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Co-situation of Using Sonki in Gum Arabic Production in Abu Zabad Locality, West Kordofan State, Sudan

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ARTICLE INFO

Article history:
Received November 26th, 2024
Revised February 10th, 2025
Accepted February 12th, 2025
Available online February 28th, 2025

E-ISSN: 2622-5093
P-ISSN: 2622-5158

How to cite:
Eltahir, M. E. S., E. M. I. Ahmed, S. A. D. A. Faragallah, F. I. Musa, and A. A. A. Mohamed, "Co-situation of using sonki in gum arabic production in Abu Zabad Locality, West Kordofan State, Sudan" *Journal of Sylva Indonesiana*, Vol. 08, No. 01, pp. 45-58 Feb. 2025, doi: 10.32734/jsi.v8i01.18986

ABSTRACT

This study investigated the adaptation and use of the Sonki tapping tool for gum Arabic production from *Acacia senegal* in Abu Zabad locality, West Kordofan, Sudan. Data were collected from 140 randomly selected producers (63 % of the total producers' population) using structured questionnaires and 11 focus group discussions. Descriptive statistics and Chi-square tests were conducted using SPSS, OriginPro 2024, and Microsoft Excel. The results indicated that 78.6% of respondents engaged in farming alongside gum Arabic production, primary as an inherited tradition. Approximately, 72.9 % tapped gum trees in October. Awareness of the Sonki tools was reported by 62 % of respondents, while 52.9 % actively used it. Access to the Sonki tool was primarily through market (94.9 %), with a smaller portion obtaining it from the Forest National Corporation and NGOs. Furthermore, 83% of respondents identified the provision of tools and training as a critical factor for promoting adaptation. Chi-square analysis revealed significant differences ($P \leq 0.05$) between years of experience, knowledge of Sonki and its usage. Despite barriers related awareness, 72% of producers owned and used the Sonki tool. The study concluded that while progress has been made in the adaptation of the Sonki tool, broader dissemination and training are essential. The findings recommend improving access, promoting proper usage, and enhancing the provision of tools and training to ensure sustainable tapping practices.

Keyword: Adoption, GAPAs, Gum Arabic, NWFPs, Sudan, Tapping Tools, West Kordofan

1. Introduction

Gum Arabic is one of the Sudan's most important Non-Wood Forest Products (NWFPs) [1,2]. Gum Arabic sector in Sudan witnessed a revival and development in (production, marketing and export) aspects. *Acacia senegal* tree (Hashab) is a multipurpose tree with a vital function in generating income [2], therefore provide support to the rural livelihood in different form such as wood energy and fodder demands, as well as enriching the soil fertility and nitrogen fixation [3]. Tapping activities increased gum Arabic yield by 77.42% as compared with untapped trees [4]. Gum Arabic exudes from Hashab timber in the structure of giant (5 cm

diameter) nodules or "tears" [5]. The mature trees with 4.5 - 6 m height and 5 - 25 years old, are tapped with the aid of making incisions in the branches and stripping away the bark to accelerate exudation [3].

The Sonki was developed by the Gum Arabic Research Division (GRD) in Agricultural Research Corporation (ARC) and it was considered as efficient, effective and cheap tapping tool [6], with dimensions of 2.5 – 2.0 cm width, 20 cm length with sharp end apex 1 cm and total height with wood 2.5 m (Figure 1) as well as manufactured locally and simply adopted by the gum tappers in the gum belt of Sudan. The Sonki is reported to be a multi-functional tool, used both for tapping *A. senegal* trees and harvesting gum [6,7]. Studies indicate that Sonki does not have any negative effect on tree health [8] and poses no danger to producers or tappers. Notably, it is easy to use making it accessible for women and teenagers [6]. Additionally, it is socially accepted, economically feasible and environmentally safe. Recently, the Sonki has been adopted for training programs by local and national organizations as well as international organizations such as International Fund for Agricultural Development (IFAD), Food and Agriculture Organization (FAO), and World Food Programme (WFP). It is recognized as the most effective and appropriate tool for tapping *A. senegal* trees across gum belt in Sudan [9]. The Sonki features a spear-like blade and offers several advantages over the traditional axe (farrar) (Figure 2). It regulates the width of the bark removed, allows for tapping of branches from any direction [10], and enables a single person to tap more tree in a shorter period. Additionally, it facilitates the collection of pure gum, free from impurities, and allows for tapping higher branches. The tool can be used for gum collection further enhancing its utility [6,7,11].

The Sonki is also described as a hand tool and characterized as safer, easier and quicker to use as well as being less injurious to the tree compared to axe (farrar). It has a metal head fixed to a long wooden handle [6]. The pointed end of the head is pushed tangentially into the stem to penetrate just below the bark and then pulled up to strip a small length of bark longitudinally from the wood, which involves tapping of gum Arabic trees. Moreover, Makmak is one of the traditional tools used in tapping gum trees particularly *Boswellia papyrifer*a [6] and *Acacia seyal* [7]. Makmak weighing 0.50 – 0.75 kg with a 15 cm blade and 7 – 10 cm sharp edge (Figure 3).

