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The Economic, Health and Nutritional Benefits of Chia (S*alvia hispanica* L.) Farming in Nyeri County, Kenya. Baseline Survey Analysis.

David M. Gitau*, Monica W. Mburu*, David K. Mburu*
*(*Dedan Kimathi University of Technology)*
Corresponding Author: David M. Gitau

Abstract:*Descriptive cross-sectional survey was conducted to provide quantitative information on the status of chia cultivation in Nyeri County. This aimed at assessing the opportunities and challenges in chia cultivation in Nyeri County, Kenya. It involved the systematic collection and presentation of data to give a clear picture of awareness, knowledge, attitude and practices (AKAP) of the selected population. This was done as the preliminaries to promotion of chia cultivation and value chain development in the region. Having the beneficiaries participate in the assessment of needs and identification of problems to be addressed helps to accommodate their information, experience and analysis therefore making them actual creators of change and progress. This will result in improved involvement of target beneficiaries who will participate in the implementation of an effective and beneficial chia value chain. The baseline study expressed findings in a quantitative manner providing justification for promotion of chia production in the region, and guide the selection of most appropriate traditional and modern media to be used in a in project implementation. The results will be used as a reference point or benchmark for later comparison or impact studies to assess how well the original project objectives have been achieved. The results can also be generalized and used for similar project in other regions of Kenya.*

Keywords: *Chia, Economic, Health, Nutrition*

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I. Introduction

The cultivation of chia in Kenya is very recent, having been introduced by community health life organizations as a boost to manage lifestyle diseases and help the immune-compromised population to cope with health complications. In order to investigate the economic, health and nutritional potential of Chia plant in Nyeri County, a baseline survey was conducted in three regions in the County. A sample size of 600 respondents was generated using the Chronbach's formula. Six hundred (600) questionnaires were distributed in the three selected regions namely: -Mathira, Kieni East and Kiaeni West. Out of the 600 questionnaires administered, 558 questionnaires were returned which was a 93% response rate. However, 43 questionnaires were spoilt leaving 510 questionnaires for analysis. The data was analysed using the SPSS software. Results of the baseline survey indicate that 18% of the respondents have information on Chia while 81.9% have never heard about Chia plant. Out of the respondents who have information on Chia, 54.8% got it from friends, 29% from media, 5.4% from agricultural extension officers, while 6.5% got it from other sources. 88% of the respondents are willing to venture into Chia production. Majority are willing to venture into Chia production for economic and nutritional benefits of the plant. The baseline survey therefore sought to establish the challenges and opportunities in the cultivation of Chia in the county. The results showed a great potential for Chia cultivation in Nyeri County for economic, nutritional and health benefits.

1.1. Background information

Kenya is faced by high malnutrition rates due to low nutrition priority from all sectors in the food chain. This requires urgent attention with introduction of exotic crops that easily adapt locally and can be grown with the existing ones. Chia is one of such crops that can enhance the nutrition status of food crop and fit in mixed cropping locally. In combination to other crops like amaranth, chia can form alternative to maize farming in Kenya, which has aggravated food insecurity in the country due to its unreliable supply and low in essential nutrients. Farmers need to be sensitized to the benefits of growing chia which can be consumed as a raw seed, processed into flour, blended with other food or as a vegetable. Technically, chia seed is the fruit of a plant, thus contains more complete protein than other traditional grains. It is rich in fibre, minerals, protein and carbohydrates, (Jamboonsri*et al.,* 2012). A study by Ciftci, O. N., Przybylski, R., &Rudzińska, M. (2012) found

high levels of unsaturated fatty acids like omega-3 and omega-6, and vitamins.Chia seeds are also a source of natural lipids antioxides (Taga, M. S., Miller, E. E., & Pratt, D. E. (1984). They are found in white and dark varieties. The geometric mean diameter ranges between 1.31 and 1.36 mm for dark and white chia seeds, respectively. The chia cultivation is mainly in tropical and subtropical climate, situated between 0 - 2600 m altitudes, tolerates drought and salinity conditions, and does not withstand frost (Jamboonsri*et al.,* 2012). It is known to grow in arid environments, therefore highly recommended as an alternative crop for the field crop industry(Peiretti and Gai, 2009).

1.2. Chia seeds

Chia (Salvia hispanica L.) is a member of the Lamiaceae, or mint, family. These herbaceous hardy annuals grow to 3 feet tall (91 cm.). They have thick, dark-green leaves that are wrinkled and lobed. Tiny, soft, gray hairs cover the upper side of the leaves as well.

Chia seeds are a very high source of linolenic acid (LNA) and linoleic acid (LA). Both these essential fatty acids attract oxygen and help cell membranes to be flexible and fluid, and strengthen our immune system to help protect our bodies from viruses, bacteria, and allergies. Most people's diets are dangerously low in essential fatty acids, which results in tired muscles, fatigue, and a range of health problems. Humans need to eat EFAs daily because the human body cannot manufacture them. EFAs, such as those found in Chia, can assist with weight loss and removal of toxins from the body.

II. Methodology

2.1 Study area and population.

The study area was Nyeri County, Kenya. Nyeri County has six sub-counties namely:-Mathira East, Mathira West, Kieni East, Kieni West, Nyeri Town, Mukurweini, Othaya and Tetu. Sampling was done in three of the six sub-counties namely:-Kieni East, Kieni West and Mathira sub-counties. This represents half of the county. These 3 sub-counties would constitute 38% of Nyeri County which is a good sample representation (Mugenda and Mugenda, 2003). Kieni East and Kieni West sub-counties were picked for sampling since they are semi-arid areas, team had already established contact with farmers, and farming is the main economic activities. Mathira Sub-county on the other hand was picked since it is a high potential area and farming is the main economic activity. The study targeted farmers. It was not possible to establish the exact number of farmers as the County Department of Agriculture did not have an up-to-date record of registered farmers hence the population of the study was unknown.

