watercress	saladi	*Rorippa nasturtium-aquaticum*	- tasty; - very nice scent;	n.a.	n.a.	n.a.	1	20	0	0	0	0	1	20
African nightshade	mnavu	*Solanum* sp.	- grew easily; - many seeds;	- grew easily and widely in uncultivated land;	- bitter taste; - knew that it is a vegetable; - fast growth; - availability;	- grew widely; - easily available; - bitter taste;	1	20	6	100	3	60	4	80
n.d.	kwipa	n.d.	- grew easily; - many seeds;	n.a.	n.a.	n.a.	1	20	0	0	0	0	0	0
n.d.	magude-gude	n.d.	n.a.	- grew widely in uncultivated land;	n.a.	n.a.	0	0	1	17	0	0	0	0
n.d.	msan-gani	n.d.	n.a.	n.a.	n.a.	- sweet taste; -"just a vegetable";	0	0	0	0	0	0	5	100
n.d.	ngwiba	n.d.	n.a.	- grew easily and plenty;	n.a.	n.a.	0	0	6	100	0	0	0	0
n.d.	sawa-sawa	n.d.	n.a.	n.a.	- no reason;	n.a.	0	0	0	0	1	20	0	0
n.d.	songa	n.d.	- "it is just a vegetable";	n.a.	n.a.	n.a.	1	20	0	0	0	0	0	0
(local mushroom)	uyoga	n.d.	- grew easily;	- available in the forest; - just grew;	n.a.	n.a.	1	20	2	40	0	0	0	0

No. = number of villages where vegetable was mentioned
% = frequency of availability in villages interviewed on consumption issues

Tab. 98 Wards and villages researched in Arumeru district, Tanzania.

Ward		Kikwe				Kimnyaki	Kiranyi	Moshono			
Village		Karangai	Kikwe	Maweni	Nambala	Olevolos	Siwandeti	Ambureni/ Moivaro	Baraa	Manyire	Moivaro
Altitude (m)		n.a.	1090	1010	1130	1570	n.a.	n.a.	1410	n.a.	n.a.
Issue		cons	prod	cons	cons	cons	prod	cons	prod	prod	prod
No. of partici-pants	**women**	11	7	16	10	8	1	6	4	3	4
	men	8	0	0	0	8	16	9	9	10	13
Time		2:30	1:55	2:45	1:55	2:15	1:30	1:10	1:50	2:15	2:00

Tab. 99 Wards and villages researched in Singida district, Tanzania.

Ward		Ihanja	Ihanja	Ihanja	Ilongero	Ilongero	Ilongero	Ilongero	Ilongero	Puma	Puma	Puma
Village		Ihanja	Iseke	Unyangwe	Ilongero	Itamka I	Itamka II	Kinyeto	Mwakiti	Musambu	Nkunin-kana	Puma
Altitude (m)		1480	1520	n.a.	1580	1610	1610	1540	1610	1550	n.a.	n.a.
Issue		prod	cons	cons	cons	cons	cons	prod	cons	prod	prod	prod
No. of	**women**	5	10	6	17	11	7	17	11	3	5	5
particip	**men**	11	1	0	0	5	0	13	0	9	20	6
ants												
Time		2:20	2:15	1:10	2:20	2:15	2:00	1:50	2:00	1:25	2:10	2:35

Tab. 9.10 Wards and villages researched in Kongwa district, Tanzania.

Ward	Chamko-roma	Chamko-roma	Hogoro	Mlali	Mlali	Sagara	Sagara	Sejeli	Sejeli	Ugogoni
Village	Tubugwe Juu "A"	Tubugwe "B"	Chamae	Mlali-Bondeni	Mlali-Iyegu	Sagara "B"	Manungu	Sejeli	Mbande	Ibwaga
Altitude (m)	1050	1070	1140	1330	1330	1250	890	960	890	1160
Issue	cons	prod	cons	prod	cons	cons	prod	prod	cons	prod
No. of participants **women**	12	8	15	6	8	15	12	6	12	5
men	0	5	0	7	0	0	16	7	0	5
Time (h:min)	1:45	1:50	1:55	1:50	2:10	2:20	1:45	1:55	2:05	1:45

Tab. 9.11 Wards and villages researched in Muheza district, Tanzania.

