Educational Level and Major Constraints Faced by Farmers and Tappers in Production and Marketing of Coconut-based Products

Kadere T. T., Oniang'o R.K., Kutima P. M. and Njoroge S. M.

Department of Food Science and Technology, Jomo Kenyatta University of Agriculture and Technology (JKUAT), P.O. Box 62000-00200, Nairobi, KENYA; Email: jacintatunje@yahoo.com

ABSTRACT

Kenya like other tropical countries has a coastal belt that is suitable for the growth and production of coconut and oil palms. More than 80% of the small-scale farmers in the coastal region derive their livelihood directly or indirectly from the coconut tree. This study, which was conducted between June 2002 and April 2003, sought information on the educational level and the major constraints faced by coconut tree farmers and tappers. Both stratified and area-sampling methods were employed using two questionnaires; one for the tappers and the other one for the farmers. A total of 9,155 coconut tree farmers and 2,812 mnazi tappers from six geographical districts in the Kenyan coastal province were interviewed. On average, 32.5% of the 9,155 farmers interviewed were found to be illiterate, while 42.0 % had primary school level of education. Only 11.2% had secondary school education while only 2.1% had college or university certificate. Out of the tapers interviewed, 40.3 % were found to be illiterate while 53.1% had primary school certificate. Only a few had secondary school education (4.5%) and less than 0.4% had tertiary level of education. The major constraints faced by the farmers in all the six districts were: lack of market (28.6%), low/fluctuation of prices (20.3%), pests and diseases (12.4%), poor transport/infrastructure (9.4%) and lack of credit/loans (7.7%). The major constraints faced by the tappers in all the five districts were: lack of market or poor marketing (31.1%), police and/or provincial administration harassment (20.8%), low/fluctuation of prices (15.7%), poor storage/preservation facilities (8.7%) and risk of falling due to snake-bites/strong winds/slippery trees (5.7%). The study identified all the major constraints that attributed to the amorphous marketing structures and lack of processing industries. The findings when well utilized could act as major catalysts in the process of revitalizing the coconut industry in the coastal region of Kenya.

KEY WORDS: Coconut, tapper, farmer, constraints, educational level

1.0 INTRODUCTION

The Coconut palm (*Cocos nucifera*) is currently grown in nearly 90 countries along the tropical belt worldwide. The Portuguese introduced it in Kenya in the 16th Century. Its cultivation spread rapidly and became an industrial crop of considerable economic importance during the 20th Century. In Kenya the coconut trees are found in the Coastal region and are grown traditionally for their tender nut, copra and oil. Other non-traditional products derived from coconut have been developed to diversify its utilization and produce high-value products (Sanchez, 1992). In Kenya, the coconut tree is more than a commercial crop, in the sense that it is also a social crop. This is attributed by the fact that, coconut-based products are the major income earners at the same time, coconut farms are usually family owned and passed from one generation to the next. Coconut production is dominantly based on smallholdings, which are beset with problems of low productivity and steady decline in hectarage (Banzon and Velasco, 1982). In some parts of Coastal Kenya, where the soil is too poor to sustain other crops, coconut and cashew nut represent the only form of livelihood for hundreds of thousands of people.

Different parts of the coconut tree are used to produce handcrafted baskets, roofing for huts and beach hotels, human and animal food (flour, nut and fiber), oil, soap, wine and charcoal (Peixoto, 1973; Lorenzi et al., 1996; Bezerra, 1999). The outer part surrounding the shell of each coconut can be processed into silver type particles, which are bundles of fiber covered by a waxy nonporous membrane similar to wheat straw. Currently, the residues are used as biomass for energy production, sometimes via direct burning, a procedure that adds little value to the waste (Invetário, Floreatal Nacional, 1983). The palm trunk is useful for construction work and in making furniture, handicrafts, blowguns (Kahn and de Granville, 1993). Non-human animals including birds, deer, parrots and beetles use the palm as food or shelter (Kiltie, 1981; Herderson, 1990; Bodmer, 1991).

Meeting the challenge of raising rural incomes in the Coastal region of Kenya where coconut is the main cash crop requires some form of transformation out of the semi-subsistence, low-input, low-productivity farming systems that currently characterize much of the region. In this region there is need for cash crop intensification through programs that are involved in integrating subsidized credit, input delivery and purchase

of coconut based-products by private sector or state marketing boards that shall operate even in the remote farming areas (Rohrbach, 1988; Byerlee and Eicher, 1997; Putterman, 1995). Cash crops such as coconut and its bi-products can help farmers overcome capital constraints on the purchase of assets and inputs, which can be used to expand food crop as well as cash crop production (Von Braun and Kennedy, 1994).

Promotional support and training of cash crop producers by private firms and state corporations may also raise the productivity of existing household resources devoted to food crop productivity. Economists have for a long time advocated for a comparative advantage strategy that aims at specialization and commercialization of the target cash crop. The underlying premise in the market structures is to allows households to increase their in-comes by producing that which provides the highest returns to land and labour, and then using cash to buy household consumption items, rather than being constrained to produce all the various goods needed for consumption (Timmer, 1997). While this concept of comparative advantage is well accepted under the assumption of frictionless markets, in reality the process of commercialization involving non-food cash crops can be impeded by risks and costs in the food marketing system. Food market failures give rise to the well-understood non-separability of household production and consumption decisions, which accounts for the potential breakdown of agricultural commercialization strategies based on comparative advantage (Singh etal., 1986; Fafchamps, 1992). These arguments form a large part of the foundation of the long-standing critique of cash crop promotion in coastal region where coconut is the main cash crop.

The specific objective of this survey was to study the major constraints faced by farmers and tappers in production and marketing of coconut-based products in the coastal region of Kenya. These findings are expected to help the policy makers in their effort to revitalize the coconut industry. This study was conducted at the coastal region of Kenya between June 2002 and April 2003.

