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Full Length Research Paper

Local preference of indigenous fruit trees in Coast Province, Kenya

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Indigenous fruit trees (IFTs) have various benefits such as enhancing nutrition and food security, but face threats of deforestation and genetic erosion. This paper focused on identification of the local people's preference of IFT. Research methods mainly involved field survey in Coast province, Kenya and analysis was by the conjoint analytical method. The survey results were as follows: (1) By the preference test, local people thought "wood products" was the most important consideration in the selection of IFT, and the next was "food value"; (2) By the utilization test, local people recognized IFT with "marketability" and "food value" as the priority species; (3) By the market survey, the trade and incomes from IFT were found to be small, while the income from IFT was limited by seasonality. In conclusion, the main factor contributing to the decrease of IFTs was the high logging pressure in accordance with the finding that the "wood products" factor came higher than "marketability" which is considered as the main source of incentive to conserve IFTs. To effectively conserve or enhance the growth of IFTs, these local preferences should be considered.

Key words: Indigenous fruit tree (IFT), Coast province in Kenya, local preference, strategy, conjoint analytical method.

INTRODUCTION

Indigenous fruit trees (IFTs)

Food insecurity, poverty, malnutrition and environmental degradation are the major unprecedented challenges that confront developing countries today. According to poverty eradication programmes in East Africa, 75 to 90% of the population makes their living from farming. The targeted 4% annual growth in African economies requires a 6% growth in agriculture. Yet the basic unit of production in the region is a small-scale family holding, that is, a high percentage of who lives below the poverty line. It is estimated that at the turn of this century, the highest incidence (33%) of people that are chronically malnourished (especially vulnerable groups, that is,women and children) is found in sub-Saharan Africa (FAO, 2003) not to mention that East Africa has the least fruit (excluding starchy plantains, etc.) consumption anywhere in the world (FAO STAT database). Africa has also been faced with a serious problem of not being able to feed its population or adequately meet its fuelwood demand (FAO, 2009). Frequent crop failure in the dry-lands often results in poor nutrition of the local people. Surprisingly, Africa has abundant wild plants and cultivated native species with great agronomic and commercial potential as food crops.

According to the assessment made by four Eastern African countries in collaboration with SAFORGEN programme (Chikamai et al., 2004), AFREA countries

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Abbreviations: FAO, The Food and Agriculture Organization of the United Nations; **IFT,** Indigenous Fruit Tree; **IK,** Indigenous Knowledge; **PRC,** Partial Regression Coefficient; **SSA,** Sub-Saharan Africa.

(Eritrea, Ethiopia, Kenya, Sudan, Tanzania and Uganda) have plenty of edible indigenous trees. The estimated indigenous food plants for Ethiopia and Kenya was about 370 and 800, respectively, whereas Sudan estimated 533 tree species and 183 shrub species as fruit trees. These IFTs play a vital role in the livelihoods of many rural communities in Eastern Africa, especially those living in arid and semi-arid areas (about 60% estimated). However, many of these species, particularly the fruit trees have not been promoted or researched and therefore remain underutilized (Gebauer et al., 2007). It is amazing to note that this important fruit diversity in East Africa is not exploited as elsewhere in West and Central Africa for the benefit of poor people, where few emerging fruit trees such as shea butter trees (*Vitellaria paradoxa*) has an important local and more international market. For example, the fruits of *Dacryodes edulis* (African plum) have become an important staple food in Central/West Africa during the fruiting season and, with increased marketing, the species is becoming a cash crop in Central/West Africa (annual trade value of US$ 1.5 million). Therefore, it is absolutely imperative to find other sources of getting food for the growing population. Improving production/domestication and marketing of IFTs is one way to improve rural livelihoods, food security and national economies as a whole.

To improve the production/domestication and marketing of IFTs, there is need to provide new income opportunities, diversity in production, increase market differentiation for traders, increase nutrition benefit in terms of vitamins and minerals, and contribute to tree species diversity on the landscape as well as release pressure on other wild relatives and thus environmental protection (Chikamai et al., 2004; Simitu et al., 2005; Jama et al., 2007; Akinnifesi et al., 2008).

IFTs provide a rare opportunity as well, since they can be used for other tree and wood products and services such as timber, fuelwood and in some cases, its fodder acting as multipurpose trees. On the other hand, the use of IFTs is well understood by the communities, hence their promotion is unlikely to be harder than that of exotic fruits. Many trees grow in the wild and often in cultivated areas, but may also be domesticated through semi-cultivation or cultivation. When domesticated, they require few inputs and tend to grow and produce in areas where cultivation of exotic trees meets with difficultly. Indigenous fruit trees may play an important role in the agriculture of the areas subjected to periodical drought. In fact indigenous trees are adapted to harsh environment such as very poor fertility soils and dry climates and may give a yield also during the years that give rise to a failure of traditional crops. However, IFTs face threats of deforestation and genetic erosion due to neglect. Some researches show that the cultivated area with major tree crops in relation to population (for example, avocados, mangoes, bananas, cashew, cinnamon citrus, cocoa, etc.) in developing countries has been increasing since 1961 toward 2001 (Simons and Jamnadass, 2004). Again, this is a big challenge to identify why areas covered by IFTs is not also increasing similarly on a large-scale. According to Simons and Jamnadass (2004), some problems associated with IFTs investments are: difference in consumer preference (shape and types), barriers to the international market, propagation and selection not linked to demand and lack of proper storage facilities that could enable more lucrative off season sales. Habte (2004) pointed that, due to urbanisation, expansion of agricultural activities, forest fragmentation, loss of habitats and inappropriate harvesting practices of indigenous fruit species, without conservation strategies and policies, are threatened to extinction according to the surveys carried out in East Africa.