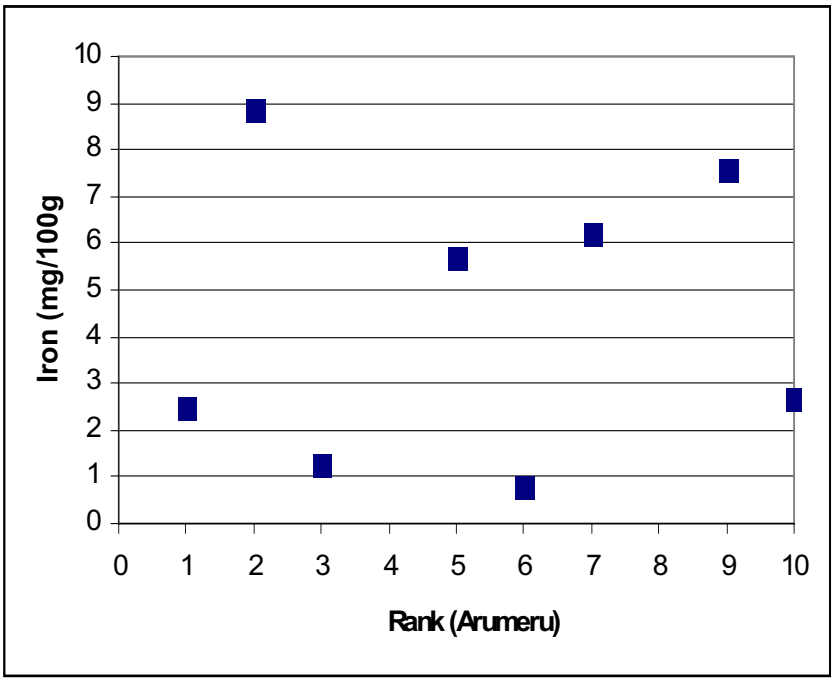
Ward	Bwem-bwera	Bwem-bwera	Kilulu	Kisiwani	Kumba	Maramba	Maramba	Misalai	Mkuzi	Mkuzi	Nkumba	Pandedarajani
Village	Potwe-Ndondondo	Potwe	Kwemsala	Mashewa	Tongwe	Mbambakofi	Mtakuja	Sakale	Daisaama-Mkuzi	Mindu	Nkumba-Kisiwani	Mzambarauni-Mlingano
Altitude (m)	330	330	240	220	n.a.	n.a.	220	1040	240	250	260	200
Issue	prod	cons	cons	prod	cons	cons	cons	prod	cons	prod	prod	prod
No. of participants **women**	8	6	14	5	8	9	9	8	20	13	6	14
men	8	0	0	8	0	0	0	8	0	5	6	8
Time	1:50	2:25	2:00	2:10	1:20	2:00	2:10	2:05	1:45	1:10	2:25	2:50

Tab. 9-12 Measures to treat certain illnesses with traditional vegetables perceived by farmers in four districts of Tanzania.