2.0 METHODOLOGY

2.1 Survey

A survey was undertaken in the coconut producing coastal districts of Kenya to assess the educational level and major constraints faced by tappers and farmers. Six,

administrative districts namely Kilifi, Kwale, Malindi, Mombasa, Tana River and Lamu were studied. Both the stratified and area-sampling methods were employed in this study. The population was divided into homogeneous sub-parts (strata), comprising of tappers and coconut farmers. Area sampling then followed in which the study area was divided into small administrative areas (districts). The districts were further sub-divided into divisions and locations. In the selected sample, all the farmers and tappers were then interviewed. The main tool used for the study included discussions with the concerned tappers and farmers. The other tools used were questionnaires and a tape recorder. The study was conducted in the local language (Giriama) and in Kiswahili. The tappers and farmers were probed through simple questions found in the questionnaires. The secondary sources of information were informal list of tappers and coconut farmers obtained from the local chiefs' offices and that from local extension workers working with the Ministry of Agriculture.

2.2 Questionnaires and data analysis

A combination of qualitative and quantitative research methods were used simultaneously and sequentially to collect the information. The questionnaires sought to find out the major constraints faced by farmers and tappers and their possible solutions. The respondents were also required to give their main source of income and their educational level. The questionnaires were pre-tested during the stakeholders seminar held at the Jomo Kenyatta University of Agriculture and Technology where each participant was given questionnaires to complete, one after 2 days for a period of 2 weeks. Additionally, fifty (50) different farmers and fifty (50) different tappers completed the questionnaires verbally and in writing. Based on the results, the questionnaire proved to be reliable and valid as in both these tests, a correlation of 85% was found. A simple cross-section survey design was applied to collect the data, where households of tappers and coconut farmers were in the projected area (Coast province) were given an equal chance of being selected for the survey. The data was collected at one point in time from a sample selected to describe and represent the entire area. The first questionnaire was specifically for the farmers while the second questionnaire targeted the tappers. In every location of the six districts where the survey was conducted,

research assistants were identified with the help of Agricultural Extension Officers, Provincial Administration and the local leaders. These research assistants were then trained for two days on how to accurately administer the questionnaires to the respondents. These trained research assistants then visited the farmers and tappers in their respective homes where the necessary questions were asked in their local language and Kiswahili. The completed questionnaires were then collected and analyzed. A total of 2,812 tappers and 9,155 farmers were interviewed.

Data analysis of the questionnaires was done using SPSS for Windows (Version 8.0) spreadsheet program and Microsoft Excel 2000. Descriptive statistics (frequencies, scores, mean, maximum, minimum) were determined. Standard deviation errors were determined and were shown using error bars.

3.0 RESULTS

3.1 Survey

During the survey a total of 9,155 farmers were interviewed out of which, Kilifi had 4,142, Kwale- 2,568, Malindi- 776, Mombasa- 754, Lamu- 791, and Tana- River- 124. At the divisional level the distribution of farmers interviewed were as follows: In Kilifi district the farmers that were intervied in Kaloleni division were 2,180; Chonyi- 892; Bahari- 772 and Kikambala- 298. Msambweni division of Kwale district had 1,837 farmers, while Matuga division still of Kwale district had 731 farmers interviewed. In Malindi district, Malindi division had 591 farmers; while Magarini had 185 farmers. In Mombasa district, Kisauni division had- 500; Likoni- 224 and Changamwe- 30. In Lamu district Faza had 397; Amu- 208 and Mpeketoni- 186. In Tana-River district 124 farmers were intervied from Kipini division. On the other hand a total of 2,812 tappers were interviewed out of which Kilifi had 1,784, Mombasa- 435, Malindi- 313, Kwale- 224, Tana-River- 56. The divisional figures for the tappers were as follows: Kaloleni- 937, Chonyi- 445, Bahari- 237, Kikambala- 165, Msambweni- 175, Matuga- 49, Malindi- 272, Magarini- 41, Kisauni- 281, Likoni- 126, Changamwe- 28, and Kipini- 56.

3.2 Farmer

On average, 32.5% of the 9,155 farmers interviewed were found to be illiterate, while 42.0% had primary school level of education. Only 11.2% had secondary school

education while 2.1% had college or university certificate. Others fall under the category of informal education. As shown in Fig. 1, the values for the farmers with no education, primary, secondary, tertiary and others/informal education in Kilifi district were 37.8, 42.6, 13.4, 2.7, and 3.5 % respectively, while those for Kwale district were: 46.9, 38.0, 11.7, 1.3, and 2.1 % respectively. In Malindi district the figures were as follows: 26.5, 53.1, 13.5, 1.3 and 5.6 % respectively. Mombasa on the other hand had 48.9, 34.5, 10.0, 2.4 and 4.1 % respectively, while those for Lamu district were: 8.4, 41.4, 8.3, 31.0 and 38.8% respectively. In Tana-River district the following figures were obtained: 25.8, 51.6, 21.8, 0.8 and 0.0 % respectively (Fig. 1).

