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Domestication and Survival of Selected Medicinal Trees and Shrubs in Chapereria Division West Pokot County Kenya

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Depletion of medicinal plant species as a result of over over-extraction in their natural habitats will have detrimental effects on the livelihood of the locals that herbal medicine is part and parcel of their health systems. Though domestication is the best strategy to conserve medicinal tree and shrub species, most medicinal trees and shrubs have remained undomesticated due to low survival rates and inadequate information on the best strategies to improve survival rates. This study was designated to determine the domestication level and survival rates of selected medicinal tree and shrub species in the semi-arid regions of Chepareria division. A cross-sectional research design was employed in this study. Chepareria division was purposely selected. 384 households were selected using systematic random sampling technique. A pre-designed data collection sheet was used to collect the information on medicinal plant species and photographs were taken where necessary during data collection. The study indicated that there were 25 medicinal tree and/or shrubs in Chepareria division. It was also found that 91.7% households had domesticated trees on their farms with *Croton megalocarpus* (71.3%) being the highly domesticated tree while *Myrsine africana* was the least (0.9%) prevalent medicinal tree in the area. Further analysis using Chi-Square (χ^2) test of fitness indicated that there were significant differences in the number of households that have domesticated different medicinal trees and/or shrub species in Chepareria

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division (P <.0001). The indicated that the various medicinal trees and/or shrubs had different survival rates in the area. The mean survival rates of *Aloe graminicola* (62.6%), *Croton macrostachyus* (69.8%) *Vernonia amygdalina* (69.3%) and *Croton megalocarpus* (72.7%) are significantly higher while the survival rates of *Tamarindus indica* (12.0%), *Myrsine afriana* (6.6%), *Dalbergia vaccinifolia* (9. 4%) and *Commiphoraboi viniana* (7.2%) are significantly lower. Chapareria to increase the domestication and survival rate of trees/shrubs.

Keywords: Medicinal; domestication; preference; abundance; survival.

1. INTRODUCTION

Over 25% and 80% of human population in developed and developing countries respectively are using herbal medicinal and food supplements derived from trees and shrubs for primary healthcare [1,2,3]. In developing countries, traditional medicine from plants are preferred because they are affordable, corresponds to the ideologies of many culture, perceived ineffectiveness of conventional medicine to treat some diseases like advanced cancer and erectile dysfunction [1,3], and low level of side effects as compared to conventional medicine as they are perceived natural and safe without toxic elements among other reasons [1,4]. High percentage (85%) of African population has at least used traditional medicine from plant extracts due to affordability and accessibility [5].

In Kenya, the use of traditional medicine from plants is widespread as over 90% of the population in rural and urban areas has used plant extracts to treat various health challenges [6,7,8]. The number of highly recognized medicinal tree species in Kenya varies from one region to the other. In Mwingi [6], and Kakamega [7] found 28 and 40 highly prioritized tree species respectively, while in Marakwet [9] found a total of 111 tree species used for medicinal purposes.

Given the increasing market base that is leading to over-collection of existing species populations, coupled with threatening impacts of climate change, about 33.3% of medicinal plant species may be extinct in many countries in Kenya [6,10,11,12]. This is evidenced that most valuable medicinal tree species are only found growing in small scattered populations in remote rural areas especially in semi arid regions [13].

Depletion of medicinal plant species will have detrimental effects on the livelihood of the locals that herbal medicine is part and parcel of their health systems [9]. This is because herbal medicine is deeply rooted in the socio-economic and cultural values of many people especially in the former Rift Valley province of Kenya [14]. To ensure conservation of depleting medicinal species in the wild, and enhance sustainability of herbal medicine to continue meeting the increasing demand, [1,11,15] recommend domestication of endangered and medicinal trees and shrubs. Domestication increases the probability of optimizing yield as it may embrace the use of biotechnology, pest and disease control among other benefits [11].

Though domestication was considered as the best option to towards conservation of endangered medicinal plants enhance sustainable supply of the products to the increasing markets, most medicinal plants have remained undomesticated [12]. This has led to unsustainable dependence on medicinal plants from the wild whose depletion will negatively affect the livelihood of many people especially in arid and semi-arid regions [9,10]. A low rate of domestication has been due to low survival rates and inadequate information to improve survival rates [1,11,16].Therefore, this study looks at the domestication and survival of selected medicinal trees and shrubs in Chapareria division, West Pokot County, Kenya.