Illness	Traditional vegetable	Measure
anaemia	• African nightshade	• just eat (A);
	• amaranth	• boil leaves and drink boiled water (K,M);
	• cassava leaves	• just eat (K, M);
	• cowpea leaves	• boil leaves and drink boiled water to increase the haemoglobin level (M);
	• black jack	• boil leaves and drink boiled water (M);
	• sweet potato leaves	• boil leaves and drink boiled water (M);
	•	
asthma	• sweet potato leaves	• rub the leaves between hands, add water → water becomes slimy, sieve and drink the water, or squeeze leaves and mix the liquid with water and drink (M);
bleeding wounds	• tikini (*Asystasia gangetica, A. mysorensis*)	• flick leaves between fingers and put them on wound → can stop bleeding (M);
burns	• sweet potato leaves	• rub soft leaves between hands and put on the skin/wound (S);
cold	• African spiderflower	• just eat the prepared vegetable (K);
continuous lactation	• African spiderflower	• just eat the prepared vegetable to stop permanent milk flow(K);
cough	• jute mallow	• chew roots (S);
diabetes	• African nightshade	• eat fresh or boiled fruit without any further ingredients (A);
diarrhoea	• cassava leaves	• pound fresh leaves, add little soda and water, stir, leave particles to settle, drink the water (K);
ear problems	• African spiderflower	• rub leaves and put liquid into ears (A, K, M); or use flowers and leaves (M);
eye diseases	• jute mallow	• treat with juice of roots or leaves roots in water overnight and treat with water (S);
head aches	• African spiderflower	• rub leaves between fingers and smell (A);
high blood pressure	• African nightshade	• eat fresh or boiled fruit without any further ingredients (A);
high fever ('degedege')	• African spiderflower	• squeeze leaves and drink liquid (especially for children);
hookworms	• hair / bitter lettuce	• boil leaves and drink boiled water (M);
'machiningi' (skin disease on head of children);	• African eggplant	• rub leaves between hands and squeeze juice on the skin / external application (A);
malaria;	• African eggplant	• boil leaves and add little salt, eat leaves and drink boiled water (A);
	• hair / bitter lettuce	• like for stomach ache, or boil leaves and drink boiled water, 1 cup in the morning, 1 cup in the evening (M) or 1/2 glass 3 times a day (A), or eat the leaves after boiling (M);
measles	• hair / bitter lettuce	• boil leaves for 15 min. and drink the boiled water and bathe in the water (A, K, M);
nosebleed ('kambaku')	• cassava leaves	• rub leaves and smell;
peptic ulcers	• African nightshade	• eat boiled fruits with little salt (A);
prevention of growing of "false" teeth	• black jack	• rub leaves and put on teeth/in mouth of children (A);
problems of sight	• African nightshade	• eat fresh or boiled fruit without any further ingredients (A);

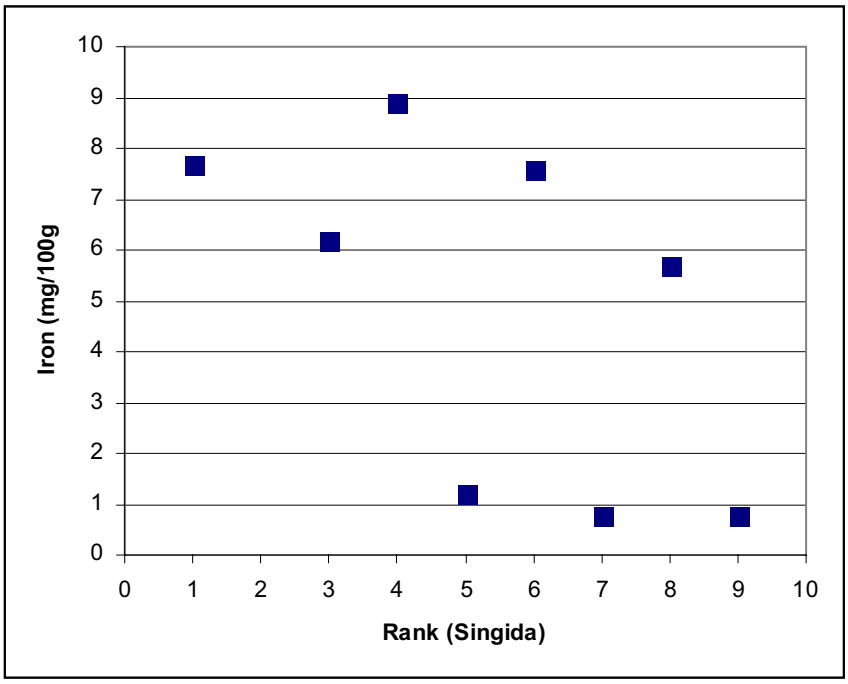
safura (ascaris)	• hair / bitter lettuce	• boil the leaves, drink boiled water and eat as a vegetable, must be bitter (A);
scabies;	• African eggplant	• rub leaves between hands and squeeze juice on the skin / external application (A);
skin irritation / abscesses (bottoms, 'gipu')	• cowpea leaves	• cover skin for 1-2 days with a paste from crushed and pounded cowpea grains soaked in water;
snake bites	• cassava leaves	• chew leaves and swallow liquid → only first aid, e.g. when in the field (M);
stomach ache / pain	• African spiderflower • hair / bitter lettuce	• squeeze leaves and drink liquid (especially for children) (M); • squeeze leaves and drink the liquid (M);
stomach upset	• jute mallow • okra	• chew roots or boil roots and drink the water (S); • eat one bowl of a meal with boiled okra fruit, pumpkin leaves, onions and tomatoes (A);
wounds	• black jack	• rub leaves between hands and squeeze liquid into wound → accelerate healing process (M);
wounds that occur due to worms under the skin	• sweet potato leaves	• wilt broad leaves over fire and put on affected skin (S);