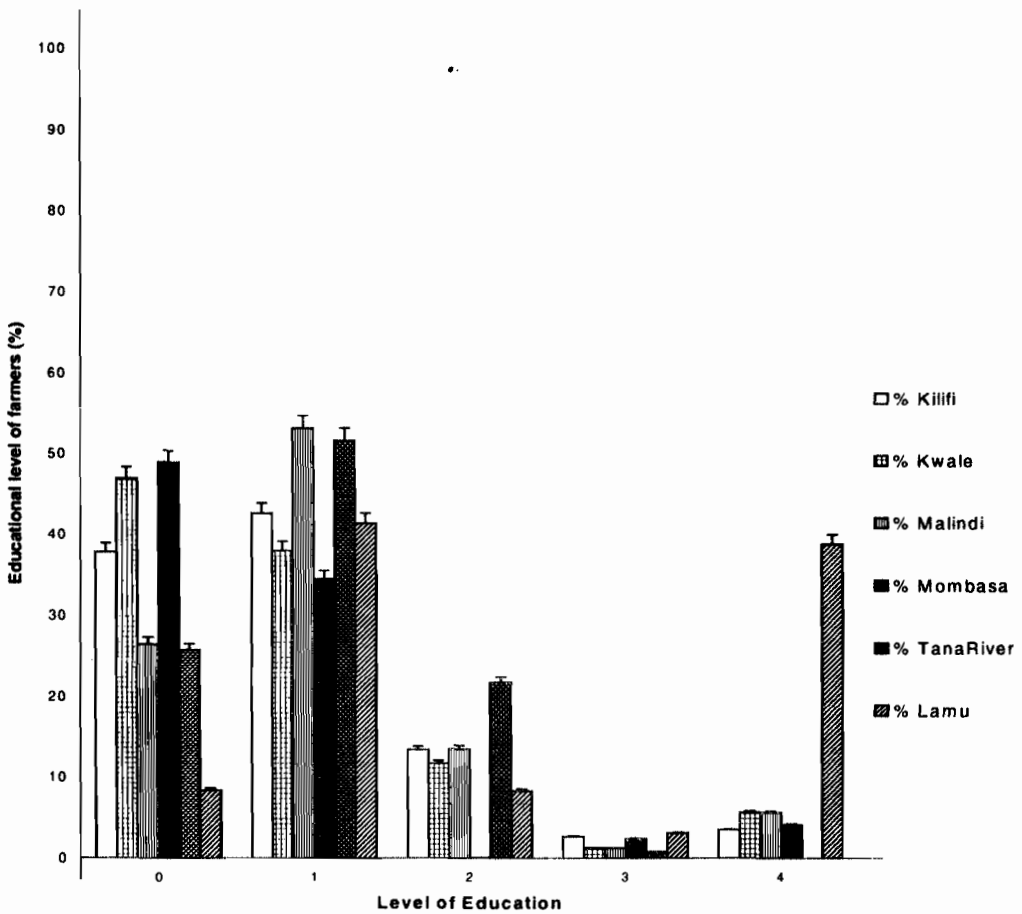
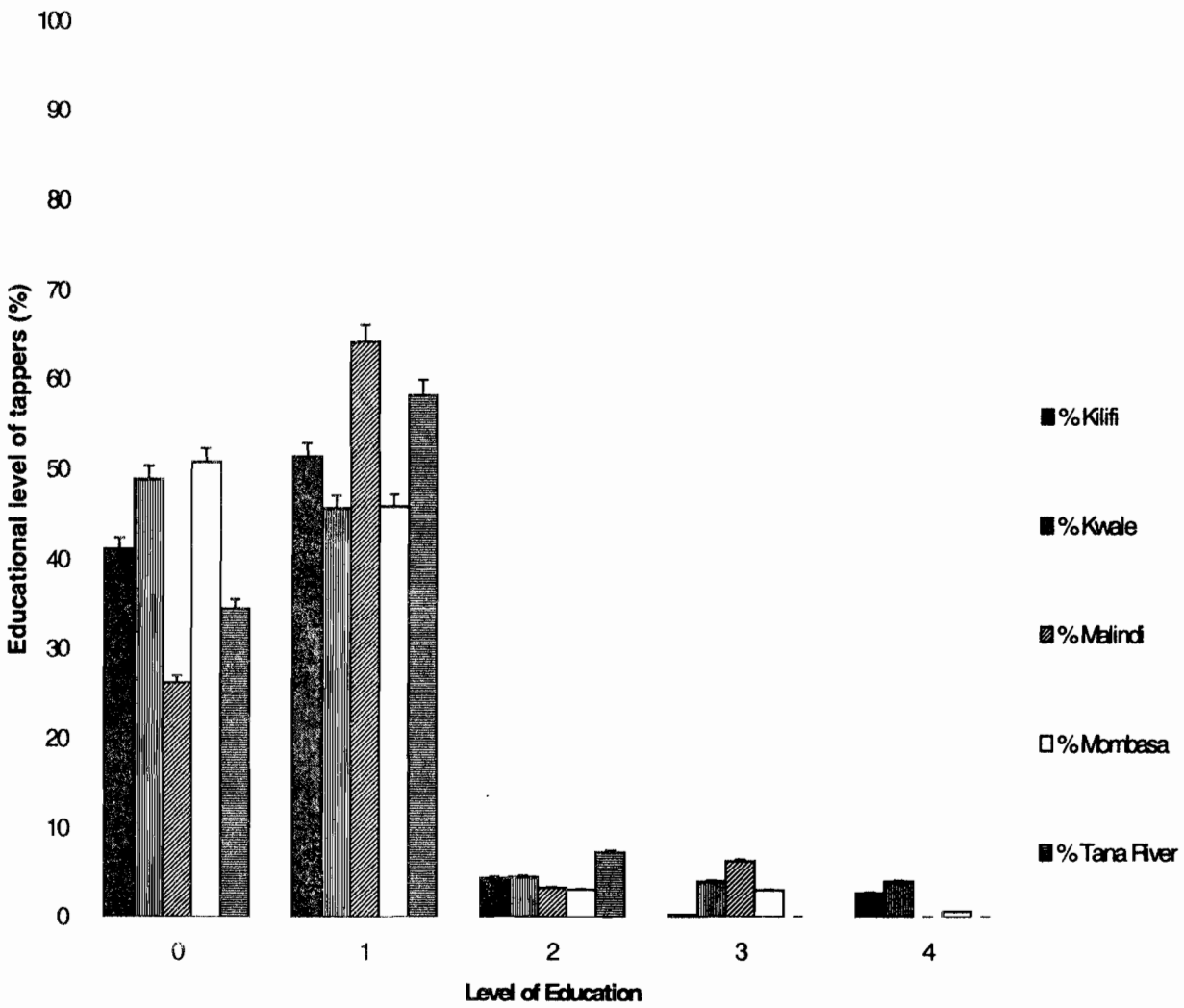