The availability and consumption of wild fruit trees appear to be declining in SSA, partly because of the greater attention given to exotic fruits and due to forest degradation. Although many wild fruits are used by many rural inhabitants, they are still not as much appreciated or valued as some of the introduced fruit trees such as mango, orange and grapes. To some extent, these wild fruits are still regarded as inferior and only appropriate for the poor. There is also a widespread decline in knowledge about the wild fruits, especially among young people and those who live in urban areas. Just a small number of indigenous fruits in SSA have been commercially exploited compared to the huge amount of edible fruits that exist in the wild. To redress the situation, it is necessary to intensify programs on the genetic improvement of species with high potential and on the development of strategies for conservation, development and production of both traditional and innovative products. There have been several studies about indigenous fruit trees: on consideration for germplasm, genetic improvement, establishment, growth, phenology and tissue culture. Rural people in East Africa, as elsewhere in Africa, periodically rely on wild fruits to supplement their diet and to generate cash income essential for purchasing the required household goods in rural areas (Mithofer and Waibel, 2003). Leaky and Simon (1998) note that throughout the tropics, indigenous tree species produce locally important fruits and other non-timber forest products that have the potential to be domesticated to provide economic and livelihood benefits to subsistent farmers. Other studies include genetic erosion and domestic and industrial uses (Gunasena and Hughes, 2000), health and wealth of IFTs (Buwalda et al., 1997), income and labour productivity (Mithofer and Waibel, 2003), value of indigenous fruit trees (Packham, 1993), participatory domestication (Leakey et al., 2003) and potential of IFTs (Muok et al., 2000). However, little has been done as regards the use and conservation of indigenous fruit tree diversity for improved livelihoods in East Africa. As such, there were very limited works of research on IFTs in East Africa.

Despite the huge number and the importance of edible

IFTs for local communities, it is noted that less importance is given to these species by research institutions in East Africa (Chikamai et al., 2004), hence they cannot be promoted because of lack of basic data and information on their geographic distribution, habitats, conservation status, intra-specific diversity, market needs, indigenous and conventional knowledge for their domestication, processing, etc. Species populations are dwindling due to over-exploitation for fuel wood and destruction of their habitats, resulting in loss of valuable resources together with erosion of related indigenous knowledge. It is essential to focus on the conservation and management of indigenous fruit trees in East Africa. That is why Bioversity International (Bioversity) started the project in 2003 entitled "Use and conservation of indigenous fruit tree diversity for improved livelihoods in Eastern Africa" and the main objective of the project was to improve livelihoods and increase incomes of rural farmers in East Africa through growing, processing and marketing of IFTs.

This project is ongoing and now, it is the initial phase of the pilot project which is aimed at promoting the conservation and sustainable utilization of indigenous fruit trees by increasing their contribution to better household income and livelihoods among rural communities in Eastern Africa for poverty alleviation, food security and environmental protection. The scope of this phase was concentrated on gathering and/or generating baseline information that would be used when implementing the main project. In addition, while the utilization of IFT depends on indigenous knowledge (IK) (Maundu, 1996), considerable amount of indigenous knowledge (IK) is being lost especially in the area of medicinal uses of plants and food crops. Thus, the project will also seek to promote local communities to maintain their rights to indigenous knowledge (IK) related to the growing, processing and consumption of each of the identified indigenous fruits and germplasm as proposed by the "convention on biological diversity".

Research result of the pilot project

In April 2003, Bioversity and its counterpart, Kilifi Utamaduni Conservation Group (KUCG), which is a community based self-help group stationed near Kilifi town in Kenya's Coast Province, started a project to document the knowledge and practice related to traditional leafy vegetables and fruit trees among the Giriama communities (Fond et al., 2006). It had an overall aim of conserving the traditional food species and enhancing the nutritional status of the community through increased consumption of the various traditional foods. During fruit tree research, the group found 125 species with edible fruit, while Maundu et al. (1999) indicated that there were about 400 IFTs in Kenya. A total of 71 species (56%) were entirely wild, 34 (28%) were entirely domesticated and 11 (9%) were occasionally found in cultivation and sometimes in the wild. Among the fruits, only 17 species (for example, coconut and mango) were marketed in major cities such as Kilifi, Malindi and Mombasa, while 40 species (32%) were sold in local markets and 69 species (55%) were only for local consumption. Apart from being used as fruits, 115 species (92%) of these local fruit trees had other uses as well. Such uses include medicinal and health uses, pesticides, tools, building, wood carving, fibers, dye, bee foliage, live fence, firewood, flavoring foods and ceremonial and spiritual uses.

They also identified the most important 5 IFTs in Kilifi and Malindi districts: *Adansonia digitata* (Muyu in local name), *Tamarindus indica* (Mkwaju), *Dialium orientale* (Mtsumbwi and Mpepeta), *Ziziphus mauritiana* (Mukunazi) and *Landolphia kirkii* (Mtoria) (Figure 1 and Table 1). This was judged using the aforementioned frequency of the species as the most important.

Communities' indigenous knowledge (IK) on valuable fruits and their utilization was good. However, there was variation in the levels based on age and gender. The older generation and the youngsters seemed to be well versed with knowledge on IFTs. The level of IK with the middle age groups and among women generally was low. Furthermore, the level of conservation and management of IFTs by the locals was also relatively low.

From these researches, Bioversity listed the following gaps in the area of IFTs (Kweka et al., 2004):

1. Lack of information on the resource base of IFTs species diversity analysis and traits (morphological, biochemical and molecular) for improvement.
2. Lack of capacity (knowledge) about the genetic basis for morphological, biochemical and molecular variation.
3. Lack of understanding of the influence of environmental and human factors. This includes species reproductive biology (understanding pollination, dispersal and propagation mechanisms) and human selection pressures such as use and traditional cultivation practices.
4. Lack of understanding of species or provenance adaptability to different environmental conditions.

Bioversity suggested that baseline survey should be conducted to study the consumption and attitudes towards IFTs. Another emphasis was on promotion and awareness creation, research in product development (quality, characterizing, branding/processing, packaging and labeling) and value adding (processing at different levels, sorting, size and presentation of the final product). Bioversity also realized the importance of organizing markets for producers, entrepreneurs and processors. The working group stressed the need for all actors to understand the markets, empowering of producers and middlemen by mobilizing them into forming associations/bulking site.

Figure 1. The pictures of 5 priority species. Source: Created by authors.

Table 1. The characteristics of 5 priority IFTs.

Name	Local name	Precocity	Taste	Size	Frequency	Fruit season	Fruit shape
Adansonia digitata	Muyu	Very slow	Sour	Very big	Once yearly	Sep-Dec	Gourd like
Tamarindus indica	Mkwaju	Very slow	Very sour	Small	Once yearly	Sep-Dec	Beans like
Dialium orientale	Mtumbwi Mpepeta	Slow	Sour	Small	Once yearly	Aug-Oct	Circular
Ziziphus mauritiana	Mukunazi	Normal	Sour	Small	Twice yearly	Jan-Apr Jul-Aug	Circular
Landolphia kirkii	Mtoria	Normal	Sour	Small	Once yearly	Aug-Oct	Circular

Source: Created by authors.