Districts: A = Arumeru; S = Singida; K = Kongwa; M = Muheza;



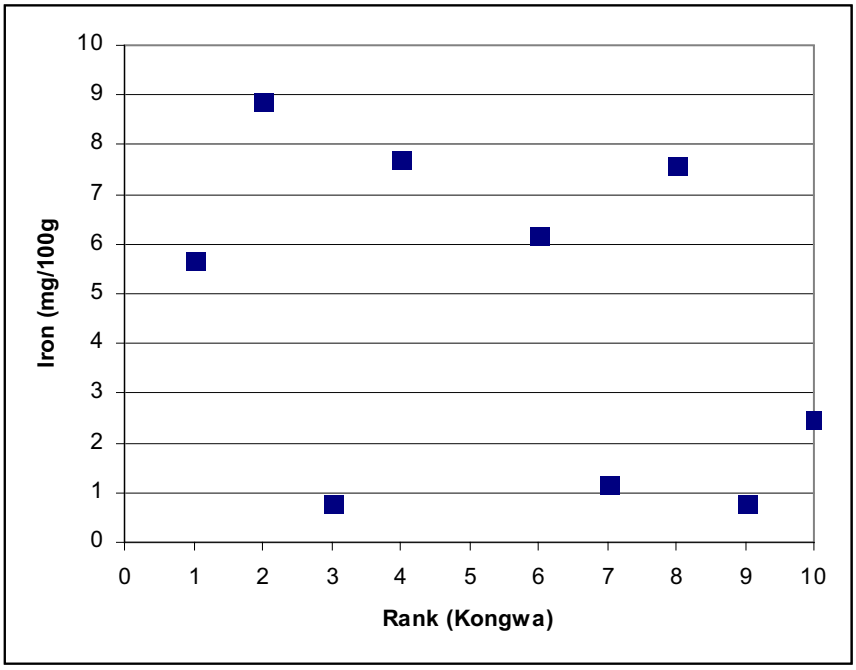
Traditional vegetable	Rank
African nightshade	1
amaranth	2
African eggplant (fruits)	3
Ethiopian kale	4
cowpea leaves	5
pumpkin leaves	6
sweet potato leaves	7
water cress	8
cassava leaves	9
hair lettuce	10

Fig. 9.13 The major ten traditional vegetables in Arumeru district, Tanzania, and their iron content. Source: Lyimo et al. (2003) and FAO (2004).