2. MATERIALS AND METHODS

2.1 Research Design

This study used a cross-sectional research design, which according to Yin [17] involves collecting data from the participants or treatments at a single point of time without altering the environment in which such participants or treatments are situated.

2.2 Study Area

The study was conducted in the semi-arid regions of Chepareria division located in Pokot South Sub-County of West-Pokot County in Kenya. The division lies at latitude between 1º15'40"N and 1º55'37"N and at longitude between 35º7'46"E and 35º27'10"E. The altitude

ranges from 708 m to 1200 m above sea level, with annual rainfall ranging from 750 mm to 1500 mm [18]. The division covers 500 km^2, divided into six administrative locations, namely: Kipkomo, Senetwo, Ywalateke, Pserum, Chepkopegh and Shalpogh, and 15 administrative sub-locations. The total population is about 41,600 people occupying approximately 7,640 households [18]. Over 90% of the populations are agropastoralist, though some farmers have started keeping improved livestock breeds for livestock [19].

2.3 Target Population

The study targeted about 7,640 households living Chepareria division, both practicing agropastora list and those that have adopted improved livestock farming.

2.4 Sampling Procedures and Sample Sizes

The study used a multi-stage sampling technique. Chepareria administrative division was selected based on purposeful sampling technique because it is one of the few divisions in West-Pokot County where farmers are practicing agropastoralist, meaning they have farms where they cultivate and the same time rear livestock. Out of six administrative locations, half of the locations (3 locations) namely; Kipkomo, Ywalateke and Chepkopegh were selected using systematic random sampling technique, where, a location was selected after every one location; meaning, the first location, the third and the fifth locations were selected after selecting the first location (Kipkomo) randomly. In each of the selected locations, 2 administrative sub-locations namely: Kipkomo (Kipkomo and Kosulol sub-Locations), Ywalateke (Kapchemogen and Propoi Sub-locations) and Chepkopegh (Chesra and Chepkope Sub-locations) were selected using systematic random sampling. In each administrative sub-location, two villages were selected based on simple random sampling and households were selected using systematic random sampling technique in each location.

The sample size was calculated based on Israel [20] equation (eqn. 1) at 0.5 margin error, and divided in each village based on equal distribution

$$\boldsymbol{n} = [\frac{\mathbf{N}}{(\mathbf{1}+\boldsymbol{N}\boldsymbol{e}^{\mathbf{2}})}] \quad (1)$$

Where n = Sample size
e = margin error = 0.05 corresponding to 95% confidence level
N= total population size = 7640 households

Therefore: $\boldsymbol{n} = [\frac{\mathbf{7640}}{[\mathbf{1}+(\mathbf{7640}*\mathbf{0.05}*\mathbf{0.05})}]$ = 380.0995025 = households.

The number of villages were (3 Location * 2 sub-locations * 2 villages) = 12 villages

Therefore, the total number of households in each village was

380.0995/12 = 31.7 households = 32 households in each village

2.5 Data Collection Procedures

The data in this study was collected using a pre-designed data collection sheet and a digital camera.

2.5.1 Number of households that had domesticated highly valued medicinal plant species

Field research assistants with prior experience on tree species (mainly those that had already worked for VI Agro forestry in various projects) were selected to visit selected households and establish whether they have domesticated by planting any medicinal tree and shrub species on the provided list. The percent of households (H%) that had domesticated by planting at least one of the medicinal tree and or shrub species provided on the list was calculated as indicated in equation 2.

$$\mathrm{H}\% = \frac{n}{N} * 100 \quad (2)$$

Where:

H%: is the percentage of households that have domesticated by planting at least one of the medicinal tree and shrub species provided on the list.

n: is the number of households that have domesticated by planting at least one of the medicinal tree and shrub species provided on the list.

N: is the total number of households that were involved in the study.

The percent of households (Hs%) that had domesticated by planting specific medicinal tree and or shrub species provided on the list was calculated as indicated in equation 3. For some species, a photograph was taken using a digital camera.

$$\text{Hs}\% = \frac{ns}{N} * 100 \quad (3)$$

Where:

N: is the total number of households/farms that were involved in the study

ns: is the total number of households that have domesticated by planting a specific medicinal tree and or shrub species on the provided list.