Given the importance of gum Arabic, it is crucial to evaluate tapping tools to ensure sustainable production and the health of the mother tree. Several studies have examined different aspects of gum Arabic including the effect of taping methods on gum and incense yield [12], gum Arabic certification and marketing opportunity [13], the impact tapping tools and tapping date [7], quality gum Arabic [14], quality management in the supply chain [14], the market chain of gum Arabic [1], and its contribution to rural household income [15]. Therefore, this study aims to study the current use of the Sonki tapping tool for *A. senegal* trees and to identify the challenges hindering its proper dissemination and adoption in West Kordofan.

Figure 1. Performance of Sonki, a tool for tapping and harvesting gum Arabic

Figure 2. Axe

Figure 3. Makmak traditional tapping tool

2. Research Method

2.1 Study Area

West Kordofan state is lies in the semi-arid region of Sudan [16]. It is located in the western part of the country, forming a transition zone between war-effected areas in the south and drought affected regions in the north [17]. The state is situated within latitudes 12°0′ N, and longitudes 28°9′E (Figure 4). It shares borders with five states, North Kordofan, South Kordofan, East Darfur, North Darfur and South Darfur. The total land area is estimated to be111,373 km2 [17], extending from low-rainfall savanna to high rainfall hill catena, with significant variations in vegetation cover [18]. Abu Zabad locality is situated in the northeastern part of West Kordofan State. It is bordered by El khewei to the North, El Nahoud to the West, Elsunut to the South and Elqoz and El Dalang to the East. The locality has a population of approximately 179000. The main economic activities include agriculture, animal husbandry, trade [19]. Abu Zabad locality is administratively divided into five units namely Abugalib, Aiak, Saata, Khamas Hallab and Khamas Eldunki [20].

2.2 Data Collection

Data were collected from the gum Arabic producer community. Respondents were randomly selected for interviews. A structured questionnaire was designed, incorporating both open and close-ended questions. Out of a total of 222 producers, 140 (representing 63%) were randomly selected and interviewed. The sample size was determined using the Robert Mathon model [21].

$$n = \frac{M}{[(S^2\ x\ (M-1):pq]+1} \quad (1)$$

Where: M = population size, N = sample size, S = (product from dividing standard degree opposite to 0.95 which is 1.96 to error rate (0.05), P = 0.50, and q = 0.50

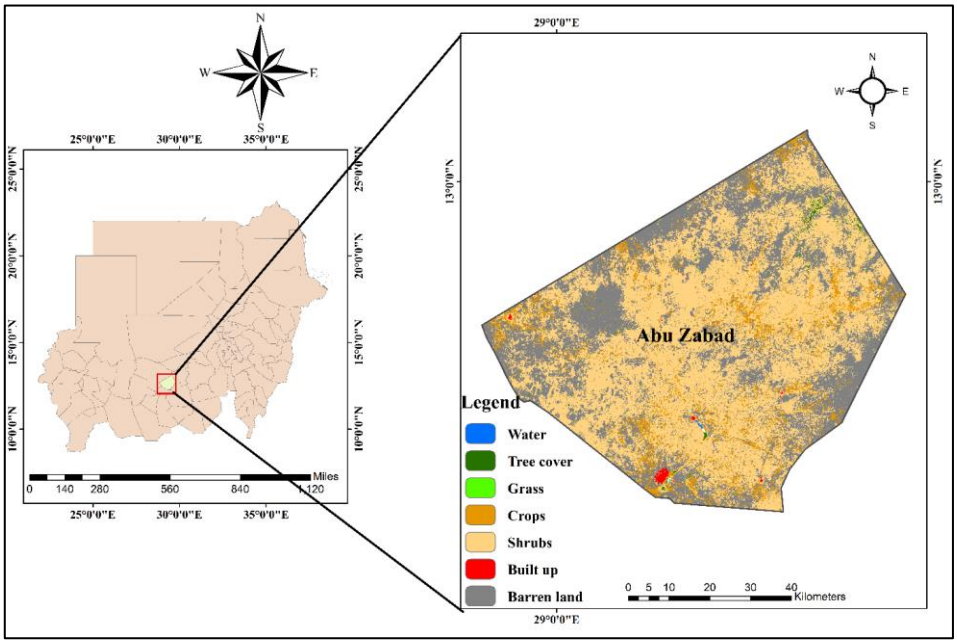

Figure 4. Map of the study area

2.3 Focused Group Discussions (FGDs)

To gather more qualitative data and validate the findings, eleven Focus Group Discussion (FGDs) were conducted in the study area. FGDs were held in the Administrations of Saata, Khamas and Abogalib, involving a total of eleven producers' communities. Each Group Discussion (GD) consisted of 8-9 randomly selected producers. The main topics covered included the introduction of the sonki tool, its introduction process and the individual responsible for introducing it. Additionally, the discussions explored the advantages and disadvantages of the sonki, factors influencing its adoption as well as the producers' opinions and observations.