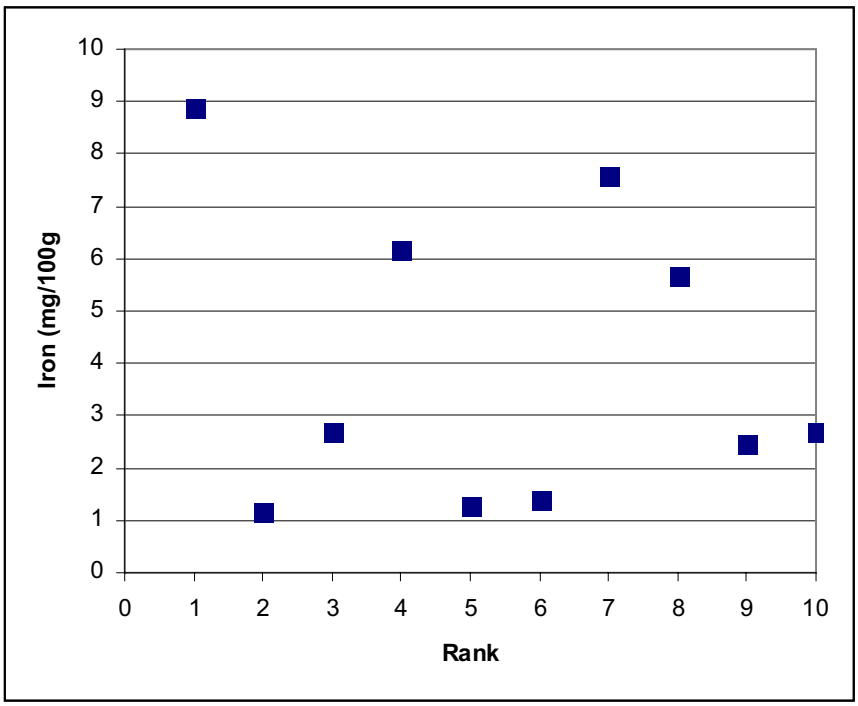
Traditional vegetable	Rank
jute mallow	1
bur gherkin	2
sweet potato leaves	3
amaranth	4
okra (pods)	5
cassava leaves	6
pumpkin leaves	7
cowpea leaves	8
African spiderflower	9
ngwiba / kwipa	10

Fig. 9.14 The major ten traditional vegetables in Singida district, Tanzania, and their iron content. Source: Lyimo et al. (2003) and FAO (2004).



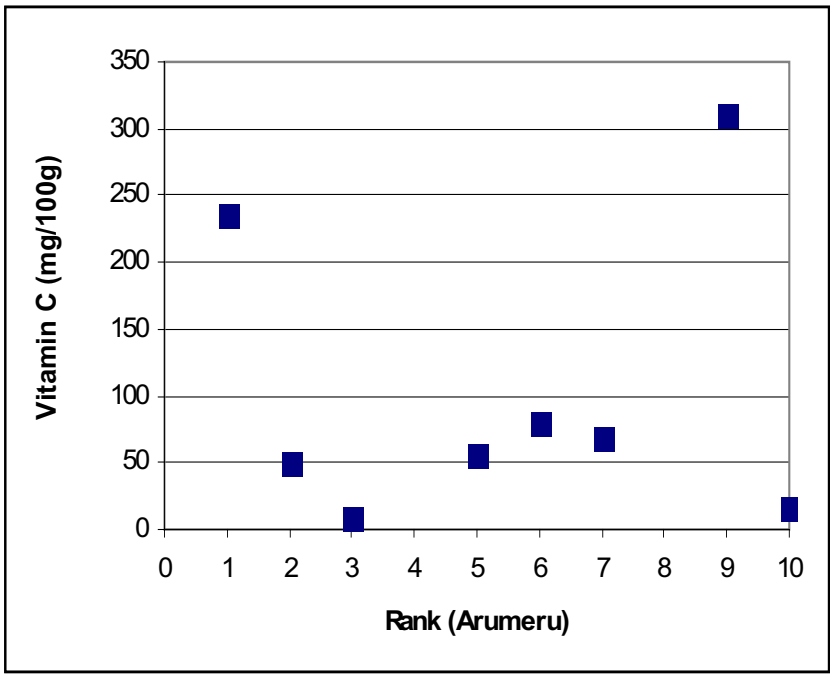
Traditional vegetable	Rank
cowpea leaves	1
amaranth	2
pumpkin leaves	3
jute mallow	4
Cleome hirta	5
sweet potato leaves	6
okra (pods)	7
cassava leaves	8
African spiderflower	9
African nightshade	10