2.5.2 On-farm prevalence of highly valued medicinal plant species

In each farm, the number of trees in each species category was counted and recorded in the data sheet. The percent prevalence (Ps%) of each species on each farm was calculated as indicated in equation 4.

$$\text{Ps}\% = \frac{nx}{Nt} * 100 \quad (4)$$

Where:

nx: is the total number of medicinal tree and or shrub species that have been domesticated by planting by the farmer

Nt: is the total number of a specific medicinal tree and or shrub species that has been domesticated by planting by the farmer

The average percent prevalence (Psv%) of each species was calculated using equation 5

$$\text{Psv}\% = \frac{(\text{Ps1}\% + \text{Ps2}\% \ldots\ldots + \text{Psn}\%)}{Nx} \quad (5)$$

Where:

Ps1%, Ps2%, all the way to Psn% refers to the percent of a particular tree and or shrub species domesticated by the 1st household, 2nd household all the way to the nth (last) household.

Nx refers to the total number of households/farms that have domesticated that particular tree or shrub species.

2.5.3 The average on-farm survival rates of highly valued medicinal plant species

In each farm with any medicinal tree and or shrub, the owner was asked to give the number of trees that he/she initially planted. Then the farmer accompanied the field assistant to the farm to manually count those trees and shrubs that had survived. Survival rates (S%) of each medicinal tree or shrub species in each farm was estimated based on equation 6.

$$\text{S}\% = \frac{nx}{Nx} * 100 \quad (6)$$

Where:

nx: is the total number of an individual species that has survived since planting, and was counted during data collection.

Nx: is the total number of an individual species the farmer planted.

The average of an individual species in Chepareria was estimated using equation 7

$$\text{Sv}\% = \frac{(\text{S1}\% + \text{S2}\% \ldots\ldots + \text{Sn}\%)}{Nx} \quad (7)$$

Where:

S1%, S2%, all the way to Sn% refers to the survival percent of a particular tree or shrub species in the 1st 2nd all the way to nth (last) farm
Nx refers to the total number of households/farms that have domesticated that particular tree or shrub species.

2.6 Data Analysis and Presentation

Data was analyzed using chi-square goodness of fit test and one way ANOVA using SPSS version 16 and presented in bar graphs and tables. Chi-square goodness of fit was used to determine whether or not the occurrence of categories within a variable is significantly equal based on the frequency of their occurrence [21]. This test was used to test if there were significant differences in the number of households that have domesticated different medicinal tree and shrub species. In this case, the test variable will be the medicinal tree or shrub species that has been domesticated by the farmer.

One way ANOVA was used to establish whether there is significant difference in the mean

prevalence and survival of medicinal trees and shrubs on farms. The species was independent variable while prevalence and survival was dependent variables. In case of significant difference between the means ($P < 0.05$), then mean separation was done using Duncan Multiple Range Test (DMRT) which has been proved to show real difference better than other methods [22].

3. RESULTS AND DISCUSSION

3.1 Results

3.1.1 Number of households that have domesticated selected medicinal plant

Out of 384 households/farms that were involved in the research, 352 households (91.7%) had domesticated at least one medicinal tree or shrub species (Fig. 1).

Table 1 indicates that 25 medicinal tree and shrub species belonging to 20 families were mainly domesticated. They included: Flacourtiaceae (1 species), Burseraceae (2 species), Ochinoidaceae (1 species), Aloaceae (1 species), Fabaceae (4 species), Oleaceae (1 species), Combretaceae (1 species), Myrsinaceae (1 species), caper (1 species), Myrtaceae(1 species), Pittosporaceae (1 species), Rhamnaceae (1 species), Moraceae (1 species), Ebenaceae (1 species), Rutaceae (1 species), Euphorbiaceae (2 species), Anacardiaceae (1 species), Meliaceae (1 species), Compositae (1 species) and Mimosaceaee (1 species).

Chi-square test of fitness indicated significant differences in the number of households that have domesticated different medicinal trees and shrubs ($\chi^2 = 220.056$, d.f 24, $P = 0.0001$). Further chi-square goodness of fit test on pairs of medicinal trees and shrubs indicated that the highest number of households (71.3%) have domesticated *Croton megalocarpus* commonly called Kenyan croton in English and Senetwo in Pokot belonging to *Euphorbiaceae* family. Contrary, the lowest percent of households (1.1%) have domesticated *Myrsineafriana* commonly called Cape mytle in English and Lakathetwa/Lagathethwa in Pokot belonging *Myrsinaceae* family. The percentages in Table 1 with homogeneous superscript alphabetic letters means there is no significant difference.