2.2 Sampling

Since the population of the study was large and unknown, it was necessary to do sampling. The study used Cochrans formula for sample size determination. Using the formula, the following sample was generated:-

$$N_0 = \frac{Z^2 pq}{e^2}$$

Where:
e is the desired level of precision (i.e. the margin of error),
p is the (estimated) proportion of the population which has the attribute in question,
q is 1 – p.
The z-value was found in a Z table.
In order to generate the results in an unknown population, a general assumption of the situation on the ground is made. In this study, it was assumed that 10% of the farmers in Nyeri County have some information on Chia plant. The margin of error was estimated at 10%. Using this assumption, "p" value will be 0.9 and "e" value will be 0.1 using a 99% confidence level, "z" value will be 2.576.

$$N_0 = \frac{(2.576)^2 x\ 0.9(0.9)}{0.1^2}$$

N_0 = 538. Hence the sample size was 538 respondents.

2.3. Data Collection Procedure

Data was collected using primary sources. A questionnaire was developed and distributed. Respondents were interviewed based on their willingness to participate in the study as well as qualification for the study. A consent form was given to all respondents who agreed to participate in the study. A total of 538 questionnaires were distributed. Out of these, 510 questionnaires were returned giving a response rate of 95% which is acceptable scientifically.

2.4. Data collection instruments

The study made use of a questionnaire as the primary data collection tool. Respondents were also provided with a consent form to fill in order to proof their willingness to participate in the study. The data collection tool and the consent form have been attached.

2.5. Data Analysis

Data was analysed using SPSS software. It was then presented using tables, graphs and pie charts.

III. Results and discussion

2.6. Data presentation and analysis

Table 1: Age bracket

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	1	.2	.2	.2
	18-30 years	150	29.4	29.6	29.8
	31-40 years	155	30.4	30.6	60.5
	41-50 years	118	23.1	23.3	83.8
	51-60 years	54	10.6	10.7	94.5
	above 60 years	28	5.5	5.5	100.0
	Total	506	99.2	100.0	
Missing	System	4	.8		
Total		510	100.0		

Majority of the respondents were between the ages of 31-40 years (30.6 %), followed by 18-30 years(29.4%), 41-50years(23.1%) . 51-60 years represented 10.7 % while those above 60 years represented 5.5%. Four respondents (0.8% did not disclose their age.

Table 2: Male persons living with respondent

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	25	4.9	6.1	6.1
	1.00	173	33.9	42.2	48.3
	2.00	127	24.9	31.0	79.3
	3.00	58	11.4	14.1	93.4
	4.00	15	2.9	3.7	97.1
	5.00	6	1.2	1.5	98.5
	6.00	4	.8	1.0	99.5
	7.00	1	.2	.2	99.8
	15.00	1	.2	.2	100.0
	Total	410	80.4	100.0	
Missing	System	100	19.6		
Total		510	100.0		

The results demonstrate that 25 respondents(6.1%) were not living with any male, 173 respondents(42.2%) were living with 1 male person, 127 respondents(31%) were living with 2 male persons, 58 respondents(14.1%) were living with 3 male persons,15 respondents(3.7%) were living with 4 male persons, 6 respondents(1.5%) were living with 5 male persons, 4 respondents(1%) were living with 6 male persons, 1 respondent(0.2%) was living with 7 male persons and 1 respondent(0.2%) was living 15 male persons.

Table 3: Female living with respondent

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	32	6.3	7.7	7.7
	1.00	181	35.5	43.7	51.4
	2.00	110	21.6	26.6	78.0
	3.00	64	12.5	15.5	93.5
	4.00	16	3.1	3.9	97.3
	5.00	7	1.4	1.7	99.0
	6.00	2	.4	.5	99.5
	7.00	1	.2	.2	99.8
	10.00	1	.2	.2	100.0
	Total	414	81.2	100.0	
Missing	System	96	18.8		
Total		510	100.0		

The result displays that 32 respondents(7.7%) were not living with any female, 181 respondents(43.7%) were living with 1 female person, 110 respondents(26.6%) were living with 2 female persons, 64 respondents(15.5%) were living with 3 female persons,16 respondents(3.9%) were living with 4 female persons, 7 respondents(1.7%) were living with 5 female persons, 2 respondents(0.5%) were living with 6 female persons, 1 respondent(0.2%) was living with 7 female persons and 1 respondent(0.2%) was living 10 female persons.

Table 4: Beneficiaries main economic activities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Farming	225	44.1	44.6	44.6
	Business	156	30.6	30.9	75.4
	Employment	106	20.8	21.0	96.4
	Others	18	3.5	3.6	100.0
	Total	505	99.0	100.0	
Missing	System	5	1.0		
Total		510	100.0		

The results show that 25 respondents (44.1%) were carrying out farming as their main economic activity, 156 respondents(30.6%) was carrying out business, 106 respondents(20.8%) were employed while 18 of the total respondents representing 3.5% were not in any of the above mentioned economic activities. 5 questionnaires representing 1% of the total population did not state their economic activity.

Table 5: Average income per month from your economic activities?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	2	.4	.4	.4
	below 10,000	232	45.5	46.0	46.4
	10,000/= - 30,000	181	35.5	35.9	82.3
	30,000/= - 50,000	46	9.0	9.1	91.5
	50,000-70,000	23	4.5	4.6	96.0
	above 70,000	16	3.1	3.2	99.2
	6.00	1	.2	.2	99.4
	12.00	3	.6	.6	100.0
	Total	504	98.8	100.0	
Missing	System	6	1.2		
Total		510	100.0		

About half of the respondents, 45.5% of the respondents were earning an average income of below 10,000, 35.5% were earning an average income of between 10,000-30,000, 9% of the respondents were earning an average income of between 30,000-50,000, 23 of the respondents representing a percentage of 4.5% were earning an average income of between 50,000-70,000, 16 of the respondents representing a percentage of 3.1% were earning an average income of above 70,000.6 respondents representing 1.2% did not disclose their income.