MATERIALS AND METHODS

Based on the research results of the pilot project, the purpose of this paper is to identify the local people's preference on IFT and the reason for their preference in terms of which trait they thought the most important and to discuss how we could promote IFTs in Kilifi district of Coast province, Kenya (Latitude: 0.00 to 4.41 degrees south, Longitude: 37.41 to 41.32 degrees east). Through these researches, research institutes including Bioversity will decide the project strategy (how to conserve / manage / promote, etc) in the next phase.

Kilifi District is one of the coastal districts in Kenya. The selection of the district for the IFTs survey was based on its strategic location as a coastal district, and distribution and importance of IFTs in the district. The district is centrally located in the coastal region and has all representative features of the region. It has all the ecological zones for the coastal region. In addition, there is a higher level of IFTs distribution and utilization by local communities as source of food and income.

The two districts (Kilifi and Malindi districts) are predominantly inhabited by the Giriama people and informants of this study were mainly Giriama people. The Giriama people live in the coastal part of Kenya and together with eight other communities namely, Kauma, Chonyi, Jibana, Ribe, Kambe, Rabai, Duruma and Digo form the Mijikenda group of communities. The Giriama is the largest (about 50%) of the nine Mijikenda community groups and have the richest diversity of edible traditional leafy vegetable and fruit trees of all ethnic groups in Kenya.

We researched three issues:

1. The Preference Test / local people's IFT preferences with a focus on five factors (wood product, marketability, food value, availability and medicinal);
2. The utilization test / the utilization of the 5 priority IFT species;
3. The market survey / survey for IFT in Kilifi / Malindi Districts especially to IFT sellers.

Research methods mainly involved the field survey accompanied by literature study. The field survey took place in Kilifi, Bamba and Vitengeni in Kilifi district, and Kakoneni and Gongoni in Malindi district from October to November 2007 (Table 2 and Figure 2).

In each town, we chose 40 informants so as to compare their age / gender difference (10 of each comprised young men, old men, young women and old women). The age boarder was set as 35 years old. Informants, more than 15 years old, were chosen and life expectancy in that area was 55 years old. 35 years old is just the middle of 15 and 55. This border was ascertained to be appropriate through researches with local people (Table 3 and Figure 3).

For the preference test of IFT, we used the conjoint analytical method. However, thorough ranking was done to identify which of the factors of IFT was put above in the 5 factors by the local people (wood product, marketability, food value, availability and medicinal). At the previous research, local people selected 5 factors as the most important among the criteria of IFT identified by Bioversity (Table 4).

Conjoint analytical method is one of the statistical methods typically used to determine consumer preferences (Prentice and Benell, 1992; Baker and Crosbie, 1993). It has a particular value in

Table 2. Research places.

Place name	Latitude (S)	Longitude (E)	Altitude (m)
Kilifi	03.38.75	39.50.48	24
Bamba	03.32.36	39.31.13	251
Vitengeni	03.23.94	39.46.53	156
Kakoneni	03.10.55	39.51.23	84
Gongoni	03.01.77	40.07.46	10
Mombasa	04.02.42	39.40.88	18
Malindi	03.13.13	40.07.21	0
Gede	03.18.35	40.00.75	4

Source: Created by authors.

unravelling the attribute preferences embedded in complex choice decision-making processes not only for the individual, but also for the community. The robustness of the conjoint analysis methodology has been confirmed in Monte Carlo studies (Carmone et al., 1978). The methodology was used to combine attributes of the 5 interventions into 8 packages used in surveys.

Each combination of attribute levels was copied onto a card (Table 5). We made these cards by using the orthogonal array. Information on the cards was carefully explained to local people before they proceeded to indicate the order of preference. There was no evidence of respondent burden, since local people compared information on only eight cards. Therefore, the likelihood of erroneous rankings was minimized. Ranks of 1 to 8 were assigned to the cards in descending order of preference indicated by each informant. Although ranking schemes do not provide a unique way to represent indifference (Mackenzie, 1993), rankings were adopted to avoid drawbacks of non-comparability of rating levels across respondents. Since both ratings and rankings reflect relative intensities of preferences (Mackenzie, 1993), the choice of ranking satisfactorily permits the accomplishment of the objective of the paper.

By the conjoint analytical method, we calculated the 'partial regression coefficient' (PRC) and the 'importance' (I) of IFT. The importance (I) was calculated to divide each PRC by the their sum. For the utilization test, the 5 priority species about 5 factors were evaluated for each. As such, the local people chose points from 1 (very bad) to 5 (very good) (Table 6).

For the 'market survey', the places of research were 3 big markets in these districts (Kilifi, Malindi and Mombasa) and 2 small markets in Gede and Kakoneni (Table 2 and Figure 2). The research was done about species to be sold, quantity and price, place to buy, fruit season, style and place to trade and so on. This is to identify the position of IFT in the market and in local people livelihoods. This market survey also supplements the research about "marketability" of IFT. The informants were mainly fruit sellers.

RESULTS

The preference test

Tables 7 to 9 show the results of the 'preference test' used by the 'conjoint analytical method'. All multiple correlation coefficients were between 0.75 and 0.81 and it meant that the accuracy was sufficient. For research places, the horizontal axis shows 120 people for Kilifi district, 80 people for Malindi district and 40 people for each town (Kilifi, Bamba, Vitengeni, Kakoneni and Gongoni), whereas, as regards gender and age, the horizontal axis shows 100 people for men, women, young and old, and 50 people for young men, old men, young women and old women.

Wood products

"Wood products" was the 1st for all 200 people (the importance was 26.31%). It was only in Kakoneni, that it was the 2nd, but it was 1st for four towns and all genders / ages. This result supports the fact that the cutting was one of the main reasons for the decrease of IFT. Local people put importance on "wood products" better than "food value" of IFT. They will not conserve IFT as food producers but cut and use IFTs as fuel woods, timbers and wood products like chairs. We can understand that Giriama people have directly lived together with forests (not only with IFTs) since long time ago.

Food value

The 2nd important factor was "food value" (the importance was 20.13%). In Kilifi and Vitengeni, it was 4th but 2nd in Bamba and Gongoni and even 1st in Kakoneni. For gender and age, it was 5th for old women only, but 2nd for all others.