Figure 1. Education level of farmers in all the six districts in the coastal province of Kenya. 0- No education, 1- Primary, 2- Secondary, 3-Tertiary & University, 4- Informal Education Bars represent mean value + SDE of the data.



p

Figure 2. Education level of Tappers in all the six districts of the coastal province of Kenya 0 – No education, 1- Primary, 2- Secondary, 3- Tertiary & University, 4- Informal education Bars represent mean value + SDE of the data.

Changamwe division of Mombasa district had the highest number of farmers who were illiterate (64.3%) followed by Likoni division still in Mombasa district (49.8%) and Matuga division of Kwale district (48.7%) respectively. Mpeketoni division of Lamu district on the other hand had the lowest number with illiterate farmers (0.6%) followed by Amu (3.7%) and Faza (12.4%) divisions all in Lamu district. Amu, Faza and

Kizingitini divisions of Lamu district had the highest numbers of farmers, under the category of others/informal education (57.8%, 51.6% and 37.7% respectively) (Table 1).

Table 1: Education level of farmers at the divisional level of each district.

Districts	Divisions	0	1	2	3	4
Kilifi	Bahari	35.9	41.5	14.8	3.8	4.0
	Chonyi	39.7	43.8	11.0	3.9	1.6
	Kaloleni	38.7	42.5	12.9	2.0	3.9
	Kikambala	29.9	43.0	2.8	1.7	4.7
Kwale	Matuga	48.7	36.9	11.0	1.9	1.4
	Msambweni	46.2	38.5	11.9	1.0	2.4
Malindi	Magarini	22.2	66.5	9.7	1.6	0.0
	Malindi	27.9	48.9	14.7	1.3	7.4
Mombasa	Changamwe	64.3	25.8	7.18	3.6	0.0
	Kisauni	47.5	38.1	10.5	2.7	90.0
	Likoni	49.8	28.2	9.5	1.4	11.3
TanaRiver	Kipini	25.8	51.6	21.8	0.8	0.0
Lamu	Amu	3.7	28.8	13.6	2.1	51.8
	Faza	12.4	26.8	3.7	5.5	51.6
	Kizingitini	26.4	22.7	13.2	0.0	37.7
	Mpeketoni	0.6	88.3	10.0	0.6	0.6

Legend:
0 No education; 1 Primary; 2 Secondary; 3 University/College;
4 Informal education

3.3 Tapper

Results of the questionnaires presented to the respective respondents showed that on average majority of the tappers in all the five districts were found to be either illiterate (40.3%) or had only primary school certificates (53.1%). Only a few had secondary school education (4.5 %) and less than 0.4% had tertiary level of education. The results on the educational level tappers interviewed in all the five districts are shown in Fig. 2. The figures for no education, primary, secondary, tertiary and others/ informal education for the tappers in Kilifi district were: 41.2, 51.4, 4.4, 0.3, and 2.7 % respectively. In Kwale district the figures were: 48.9, 45.7, 4.5, 0.4 and 0.4 % respectively, while those for Malindi district were: 26.2, 64.2, 3.3, 6.3 and 0.0 % respectively. In Mombasa district the values were: 50.8, 45.8, 3.1, 0.3 and 0.4 % respectively while Tana-River had 34.5, 58.2, 7.3, 0.0, and 0.0 % respectively. The divisions that were leading in terms of illiterate tappers were Likoni and Kisauni in Mombasa district, Matuga in Kwale and Kaloleni in Kilifi with figures of 56.0, 51.8, 51.0 and 50.4 % respectively. Bahari, Chonyi

and Kikambala all of Kilifi district and Matuga of Kwale district were the leading divisions with tappers that had attained secondary school education (13.6, 9.7, 6.4, 6.1 and 6.1% respectively). On the other hand Malindi division of Malindi district was found to be leading in terms of tappers that had attained tertiary level of education (7.3 %) followed by Matuga of Kwale district, which had 2.0% (Table 2).

Table 2: Education level of tappers at the divisional level of each district.

Districts	Divisions	0	1	2	3	4
Kilifi	**Bahari**	28.4	60.6	9.7	0.0	1.3
	Chonyi	35.2	54.2	6.4	1.4	2.5
	Kaloleni	50.4	44.7	1.7	0.0	3.2
	Kikambala	24.2	67.3	6.1	0.0	2.4
Kwale	**Matuga**	51.0	38.8	6.1	2.0	2.0
	Msambweni	48.3	47.7	4.0	0.0	0.0
Malindi	**Magarini**	2.4	95.1	2.4	0.0	0.0
	Malindi	29.9	59.4	3.4	7.3	0.0
Mombasa	**Changamwe**	35.7	60.7	3.6	0.0	0.0
	Kisauni	51.8	44.5	3.3	0.4	0.0
	Likoni	56.0	36.0	0.0	0.0	8.0
TanaRiver	**Garsen**	39.4	57.6	3.0	0.0	0.0
	Kipini	27.3	59.1	13.6	0.0	0.0

Legend: 0 No education; 1 Primary; 2 Secondary; 3 University/College;
4 Informal education

3.4 Major constraints faced by the farmers

Among the major constraints faced by the farmers in the entire six districts are shown in Fig. 3. Lack of market for the coconut-based products was ranked highest (28.6%) followed by low/fluctuation of prices (20.3%). Pests and diseases (12.4 %), poor transport/infrastructure (9.4 %) and lack of credit/loans (7.7 %) were ranked third, fourth and fifth respectively. Other constraints included destruction of young and old coconut trees by fire and wildlife (6.9 %), provincial administration and police harassment (5.3 %), drought/poor soil/low production (6.4 %), lack of storage facilities (1.6 %), lack of technical know-how (1.4 %) and lack of regulatory body (0.5 %) (Fig. 3).