Table 6: Information on chia as a food crop

Have you heard about chia		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	90	17.6	18.0	18.0
	no	408	80.0	81.8	-99.8
	3.00	1	.2	.2	100.0
	Total	499	97.8	100.0	
Missing	System	11	2.2		
Total		510	100.0		
If yes, what was the source of information					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	4	.8	4.3	4.3
	Friends	51	10.0	54.8	59.1
	Media	27	5.3	29.0	88.2
	agricultural extension officers	5	1.0	5.4	93.5
	Others	6	1.2	6.5	100.0
	Total	93	18.2	100.0	
Missing	System	417	81.8		
Total		510	100.0		

The results obtained showed that 90 respondents (17.6%) have heard of chia before, 408 respondents (80%) had never had of chia before, 1 respondent (0.2%) were not sure of whether they have ever heard of chia. 11 respondents(2.2%) did not respond to this question.

Also 51 respondents (54.8%) have heard about chia from friends, 27 respondents (29%) have heard about chia from media, 5 respondents(5.4%) have heard chia from agricultural extension officers, 6 respondents (6.5%) have heard from other sources which they didn't specify.

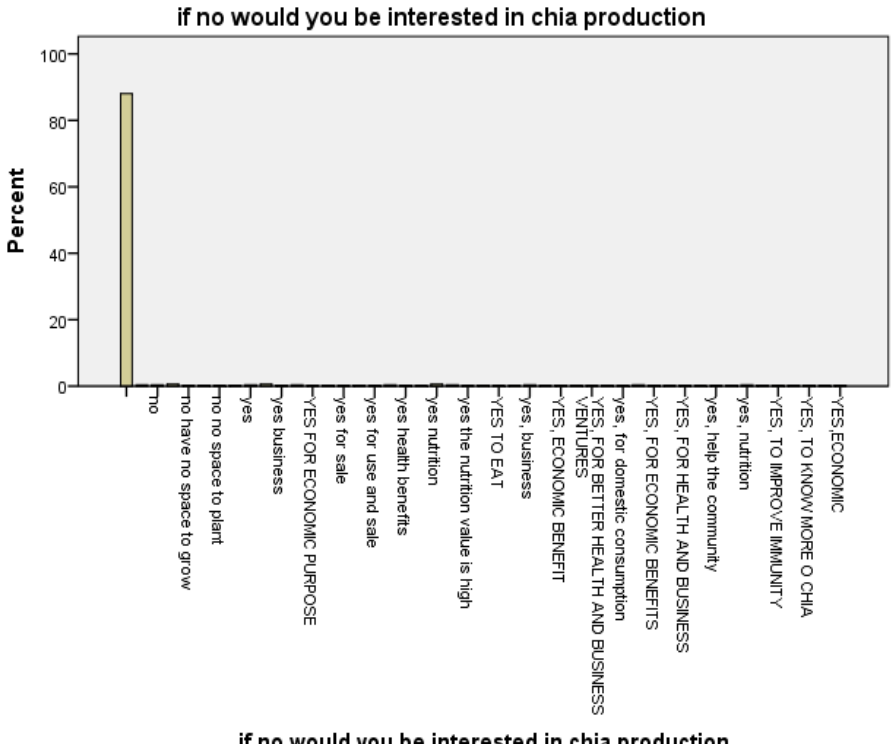

Figure 1: Respondents interested in Chia production

Figure 1 indicates that 449 respondents(88%) did not respond to this question,7 respondents (1.4%) were not interested in chia production they did give any reason, 4 respondents (0.8%) said they would not carry out chia production because they had no land to do the farming, 50 respondents(9.8%) said thay would be interested in carrying out chia farming because of such reasons as, its health benefits, nutritional value, for commercial purposes, to help the community, for domestic consumption and to improve immunity.

12 respondents (2.6%) reported that their relative had cultivated chia, 446 respondents (97.4%) reported that none of their relatives had cultivated chia. 52 respondents (10.2%) did not respond to this question.