For all districts, local people recognized IFT as food and the important source of livelihood by selling it. One interesting custom of IFT is "it was usually for children but even adults eat it when the food is short." It means that IFT usually functions as "the source of nutrition" for children, but also as "the food security" in emergencies. This custom can also be evaluated to prevent excess consumption and support the "unintended" sustainable use.

For gender and age, "food value" was of low priority in such places as Kilifi and Vitengeni, which has good access to big city like Mombasa and Malindi, as they have good access to the other foods. However, in far places of the city, such as Bamba, Gongoni and Kakoneni, it played an important role. Low priority for old

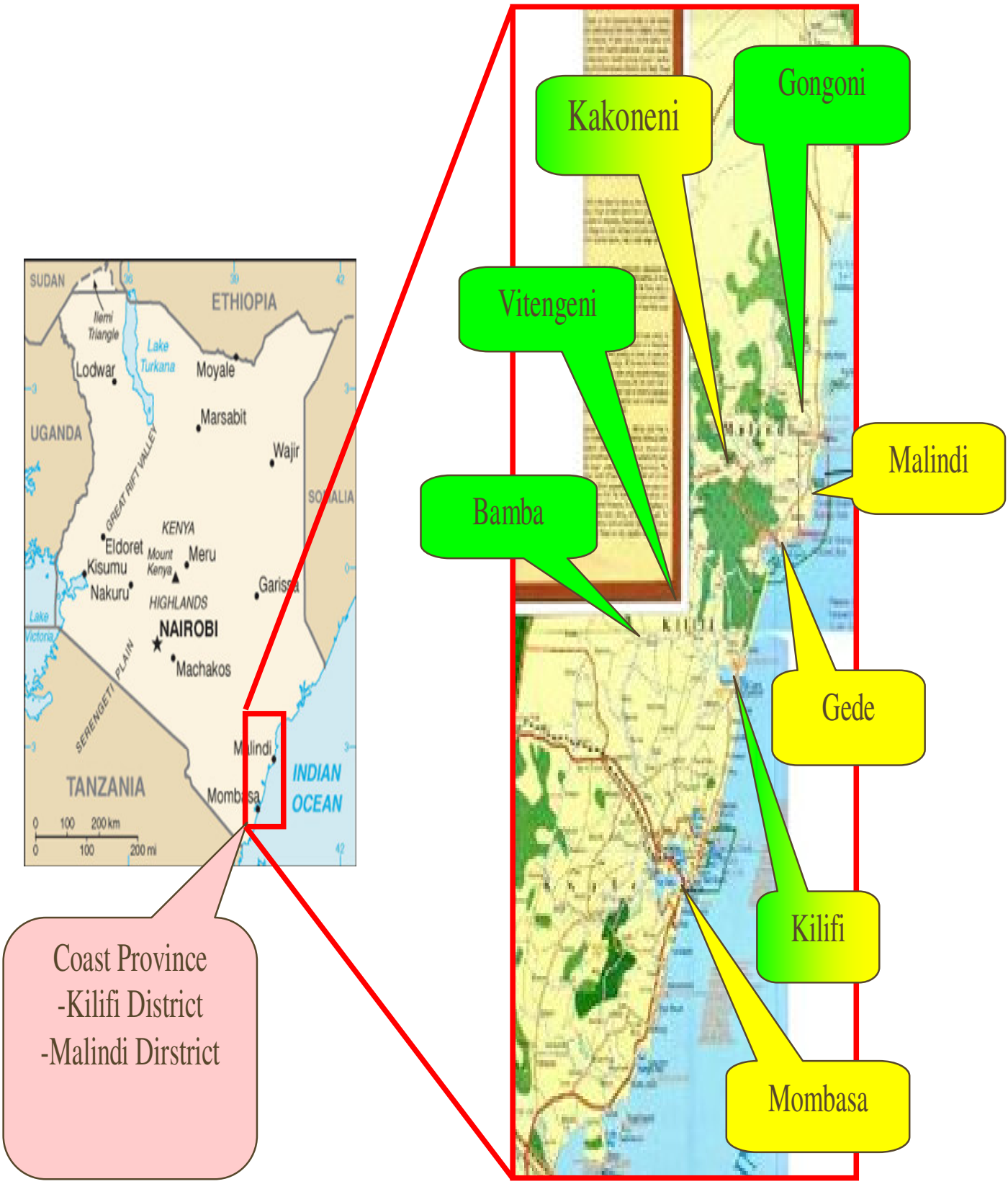

Figure 2. The map of research places. Note: “Green” is for the research places of the preference test and the utilization test, while ‘yellow’ is for the market survey. Source: Created by authors.

Table 3. Sample number of informants.

	Kilifi District			Malindi District		Total
	Kilifi	Bamba	Vitengeni	Kakoneni	Gongoni	
Young men	10	10	10	10	10	50
Old men	10	10	10	10	10	50
Young women	10	10	10	10	10	50
Old women	10	10	10	10	10	50
Total	40	40	40	40	40	200

Source: Created by authors.