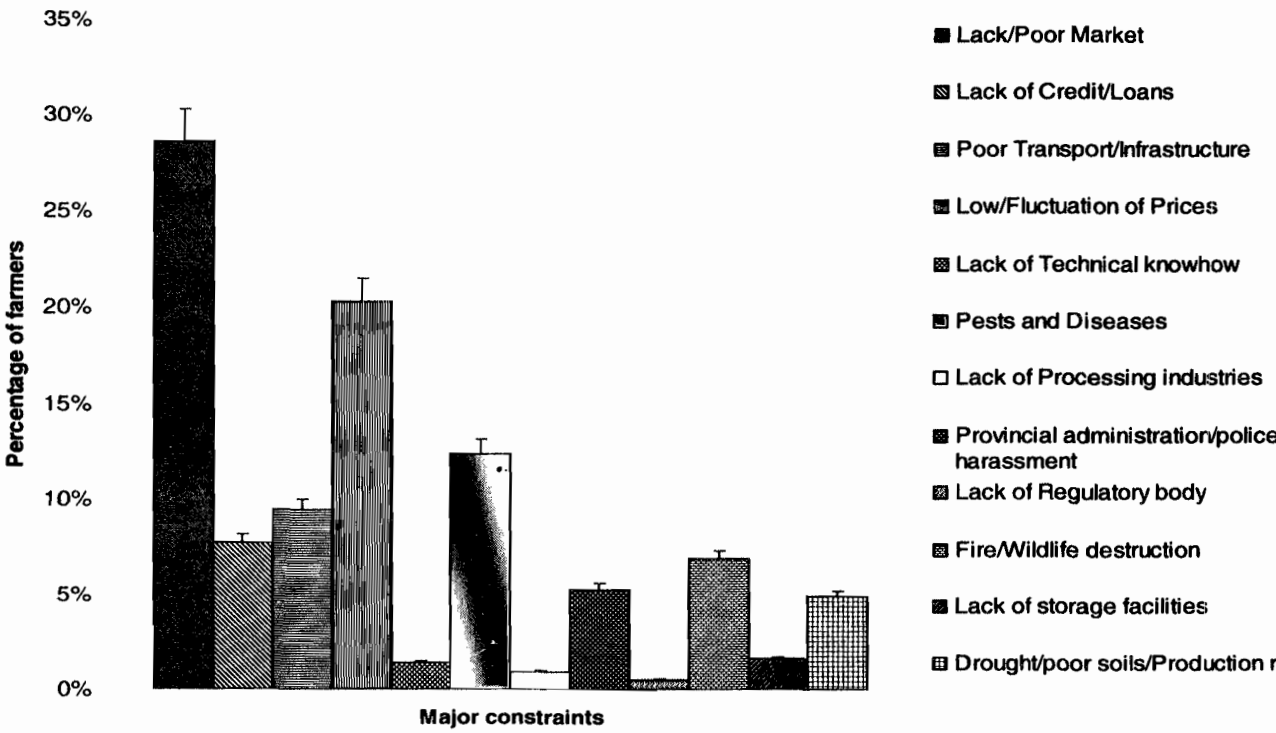


Figure 3. Summary of constraints of farmers in all the six districts of the coastal province of Kenya. Bars represent mean value + SDE of the data.

3.5 Major constraints faced by the tapper

Major constraints faced by the tappers in all the five districts compared well with those given by the farmers. Lack of market or poor marketing was ranked highest (31.1%), the constraint of police and/or provincial administration harassment (20.8%) was ranked second unlike in the case of farmers where it was ranked seventh. Third in the series was low/fluctuation of prices (15.7 %), followed by poor storage/preservation facilities (8.7%). Fifth in the series was risk of falling from the coconut tree due to snake-bites/strong winds/slippery trees (5.7%). Other constraints included: pests and diseases (4.3 %), lack of regulatory body (3.8 %), lack of technical know-how (3.2 %), poor transport and infrastructure (1.8 %), lack of payment by unfaithful vendors and drunkards (1.7), destruction by fire and wild animals (1.2 %) as well as lack of credit facilities (2.0 %) (Fig. 4).