2.4 Key informant Interview

Three key informant interviews were conducted. One was conducted with the chairman of the Gum Arabic Producers Association (GAPA) in West Kordofan State, and chairman of Abu Zabad GAPAs, and the third with director of Forest National Corporation in the locality.

2.5 Statistical Analysis

The collected data were organized and entered into Statistical Packages for Social Sciences (SPSS), OriginPro 2024b and Microsoft excel for further analysis. Descriptive analysis and the Chi square test were applied, and the results were presented in tables and figures.

3. Results and discussions

3.1 Age and Occupations of Respondents

It was found that more than one-third of respondents were between 41-50 years old, with about one-third of respondents being over fifty. These results suggest that the older generation is more engaged in farming and gum Arabic production compared to the younger group (Table 1). Therefore, it appears that younger individuals in the area may be pursuing other jobs or focusing on education. Chinchmalatpure and Koshti [22] noted that youth tend to show less interest in agricultural activities. Regarding the occupation, the majority (78.6%) of respondents practiced both farming and gum Arabic production (Table 1).

3.2 Producers' Years of Experience in Gum Production

There was variation in years of experience among the producers. Some had extensive experience, while others had less. For example, 24.3% had 10-15 years of experience, while 27.1% had more than 20 years of experience (Table 2). It was observed that experience in gum Arabic production is often inherited. As a result, some younger individuals in certain families had more experience than other elder individuals in other families. Naturally, elder people tend to have more experience overall. It is worth noting that a lack of experience and financial means may remain significant challenges for adoption [9].

Table 1. Age and jobs of respondents

Variables		Frequency	Percentage
Age	20-30 years	20	14.3
	31-40 years	28	20.0
	41-50 years	52	37.1
	Over 50 years	40	28.6
Jobs	Farming	4	2.9
	Gum production	5	3.6
	Farming & laboring	21	15
	Farming & Gum production	110	78.6

Table 2. Producers' experience in gum production

Variables	Frequency	Percentage
Less than 5 years	14	10.0
From 5-10 years	34	24.3
From 10-15 years	24	17.1
From 15-20 years	30	21.4
Over 20 years	38	27.1
Total	140	100.0

3.3 Tapping Time and Tapping Position

Tapping time and tapping position are important factors that influence the quantity and quality of gum Arabic [23]-[25]. According to the response, 72.9% of the respondents indicated that October is peak time for tapping (Table 3), a finding that is consistent with numerous studies [6,8,26,27]. Producers prefer to tap in October because, based on their experience, it is considered the optimal month for tapping. During October, most trees reach maturity and are ready for tapping, as indicated by certain signs, such as leaf shedding, yellowing bark and leaves, cessation of rainfall, and relative increase in temperature. Additionally, by October, most agriculture activities have concluded, providing producers with time to focus on gum production. Regarding tapping positions, approximately 60% of the producers tap branches only, while more than 40% tap both branches and stems (Table 3). Several studies recommended that branches are the best part of the tree for tapping gum Arabic production [9,28]. Therefore, tapping on branches reflects the producers' experience in gum Arabic production.

Table 3. Tapping time and tapping position

Tapping system	Month/position	Frequency	Percentage
Tapping time	October	102	72.9
	November	30	21.4
	December	1	0.7
	All above (three months)	7	5.0
Tapping position	Branches	77	55.0
	Stems	3	2.1
	Branches and stems	60	42.9

3.4 Gum Arabic Tapping Tools

Historically, local community used Axe (farrar) and Makmak as tapping tools for *A. senegal* and *A. seyal* respectively [29]. However, after the innovation of Sonki by a related research institute, and producers began adapting this tool. Our study found that 31.4% of respondents still using axe (farrar), while only 13.6% use Sonki exclusively for tapping *A. senegal* for gum production (Table 4). This aligns with findings from [30], who reported that most of the producers still use axe for tapping gum trees. Therefore, the use of Sonki remains low in our study area, likely due to adaptation issues or a lack of knowledge among the local community and producers. However, the use of Sonki improves gum production and helps maintain the health of mother trees [7,10]. This situation calls for intervention, including training and raising awareness among gum Arabic producers. Notably, the Institute of Gum Arabic Research and Desertification Studies (IGARDS) has made significant effort in training gum Arabic producers and building up their capacity [31], but continued support

from governments, NGOs and community-based organizations is essential for sustainable production. Furthermore, training gum Arabic producers on tapping and harvesting methods could lead to sustainable gum productions [2].

Table 4. Common tapping tools

Tapping tools	Frequency	Percentage
Sonki	19	13.6
Makmak	4	2.9
Axe (farrar)	44	31.4
Axe (farrar) and makmak	29	20.7
Axe (farrar) and *sonki*	44	31.4

3.5 Producers' Information about Sonki

Sonki has been introduced in the area for quite some time, but not all producers are familiar with it. Our study found that 62.1% of the community members were aware of Sonki, while 38% were not (Figure 5). This highlights the need for further awareness campaigns, radio programs, and training to inform producers about the tool, its benefits and advantages.