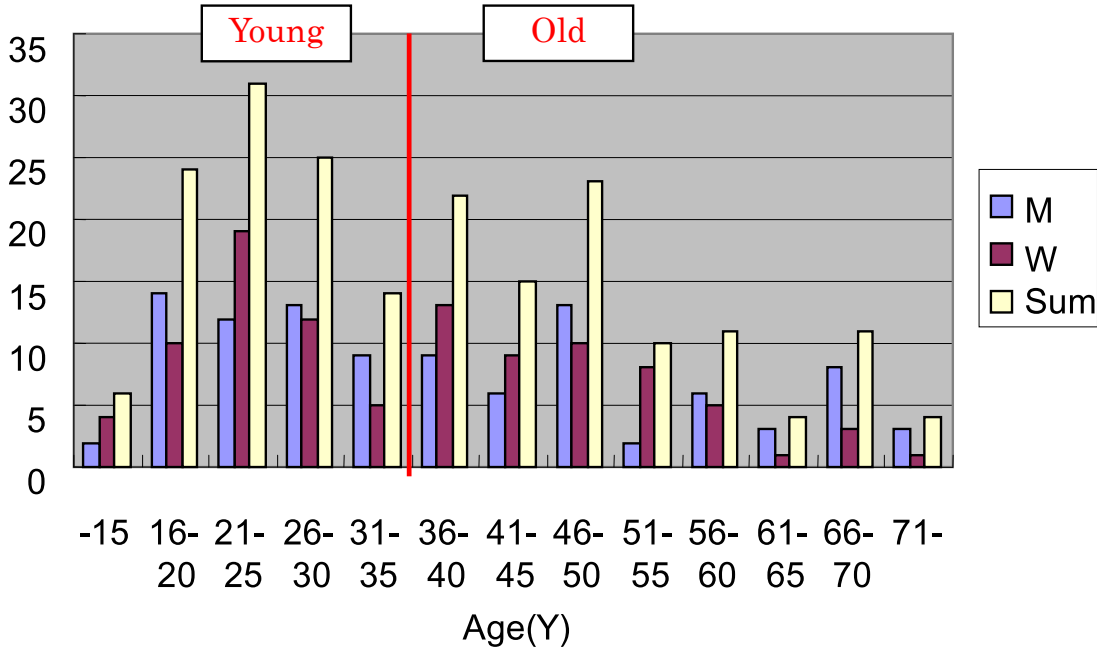

Figure 3. Sample number of informants.M, Men and W, Women. Source: Created by authors.

women will reflect that the collection of IFT is mainly done by the men or young women.

Availability

"Availability" was the 3rd important factor (the importance was 18.25%). As it will be seen in the foregoing that the trade amounts and marketability of IFT were small, local people put importance on the easy access.

For district, it was 3rd in Bamba, Vitengeni and Kakoneni, 4th in Kilifi and 5th in Gongoni. For gender and age, it was almost 3rd, but 5th for young women and 4th for old women. One characteristic was low priority of "availability" for women. The reason why "availability" was low in Gongoni is unclear, but the gender / age difference depends on the collection which is usually done by men.

Marketability

"Marketability" was the 4th important factor which is almost similar to "medicinal" (the importance was 17.67%). This result was a little surprising as "marketability" was hypothesed as important for local people as it is the poor income source. This reflects that the marketable fruits are mainly the exotic ones for mango and orange while the indigenous ones are for captive use.

For district and gender / age, there was a wide variety. For district, it was 2nd in Kilifi and Vitengeni, 4th in Kakoneni and Gongoni and 5th in Bamba. For gender and age, it was low for men (5th for total, 4th for young men and 5th for old men), but high for women (2nd for total, 3rd for young women and 2nd for old women).

While Kilifi and Gongoni are coastal areas and some of them live by fishery, in Vitengeni surrounded by plenty

Table 4. The criteria of IFTs.

Criteria	5 Factors
Food value	
Taste	
Colour	
Fleshiness	Food value
Sweetness	
Size	
Fruits that can also be cooked	
2. Economic value	
Marketability	Marketability
Potential for value adding	
Availability	
Distribution	Availability
Abundance	
Seasonality	
Other uses/Attributes	
Medicinal	Medicinal
Timber	
Firewood/charcoal	Wood Products
Fodder	
Carving	
Ecological value	
Ease of propagation	

Source: Created by authors.

Table 5. The 8 cards for the preference test.

	Wood product	Marketability	Food value	Availability	Medicinal
Card1	Yes	Yes	Yes	Yes	Yes
Card2	Yes	Yes	Yes	No	No
Card3	Yes	No	No	Yes	No
Card4	Yes	No	No	No	Yes
Card5	No	Yes	No	Yes	No
Card6	No	Yes	No	No	Yes
Card7	No	No	Yes	Yes	Yes
Card8	No	No	Yes	No	No

Source: Created by authors.

forests, so many people depend on forests to sell wood products and fruits to the market in Mombasa or Kilifi. This is one of the reasons why “marketability” is of high priority in Vitengeni. For gender and age, local people share their house works and in many houses, men do physical labor (like collecting of IFT) outside the house and women sell them inside or near the house. So many women have interest in “marketability” which is directly connected with house incomes.

Medicinal

“Medicinal” function was the 5th totally (the importance was 17.64%). For district and gender / age, there was also a wide variety and it was 2nd in Bamba and Gongoni,

Table 6. Points for the utilization test.

1	2	3	4	5
Very bad	Bad	Even	Good	Very good

Source: Created by authors.

Table 7. The results of the preference test for all 200 people.

	All	
	PRC	I (%)
1. W	2.06 (0.07)	26.31
2. Ma	1.39 (0.07)	17.67
3. F	1.58 (0.07)	20.13
4. A	1.43 (0.07)	18.25
5. Me	1.38 (0.07)	17.64

PRC=Partial Regression Coefficient, I = Importance. (1) W, wood product; (2) Ma, marketability; (3) F, food value; (4) A, availability; (5) Me, medicinal. (), contain standard errors; levels of significance of parameter estimates are all 1%. Source: Created by authors.

4th in Kakoneni and 5th in Kilifi and Vitengeni. For gender and age, it was almost 4th or 5th, but 3rd for both young and old women.

This "medicinal" function particularly has a relation with the indigenous knowledge (IK) which Bioversity also thinks a great deal. As such, there were various examples of the traditional use of IFT in each town:

1. *Adansonia digitata*: Fumed fruits were used for the prevention of mosquito (Kilifi) and leaves were used for malaria (Bamba and others).
2. *Tamarindus indica:* Roots and flowers for stomach-ache (Kakoneni) and grinded roots for swollen legs (Gongoni).
3. *Dialium orientale:* Boiled roots for the health of pregnant women (Vitengeni);
Ziziphus mauritiana: Leaves as antidotes for snake bite (Vitengeni), roots and leaves for stomachache (Gongoni).
4. *Ziziphus mauritiana*: Leaves as antidotes for snake bite (Vitengeni), roots and leaves for stomachache (Gongoni).
5. *Landolphia kirkii:* Roots were used for aching purposes.

We hypothesed that the preference for the old would be higher than that for the young as it is strongly related with indigenous knowledge (IK) and as such, the old usually have more indigenous knowledge (IK) than the young, but the result was not so remarkable. The high priority in Bamba indicates that they have bad access to the medicinal products as Bamba is far from the city, so they utilize IFT as medicine even until now. The higher priority for women than men is due to the fact that IFT is often used as medicine for children and the management of children is always women's job.