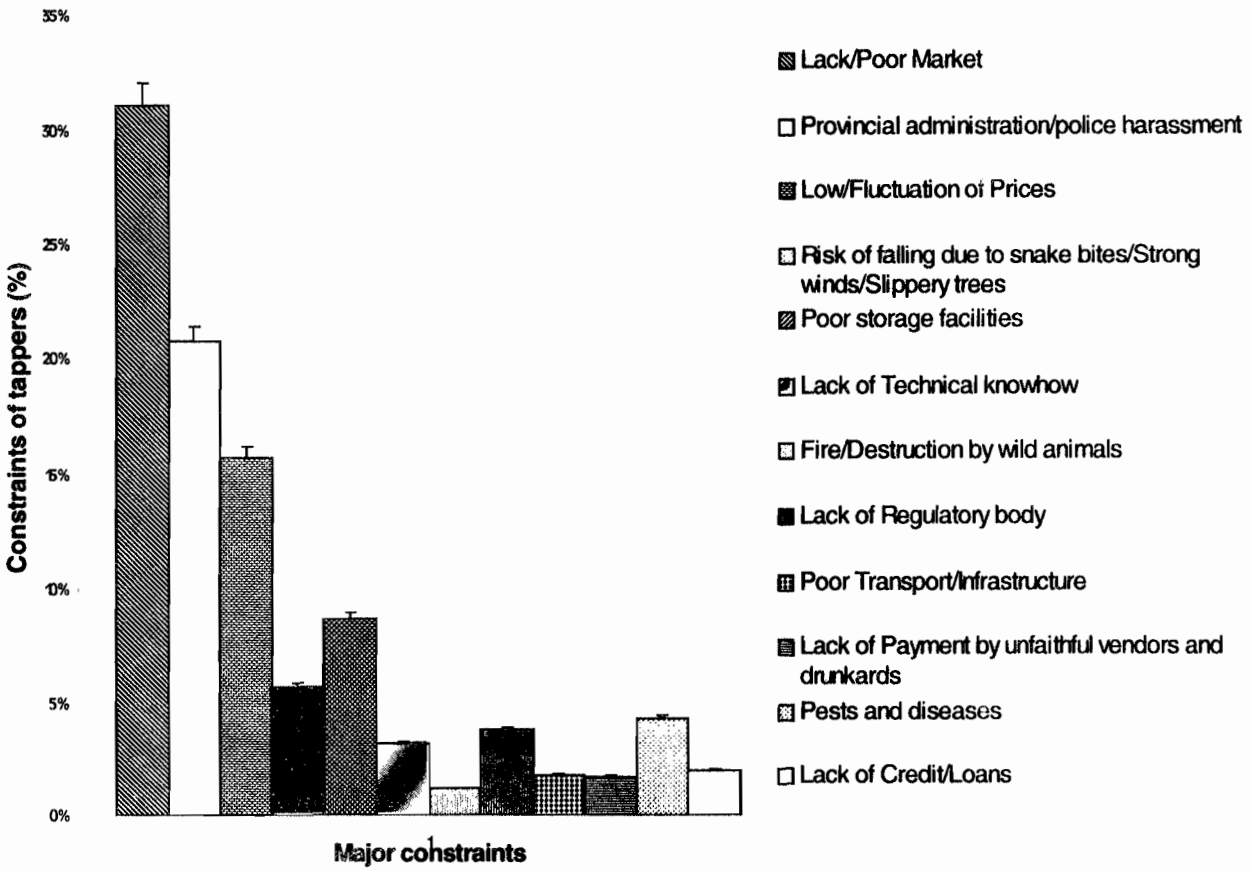


Figure 4. Summary of constraints of tappers in all the six districts of the coastal province of Kenya. Bars represent mean value + SDE of the data.

4.0 DISCUSSION AND CONCLUSIONS

The overall results on educational level of the tappers and farmers are shown in Fig. 1 and 2 and Tables 1 and 2 respectively. From the results, majority of the tappers were found to be either illiterate (40.3 %) or had only primary school certificate (53.1 %). The same applied to the farmers of whom 32.5 % of them were illiterate while 42.0 % of them had primary school certificate of education. During the survey it was observed that lack of adequate education was a major contributory factor to lack of general understanding of the marketing structure facing the coconut industry. This in turn left most farmers and tappers with no solution to the major constraints facing their most cherished crop (the

coconut tree), the so-called "tree of life". Although most respondents (farmers and tappers) were able to articulate the problems surrounding the coconut industry, most of them were pessimistic of any possible solutions in the near future. Farmers and tappers alike believed that any person who will come up with solutions to the problems surrounding the industry would be like a God sent "Messiah" to them. The study established that most cooperative societies in the whole region were inefficient due to managerial problems. As a result of this, farmers seemed to have lost confidence in their once popular societies. Most cooperative managers were exploiting the illiterate farmers to by enriching themselves leaving the poor farmers and tappers alike at the hands of scrupulous middlemen and private traders. This was evident in a situation where one bundle broom that sold at Kshs.5/= at farm gate, was subdivided into 2 to 3 bundles of broom by the so-called middlemen and later each bundle was sold at a price of Kshs.20/= in the streets of Nairobi and its environs. This means a broom that was bought for Kshs.5/= at farm gate ended up fetching as much as Kshs.60/=. This study established that most of the problems currently facing coconut tree farmers and tappers could be traced as early as 16^{th} century (over five centuries). The fact that no solutions have been found for the myriads of problems facing the coconut industry in the country is partly due to the level of illiteracy facing the farmers and tappers as well as lack of proper government policy on the coconut industry. As a result of all this, the communities in the region are faced with many other poverty related problems such as malnutrition, lack of school fees, poor and inadequate of health facilities, poor shelter and lack of safe drinking water. Despite of all this, it encouraging to note that most farmers and tappers still have hope that one day the government shall find a lasting solution to their problems. High level of illiteracy in the region leaves tappers and farmers alike with no option but to rely on coconut farming and tapping for they cannot find formal employed in the government or private sector. The policy makers therefore should formulate clear policies that will address the major constraints facing coconut farmers and tappers if poverty is to be eradicated in the region.

Among the major constraints that were highly ranked by most farmers and tappers alike are lack of market and low prices for the coconut-based products. In Kenya, the amorphous marketing structure in the coconut industry is responsible for the low prices

of most coconut-based products. Mismanagement and collapse of most Farmers Cooperative Societies in the region in 1980's, and consequently, liberalization and privatization, resulted in uncoordinated marketing structure that placed marketing and production of coconut-based products wholly under the private sector. As a result, farmers have had a free hand to sell their products to buyers or agents of their choice. Under such circumstances, the marketing structure became amorphous; thereby subjecting most coconut growers and tappers to unfair tactics of private traders with middlemen taking the center stage. It is therefore necessary for farmers and tappers to be organized in order to create competitive marketing of their coconut-based products. There are many achievements that can be made by having organized marketing structures. Firstly, farmers stand to benefit by collective action in getting their agricultural inputs, selling their produce, getting and disseminating information, or sharing expertise. Secondly, farmers' organizations likewise may serve as an organizational framework for the efficient delivery of credit and extension services. This is expected to increase productivity and income generation hence economic poverty alleviation.

