Ondo University Journal of Agriculture and Social Sciences 2023, 1(1): 22–28

GLINTPLUS

Original Article

Users' suggested roadmap to increase adoption of innovation: the case of shea butter processing technologies in Oyo State, Nigeria

Oluwatoyin. K. Zaka[a,*], Benjamin G. Ahule[b], Magret Bai-Tachia[b] and Festus O. Ilemaiye[c]

[a] Centre for Food Technology and Research, Benue State University, Makurdi, Nigeria; [b] Benue State University Makurdi, Nigeria; [c] Nigeria Stored Products Research Institute, Ilorin Kwara State, Nigeria

ABSTRACT

This study examined processors' suggestions to improve the adoption of shea butter processing technologies in Oyo State, Nigeria. A multi-stage sampling procedure was used to select 386 shea butter processors as respondents. Quantitative data were collected using an interview schedule, while qualitative data were collected with the use of Key Informant Interviews (KII). Data collected were described with descriptive statistics like frequency counts, percentages and mean and qualitative data collected were analysed using Atlasti and transcription method. Findings showed that 50.5% of the respondents always used cold press technology, 47.2% always used centrifuge technology, and 1.3% always used solvent extraction technology. The respondents further suggested interventions on the cost of improved shea butter technologies (38.7%), social factors (23.3%), technical training of processors on improved shea butter technologies (20.7%), and access to the market for shea butter production. The study concludes that the usage of improved shea butter processing technologies is low. Therefore, it recommended that agricultural extension organizations in the study area should improve on their efforts to address the needs of the users for the effective adoption of improved shea butter processing technology in Oyo State.

HIGHLIGHTS

- Increased adoption of ISBPTs give shea butter overall productivity outcome
- Efficient processing ensures shea butter targeted demand with high returns.
- Social Factors and market opportunity promote increased adoption of ISBPT
- Shea butter processors face financial menace and processing skills obstacle

Article History:
Received: 26th March 2024
Accepted: 25th June, 2024
Available online: 18th September, 2024

Keywords:
Technology adoption; shea butter processing; Oyo State; innovation roadmap; technical training

1. Introduction

Increasing the adoption and utilization of advanced agricultural technologies is crucial for enhancing the productivity and efficiency of the agricultural sector, which, in turn, plays a significant role in alleviating poverty and reducing food insecurity in developing countries (Atsriku et al., 2020). Shea butter, a product of substantial economic value with diverse applications, is a prime example of an agricultural commodity in need of such technological advancement. Despite the presence of an estimated 500 million shea trees across West, Central, and East Africa, only about 2.5 million trees are currently used for shea butter production (FAOStat, 2013). Meeting the growing demand for shea butter domestically and internationally has proven to be challenging. Most processors in these regions still rely on traditional, labor-intensive methods characterized by high time consumption and low-quality output. The high costs associated with purchasing and maintaining modern shea butter processing equipment, coupled with limited knowledge about their operation, have significantly hindered the adoption of improved technologies in this sector.

The introduction of appropriate technologies that mechanize specific operations within the traditional manual system is essential. For example, the use of kneaders, hydraulic or screw presses, and nut crushers in addition to manual processes can significantly reduce the labor burden associated with traditional methods. Improved agricultural technologies can lead to increased incomes for farm workers, better nutrition, more employment opportunities, higher income levels, and reduced prices for staple foods (Sennuga et al., 2020). While developed countries have successfully implemented agricultural innovations such as those during the Green Revolution (Kasirye, 2010), the adoption of enhanced shea butter processing techniques has shown positive impacts on farmers' livelihoods and business growth in Africa (Mohammed et al., 2013) and other developing regions (Kimaru-Muchai, 2020). These technological advancements have greatly contributed to increased agricultural output in these nations (Mapila, 2011).