Fig. 9.15 The major ten traditional vegetables in Kongwa district, Tanzania, and their iron content. Source: Lyimo et al. (2003) and FAO (2004).



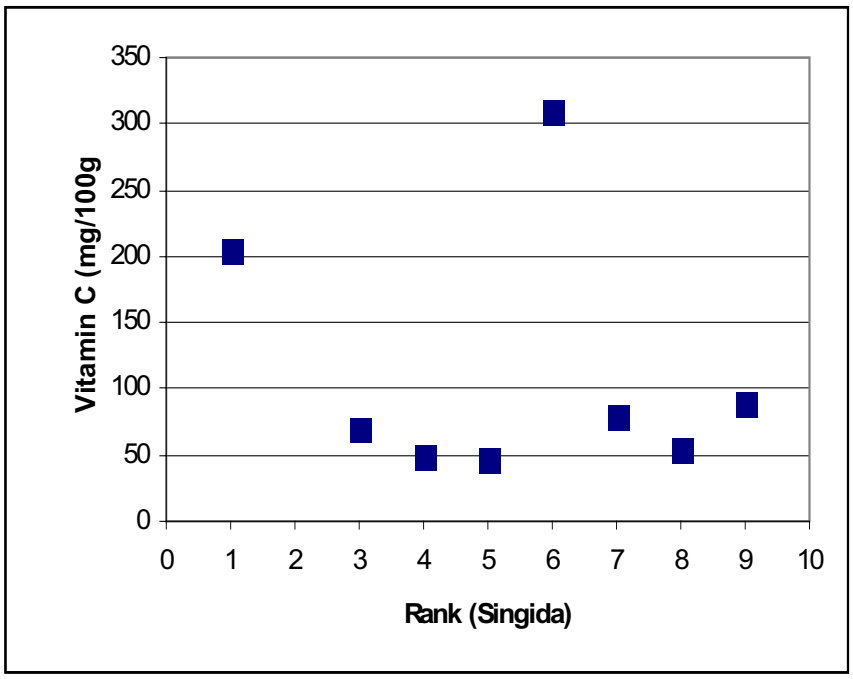
Traditional vegetable	Rank
amaranth	1
okra (pods)	2
hair lettuce	3
sweet potato leaves	4
African eggplant	5
pumpkin leaves	6
cassava leaves	7
cowpea leaves	8
African nightshade	9
black jack	10

Fig. 9.16 The major ten traditional vegetables in Muheza district, Tanzania, and their iron content. Source: Lyimo et al. (2003) and FAO (2004).