The utilization test

Tables 10 to 12 show the results of the utilization test. This is the evaluation of 5 factors for 5 priority IFTs. As such, we calculated the average for each. For all 5 species, the points of "marketability" and "food value" were high. This shows that local people recognize and expect IFT as both the income source and food and it goes along with Bioversity's hypothesis. From this result, it can be said that 5 priority species have 2 factors both, so that they can be chosen as the priority species. On the other hand, *Adansonia digitata* and *Landolphia kirkii* were nearly valueless as "wood products" and the other 3 species could not get as high points as "marketability" and "food value". This evaluation is same with "availability". However, "medicinal" in relation with indigenous knowledge (IK) got low points generally. These results will reflect that local people think "wood products" and "medicinal" as replaceable factors with the other trees.

In conclusion, to recognize the priority species by local people, IFT should have "marketability" and "food value" for the first, "availability" and "wood products" for the next and "medicinal" factor is not so important.

These results of the utilization test are very interesting compared with those of the preference test. About "food value", both researches show that it is important. The factor of "wood products" is the highest priority for general IFTs (by the preference test), but it is not the criteria for the priority species (by the utilization test). In addition, "marketability", which is not so important for general IFTs, is an important criterion for the priority species.

Through the preference test and the utilization test, local people expect "wood products" and "food value" for general IFTs, while IFTs with "marketability" and "food value" can be the priority species.

For district, the point of "wood products" was higher in Kilifi. About "marketability" and "food value", each district shows the same results. As such, it can be understood that there are no differences for the value recognition about "marketability" and "food value" of 5 priority species. On the other hand, there were great differences about "availability". For example, *Adansonia digitata* got high points in Kilifi and Gongoni, but low points in Kakoneni. *Ziziphus mauritiana* got high points in Kilifi and Gongoni, but low points in Bamba and Kakoneni.

This result indicates the important point that there are great geographical differences such as environment or climate even within a 50 km radius, like Kilifi and Gongoni as coastal areas, Vitengeni and Kakoneni as forest areas and Bamba as a dry and high area. In addition, "availability" also affects "wood product" preferences, because if they are not available, they do not use IFT as

Table 8. The results of the preference test for each district and town.

	Kilifi district								Malindi district					
	All		Kilifi		Bamba		Vitengeni		All		Kakoneni		Gongoni	
	PRC	I(%)	PRC	I (%)	PRC	I (%)	PRC	I (%)	PRC	I (%)	PRC	I (%)	PRC	I (%)
1. W	2.26 (0.09)	29.03	2.77 (0.15)	36.57	1.95 (0.16)	24.45	2.07 (0.16)	26.37	1.76 (0.11)	22.29	1.63 (0.16)	21.03	1.89 (0.16)	23.51
2. Ma	1.43 (0.09)	18.29	1.35 (0.15)	17.79	1.31 (0.16)	16.46	1.62 (0.16)	20.64	1.33 (0.11)	16.76	1.22 (0.16)	15.71	1.43 (0.16)	17.77
3. F	1.38 (0.09)	17.65	1.09 (0.15)	14.33	1.58 (0.16)	19.75	1.47 (0.16)	18.73	1.88 (0.11)	23.79	2.11 (0.16)	27.16	1.66 (0.16)	20.56
4. A	1.44 (0.09)	18.45	1.31 (0.15)	17.30	1.41 (0.16)	17.71	1.59 (0.16)	20.32	1.42 (0.11)	17.94	1.58 (0.16)	20.39	1.26 (0.16)	15.59
5. Me	1.29 (0.09)	16.58	1.06 (0.15)	14.00	1.73 (0.16)	21.63	1.09 (0.16)	13.94	1.52 (0.11)	19.21	1.22 (0.16)	15.71	1.82 (0.16)	22.58

PRC, Partial regression coefficient; I, Importance. More than 110% of the importance (I) compared with that of the 200 people is shown in red cell and less than 90% is shown in blue. (), contain standard errors; levels of significance of parameter estimates are all 1%. Source: Created by authors.

Table 9. The results of the preference test for each gender and age.

	M		W		Y		O		YM		OM		YW		OW	
	PRC	I (%)	PRC	I (%)	PRC	I (%)	PRC	I (%)	PRC	I(%)	PRC	I (%)	PRC	I (%)	PRC	I (%)
1.W	2.09 (0.10)	27.33	2.03 (0.10)	25.33	2.03 (0.10)	25.70	2.10 (0.10)	26.93	2.16 (0.14)	27.81	2.02 (0.15)	26.84	1.88 (0.14)	23.64	2.18 (0.14)	27.01
2.Ma	1.20 (0.10)	15.72	1.57 [0.10]	19.54	1.37 (0.10)	17.32	1.41 (0.10)	18.03	1.25 (0.14)	16.12	1.15 (0.15)	15.31	1.47 (0.14)	18.50	1.66 (0.14)	20.57
3.F	1.61 (0.10)	21.07	1.54 (0.10)	19.23	1.70 (0.10)	21.57	1.46 (0.10)	18.67	1.66 (0.14)	21.39	1.56 (0.15)	20.74	1.73 (0.14)	21.76	1.35 (0.14)	16.73
4.A	1.47 (0.10)	19.24	1.39 (0.10)	17.30	1.44 (0.10)	18.21	1.43 (0.10)	18.28	1.49 (0.14)	19.20	1.45 (0.15)	19.28	1.37 (0.14)	17.24	1.40 (0.14)	17.35
5.Me	1.27 (0.10)	16.63	1.49 (0.10)	18.60	1.36 (0.10)	17.20	1.41 (0.10)	18.09	1.20 (0.14)	15.48	1.34 (0.15)	17.83	1.50 (0.14)	18.87	1.48 (0.14)	18.34

PRC, Partial regression coefficient; I, Importance; M, Men; W, Women; Y, Young; O, Old; YM, Young men; OM, Old men; YW, Young women and OW, Old women. More than 110% of the importance (I) compared with that of the 200 people is shown in red cell and less than 90% is shown in blue. (), contain standard errors; levels of significance of parameter estimates are all 1%. Source: Created by authors.

Table 10. The results of the utilization test for all 200 people.

Total	1.W	2.Ma	3.F	4.A	5.Me
Adansonia digitata	1.115	4.250	4.440	4.210	2.195
Tamarindus indica	4.265	4.490	4.510	4.245	1.955
Dialium orientale	4.050	4.400	4.520	3.945	1.305
Ziziphus mauritiana	3.700	4.380	4.490	3.870	1.485
Landolphia kirkii	1.200	4.370	4.530	4.175	1.230

Source: Created by authors.