Despite the availability of new agricultural production innovations, adoption rates remain low among rural farm households, leading to persistently low incomes and significant challenges in developing countries (Matanmi et al., 2011; Emily, 2015). This study aims to promote knowledge exchange and build

* CONTACT: O. K. Zaka; apinkemisi2004@gmail.com; Centre for Food Technology and Research, Benue State University, Makurdi, Nigeria
https://doi.org/10.52493/j.oujas.2023.1.91

awareness to encourage the practice of improved shea butter processing technologies. The acceptance, implementation, and utilization of modern technologies can enhance efficiency, productivity, and overall outcomes. This often involves replacing outdated technologies with newer ones that offer better features, performance, or functionality, thereby empowering farmers to overcome processing challenges, increase productivity, reduce costs, enhance sustainability, and access new market opportunities. Such steps are vital for building resilient and efficient agricultural systems capable of meeting the food demands of a growing global population while minimizing environmental impacts.

The adoption of new technologies typically follows a phased process: awareness, interest, evaluation, testing, and final adoption (Sennuga and Oyewole, 2020; Rogers, 2010). This process enhances the capacity of shea processors to adopt improved technologies that increase both the quality and quantity of shea butter production, thereby boosting the income of processors and other stakeholders in the value chain (Baiyegunhi et al., 2018). In line with this, the present study presents a suggested roadmap to increase the adoption of innovative shea butter processing technologies in Oyo State. Specifically, the study examined the level of usage of improved shea butter processing technologies, identified constraints to the adoption of improved shea butter processing technologies and proffered ways to promote increased adoption of improved shea butter processing technologies.

2. Methodology

The study adopted a mixed research design, which meant that the data collected was not only qualitative but also quantitative. Interviews were conducted with key stakeholders in the shea industry to gather insights on the impact of improved processing technologies. Therefore, personal communication was cited in this study using the term interviewee followed by the date of the interview. The research was conducted in Oyo State, Nigeria. The state land mass coverage is 28,454 square kilometers and it lies between latitude $9^{\circ}8.74^{1}$N and $7^{\circ}1.68^{1}$N and longitude $2^{\circ}38.66^{1}$E and $4^{\circ}38.25^{1}$E of the Greenwich Meridian. The state comprises 33 local government areas and has a population density of 297 people per square kilometre (Eme & Idike, 2015). The majority of people engaged in growing different types of food crops (Maize, Yam, Cassava and so on) and cash crops (Cocoa, palm tree, and kolanut to mention but a few). *Parkia biglobosa* tree and shea butter tree are mostly found in the wild.

The population of this study is shea butter processors in Oyo state, comprising only the people who process shea nuts into butter. The estimated population of shea butter processors in Oyo State is 882,738 according to the Agricultural Development Program (ADP), Ministry of Agriculture, Oyo State (2019). However, this study selected only 400 respondents to represent the entire population using sample size determination. The Taro Yamane (1967) sample size determination formula for finite populations was used in determining the sample size for this study. Obtaining information from the entire population in an empirical study of this nature is often unfeasible. Accordingly, inferences are drawn from data obtained from a sample of the whole population. Hence, a multi-stage procedure was therefore used for the study. The shea butter-producing areas in Oyo state are clustered into three ADP zones, namely Saki, Ogbomoso and Oyo. The researcher narrowed the study area to a manageable size for effective sampling. Five (5) local government areas (LGAs) namely; Itesiwaju, Orire, Atisbo, Saki West and Saki East were selected from the clustered zones using purposive sampling techniques. This was based on the preponderance of shea butter processing in these areas. Simple random sampling through balloting was then employed to select four (4) council wards from each of the Local Government Areas (LGAs) sampled for the study. This is to ensure that every council has an equal chance of being selected. A purposive sampling technique was used in selecting twenty (20) households from each of the council wards. This was done based on the shea butter processing activity in the households. And in every of the households selected, a respondent was randomly selected giving every element of the population an equal chance of being selected. Hence 20 respondents were selected in each of the 20 sampled council wards bringing a total of 400 respondents used in the study area. Furthermore, purposive sampling was employed to select fourteen (15) informants for key study interviews. The informants are executives (chairman, secretary) of the Shea Butter Processing Association in each local government area and extension agents covering the areas. The selection was done based on the perspective that they were informed of the phenomena of the study considering their position as executive members and agricultural extension agents who have worked with the shea butter processing associations in their respective local government areas for 5 years and above.