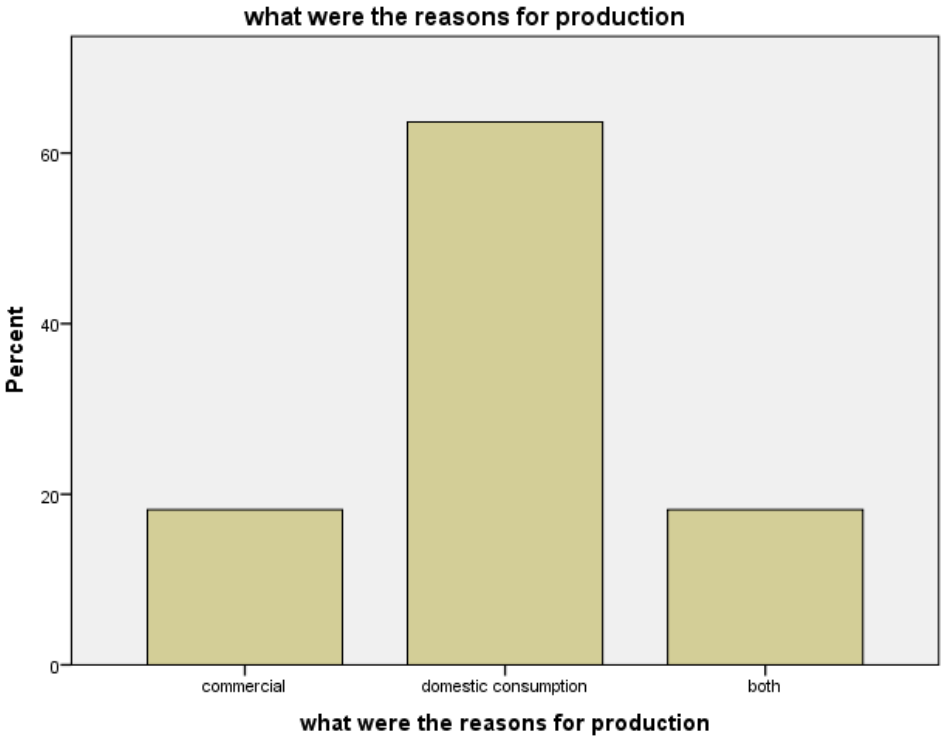

Figure 2: Reason for respondents' family member on chia production

Among the respondents 2 (18.2%) reported that they were producing chia for commercial purposes, 7 respondents (63.6%) reported that they were producing chia for domestic consumption, 2 respondents(18.2%) were producing it for both commercial and domestic consumption. 499 representing(97.8%) of the total target population did not respond to this question.

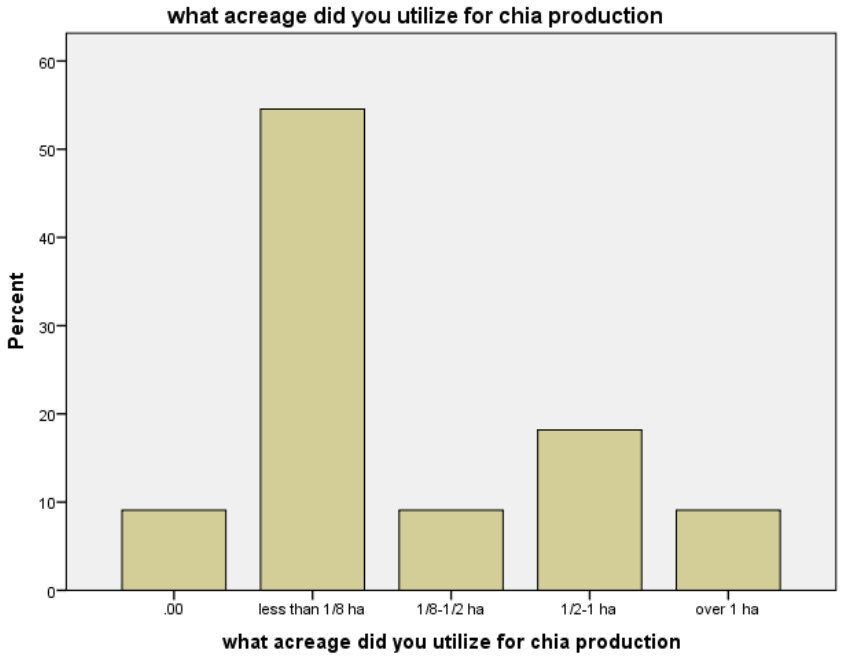

Figure 3: Acreages for chia production

Figure 3 shows that 7 respondents (63.6%) were utilizing less than1/8 ha for chia production, 1 respondent (9.1%) was utilizing between 1/8-1/2 ha for chia production, 2 respondents (18.2%) were utilizing between ½-1 ha for chia production, 1 respondent (9.1%) was utilizing over 1ha for chia production.

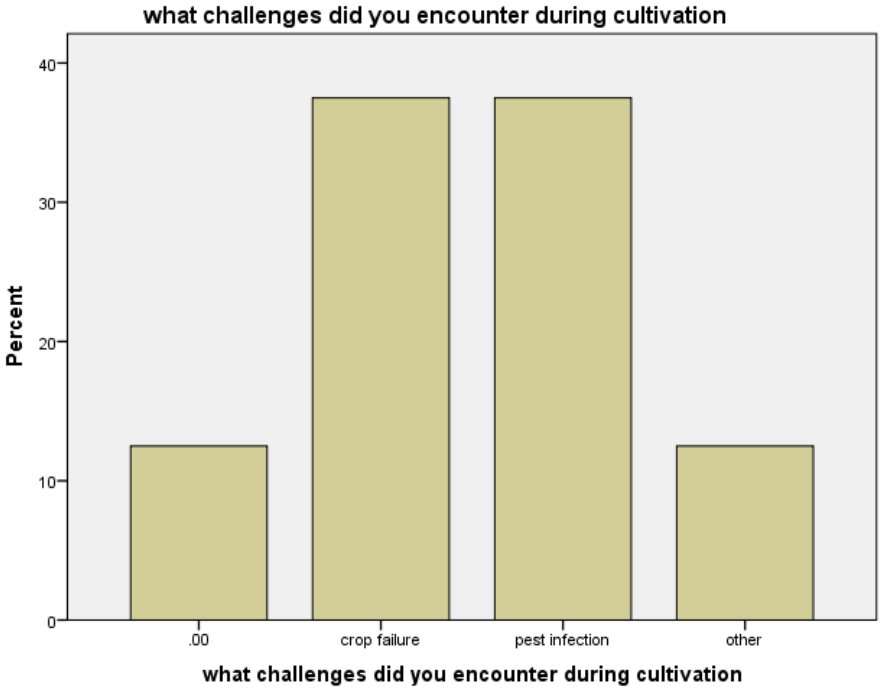

Figure 4: Challenges encountered in chia production

In Figure 4, 37.5% reported to have encountered crop failure, 37.5% reported to encounter pest infection, 12.5% reported to have encountered other challenges, which they did not specify, while 12.5% did not respond to this question.