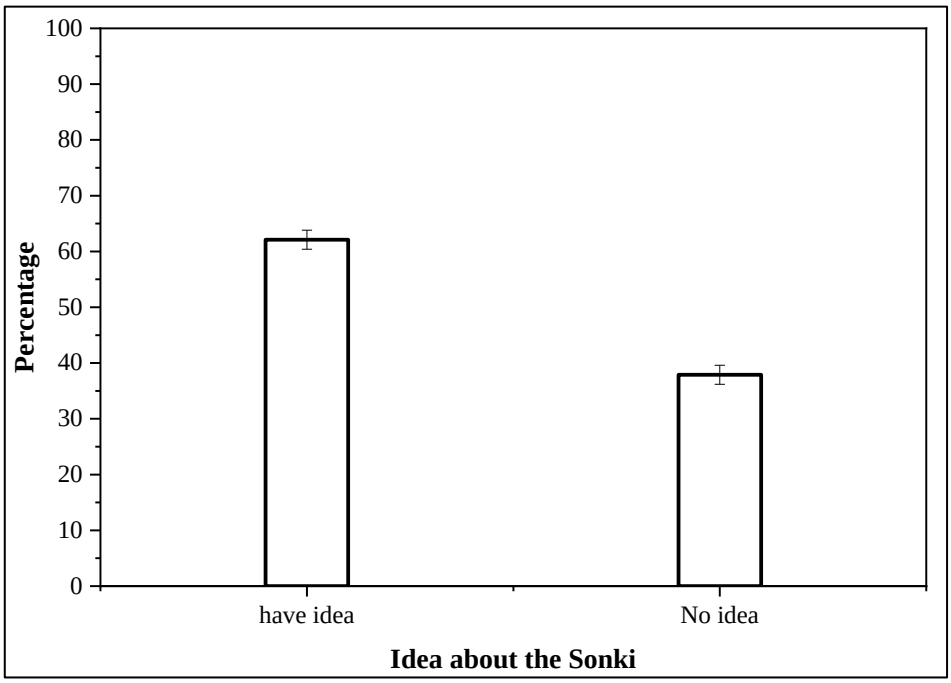

Figure 5. Ideas about the sonki among respondents

3.6 Introduction and Usage of Sonki

Tabel 5 shows the years when respondents first encountered Sonki. It was found that 31.5% of respondents become aware of the tool between 5 – 10 years ago while 45% of respondents reported that Sonki was introduced to the area in 1980 (Table 5). This means that the tool has been in use for over 50 years. If it has significant advantages, it should be more widely disseminated. Comparing this information with current usage, the results show 52.9% of respondents use Sonki while 47.1% still do not use it for tapping their trees (Table 5). A review by [6] confirmed that Sonki was first invented in 1961 by Mr. Vidal Hall at the Agricultural Research Corporation (ARC), El Obied Station in Western Sudan.

Table 5. When did you know sonki, when introduced and use?

Sonki	Time	Frequency	Percentage
When did you know	Less than 5 years	25	28.1
	5-10 years	28	31.5
	10-15 years	26	29.2
	20-30 years	10	11.2
When introduced	1970s	1	0.7
	1980s	63	45.0
	1990s	38	27.1
	2000s	38	27.1
Use	Yes	74	52.9
	No	66	47.1

3.7 Barriers to Sonki Adoption

The study revealed significant barriers to the adaptation and utilization of Sonki tapping in the area. A large portion of respondents (46.2 %) were unaware of the tool, indicating insufficient dissemination efforts (Table 6). Furthermore, 24 % of producers lacked access to the tool, suggesting economic or logistical constraints that hinder its availability in rural markets. Some producers also reported difficulties using Sonki (10 %) and its perceived heaviness, emphasizing the need for tailored training and economic improvements. Addressing these challenges through practical, hand-on training sessions could significantly improve user confidence and adoption rates. Ownership of Sonki also emerged a key factor in its usage, with 56 % of users owning the tool (Figure 6). However, 44 % of the producers who rely on borrowed or shared tools likely face inconsistent availability, which can hamper sustainable use. The dominance of market-based access (93.7 %) (Table 7) suggests limited involvement of institutional actors such as NGOs and the Forest National Corporation (FNC). While organizational support accounted for only 6.3 % of access, this mechanism is insufficient for large-scale dissemination.

Table 6. Reasons for not using Sonki

Reason	Frequency	Percentage
Do not have it	16	24.6
Do not know it	30	46.2
Difficult to use	7	10.8
Heaviness	4	6.2
No interest	5	7.7
Do not have and don not know	3	4.6