Other constraints such as lack of credit and loans, poor infrastructure and/or transportation systems, lack of regulatory bodies and provincial administration/ police harassment are all directly or indirectly related to lack of proper government policy on the coconut industry. This in turn has rendered the coconut dependant communities in a state of hopelessness, pathetic and abject poverty. Lack of proper government policy on the coconut industry in Kenya can be traced back as early as 1915 in our history. In 1915, the Coconut Preservation Act Chapter 332 of the laws of Kenya was enacted generally to protect coconut plantations from trespass and theft. In 1923, the Coconut Industry Act Chapter 331 of the laws of Kenya was developed. Under this Act, coconut plantation owners were given authority to market their coconut products without license. This however, did not give provision for other stakeholders in the coconut industry the autonomy to do so. The dropping of coconut and cashewnut trees from the list of protected crops in 1997, as well as the restrictive laws such as the Traditional Liquor Act (Chapter 122) of the laws of Kenya hampered the use, development and exploitation of coconut-based products. All these laws have had a negative impact on production and marketing of products from the coconut tree. In order to revitalize the industry, there is

need to put in place proper government policy on coconut industry that shall make it possible to repeal some of the outdated Acts in the laws of Kenya, with the purpose of introducing new laws that will make coconut processing and marketing of coconut-based products more viable and competitive. In order to monitor the activities of the industry, a regulatory body should be established. The composition of this body should include all the key players in the industry.

Lack of small and medium-scale industries (SMIs) as well as large industries to process coconut based products in Kenya, contribute greatly to the constraints related to lack of technical know-how and lack of proper storage facilities faced by both farmers and tappers. In view of this, the government should put in place all the necessary mechanisms that will address this issue as a matter of urgency. This can be done through the establishment of promotion, development and research boards by Acts of parliament. Such boards should be vested with the responsibilities of finding lasting solutions to the problems of production, processing, and marketing as well as research and development. Currently there are only three copra-milling companies are operational, situated in Mombasa, Malindi and Lamu respectively. The extracted oil from copra is used in soap industries, candle manufacturing and in some cases the oil is further refined for making cooking fat and oil. However, it is important to note that, technologies developed in other parts of the world have seen countries like Malaysia taking a leading role in the processing of products like pared kernel, desiccated coconut, coconut cream, coconut shell, coconut flour, and activated carbon through the SMIs and large industries (Severio, 1996). In Thailand, where the coconut industry is well developed, the fruit of the coconut palm is the main source of many food products such as coconut milk/cream, desiccated coconut, coconut chip, coconut water, nata de coco, coconut oil, copra plasticizers, resins, non-soap detergents, food preparations and confectioneries, handicraft, vinegar and alcoholic beverages, culture media and others such as carpets and rugs. The tapped palm sap (mnazi) is used for sugar production and making of toddy beverages (Severio, 1996). Recent research carried by Crabbe *et al.*, (2001) has shown that bio-diesel can be generated from palm oils, with an aim of substituting N0.2 diesel fuel. This fuel is environmental friendly because there is substantial reduction of unburned hydrocarbons, CO and particulate matter emission when it is used in conventional diesel engines (Sharp,

1996). Moreover, it contains no sulphur, so the sulphate fraction in the fuel is eliminated and since the oil originates from vegetable matter, the CO_2 produced is sequestered and the net CO_2 released into the atmosphere would be reduced greatly. Taking all this into consideration, Kenya as a country will benefit a lot once diversified processing industries and coconut research institutions are established.

Other constraints sited were pests and diseases, destruction of young and old coconut trees by fire and destruction of young trees by wild animals. The constraint related to pests and diseases can be solved through intensive research on germplasm development. The involvement of farmers through a participatory approach to the coconut genetic diversity is expected to contribute to several objectives with high rates of returns. One being to develop locally adapted varieties that are able to perform in less favoured environment (pests and diseases) with few inputs and low levels of husbandry (Persley, 1992). Another is to identify uses and techniques to exploit and derive greater value from a wider range of coconut palm products. On the other hand, provision of credit to the affected farmers will go a long way in solving the problem associated with frequent destruction of coconut trees by fire due to poor husbandry. Fencing of game reserves and game parks is the only solution to crop destruction by wild life.

Research on germplasm development coupled with modern climbing technologies during coconut harvesting and tapping are some of the solutions to the constraint related to falling from the coconut tree due to snake bites, strong winds and slippery trees. According to Persley (1992), some significant achievements have been made by coconut breeders with the release of dwarf hybrids, which have higher yields of copra and oil. In Kenya once proper policy is in place, followed by establishment of appropriate research institutions, the technology involving the release of dwarf hybrids can easily be made available to the respective farmers through appropriate research by the breeders. This will go a long way in solving the problems associated with tall varieties that are most abundant in the Coastal region of Kenya.

Constraints related to poor soil and low production or yields were also reported by some of the farmers. This study established that low yields were attributed to use of genetically inferior cultivars, aging palms and poor management practices particularly on crop nutrition and population density. Although mixed cropping of coconut has been

proven economically viable, very few farmers actually practice this system. During the survey, it was observed that research activities based on coconut were minimal. Research should therefore be given first priority so as to identify high yielding coconut varieties for establishment of new orchards. The approach in research should therefore bring together farmers, breeders, genetic resource scientists as well food technologists to define a wider range of utilization of coconut and other bi-products from the coconut tree.

In conclusion the coconut industry in Kenya requires to be revitalized through proper government policy. By so doing the industry shall be transformed from semi-subsistence, low-input, low-productivity system into a full-fledged commercial cash crop. Solutions to problems facing the coconut industry shall be found once appropriate promotion, development and research institutions are established.