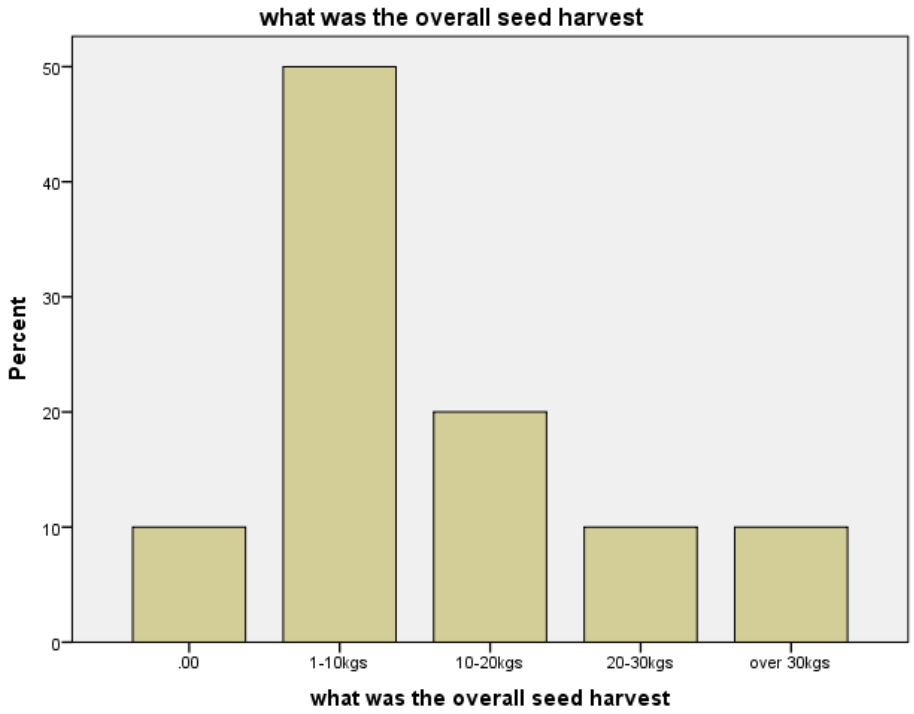

Figure 5: Overall seed harvest

In Figure 5, 60% had an overall seed harvest of between 1-10kgs, 20% had an overall seed harvest of 10-20kgs, 10% had a seed harvest of 20-30kgs while 10% respondent had a seed harvest of above 30kgs.

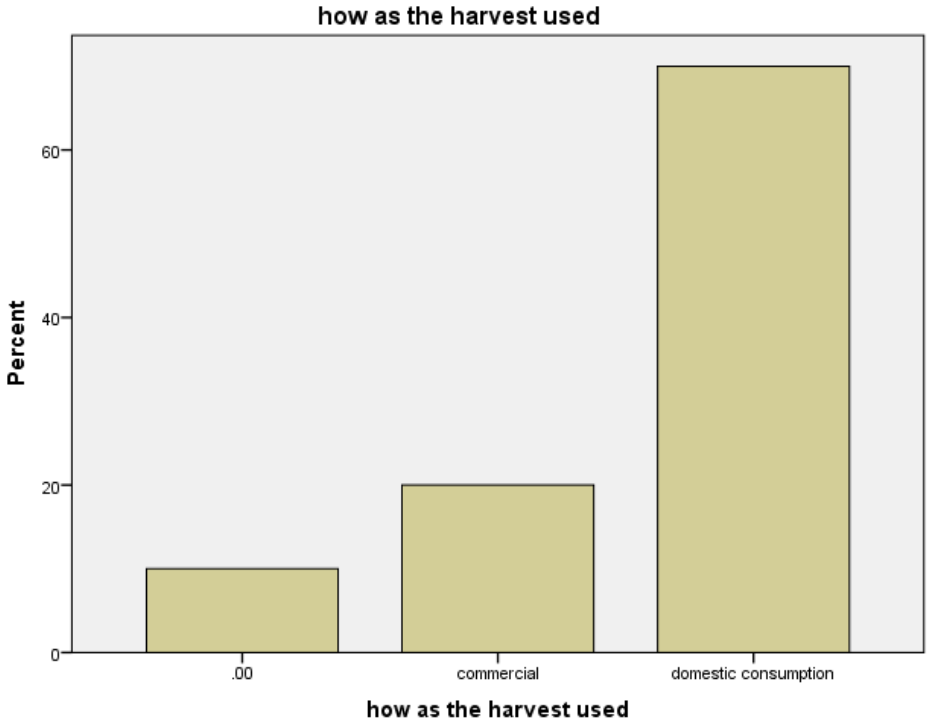

Figure 6: How the harvest was used

The results indicate that 30% used the harvest for commercial purposes while 70% used the harvest for domestic purpose. All respondents used manual harvesting method followed by sun drying of seeds. The dry seeds are stored with gunny bags in well-aerated stores on raised pallets, or timber.

Table 7: Source of Chia seeds for planting

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		505	99.0	99.0	99.0
	0	1	.2	.2	99.2
	friends/neighbors	1	.2	.2	99.4
	Uganda	1	.2	.2	99.6
	Market	1	.2	.2	99.8
	Relative	1	.2	.2	100.0
	Total	510	100.0	100.0	

Among the farmers willing to plant chia as a food crop, the sources of chia seeds for planting was not available. According the Table7, 0.2% reported to have received the seeds from friends/neighbour while one other respondent 0.2% reported to have received the seeds from relatives. Another 0.2% received the seeds from Kampala market while majority of the respondents, 99% respondents did not have information on sources of chia seeds.