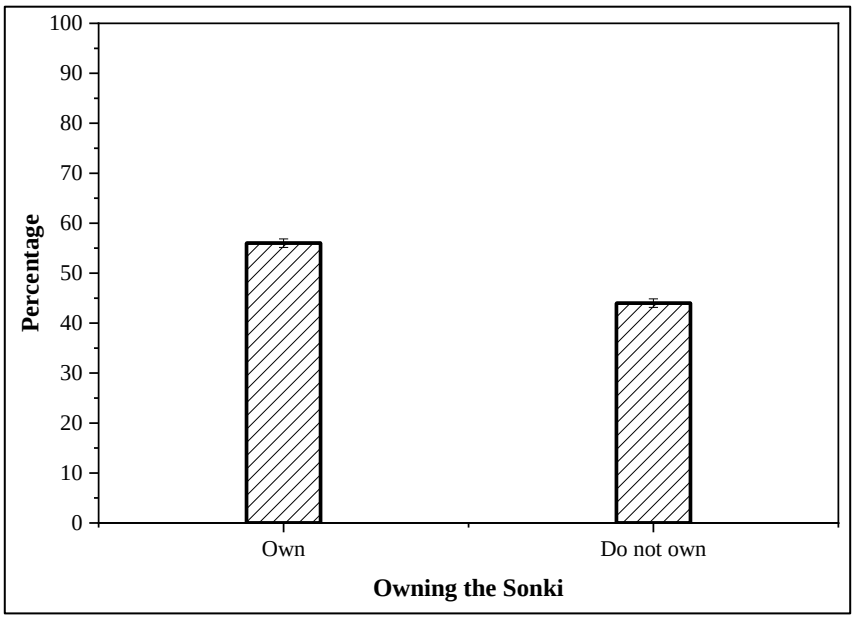

Figure 6. Owing sonki among respondents

Table 7. Ways of owning Sonki

Finding *sonki*	Frequency	Percentage
Gift	3	3.8
Market	74	93.7
Training	2	2.5

3.8 Sonki Sources, Access and Use in Gum Picking

Sonki is available in the local market. Our study found that 94.9% of respondents obtained Sonki from the markets, 3.8% from concerned organizations, and 1.3% from Forest National Corporation (Table 8). It is worth to noting that IFAD through Integrated Agricultural and Marketing Development Project (IAMDP), has trained blacksmiths in the manufacturing of Sonki at locality level in North, West, and South Kordofan, and Sinnar states. The Sonki is designed for both gum tapping and picking. However, only 26% of respondents used Sonki for both gum tapping and collection (Figure 7), which is lower than expected. This could be due to a lack of technical knowledge on its use.

Table 8. Access to sonki

Access	Frequency	Percentage
Forest National Corporation	1	1.3
Concern organization	3	3.8
Market	74	94.9

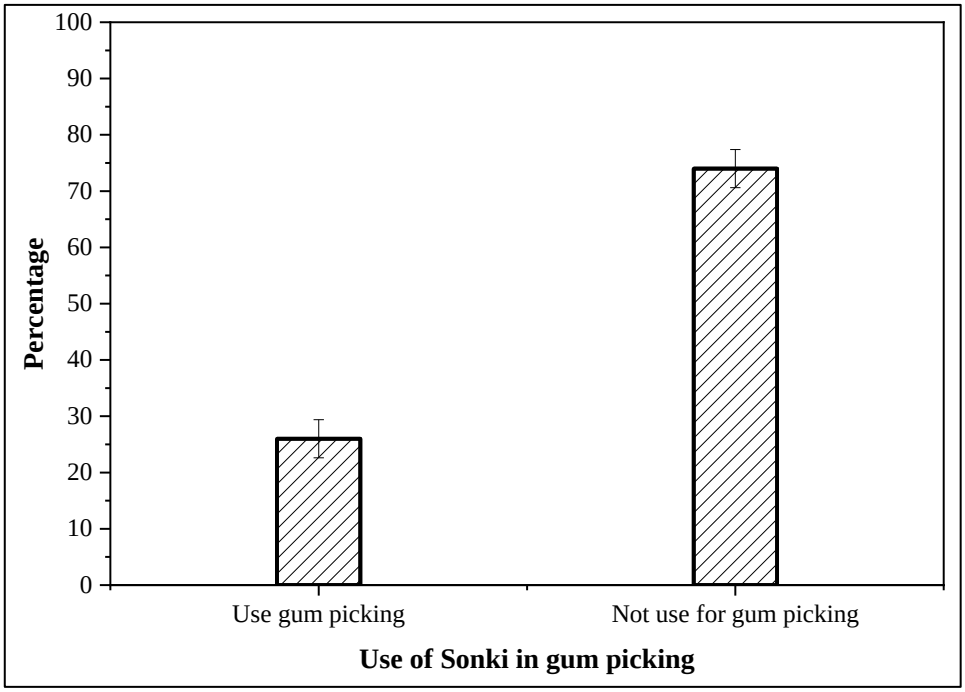

Figure 7. Use sonki in gum picking

3.9 Perceptions of Sonki among Users

The findings revealed that 88.9% of respondents agreed that Sonki is an effective tapping tool for *A. senegal* trees (Figure 8). They reported that it is safe, time-efficient, and easy to use by men, women, youth, and teens. However, some researchers found that Sonki is faster than axe (farrar), which is commonly used for tapping gum trees [32]. This is a positive indicator for further investigations into Sonki adaptation. Sonki lightweight, affordability and ease of access to high branches make it an attractive option for producers [6,33].