3.1.2 Prevalence of medicinal trees and shrubs on farms

Table 2 indicate that the percent *Croton megalocarpus* (79.6%) is the most prevalent medicinal tree species while *Myrsineafriana* (0.9%) is the least prevalent species among the 25 medicinal tree and shrub species that have been domesticated by households in Chepareria division. The medicinal trees and shrubs are mainly planted on the boundary, in home gardens, as shelter belts, live fence and as scattered trees or shrubs on farm.

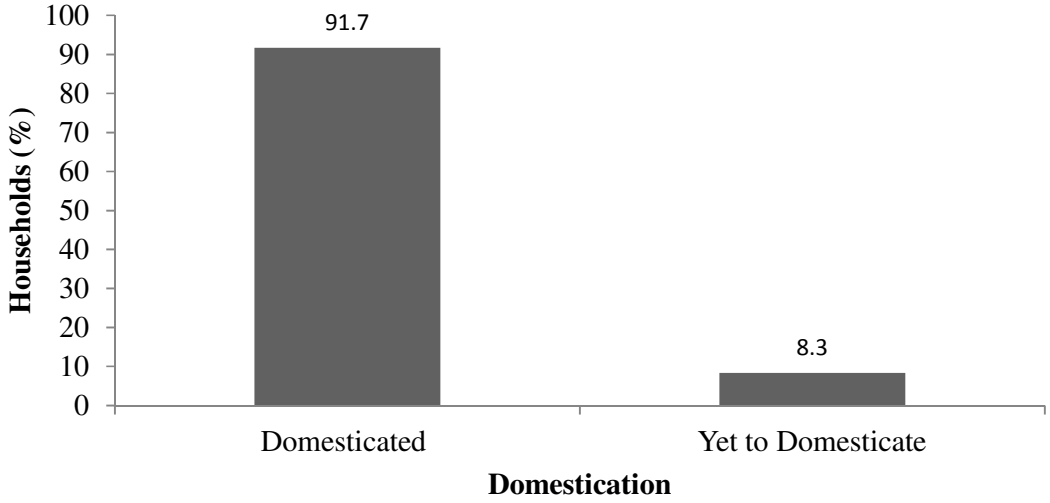
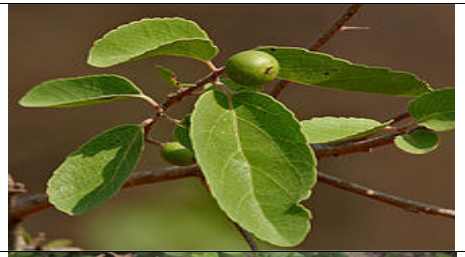
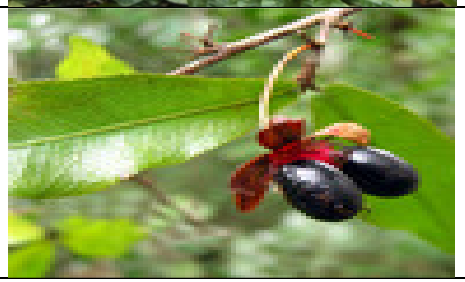
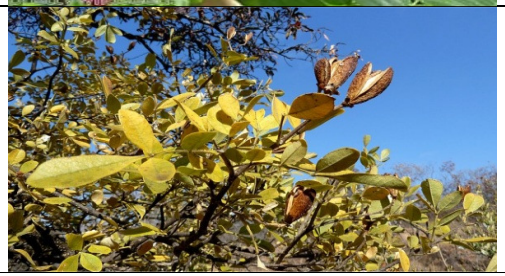
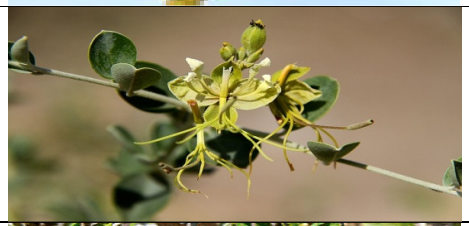


Fig. 1. Domestication of medicinal trees and or shrubs in Chepareria

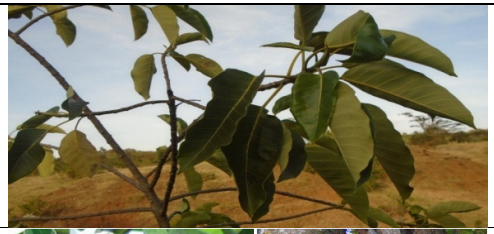
Table 1. Medicinal tree and shrub species domesticated by different households