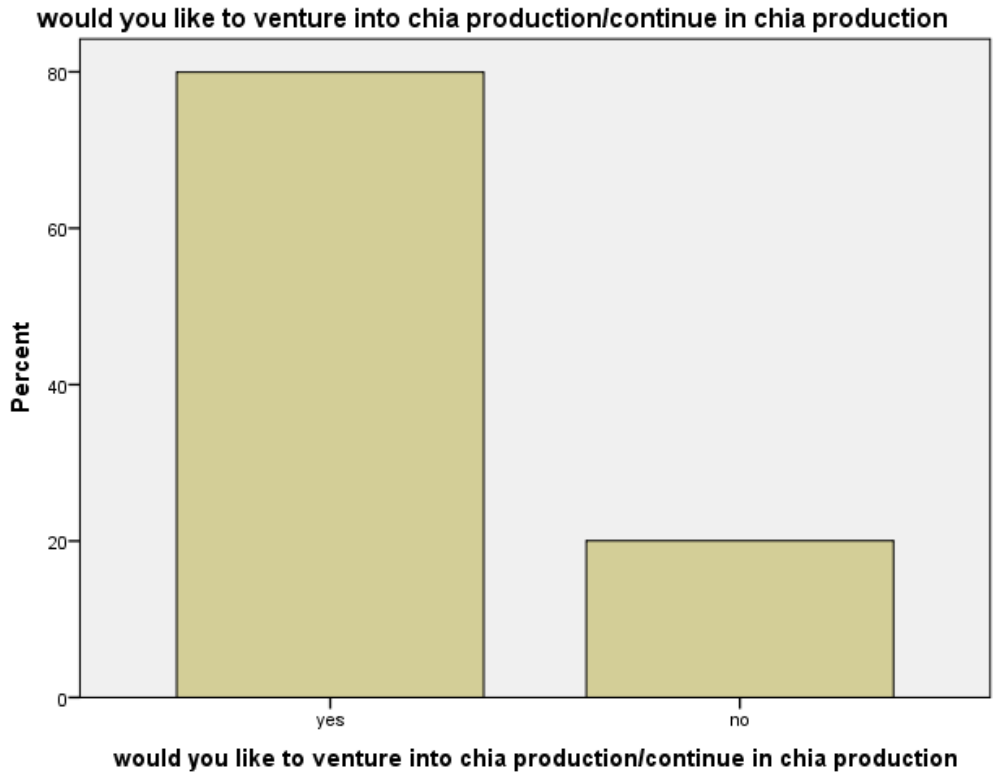

Figure 7: Interest in chia farming

Figure 7 indicates that 77.5% reported that they would like to venture into chia production while 19.4% said that they would not like to venture into chia production, and 3.1% did not give their opinion on venturing in chia production.

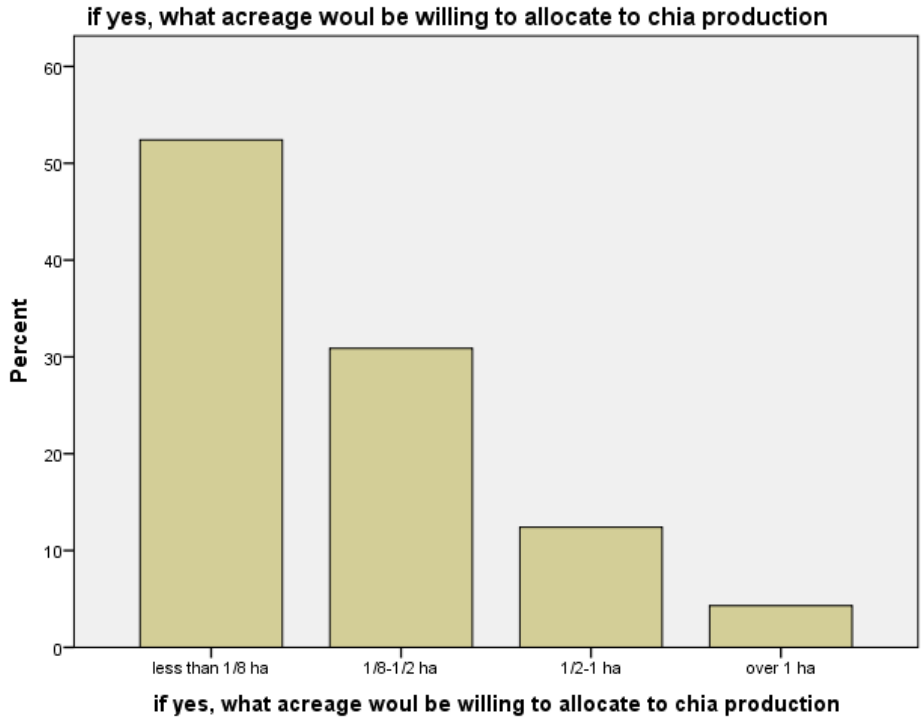

Figure 8: Acreages farmers are willing to dedicate for chia production

Out of the 395 respondents who showed interest in Chia production, 207 respondents (40.6%) would allocate less than 1/8 ha of land, 122 (23.9%) respondents would allocate 1/8-1/2 ha, 49 (9.6%) would allocate ½-1ha while 17 respondents (3.3%) would allocate more than an acre of land for Chia production.