Structured questionnaires and key informant interviews were used as instruments of data collection for mixed method research design that is quantitative and qualitative data of the study. Test for the reliability of the research instrument (test-retest) was conducted on 20 shea butter processors randomly selected within two weeks in Ilorin (Kwara State) with similar characteristics to those in the study area (Pearson Product Moment Correlation Analysis). The result of the test-retest was a Coefficient of Reliability (r) of 0.7, indicating that the research instrument was reliable. In constructing the questions for the interview, the researchers ensured that the questionnaires were not open-ended but structured. This was administered by the researchers reading out the questions to the respondents and writing down their responses. This was done with the help of three (3) research assistants based on the objectives of the study. There was face-to-face interaction with the researchers and the respondents. This instrument of data collection reduces the bias of the interviewer and also enables the researcher to cover a relatively large number of respondents. The key Informant Interview (KII) guide was used to collect qualitative data to complement the structured questionnaire used. Fifteen (15) participants were purposively selected, three (3) from the executives of shea butter processing associations and extension agents (chairman, secretary and a member) in each of the five local government areas of study. Informants who have good knowledge of shea butter processing technologies, from 5-30 years of experience were interviewed using key informant interviews with only seven (7) questions. This is because the school of thought believes experience is the best teacher and these categories of informants have garnered a consistent wealth of experience in working with the shea processors over the years. The interview was conducted in the respective homes of the respondents within the space of 45mins-1hour each. This instrument enables the study to cross-check the responses gathered through the structured interview schedule.

Quantitative data was analyzed using Statistical Package for Social Science version 23, while qualitative data were analysed with the use of thematic stories and direct quotes from people's responses. Primary data collected were analyzed using descriptive statistics like frequency counts, percentages, mean, and standard deviations.

Table 1. Distribution of respondents according to level of usage of improved shea butter processing technologies

ISBPT	Stopped Using it (%)	Rarely (%)	Sometimes (%)	Always (%)	Mean (SD)	Remark
Cold Press	4(1.0)	13(3.4)	31(8.0)	195(50.5)	2.34(1.86)	Low
Centrifuge	6(1.6)	9(2.3)	91(23.6)	182(47.2)	2.66(1.65)	High
Solvent Extraction	134(34.7)	43(11.1)	8(2.1)	5(1.3)	0.68(0.85)	Low

3. Results and Discussion

The results in Table 1 from the study revealed the level of usage of the improved shea butter processing technologies. Findings showed that 195 (50.5%) respondents always use a cold press, followed by 31(8.0%) respondents that sometimes use it, while 4 (1.0) respondents that had stopped the use were the least. The same happened in the case of centrifuge technology with 182 (47.2%) respondents always use and the least 6(1.6) respondents stopped use, however, in solvent extraction technologies, the majority 134 (34.7%) of the respondents had stopped using, followed by 43 (11.1%) respondents that rarely use and 5(1.3%) respondents that always use was the least. The data showed the level of usage of all the improved shea butter processing technologies. Any improved technology with a mean score between 2.5 -3.0 is rated high usage and the mean score below is considered low usage. Centrifuge-improved technologies have a mean score of 2.5-3.0 which indicates a high level of usage. On the other hand, cold press and chemical extraction technologies had a mean score below 2.5, indicating a low level of usage of these technologies.

The low usage recorded of the last two technologies was from the fact that the respondents thought the application of heat to the kernel by either roasting or boiling, is the only way to harvest increased oil yield and vice versa using a cold press. The finding conforms to the previous study which stated that heating up of shea kernel during dry extraction yielded more oil. However, the process with its worldwide acceptance and popularity in modern vegetable industries has not widely extended to shea butter processing (Nosiru *et al.*, 2022). The shea butter is normally collected in this form (oil) before it solidifies.

In addition, chemicals are used for the extraction of shea butter during processing which is frowned upon by the respondents. This is because using chemicals on food is detestable among the processors. Shea butter is a food condiment. This finding also corroborates the findings of the previous studies which stated that intimate knowledge of farmers' local conditions and resources improves farmers' adaptive capacity to select and adopt solutions that best suit their needs (Kambani *et al*., 2022). Otherwise, there will be issues of non-adoption or partial adoption by the respondents (Obayelu *et al*., 2017; Nwaubani *et al*., 2020).