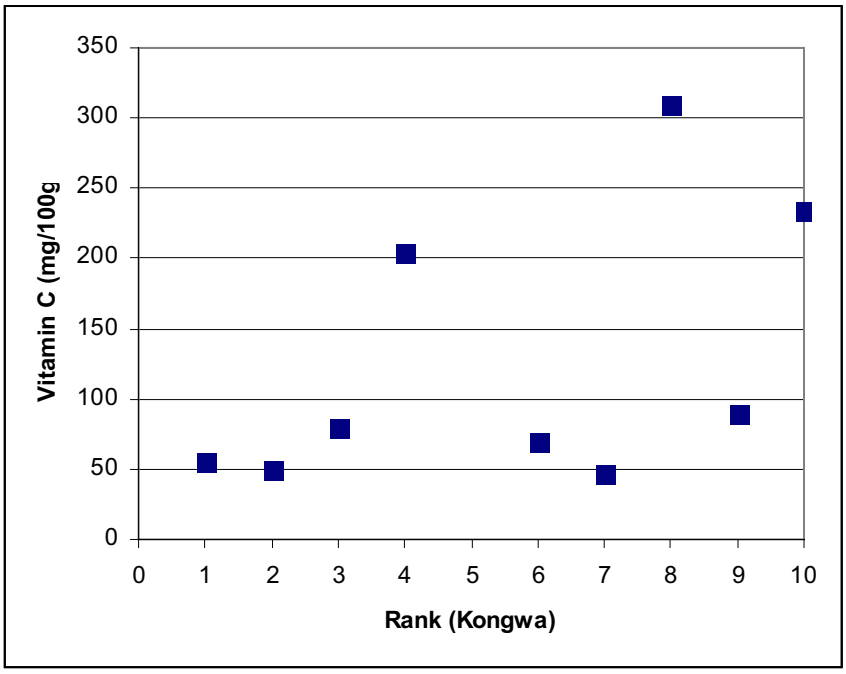
Traditional vegetable	Rank
African nightshade	1
amaranth	2
African eggplant (fruits)	3
Ethiopian kale	4
cowpea leaves	5
pumpkin leaves	6
sweet potato leaves	7
water cress	8
cassava leaves	9
hair lettuce	10

Fig. 9.16 The major ten traditional vegetables in Arumeru district, Tanzania, and their vitamin C content. Source: Imo et al. (2008) and FAO (2004).



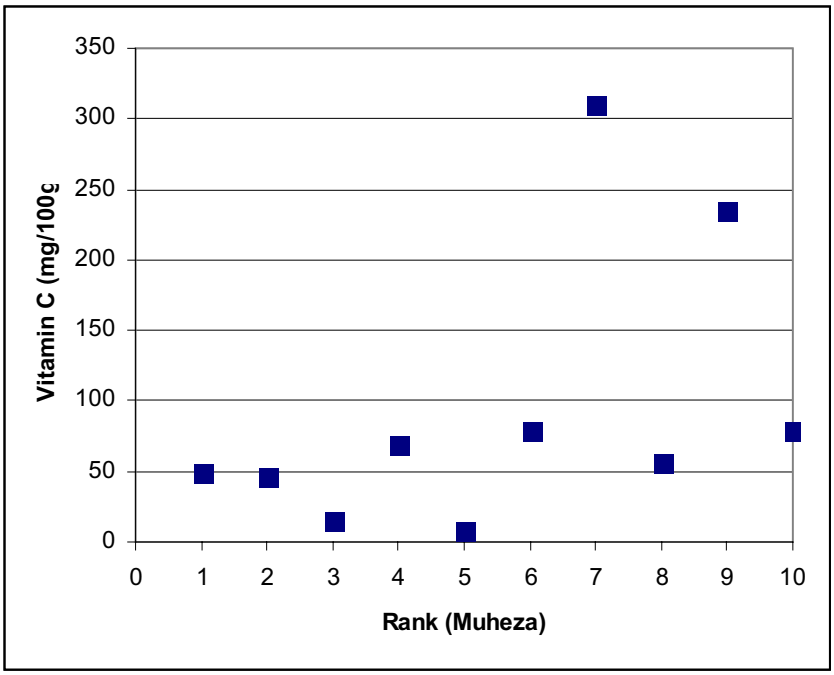
Traditional vegetable	Rank
jute mallow	1
bur gherkin	2
sweet potato leaves	3
amaranth	4
okra (pods)	5
cassava leaves	6
pumpkin leaves	7
cowpea leaves	8
African spiderflower	9
ngwiba / kwipa	10

Fig. 9.17 The major ten traditional vegetables in Singida district, Tanzania, and their vitamin C content. Source: Imo et al. (2008) and FAO (2004).