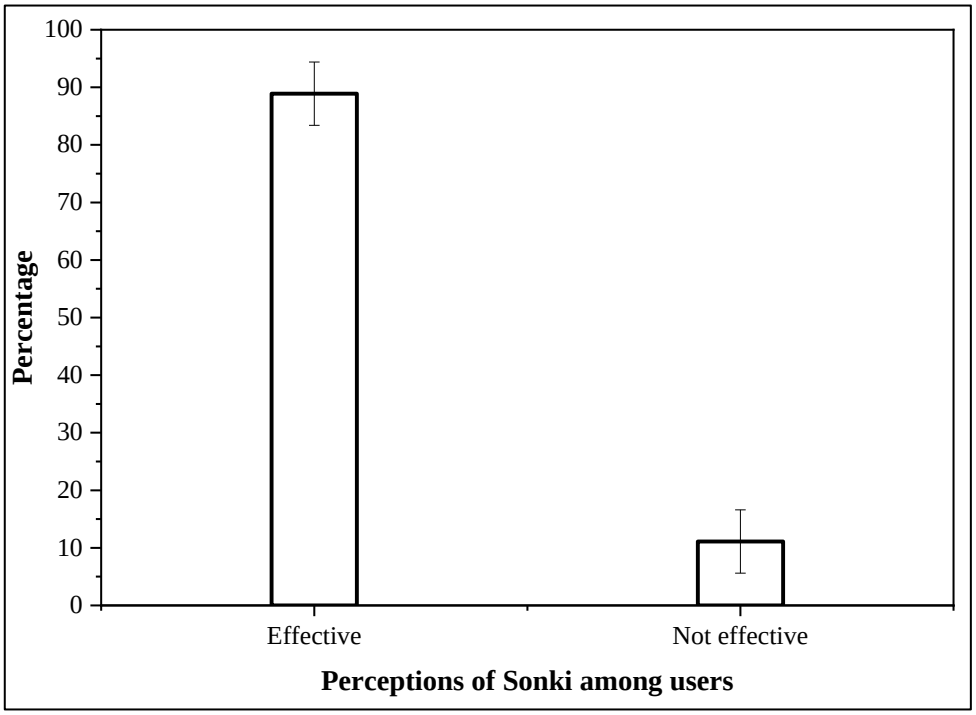

Figure 8. Effectiveness of sonki

3.10 Factors Affecting Adoption of Sonki

The main factor affecting Sonki adoption is the lack of training, with 77.7% of respondents highlighting the absence of training as a barrier (Table 9). Therefore, training is crucial for improving knowledge dissemination and accelerating adoption. Several researchers have suggested that promoting gum Arabic production depends on a thorough situation analysis, which must be complemented by intensive training and infrastructure development. Local knowledge and producers interest remain critical for successful adoption [32].

Table 9. Factors affecting adoption of Sonki

Factors	Frequency	Percentage
Absence of training	108	77.7
In availability	9	6.5
Both absence of training and in-availability	7	5.0
Not applicable	6	4.3
Costly	5	3.6
Not applicable and absence of training	4	2.9

3.11 Strategies to Increase Sonki Adoption

Several methods have been identified to increase Sonki adoption. According to producers' perception, the most effective strategies include the provision training (82.9%) (Figure 9). Providing training is essential for a sustainable model of tapping and gum collection. Efforts have been made to increase the adoption of sonki, such as IGARDS, conducting annual training in the gum belt to promote Sonki in adoption [34]. IGARDS has also partnered with FNC and ARC to extend the reach of Sonki through training and extension services. However, the effectiveness of training should be improved, and it is proposed that GAPAs organize and conduct these training sessions. Unfortunately, in many GAPAs, members fail to support the association financially and physically due to the small size and poverty of producers who are not fully aware of the importance of collective action [35].

3.12 Chi-square for Significant Differences between Years of Experience and Information about sonki

The Chi square test revealed a significant relationship between years of experience in gum Arabic production and knowledge of Sonki tapping tool. Producers with over 20 years of experience have a

significantly higher level of knowledge about Sonki compared to those with less experience. This finding suggests that long-term involvement in gum Arabic production allows producers to gradually accumulate knowledge about tools like Sonki (Table 10). The association between extensive experience and knowledge highlights the crucial role of experiential learning and peer networks in disseminating information. Veteran producers often acquire knowledge through observation, interaction with peers, and sustained involvement in the sector. However, this gradual learning process may slow the widespread adaptation of new tools, particularly among less experienced producers who have limited exposure to informal knowledge-sharing networks. This underscores the need for targeted interventions to accelerate knowledge acquisition among newer producers. Structured training programs, awareness campaigns, and hand-on demonstrations can help bridge this knowledge gap. Providing comprehensive information about Sonki, its benefits, and proper use, can significantly enhance adoption rates. Additionally, engaging experienced producers as trainers or advocates could further support knowledge dissemination across the community.