3.1. Constraints to Adoption of Improved Shea Butter Processing Technologies

As shown in Table 2, bureaucratic bottlenecks in procuring ISBPT equipment (Mean=2.23) ranked first, high cost of ISBPTs equipment (Mean=2.23) ranked second, Lack of funds for shea butter processing (Mean=2.18) ranked third, the inadequacy of equipment supplied of ISBPTs (mean=1.70) ranked the fourth, high cost of energy – woods, fuel (Mean=1.67) ranked fifth, high maintenance/operational costs (Mean=1.59) ranked sixth, unfavourable government policies (Mean=1.57) ranked seventh, inadequate extension services for timely information on ISBPTs (Mean=1.54) ranked eighth, lack of technical know-how on the operation of ISBPTs and maintenance of equipment (Mean=1.53) ranked ninth, scarcity of spare parts (Mean=1.52) ranked tenth, inadequate of electricity/power supply to operate ISBPTs equipment (Mean=1.47) ranked eleventh, untimely distribution of ISBPTs equipment (Mean=1.40), and High cost of labour (Mean=1.31) ranked thirteenth positions of constraints to adoption of shea butter process.

The high cost of ISBPT equipment, lack of credit/funds for shea butter processing and inadequacy of equipment supply of ISBPTs were the foremost constraints facing shea butter processors to adopt the use of ISBPTs in Oyo State. This finding is consistent with the report by Kabiru and Ayanfunke (2018) who earlier found that the lack of credit facilities and the high cost of processing equipment were the leading constraints to the utilization of modern shea butter processing technologies in Niger State. A study by Egbunonu *et al.* (2019) similarly found that the high cost of equipment was the major limiting constraint militating against the usage of improved Shea butter technologies in Kwara State. The high cost of agricultural technology has been reported by several studies as a hindrance to the adoption of agricultural technology (Sennuga *et al*., 2020; Chi & Yamada, 2002).

Furthermore, respondents in the key informant interviews highlighted challenges with the supply, cost, and maintenance of Improved Shea Butter Processing Technologies (ISBPTs). One interviewee stated, "I am conversant with these improved technologies and perceive them as a mere wish. They are easy to understand, can be easily adapted, and offer higher yield and quality output of shea butter, but they are highly expensive. The government should increase the availability of improved technologies and help subsidize the cost." The literature supports this view, noting that financial constraints hinder technology adoption in agriculture and recommending subsidies to enhance accessibility (Pan et al., 2018; Balana & Oyeyemi, 2022).

Another key informant responded on June 15, 2021, stating, "There is a pilot unit of shea butter processing technologies in Saki and a few other privately owned firms. There is still a need for more of these units in other zones to lessen the burden on processors during operation." The respondent emphasized the need for more shea butter processing units across different zones, highlighting that the existing pilot unit in Saki is too far for many producers. This distance discourages processors from utilizing the available technology, as they are unwilling to incur the extra costs associated with transportation and time away from their operations. The inability to access credit from financial institutions exacerbates this issue, limiting producers' capacity to invest in these technologies. This observation is consistent with Kabiru and Ayanfunke (2018), who identified a lack of credit facilities and the high cost of processing equipment as significant barriers in Niger State. These constraints hinder the widespread adoption of modern shea butter processing technologies. Expanding access to credit and establishing more localized processing units are essential steps to reduce operational burdens and promote economic growth, ultimately improving productivity and profitability for shea butter producers.

The respondents, many of whom have been involved in shea butter processing since birth, emphasize the critical need for