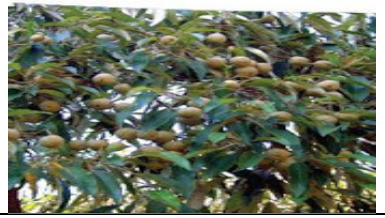
	Local name	English name	Scientific name	Family	Households/ 352 (%)	Photos
1	Tingoswo	Common flacourtia	*Flacourtia indica*	Flacourtiaceae	8.8[d]	
2	Katagh	African myrh	*Commiphora Africana*	Burseraceae	12.2[cd]	
3	Lakatet/Lagatet	Vietnamese mickey-mouse plant	*Ochna insculpta*	Ochinoidaceae	4.8[d]	

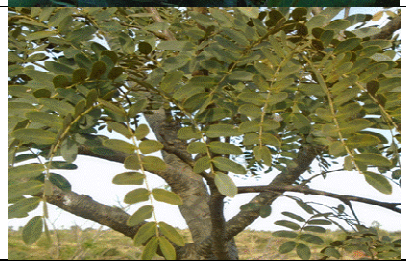
	Local name	English name	Scientific name	Family	Households/ 352 (%)	Photos
4	Tolkos/Olkos	Lace aloe or Guinea-fowl aloe	*Aloe graminicola*	Aloaceae	50.1[b]	
5	Oron	Termarindi	*Tamarindus indica*	Fabaceae	3.7[d]	
6	Chetoye	Wing-leaved wooden pear	*Schrebera alata*	Oleaceae	7.6[d]	

	Local name	English name	Scientific name	Family	Households/ 352 (%)	Photos
7	Komel/ Kemol	Velvet bush willow	*Combretum molle*	Combretaceae	6.8[d]	
8	Lakathetwa/ Lagathethwa	Cape mytle	*Myrsine afriana*	Myrsinaceae	1.1[d]	
9	Arerenyon	Cadaba bush	*Cadaba farinose*	caper	7.1[d]	
10	Pukwa/Pungwa	Waterberry tree	*Dalbergia vaccinifolia*	Fabaceae	5.8[d]	

	Local name	English name	Scientific name	Family	Households/ 352 (%)	Photos
11	Reperwo/Reper	Waterberry tree	*Syzygium cordatum*	Myrtaceae	10.2[cd]	
12	Chelewa/Chelewe	Cheesewood	*Pittosporum viridiflorum*	Pittosporaceae	8.2[d]	
13	Mashan	Baamba	*Commiphora boiviniana*	Burseraceae	11.1[cd]	
14	Tirak	Abysinian jujube	*Ziziphus abyssinica*	Rhamnaceae	17.3[c]	

	Local name	English name	Scientific name	Family	Households/ 352 (%)	Photos
15	Simotwo	Common wild fig	*Ficus thonningii*	Moraceae	5.4[d]	
16	Chepthuya	Diamond-leaved eulea	*Euleadivinoum*	Ebenaceae	16. 5[c]	 
17	Manapelion	Winged cherry orange	*Teclea pilosa*	Rutaceae	12.2[cd]	
18	Toboswo/ Toboswa	Boad-leaved coton	*Croton macrostachyus*	Euphorbiaceae	52.8[b]	

	Local name	English name	Scientific name	Family	Households/ 352 (%)	Photos
19	Lolotwo	False marula	*Lannea fulva*	Anacardiaceae	20. 5[c]	
20	Ririon	Creamy peacock flower	*Delonix elata*	Fabaceae	8.0[d]	
21	Mwarubaine	Neem	*Azadirachta indica*	Meliaceae	18.8[c]	
22	Senetwo	Kenyan croton	*Croton megalocarpus*	Euphorbiaceae	71.3[a]	

	Local name	English name	Scientific name	Family	Households/ 352 (%)	Photos
23	Chebriandar	Bitter leaf venonia	*Vernonia amygdalina*	Compositae	46.0^{bc}	
24	Koyopkwo	*Camel's foot*	*Piliostigma thonningii*	Fabaceae	29. 5^{c}	
25	Mushebut	Tree Entada	*Entada abyssinica*	Mimosaceae	16.8^{c}	

Note: The mean percentages with homogeneous superscript alphabetic letters means there is no significant deference in such means as indicated by DMRT

DMRT indicated that the mean percent prevalence of *Croton megalocarpus* (79.6%) is significantly higher compared to percent prevalence of other medicinal trees and shrubs that have been domesticated in Chepareria administrative division.