3.13 Chi-square for Significant Differences between Owning and Use of Sonki

The Chi square test showed a highly significant difference ($P \leq 0.05$) between owing and using Sonki, with a strong association observed (significance = 0.000). Producers who owned the tool were far more likely to use it, with 72% (Table 11) of owners actively utilizing it. This finds underscore ownership as a critical factor in adaptation, as it ensures consistent availability and familiarity with the tool. Furthermore, the results suggest that promoting ownership among producers is a key strategy for increasing its adaptation and sustained use. Producers who rely on borrowed or shared tools may face constraints such as limited access during peak tapping periods, which can discourage consistent use. Additionally, ownership allows producers to tailor usage practices to their specific needs, enhancing their efficiency and confidence over time.

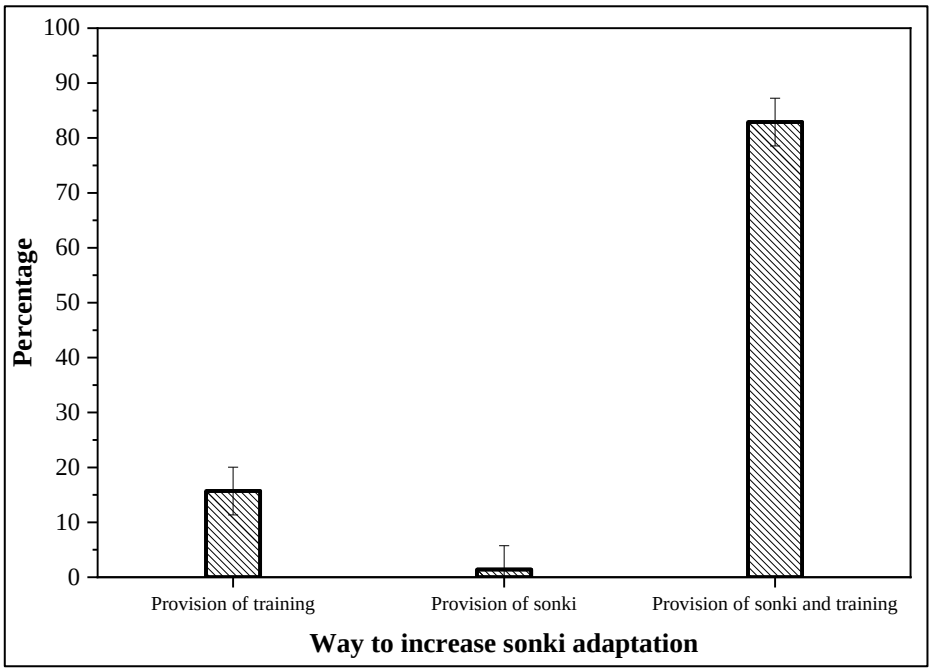

Figure 9. Ways of increasing the adoption rate of sonki

Table 10. Chi-square for significant differences between years of experience and information about sonki

Years of experience	Information about *sonki*		Sig
	Yes	No	
Less than 5 years	6	8	
From 5-10 years	22	12	0.593
From 10-15 years	16	8	
From 15-20 years	18	12	
Over 20 years	25	13	

$P \leq 0.05$ = Significant, indicating by Chi-square test, X2= 2.790

Table 11. Chi-square for significant differences between owning and use of sonki

Do you own *sonki*	Have you used *sonki*		Sig
	Yes	No	
Yes	72	7	0.000
No	2	59	

$P \leq 0.05$ = Significant, indicating by Chi-square test, X2= 106.634

3.14 Output of FGDs

The majority of respondents stated that sonki was introduced in the 1980s, while in some communities it was introduced in 1990s (Appendix 1). In most areas local experience and influence from neighboring communities are adopted. In some villages, blacksmiths played a role in their introduction. Additionally, organizations such as cooperative for assistance relief everywhere (CARE) have significantly contributed to promoting the use of Sonki in tapping areas. Radio broadcasts have also helped raise awareness among producers. In most communities where Sonki was introduced, it was primarily used for tapping. However, only about 50% of users are utilized for gum collection. Respondents who used Sonki in gum collection or harvesting noted it is safe, environmentally friendly, fast, effective, and results in clean, high-quality gum. However, others pointed out certain drawbacks, such as its weight, time consumption, and difficulty in collection. Some also argued that Sonki does not clean the tapping position as effectively as the axe (farrar) and makmak. This perception may be due to a lack of experience or improper use of the recommended Sonki.