Table 2. Constraints to Adoption of Improved SBPT

Constraints	Highly severe (%)	Moderately severe (%)	Not severe (%)	Mean (SD)	Ranking
Bureaucratic bottlenecks in procuring ISBPT equipment	181(46.9)	112(29.0)	93(24.1)	2.23(0.812)	1st
High cost of ISBPT equipment	154(39.9)	167(43.3)	65(16.6)	2.23(0.718)	2nd
Lack of access to credit/funds	165(42.7)	126(32.6)	95(24.6)	2.18(0.801)	3rd
Sociocultural factors	48(12.4)	175(455.3)	163(42.2)	1.70(0.678)	4th
High cost of energy – wood, fuel	28(7.3)	203(52.6)	155(40.2)	1.67(0.606)	5th
High maintenance/operational costs ISBPT equipment	8(2.1)	212(54.9)	166(43.0)	1.59(0.533)	6th
Unfavourable government policies	37(9.6)	146(37.8)	203(52.6)	1.57(0.662)	7th
Inadequate extension services for timely information on ISBPT	42(10.9)	125(32.4)	219(56.7)	1.54(0.683)	8th
Lack of technical know-how on the operation of ISBPT and maintenance of equipment	28(7.3)	147(38.1)	211(54.7)	1.53(0.629)	9th
Scarcity of spare parts	37(9.6)	128(33.2)	221(57.3)	1.52(0.665)	10th
Inadequate electricity/power supply to operate ISBPT equipment	43(11.1)	97(25.1)	246(63.7)	1.47(0.688)	11th
Untimely distribution of ISBPT equipment	8(2.1)	136(35.8)	240(62.2)	1.40(0.531)	12th
High cost of labour	27(7.0)	65(16.8)	294(76.2)	1.31(0.595)	13th

governmental support to make ISBPTs accessible to farmers in the region. Most of these farmers operate on a subsistence level, and without subsidies, the high cost of innovations may impede the adoption of ISBPTs despite their potential benefits. The majority of processors are small-scale operations dispersed across the state, making it financially challenging to purchase advanced technologies. Key informants indicated that although shea butter processors are eager to adopt ISBPTs, affordability remains a significant barrier. One respondent noted, "I am conversant with these improved technologies and perceive them as a mere wish. They are easy to understand, can be easily adapted, and offer higher yield and quality output of shea butter, but they are highly expensive. The government should increase the availability of improved technologies and help subsidize the cost." Additionally, the availability of traditional, less expensive processing methods contributes to the perception of ISBPTs as costly. Subsidizing ISBPTs could significantly encourage their

adoption. The literature consistently identifies the cost of technology, including acquisition and operational expenses, as a key factor influencing the adoption of innovations among smallholder farmers (Foster & Rosenzweig, 2010; Michalscheck et al., 2018; Akrofi et al., 2019). Similarly, Senyolo et al. (2018) noted that smallholder farmers in Africa often avoid adopting technologies with high acquisition and operational costs, highlighting the need for financial support to facilitate technology uptake.

Another female interviewee, aged 38 with 20 years of experience in shea butter processing, commented on 15th June 2021, “Although ISBPT is a promising project for the future of shea processors, I foresee a problem where established, traditional processors might be edged out of business by those who can afford the new technologies. This has led to a shift in the industry dynamics, creating a divide between original processors and newcomers who can leverage these advanced technologies.” This perspective highlights a significant barrier to the adoption of ISBPTs in the Oyo area. The existing literature supports this concern, indicating that technological advancements can disrupt traditional practices and marginalise long-standing producers (Lutomia & Bello-Bravo 2017). As such, it is crucial to address these disparities to ensure equitable access to improved technologies and maintain the viability of traditional processing methods within the industry.

Another interviewee on 15th June 2021 remarked, “The sense of belongingness and bond which make the processors identify with each other will not be strong again once improved technologies take over. This is because what 8 persons will achieve in an hour, improved technologies will do in fewer minutes with fewer people. Many will be made redundant, which may lead to sickness, poverty, even death.” This perspective highlights the potential social implications of adopting improved technologies, where job displacement could exacerbate socioeconomic issues. This finding aligns with Zaka (2020), who emphasises that sociocultural factors significantly influence the adoption of new technologies. Addressing these social impacts is crucial to ensure that technological advancements do not undermine community cohesion and well-being.

Understanding and respecting traditional shea butter processing practices is essential when designing technologies for adoption. These practices provide crucial insights for mobilising expertise and resources effectively. As such, a participatory approach to technology development, which integrates extension efforts and acknowledges agro-ecological and socio-economic contexts, is vital. This approach should also incorporate knowledge from diverse sources beyond just research (Leeuwis & Aarts, 2011; Zaka, 2020). Such a comprehensive strategy enhances the relevance and acceptance of improved technologies. Failure to account for these traditional practices and contextual factors may impede adoption and limit the potential benefits of technological advancements.