One-way ANOVA indicated that there is significant difference in the mean percent prevalence of medicinal trees and shrubs domesticated on farms in Chepareria administrative division of West-Pokot County ($F = 9.447$, d.f = 24, $P < .0001$) (Table 3).

3.1.3 Survival of medicinal trees and shrubs on farms

Table 4 indicates that *Croton megalocarpus* and *Myrsineafriana* have the highest (72.7%) and lowest (6.6%) survival rates respectively compared to all the 25 medicinal tree and shrub species domesticated in Chepareria.

DMRT indicated that the mean survival rates of *Aloe graminicola* (62.6%), *Croton macrostachyus* (69.8%) *Vernonia amygdalina* (69.3%) and *Croton megalocarpus* (72.7%) are significantly higher while the survival rates of *Tamarindus indica* (12.0%), *Myrsine afriana* (6.6%), *Dalbergia vaccinifolia* (9. 4%) and *Commiphoraboi viniana* (7.2%) are significantly lower.

One-way Anova indicated that there is a significant difference in the survival rates of medicinal tree and shrub species domesticated by planting in the administrative division of Chepareria in West-Pokot County ($F = 810. 572$, d.f = 24, $P < 0.0001$) (Table 5).

Table 2. Average percent prevalence of medicinal trees and shrubs on farms

	Scientific name	Prevalence (%)	Where planted or reserved
1	*Flacourtia indica*	10. 5^{cd}	Boundary, scattered
2	*Commiphora Africana*	17.1^{cd}	Boundary
3	*Ochna insculpta*	15.8^{dc}	Garden, boundary
4	*Aloe graminicola*	33.7^{b}	Garden
5	*Tamarindus indica*	4.3^{d}	Boundary, shelter belts
6	*Schrebera alata*	13.4^{cd}	Boundary
7	*Combretum molle*	10.7^{cd}	Garden, boundary
8	*Myrsine afriana*	0.9^{d}	Garden, Boundary
9	*Ziziphus abyssinica*	21.1^{c}	Garden
10	*Ficus thonningii*	8.9^{cd}	Boundary, scattered on farm
11	*Cadaba farinose*	7.0^{d}	Boundary, Garden, scattered on farm
12	*Dalbergia vaccinifolia*	10.3^{cd}	Boundary
13	*Syzygiumcordatum*	6.3^{d}	Boundary
14	*Commiphora boiviniana*	4.3^{d}	Boundary, scattered on farm
15	*Euleadivinoum*	9.0^{cd}	Boundary, Life fence
16	*Pittosporum viridiflorum*	5. 5^{d}	Boundary, scattered on farm
17	*Teclea pilosa*	8. 5^{d}	Boundary, scattered on farm
18	*Croton macrostachyus*	72.7^{a}	Boundary, Life fence
19	*Lannea fulva*	19.8^{c}	Boundary, wind breaks scattered on farm, garden
20	*Delonix elata*	8.7^{d}	Boundary
21	*Azadirachta indica*	20.9^{c}	Wind breaks, Boundary Scattered
22	*Vernonia amygdalina*	47.7^{b}	Boundary, wind breaks
23	*Piliostigma thonningii*	17.1^{c}	Wind breaks, Boundary, Scattered, garden
24	*Entada abyssinica*	14. 4^{cd}	Boundary, Scattered, garden
25	*Croton megalocarpus*	79.6^{a}	Garden, Scattered, Boundary

Note: The mean percentages with homogeneous superscript alphabetic letters means there is no significant difference in such means as indicated by DMRT

Table 3. One-way ANOVA for abundance of medicinal tree and shrub species on farm

	Sum of squares	df	Mean square	F	Sig.
Between Groups	3649.188	8	456.148	9.447	.000
Within Groups	47800.110	990	48.283		
Total	51449.297	998			