It is important to note that the targeted Sonki has specific measurements, weight and a proper method of use. Incorrect tools or improper techniques can lead to misconception about its effectiveness. The main barriers to Sonki adoption as identified by respondents, including its unavailability, lack of information, and insufficient training. When asked about ways for increase adoption, they suggested (1) ensuring Sonki readily available and accessible, (2) providing training on its proper use, and (3) improving the design of Sonki to better accommodate the gum producing trees in the area. Respondents also noted that their regions have a wide range of gum producing trees species. However, gum Arabic production is increasingly threatened by factors such as tree locust infestations, overgrazing, excessive tree cutting, and fire damage. Additionally, agricultural expansion, particularly the replacement of gum Arabic trees with ground nuts and other cash crops, has further reduced production [36,37]. Despite the introduction of Sonki, the axe (farrar) remains widely used, with 100% of producers in some areas still relying on it. This underscores the urgent need for intensive training and intervention. Producers prefer the axe because it serves multiple functions, including tapping, pruning small branches, cleaning the tapping position to enhance gum exudation, and facilitating collection. However, they often overlook its negative impact on the trees. Pruning small branches reduces gum productivity, and untrained tappers may mistakenly believe that intensive tapping increases gum yield. Improper tapping techniques, particularly by inexperienced users, can cause wounds on branches and stems, making trees susceptible to pests and diseases, ultimately leading to their decline [28]. Thes challenges are particularly significant because gum Arabic is a key economic product in Sudan. In the 1970's, gum production was the second most important source of income after annual crops. However, in recent years, income from labor migration has become increasingly vital in many parts of the gum belt [38].

4. Conclusion and Recommendations

The Sonki tapping tool was introduced to the study over 40 years ago as a recommended alternative to traditional tools such as the axe (farrar) and makmak. In contrast, research has consistently shown that Farrar threatens tree health and reduces productivity, making it less suitable for sustainable gum Arabic production. Producers have expressed a willingness to adapt modern tools and techniques to improve tapping and collection practices, reflecting their interest in advancing the sector. However, the adaptation of Sonki remains limited due to inadequate training, lack awareness, and restricted accessibility. Despite the economic significance of the gum Arabic sector in Sudan, it receives insufficient attention and investment in capacity-building initiatives.

To address these challenges and promote the widespread adoption of Sonki, the following interventions are recommended: technical and practical training programs implement structured training programs focusing on gum Arabic production and tapping techniques. These should include demonstrations and hands-on sessions to enhance the producer's confidence and competence. Improve the design of Sonki to better meet user needs and make it more efficient and easier to handle. Train local blacksmiths to manufacture the Sonki according

to recommended specifications, ensuring its availability and affordability. Launch awareness campaigns to educate producers on the benefits of Sonki and ensure that the tool is readily accessible in key gum producing areas. Encourage government and private sector investment in capacity-building initiatives to strengthen the gum Arabic industry and support sustainable production.

Acknowledgement
Thanks to all the community in the study area for helping us and given us their perception to carry out this research

Conflict of Interest
The authors declare no competing interests.

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Appendix

Appendix 1. Summary of the group discussion output with the gum *Arabic* producers

Admin/community	Year of introducing *sonki*	Introduced by	Way of introduction	Use in tapping	Use in collection	Positives of *sonki*	Negatives of *sonki*	Problem of adoption	Proposes for increasing adoption	Observations
Khamas/Donki	1980s	Producers	Experience	Most have no experience	Most have no experience	No idea	No idea	Isn't known Isn't available	Make *it* available Training	Overgrazing Over cutting
Khamas/Um Erig	1980s	Producers	Adoption from other	Most have no experience	Most have no experience	No idea	No idea	Isn't known Isn't available	Make it available Training	100% *axe (farrar)*
Khamas/Halab	1980s	Producers	Experience	Not known	Not known	No idea	No idea	Not known	Make it available Training	100% *axe (farrar)*
Khamas/Hajar	1980s	CARE	Training	Most have No experience	Most have No experience	No idea	No idea	Isn't known Isn't available	Training	Replacing *Hashab* with groundnut
Saata/Saata Abdelrazig	2007	FNC	Radio	Used in tapping	Used collection	Safe and efficient	Difficult to use in collection	No experience	Make it available	*Axe (farrar)* and makmak are used
Saata/Saata Zarga	1986	Black smith	Adoption	Used in tapping only	No experience	Safe and efficient	Heavy Need training	Not available No training	Make it available Training	Overcutting Overgrazing Tree diversity
Saata/Saata Zalat	2015/2016	Producers	Adoption from others	Used in tapping	Used collection	Safe and efficient	Can't be used for aged trees	Not available and costly	Training	Fire Tradition *sonki*
Saata/Saata Um Khir	1986	Producers	Adoption from others	Used in tapping	Used in collection	Efficient	Difficult to use in collection	No experience	Make it available Training	Overcutting Overgrazing Age gradation
Saata/Elkhairy	1986	Producers	Adoption from others	Used in tapping	Used collection	efficient	Difficult to use in collection	No experience	Offering it and train	Tree diversity Overgrazing Over cutting Fire/Age gradation
Abogalib/Awlad Aamir	1990	Blacksmith	Black smith	Used in tapping only	No experience	Efficient	Costly Doesn't clean tapping positions	Isn't known Isn't available	Training	Random tapping Pests Need for seedlings
Abogalib/Um Bada	1990	FNC	Radio	Used in tapping	No experience	Safe	Heavy and slow	*Sonki* is not improved	Make it available	Tree diversity Replacing *Hashab* with groundnut
Abogalib/Um Diffais	1990s	CARE	Training	Used in tapping only	No experience	High yield Safe	Heavy and slow	No training	Avail *sonki* Training Improve *sonki*	Tree diversity Regeneration of *Hashab*, *axe* and makmak are used