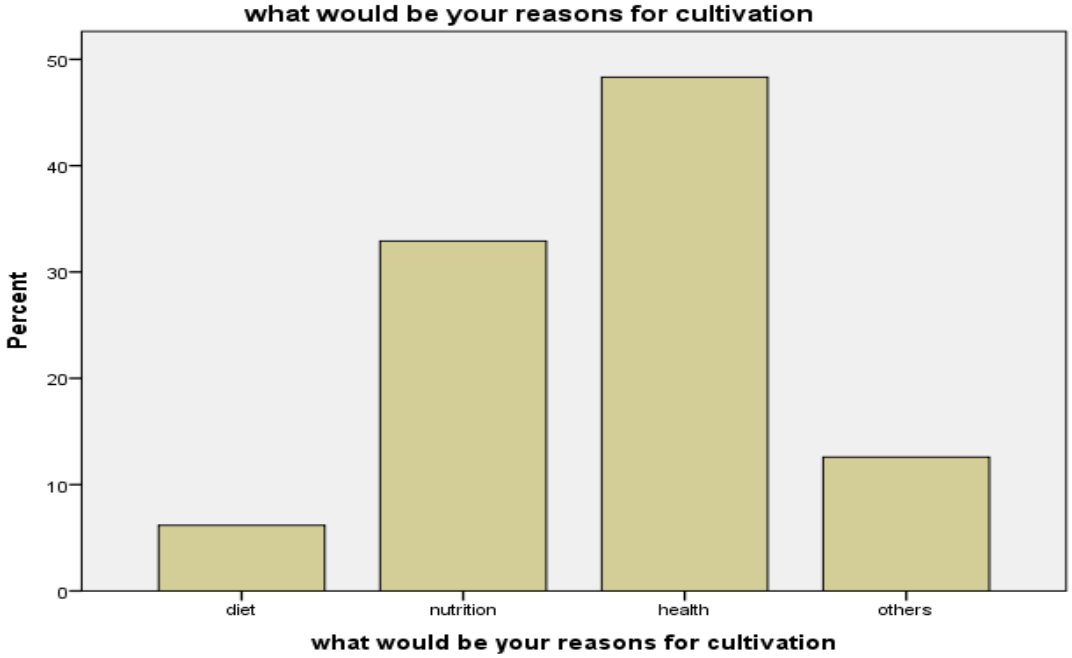

Figure 9: Reason for interest in chia production

Twenty-four respondents (4.7%) reported that they would cultivate Chia for diet purposes, 128 respondents (25.1%) for nutrition purposes while 188 respondents (36.9%) would do it for health purposes. Forty nine respondents (9.6%) would cultivate Chia for other reasons.

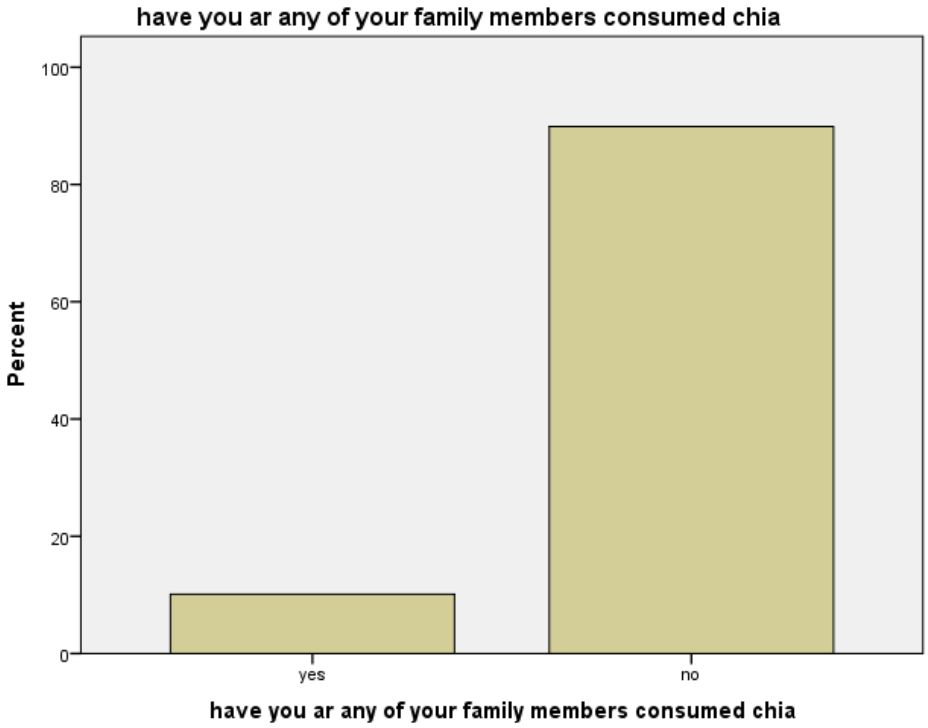

Figure 10: Trends on chia consumption

forty seven respondents (9.2%) reported that they/ their family members have ever consumed Chia while 417 (81.8%) reported that they have never consumed Chia. This shows that majority of the people in Nyeri County have not consumed Chia in their lives.