Table 4. Survival rates of medicinal trees and shrubs

	Scientific name	Survival (%)
1	*Flacourtia indica*	33.3bc
2	*Commiphora africana*	24.0c
3	*Ochnain sculpta*	37.8bc
4	*Aloe graminicola*	62.6a
5	*Tamarindus indica*	12.0d
6	*Schrebera alata*	35.6b
7	*Combretum molle*	41.9b
8	*Myrsine afriana*	6.6d
9	*Ziziphus abyssinica*	15.9c
10	*Ficus thonningii*	43.7b
11	*Cadaba farinose*	23.1c
12	*Dalbergia vaccinifolia*	9. 4d
13	*Syzygium cordatum*	19.6c
14	*Commiphoraboi viniana*	7.2d
15	*Eulea divinoum*	31.1c
16	*Pittosporumvin vidiflorum*	11.9cd
17	*Teclea pilosa*	24.1c
18	*Croton macrostachyus*	69.8a
19	*Lannea fulva*	48.4ab
20	*Delonix elata*	31.9c
21	*Azadirachta indica*	43.7b
22	*Vernonia amygdalina*	69.3a
23	*Piliostigma thonningii*	46.8b
24	*Endata abyssinica*	27.6c
25	*Croton megalocarpus*	72.7a

To improve survival rates, farm owners are taking a number of activities as presented in Fig. 2.

3.2 Discussion

3.2.1 Domestication of medicinal plants and shrubs

This study showed that the Pokot community which is one of the ASAL inhabitants in Kenya has placed high value on medicinal trees and shrubs. 91.7% of the sampled households had domesticated at least one medicinal tree/shrub. They value traditional medicine prescribed by traditional healers rather than the pharmaceutical drugs administered in modern health centers [9]. This finding agrees with that of Milimo et al. [23] who asserted that most communities in the East Africa ASALs rely heavily on trees and shrubs hence they have opted to domesticate them in order to access their services easily.

Croton megalocarpus had the highest rate of adoption because most people were familiar with it and aware of its medicinal value. Rather than the medicinal purpose, the tree also provided fuel, fodder, shade and timber to the households and it was well adapted to the harsh climatic condition of the region because it is an indigenous tree in Kenya hence high domestication rate. This result conferred with that of Muthee et al. [24] who indicated that most of trees which are domesticated are chosen based on their beneficial values, and a multipurpose tree is highly prioritized.

3.2.2 Prevalence medicinal plants and shrubs

Flacourtia indica, Commiphora Africana, *Ochnainsculpta*, *Aloe graminicola*, *Tamarindus indica*, *Schrebera alata, Combretum molle, Myrsine afriana*, *Ziziphus abyssinica, Ficus thonningii, Cadaba farinose, Dalbergia vaccinifolia*, *Syzygium cordatum, Commiphoraboi viniana, Euleadivinoum*, *Pittosporum vividiflorum*, *Tecleapilosa*, *Croton macrostachyus*, *Lannea fulva, Delonix elata, Azadirachta indica*, *Vernonia amygdalina, Piliostigma thonningii, Endata abyssinica and Croton megalocarpus* were found to be the most common medicinal trees and/or shrubs domesticated in the area. This list of medicinal tree and/shrubs found in Chepareria concurs with that reported by Falodun [5] with *Croton megalocarpus* being the most prevalent medicinal tree. The trees were found as live fences, homegardens, scattered on farms and pastures to provide shade as was also indicated by Furukawaa et al. [9].

Myrsine africana was the least adopted tree species in the region since it was a rare species and the community had little knowledge about it except the medicinal specialists. This finding is in agreement with that of Street and Prinsloo [25] who indicated that local communities prefer to domesticate trees that they fully understand besides its monetary return. Further, different famers had different perception and view on specific species hence adoptions varied. This study is against the findings of Ngarivhumea et al. [26] who asserted that there are no variations in the adoptions on medicinal trees by herbalists.

3.2.3 Survival medicinal plants and shrubs

Survival of medicinal tree/shrub planted on farms depended on various factors. These factors included tree species, ability of the plant to adopt to the environmental conditions such as low precipitation leading to prolonged dry seasons, very high evapotranspiration, poor edaphic conditions (little nutrients and low organic matter), strong dry winds during drought, destruction by wildlife and livestock, destruction

by human. This finding confers with the study by Njoroge [27] which showed that trees have different adaption ability, and some plants can survive in harsh environmental conditions. The 25 medicinal trees/shrubs that have survived in Chapareria have the following xerophytic characteristics:- deep rooted to absorb water from the lower soil layers, small leaves mainly spines to reduce the surface area for evapotranspiration and destruction by herbivores which feed on plant leaves, fleshy stems and bark to store water and reversed stomata sequence ,and it agrees by the study of Zhang [28].