Traditional vegetable	Rank
cowpea leaves	1
amaranth	2
pumpkin leaves	3
jute mallow	4
Cleome hirta	5
sweet potato leaves	6
okra (pods)	7
cassava leaves	8
African spiderflower	9
African nightshade	10

Fig. 9.18 The major ten traditional vegetables in Kongwa district, Tanzania, and their vitamin C content. Source: Imo et al. (2008) and FAO (2004).



Traditional vegetable	Rank
amaranth	1
okra (pods)	2
hair lettuce	3
sweet potato leaves	4
African eggplant	5
pumpkin leaves	6
cassava leaves	7
cowpea leaves	8
African nightshade	9
black jack	10

Fig. 9.19 The major ten traditional vegetables in Muheza district, Tanzania, and their vitamin C content. Source: Imo et al. (2008) and FAO (2004).

Neglected IVCrops for Nutritional Health in Tanzania -

Semi-structured questionnaire for focus-group meetings

Village name: _____ No. of women: _____ No. of men: _____
Date: _____Time at arrival: _____ Time at leave: _____

1. General statements on IVs

We would like to get a better understanding of the various (neglected) indigenous vegetables that are grown in your community. Indigenous vegetables we define as crops which are traditional in your area and have not brought into from other areas, regions or even countries. These are e.g. MCHICHA, MGAGANI, NGOGE or MAJANI YA KUNDE.

1.1 What types of IVs (or local vegetables) does your community plant?
1.2 Define which species are cultivated and which are collected from the wild.
1.3 Rank species from the most important to the least important (best five only).

Rank/ No.	Vegetable species	Cultivated (c) or collected from the wild (w)

1.4 In the past (e.g. when you were a child), do you remember consuming / producing some IVs that are not available any more? If yes, what species and/or varieties and what may be a reasons for this? (Genetic erosion)

Production issues

Name of IV Crop _____

Rank	Variety(name)	Characteristics

1.5 What are positive and negative characteristics of these varieties?

CRITERIA:

- **TASTE**
- **YIELD**
- **MARKET**
- **SIZE OF LEAVES**
- **SIZE OF FRUITS**
- **STORAGE PROPERTIES**
- **CROP DURATION**
- **RESPONSE TO ABIOTIC STRESSES**
- **RESPONSE TO BIOTIC STRESSES**

Rank	Positive Characteristics	Negative Characteristics

Production issues

How does the cropping patter of this IV look like (sole or intercropping, random or in rows)? Why is that so?

Intercropping:

Monocropping:

What are constraints in producing this IV?

Labour availability	
Water	
Soil fertility	
Seeds	
Weeds	
Pests	
Diseases	
Marketing	

2.3 Who is responsible for the production of this IV – women or men or both?
[field preparation, sowing, transplanting, weeding and watering, application of fertilizer and pesticides, harvesting, processing]

Consumption issues

Name of IV Crop _____

Rank	Variety(name)	Characteristics

1.5 What are positive and negative characteristics of these varieties?

CRITERIA

- TASTE
- YIELD
- MARKET
- SIZE OF LEAVES
- SIZE OF FRUITS
- STORAGE PROPERTIES
- CROP DURATION
- RESPONSE TO ABIOTIC STRESSES
- RESPONSE TO BIOTIC STRESSES

Rank	Positive Characteristics	Negative Characteristics

Consumption issues

3.1 Which parts of the IV do you use? How often do you harvest this part (e.g. once per week) and for what period of time?

IV Part	How often harvested?	Period of time

3.2 How do you usually prepare and process this IV? How long does this take? How long can you keep the processed IV crop? Is there a reason for this?

Preparation (step by step)	Time	Reason

Processing (step by step)	Time	Reason

3.3 Are you aware of any medicinal values of these IV?

3.4 Are you or some hh members not consuming this IV for any reason?

3.5 In which season / month do you collect the wild IVs you mentioned already? Why do you collect them?

IV crop	Why is it collected?	Month when it is collected

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Researchers on the way to a village in Muheza district, Tanzania.