ACKNOWLEDGEMENTS

The Kenya Agricultural Research Institute (KARI) through The Agricultural Research Fund (ARF), for the provision of financial support for the main project entitled "Study and improvement alcoholic beverage (mnazi)", Project No. ARF/PHT/I005024/1. The Coast development Authority (CDA) for support in human resource and transport and the staff of the ministry of Agriculture and the Provincial Administration for their logistical support.

REFERENCES

Banzon J.A. (1978). Reconstitution of milk using coconut milk and non-fat dry milk *PJCS* **3** (2), 1-8.

Banzon J.A. and Velasco, J. (1982). Coconut; Production and Utilization. Philippine Coconut Research and Development Foundation, Inc. Publication, Metro Manila, Philippines. pp. 349.

Bezerra J.A. (1999). Babaçu: as guerreiras do Mearim/mulheres de fibra. Rev. *Globo Rural* **14** (161), 38-45.

Brown K.C. and Symons C. T. (1961) Coconut toddy in Ceylon. *J. Sco. Chem. Ind.*, **35**, 1238-1142.

Byerlee D., Eicher C. (Eds.), (1997). Africa's Emerging Maize Revolution. Lynn Reinner

Publishers, Boulder, CO.

Crabbe E., Nolasco-Hipolito C., Kobayashi G., Sonomto K. and Ishizaki A. (2001). Bio-diesel production from crude palm oil and evaluation of butanol extraction and fuel properties. *Process Biochemistry;* **37**, 65-71.

Cunningham A. B. and Wehmeyer A. S. (1988). University of Cape Town. *Economic Botany,* **42** (3), 301-306.

Deacon K. H. (1980). The South African liquor industry: Structure, conduct, performance and strategies for future action. Ph.D. dissertation, University of Stellenbosch.

Eicher C. (Eds.). (1997). Zimbabwe's Agricultural Revolution. Harare University of Zimbabwe Press, pp. 219–233.

Essiamah S. K. (1989). Second Pacific Reginal Wood Anatomy Conference, October 15-21; College Laguna, Philippines (convened by Tesoro, F.O.J. Absracts of Papers and Posters). IANA. *Bulleting, 1989*, **10** (3), 335.

Fafchamps M. (1992). Cash crop production, food price volatility, and rural market integration in the third world. *Am. J. Agric. Econ.* **74** (1), 90–99.

Faparus S. I. (1971). Microflora of fermenting palm wine *J. Food Science Technology*, **8**, 206-10.

Haggblade S. (1984). A history of indigenous beers in sub-saharan Africa. Paper Presented to the conference of New Themes in African colonial history, Michigan State University, East Lasing, April 26-28.

Hardy G. and Richet C. H. (1933). L'alimentation indigene dan les colonies fracaises. Vigot Freres, Paris.

Invetário, Floreatal Nacional. (1983). Florestas natives Rio Grande do Sul. Ministério da Agricultura, Brasilia, p. 433.

Lorenzi H., Souza H.M., Medeiros-Costa J.T., Cerqueire L.S.C., von Behr N. (1996). Palmeiras do Brazil: nativas e exóticas. Plantarum, Nova Odessa, p.460.

Marravilla J.N. (1975). Toddy tapping - its effect on the yield of coconut. pp. 9-12 in Annual Report 1974-75. Philippine Coconut Authority.

Okerere O. (1982). University of Nigeria; *Nsukka -Agricultural Systems* **9** (4), 239-253.

Okerere O. (1983). University of Nigeria; *Nsukka - Quarterly Journal of International Agriculture,* **22** (4), 368-382.

Peixoto A.R. (1973). Plantas oleaginosas arbóreas. Bibilioteca Rural, Sáó Paüló, p. 248.

Persley G.J. (1992). Replanting of tree of life, towards an International Agenda for coconut palm research. CAB International Wallingford, UK. p. 90.

Putterman L. (1995). Economic reform and smallholder agriculture in Tanzania: A discussion of recent market liberalization, road rehabilitation, and technology dissemination efforts. *World Dev.* **23** (2), 311–326.

Rohrbach D. (1988). The Growth of Smallholder Maize Production in Zimbabwe: Causes and Implications for Food Security. Unpublished PhD Dissertation, Michigan State University, East Lansing, MI.

Severio S. M. (1996). Intercropping and toddy/sugar production in coconut based farming systems: Possible integration with germplasm conservation and varietal improvement. In promoting and multipurpose uses and competitiveness of the coconut (Batugal, P.A., Ramanatha Rao, V. and Bong C., eds), Proceeding of workshop in Chumphon, Thailand: 26-29 September 1996. pp 57-68.

Sharp C. A. (1996). Emissions and Lubricity evaluation of rapeseed derived bio-diesel fuels. Prepared by Montana Department of Environmental Quality, Southwest Research Institute, USA 1-57

Singh I., Squire L., Strauss J. (1986). Agricultural Household Models: Extensions, Applications, and Policy. Johns Hopkins University Press, Baltimore, MD, USA.
The Coconut Committee. (1992). The Philippines Recommends for Coconut. (Philippine Recommends Series. No. 2B/1992). PCARRD, PARRFI and PCRDF, Los Baňos, Laguna.

Timmer C. P. (1997). Farmers and markets: the political economy of new paradigms. *Am. J. Agric. Econ.* **79**, 621–627.

Von Braun J., Kennedy E. (1994). Agricultural Commercialization, Economic Development, and Nutrition. Johns Hopkins University Press, Baltimore, MD, USA.

Wood B. J.B. (1982). Soy Sauce and Miso. In: Rose, A. H. (ed.). Fermented foods. Academic Press, London. pp 39-86.