3.2. Ways to Promote Increased Adoption of Improved Shea Butter Processing Technologies

Among the key determinants of increased adoption of improved technology is the establishment of a cordial relationship between the research system, extension system and farming

system. In addition, are the market for the shea products, adequate resources for processing, incentives in the form of cost reduction or subsidies on the processing equipment and adequate social amenities. Furthermore, the linkages and value-added opportunities foster support for the shea butter processors in accessing markets for their products. All these will facilitate cordial relationships between buyers, exporters, and value-added industries that demand high-quality shea butter products. With global markets becoming increasingly interconnected, farmers who adopt improved technologies often gain a competitive edge. Technologies that improve product quality, traceability, and compliance with food safety standards can help farmers access higher-value markets and meet consumer demand. Farmers can expand their market opportunities and increase profitability.

The provision of technical training, and capacity building is another way to promote the adoption of improved shea butter processing technologies. Programs and workshop training for technical knowledge and skills enhancement of shea butter processing should be embarked upon. This should be with the focus of providing practical training on the operation, maintenance, and troubleshooting of improved technologies which will empower individuals to confidently adopt and utilize them. To promote the adoption of improved technologies there should be continuous learning and skill development for farmers to embrace new technologies. This learning process will enhance farmers' overall capacity, improve decision-making, and foster innovation within the agricultural sector.

Removing financial barriers is crucial for making improved technologies more accessible and affordable. This can be achieved through targeted subsidies, grants, or low-interest loans to lower upfront costs for shea butter processing equipment. Additionally, incentives such as tax breaks, grants, and certification programmes should be promoted to encourage processors to adopt these technologies. Such measures would help bridge the gap between the potential benefits of ISBPTs and their current limited adoption.

Collaborators such as financial institutions, government agencies, and development organizations should create financial mechanisms that support technology adoption. Stakeholders can also be engaged, forming partnerships with local communities, industry, associations, research institutions, and non-governmental bodies to create a supportive ecosystem for technology adoption. Collaboration with relevant stakeholders should also include infrastructure development organizations to address infrastructure gaps that will improve the overall efficiency of shea butter processing operations (Owen *et al.*, 2012).

Policies that are conducive to a regulatory environment should be developed and well inculcated for increased adoption; working together with the policy maker. The starting point is to ensure that enabling conditions to adopt technologies that will promote technology transfer, research and development, and innovation. There must be policies and programs reviewed to reduce the technological divide with access to infrastructure, information, external knowledge and removal of the regulatory bottleneck. All these will help the processors and policymakers to make informed

decisions in designing and implementing interventions. Data were collected on these salient points out of which, four most prominent points were illustrated in Figure 1.

On 15th June 2021, interviewees noted that "the Improved Shea Butter Technologies take away most of the traditional processing burden of truth, but the cost of development is on the high side without any intervention. The cost will come to bear on the production. If the cost of the product is no longer affordable, no one will be interested in buying. It is because it is cheap and affordable that we are still in the market anyway." This highlights a crucial issue: while improved technologies can alleviate traditional processing challenges, their high costs threaten market viability if left unaddressed. The implication is clear: without affordable