The results of this study showed that *Croton megalorcapus* has the highest survival rate meaning it has all the desirable characteristics needed for survival in the dryland ecosystem of Chapareria, being an indigenous tree in the region, it was easy to establish, required minimal tendering throughout its life cycle, and people had placed very high value on this tree species hence promoting its conservation, this concurs with the study [27]. The species with low survival rates indicated that they required intensive care especially during the initial stages of development which was not accomplished by many households due to lack of silvicultural knowledge. Low survival could also be caused by animal damage, low adaptation rate to the dryland conditions especially the exotic tree/shrub species; this adheres to the results indicated by the vegetation inventory by Durugbo et al. [29].

The study also indicated that most death of the domesticated trees and/or shrubs are caused by human/animal damages and low seed quality; hence protection from damages by animals and human was the most crucial activity to be carried out. Other management practices that could increase the survival rate included, weeding, watering seedlings, using high quality planting material and pruning, this management practices confers with the study on dryland tree management practices outlined by Jeruto et al. [30].

Table 5. One-way ANOVA for survival rates of medicinal tree and shrub species on farm

	Total harvest				
	Sum of squares	**df**	**Mean square**	**F**	**Sig.**
Between Groups	7.520E11	8	9.400E10	810.572	.000
Within Groups	1.148E11	990	1.160E8		
Total	8.668E11	998			

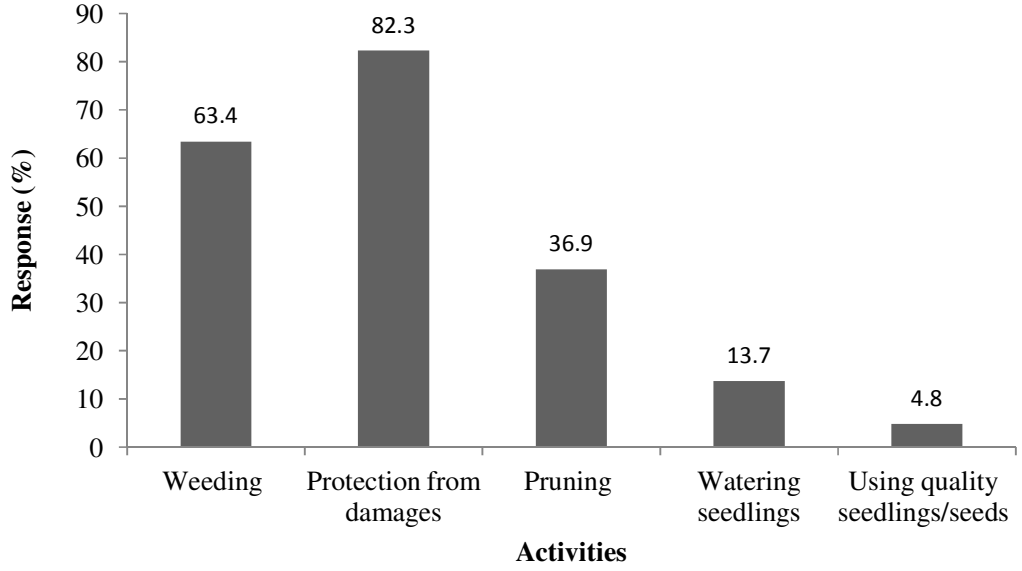


Fig. 2. Activities improve survival of medicinal trees and shrubs in Chepareria

4. CONCLUSION AND RECOMMENDATION

Medicinal trees and shrubs are highly valued in most African ASAL societies including Chapareria since they still appreciate the power of taking raw medicine from plants. Use of traditional medicine is a form of preserving their cultures and connecting to their ancestors. Changes in the modern society such as population increase of human and livestock diseases and commercialization of the traditional medicine as a result of development of a currency economy has led to exploitation of these tree species in the wild. This has led to decrease in the population of medicinal trees and/or shrubs and even extinction of some trees. Domestication of this medicinal trees and shrubs on farms by the local households in Chapareria has been adopted to reduce the pressure on the natural woodlands and increase production of traditional medicine to serve the local community.

Based on the findings of this study, the study recommends that an intensive farm forestry extension should be carried out in Chapareria by the forest extension officers to teach and encourage the households to domesticate and adopt the medicinal trees/shrubs in their farms. The government should also provide high quality affordable seeds or seedlings to the households in Chapareria to increase the domestication and survival rate of trees/shrubs.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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