Table 11. The results of the utilization test for each district and town.

Kilifi district	**1.W**	**2.Ma**	**3.F**	**4.A**	**5.Me**	**Malindi district**	**1.W**	**2.Ma**	**3.F**	**4.A**	**5.Me**
Adansonia digitata	1.167	4.267	4.375	4.383	2.267	*Adansonia digitata*	1.038	4.225	4.538	3.950	2.088
Tamarindus indica	4.292	4.483	4.558	4.292	1.892	*Tamarindus indica*	4.225	4.500	4.438	4.175	2.050
Dialium orientale	4.167	4.433	4.508	3.867	1.325	*Dialium orientale*	3.875	4.350	4.538	4.063	1.275
Ziziphus mauritiana	3.850	4.458	4.517	4.033	1.617	*Ziziphus mauritiana*	3.475	4.263	4.450	3.625	1.288
Landolphia kirkii	1.242	4.400	4.583	4.183	1.250	*Landolphia kirkii*	1.138	4.325	4.450	4.163	1.200
Kilifi	1.W	2.Ma	3.F	4.A	5.Me	Kakoneni	1.W	2.Ma	3.F	4.A	5.Me
Adansonia digitata	1.200	4.425	4.500	4.775	2.350	*Adansonia digitata*	1.075	4.200	4.525	3.075	2.075
Tamarindus indica	4.625	4.550	4.575	3.575	1.575	*Tamarindus indica*	4.150	4.475	4.500	4.175	1.875
Dialium orientale	4.500	4.325	4.550	3.300	1.250	*Dialium orientale*	3.925	4.375	4.450	4.450	1.200
Ziziphus mauritiana	4.500	4.650	4.700	4.875	1.700	*Ziziphus mauritiana*	3.350	4.375	4.500	2.950	1.275
Landolphia kirkii	1.150	4.325	4.575	3.250	1.250	*Landolphia kirkii*	1.100	4.425	4.450	4.075	1.175
Bamba	1.W	2.Ma	3.F	4.A	5.Me	Gongoni	1.W	2.Ma	3.F	4.A	5.Me
Adansonia digitata	1.150	4.175	4.300	4.475	2.700	*Adansonia digitata*	1.000	4.250	4.550	4.825	2.100
Tamarindus indica	3.975	4.600	4.575	4.750	2.100	*Tamarindus indica*	4.300	4.525	4.375	4.175	2.225
Dialium orientale	4.125	4.625	4.600	4.525	1.325	*Dialium orientale*	3.825	4.325	4.625	3.675	1.350
Ziziphus mauritiana	3.300	4.200	4.475	3.350	1.700	*Ziziphus mauritiana*	3.600	4.150	4.400	4.300	1.300
Landolphia kirkii	1.100	4.425	4.650	4.575	1.200	*Landolphia kirkii*	1.175	4.225	4.450	4.250	1.225
Vitengeni	1.W	2.Ma	3.F	4.A	5.Me						
Adansonia digitata	1.150	4.200	4.325	3.900	1.750						
Tamarindus indica	4.275	4.300	4.525	4.550	2.000						
Dialium orientale	3.875	4.350	4.375	3.775	1.400						
Ziziphus mauritiana	3.750	4.525	4.375	3.875	1.450						
Landolphia kirkii	1.475	4.450	4.525	4.725	1.300						

More than 110% of the points compared with that of the 200 people are shown in red cell and less than 90% is shown in blue. Source: Created by authors.

"wood product". Our suggestion from this result is almost same with the preference test that Bioversity should take the regional difference into consideration. To decide the priority species broadly is not so adequate and to decide each district, each town is more desirable.

The horizontal axis shows 100 people for men, women, young and old, and 50 people for young men, old men, young women and old women with regards to gender and age.

For gender and age, the factors were not so different for the 200 people except "medicinal". About "medicinal", while the differences are not so big for women, young men put the low points generally and old men put the high points for all IFTs in comparison with the total. As a result, there is no gender difference, but age difference. The old put higher scores than the young for all. With this point, we can ascertain the general thought that the old has more indigenous knowledge (IK) and as such, Bioversity should help the transmission of indigenous knowledge (IK) from the old to the young strategically from the viewpoints of IFTs conservation.

The differences are not so apparent, but men have higher scores than women about "marketability" and "food value", and this is because women are house workers, so their importance and interest would be higher than those of men. One more finding is that men and the young have higher scores than women and the old about "availability", and this is because men and the young are collectors of IFTs, so their points would be higher than those of women and the old.

The market survey

The third research involved a market survey. Firstly, we found that the trade and income from IFT were small. So, IFTs are sold together with the exotic fruits such as mango and orange and the income from exotic fruits are the main source of income for the seller. All informants said "it is impossible to live only by IFT trade", and this means that marketability of IFT is very low now. As such, a lot of them sold IFTs at that place only. This is because income from IFT is low and they do not have the strategy to sell them at the other places.

Table 12. The results of the utilization test for each gender and age.