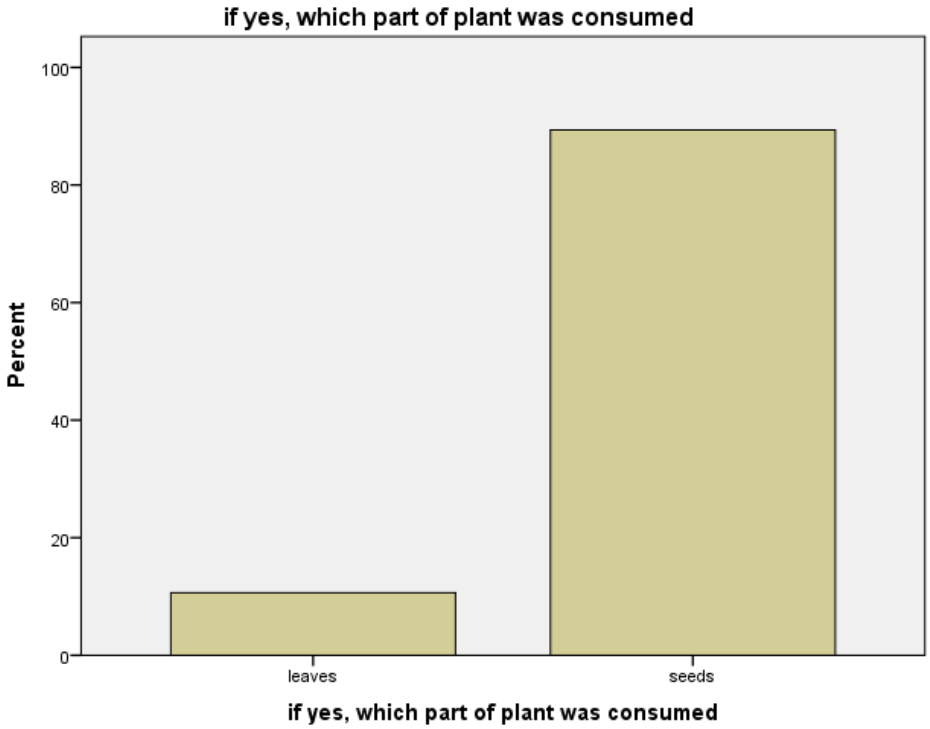

Figure 11: Trends in chia consumption

Out of the forty-seven respondents who reported to have consumed Chia, five of them (10.6%) reported the have consumed Chia plant leaves while 42 respondents (89.4%) reported to have consumed Chia Plant seeds.

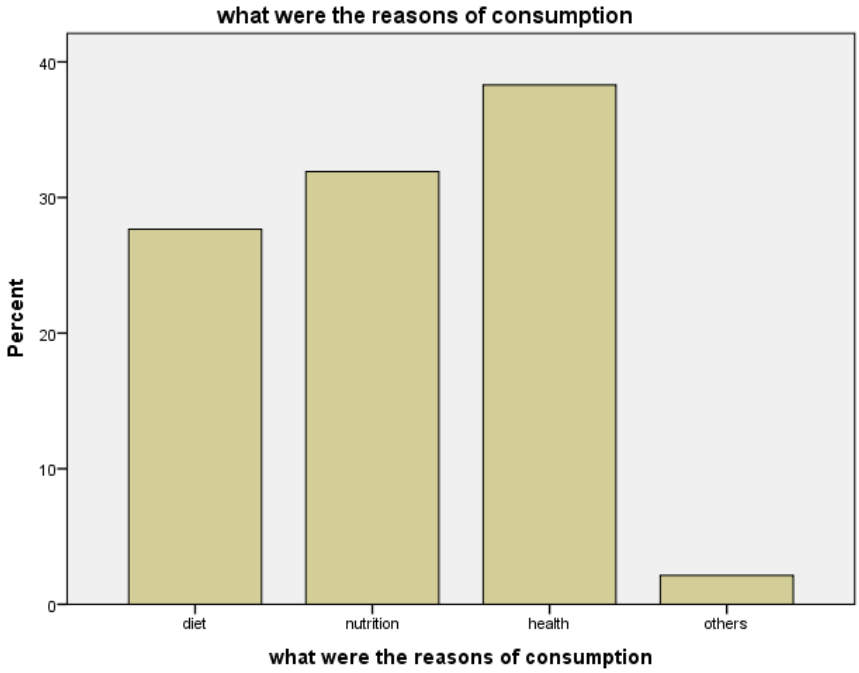

Figure 12: Reasons for chia consumption

Out of the 47 respondents who reported to have consumed Chia, 13 respondents (27.7%) reported to have consumed Chia for dietary purposes, 15 respondents (31.9%) for nutrition purposes while 18 respondents (38.3%) for health purposes. One respondent (0.2%) reported to have consumed it for other purposes.

Table 8: Willingness to use chia to enrich household foodwould you be willing to produce chia enriched porridge

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	187	36.7	75.4	75.4
	no	61	12.0	24.6	100.0
	Total	248	48.6	100.0	
Missing	System	262	51.4		
Total		510	100.0		

Table 8 shows that 187 respondent (75.4%) reported that they would be willing to produce Chia enriched porridge while 61 respondent (24.6%) were unwilling to produce Chia enriched porridge

Table 9: Willingness to sell chia productswhere would you sell your chia products

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	local consumers	281	55.1	64.7	64.7
	urban market	118	23.1	27.2	91.9
	export to international markets	30	5.9	6.9	98.8
	Other	5	1.0	1.2	100.0
	Total	434	85.1	100.0	
Missing	System	76	14.9		
Total		510	100.0		

Table 9 indicates that 281 respondents (64.7%) would be willing to sell chia products in the local markets, 118 respondents (27.2%) would be willing to sell chia products to the urban market while 30 respondents (6.9%) would be willing to sell chia products in the export markets while 5respondents (1.2%) were willing to sell it to other markets.

Chia is consumed as a raw meal by soaking in water, as it is known to produce large amounts of mucilage. In this context, chia commercial viability in Kenya in the context of food security and household nutrition, cascading to characteristics and classification, agronomic requirements, germination of seeds, and crop management practices, chemical and nutritional composition, postharvest handling, value addition and marketing need to be investigated.

IV. Conclusion

The baseline survey identified the strengths in the region including that Nyeri County is an Agricultural area with farming as the main economic activity, and several contacts were established with the farmers where most were willing to participate in the study. There was easy access to respondents (farmers) and information. However, some weaknesses were notedincluding the study area being wide hence sampling had to be done. Also some respondents did not seem to understand what the study was about despite their willingness to participate. This led to some spoilt questionnaires.

There are opportunities for chia production in the area with one existing farmer in King'ong'o growing chia seeds. The farmer was useful in providing crucial information on chia cultivation and consumption. In addition, chia seeds are being sold in all supermarkets in Nyeri and some specific retail outlets, therefore gaining popularity among consumers who are keen on health eating and purchase of superfoods.

Some threats were identified consisting of the possibility of process errors during the survey including coding, editing, calculating, tabulating, tallying, posting and consolidating. There were some errors in interpretation of the questionnaire by some respondents and variability in response as well as biases in response by the respondents.

From the findings of this survey, it can be concluded that Nyeri County has the potential for chia cultivation and overall value chain development with need for processors and exporters to open the export market thus enhance production.

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