M	1.W	2.Ma	3.F	4.A	5.Me	YM	1.W	2.Ma	3.F	4.A	5.Me
Adansonia digitata	1.200	4.190	4.370	4.280	2.130	*Adansonia digitata*	1.300	4.240	4.340	4.540	1.460
Tamarindus indica	4.270	4.440	4.420	4.280	1.890	*Tamarindus indica*	4.340	4.400	4.380	4.520	1.520
Dialium orientale	3.870	4.340	4.440	4.120	1.390	*Dialium orientale*	3.840	4.340	4.440	4.360	1.300
Ziziphus mauritiana	3.520	4.260	4.410	3.930	1.510	*Ziziphus mauritiana*	3.460	4.380	4.420	3.980	1.340
Landolphia kirkii	1.210	4.300	4.430	4.110	1.310	*Landolphia kirkii*	1.220	4.300	4.440	4.260	1.260
W	1.W	2.Ma	3.F	4.A	5.Me	OM	1.W	2.Ma	3.F	4.A	5.Me
Adansonia digitata	1.030	4.310	4.510	4.140	2.260	*Adansonia digitata*	1.100	4.140	4.400	4.020	2.800
Tamarindus indica	4.260	4.540	4.600	4.210	2.020	*Tamarindus indica*	4.200	4.480	4.460	4.040	2.260
Dialium orientale	4.230	4.460	4.600	3.770	1.220	*Dialium orientale*	3.900	4.340	4.440	3.880	1.480
Ziziphus mauritiana	3.880	4.500	4.570	3.810	1.460	*Ziziphus mauritiana*	3.580	4.140	4.400	3.880	1.680
Landolphia kirkii	1.190	4.440	4.630	4.240	1.150	*Landolphia kirkii*	1.200	4.300	4.420	3.960	1.360
Y	1.W	2.Ma	3.F	4.A	5.Me	YW	1.W	2.Ma	3.F	4.A	5.Me
Adansonia digitata	1.180	4.260	4.420	4.380	1.850	*Adansonia digitata*	1.060	4.280	4.500	4.220	2.240
Tamarindus indica	4.210	4.420	4.500	4.350	1.780	*Tamarindus indica*	4.080	4.440	4.620	4.180	2.040
Dialium orientale	3.930	4.330	4.520	4.120	1.210	*Dialium orientale*	4.020	4.320	4.600	3.880	1.120
Ziziphus mauritiana	3.680	4.460	4.500	3.950	1.370	*Ziziphus mauritiana*	3.900	4.540	4.580	3.920	1.400
Landolphia kirkii	1.200	4.340	4.510	4.320	1.200	*Landolphia kirkii*	1.180	4.380	4.580	4.380	1.140
O	1.W	2.Ma	3.F	4.A	5.Me	OW	1.W	2.Ma	3.F	4.A	5.Me
Adansonia digitata	1.050	4.240	4.460	4.040	2.540	*Adansonia digitata*	1.000	4.340	4.520	4.060	2.280
Tamarindus indica	4.320	4.560	4.520	4.140	2.130	*Tamarindus indica*	4.440	4.640	4.580	4.240	2.000
Dialium orientale	4.170	4.470	4.520	3.770	1.400	*Dialium orientale*	4.440	4.600	4.600	3.660	1.320
Ziziphus mauritiana	3.720	4.300	4.480	3.790	1.600	*Ziziphus mauritiana*	3.860	4.460	4.560	3.700	1.520
Landolphia kirkii	1.200	4.400	4.550	4.030	1.260	*Landolphia kirkii*	1.200	4.500	4.680	4.100	1.160

More than 110% of the points compared with that of the 200 people are shown in red cell and less than 90% is shown in blue. Source: Created by authors.

The next finding is the seasonality of IFT. This time (Octover, 2007), we could find almost 2 IFTs only, *Adansonia digitata* and *Tamarindus indica*. As such, it was only in Malindi that *Ziziphus mauritiana* was found. As shown in Table 1, we could not find *Dialium orientale* and *Landolphia kirkii* as they were out of season. This result indicates the impact of seasonality. That is, income from IFT is strongly limited by seasonality.

Another finding is the importance of the Mombasa market. In a case where collected fruits were sold directly at the shop, a lot of IFTs went through that market. Mombasa is the 2nd largest city (next to Nairobi) in Kenya and is much bigger than the other researched markets.

CONCLUSION AND DISCUSSION

As it is seen earlier, various important indications could be achieved through the preference test, the utilization test and the market survey. Based on these research results, we propose the effective strategies about IFT especially for research institutions including Biodiversity which is as follows: (1) The domestication and plantation of the useful tree species such as *Azadirachta indica* (Neem and Mkilifi), *Diospyros mespiliformis* (Mukulu) and *Monanthotaxis* sp. (Mfunda) in order to decrease the logging pressure; (2) The promotion activities at the Mombasa market are used to improve the “marketability” of IFT and (3) The concerning indigenous knowledge (IK).

To be recognized as the priority species by local people, the IFTs should have both “marketability” and “food value”. From the viewpoint of local people’s lives, the plantation of these priority species has the incentive for it to be conserved by local people as they are useful for food and source of income. One of the important factors for IFT compared with other tree species is that its fruit has “food value”. We should take this factor into consideration to set its conservation strategy. For example, to analyze their heredity, the essential nutrition is discerned for health maintenance, and its information which is utilized for the promotion at the market is one idea. In a situation where unstable food supply is worried

by various external factors such as climate change, the importance of IFT's function as "food security" will become more and more important.

At the same time, it is important that the identified IFTs so far only has "food value", but without "marketability" as same as "wood products", "availability" and "medicinal." It means that these IFTs without "marketability" may be judged as useless so that they have the risk to be cut. To conserve the low priority species which do not have both "marketability" and "food value" is also an important strategy.

The results about "availability" indicate the importance to set the strategy for each district. While the preference of "medicinal" is low, local people still use IFT as local medicine in many places. So, we should research about its current status as medicine in more details and set its strategy based on this information even from the viewpoints of the conservation of indigenous knowledge (IK).

As a whole, the regional difference is bigger than the gender and age difference. Red or blue colored cell is more for regional results. So, the regional difference rather than the gender and age difference should be taken into consideration.

About the issue of seasonality, the possible strategy is the arrangement of the storage system in order to trade period. Through this, the position of IFT as a source of income will improve for local people. The next strategy is the promotion activity. It is important to utilize the indigenous knowledge (IK) of local people and to discern the essential nutrition for health maintenance by analysis of their heredity, and as such, promote IFT with these information. The demand for IFT will increase according to the success of the promotion activity which will increase the trade amount and sales, and as a result, it can improve local livelihoods. However, we should take care to prevent the excess consumption and utilization of target IFTs or to prevent from driving away untargeted IFTs. The promotion at big markets such as the Mombasa market (or Nairobi market) will be more effective and efficient as many IFTs go through those markets.

In addition, we can also explain the decreasing trend of IFT from the viewpoint of local preference. As stated in the study's "introduction", one of the main factors of the decrease of IFTs is logging and low incentive to conserve. These trends can also explain the local preference about IFT. As local people put high priority on the factor of "wood products," it can make the logging pressure higher. As local people think IFT has low "marketability," it cannot improve the incentive to conserve higher.

IFT has multi functions which are very useful for various means. We hope these results can help in constructing the strategy to conserve, manage and utilize IFTs. At last, future challenges for this study are to: (1) Focus on cultural/traditional traits and environmental traits and research how they can contribute to IFT conservation / management strategies. For example, *A. digitata* used to be the sacred tree and people prayed at the bottom of it. (2) Focus on each IFT and the trait that is important for local people through preference testing.

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