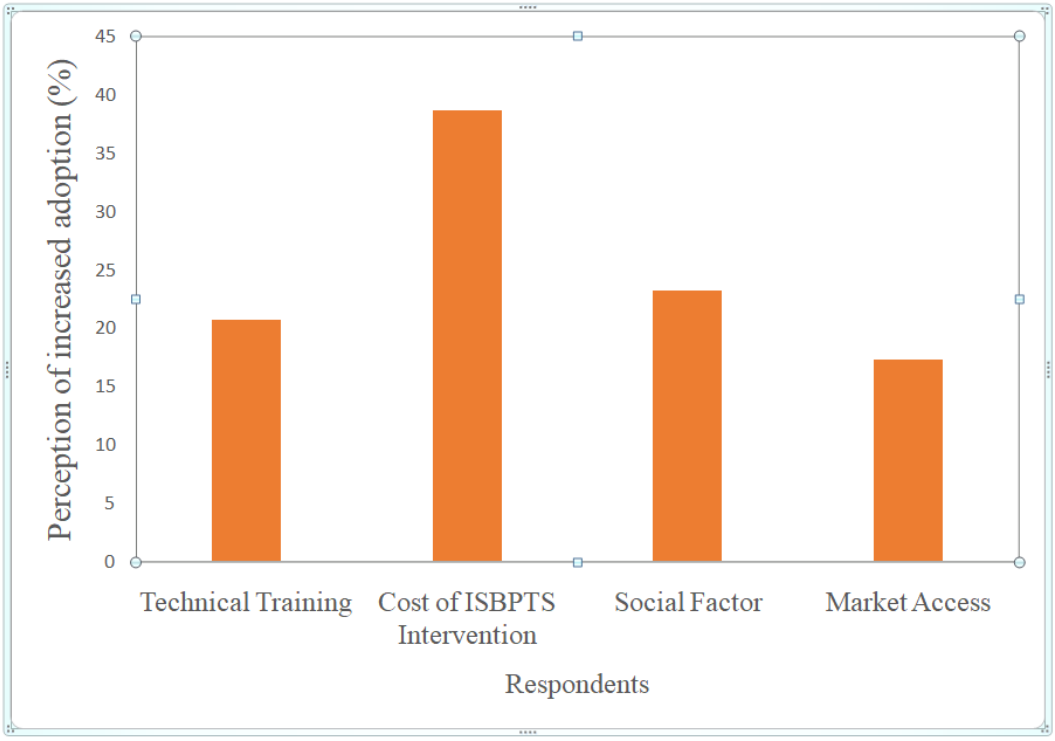

Figure 1. Distribution of Respondents Ways to Promote Increase in Adoption of ISBPTs

options, consumer interest may wane. Existing research supports the need for accessible technologies, showing that licensing external technology positively impacts new product innovation and market access (Musandiwa & Ngwakwe, 2020; Jae et al., 2002). Therefore, addressing cost barriers is essential for fostering widespread adoption and sustaining market engagement.

Another set of key informants remarked that “The training on improved shea butter processing technologies was awesome and well organised each time there is a gathering by OYSADEP, the extension department under the Oyo State Ministry of Agriculture. It is just that the capital required to set up the ISBPTs is huge.” This feedback highlights the effectiveness of training programmes in enhancing skills, yet underscores the significant financial barrier to technology adoption. Boothby et al. (2021) support this, noting that while training boosts productivity, substantial investment is crucial for overcoming capital constraints.

On the same day, key informants highlighted that “the cultural and social factor of the respondents should be taken into cognisance to know the ISBPTs types that will work for them. It is not all improved technologies that are acceptable to the people that are to use them because proper consultation was not done about the culture, norms and values of the people targeted to help.” This finding aligns with Bai-Thachia et al. (2024) and Zaka (2020), who emphasise that incorporating sociocultural factors is crucial for successful technology adoption. Neglecting these factors may hinder the effective uptake of Improved Shea Butter Processing Technologies (ISBPTs), underscoring the need for inclusive consultations that address cultural and social considerations to enhance technology acceptance and impact.

Conclusion and Recommendation

The study concluded that the adoption of improved shea butter processing technologies (ISBTs) remains low. Most respondents continue to use traditional methods, such as boiling or roasting shea kernels, due to several barriers. These include bureaucratic hurdles in acquiring ISBTs, high costs, insufficient support from financial institutions, and sociocultural factors. To address these issues, extension organisations and all other actors along the shea butter processing value chain must develop comprehensive strategies to facilitate the acquisition of ISBTs. This should include cost interventions, consideration of social factors, and technical training for processors. Additionally, improving market access for shea butter products could further enhance adoption rates. By tackling these constraints, stakeholders can promote wider use of ISBTs, ultimately boosting productivity and quality in the shea butter industry.

CRediT authorship contribution statement

OKZ: Conceptualization, data curation, writing original draft, review and editing; BGA: Writing original draft, review and editing; MB: data curation, review and editing; FOI: Review and editing

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Akrofi, N.A., Sarpong, D.B., Somuah, H. A. S., & Osei Owusu, Y. (2019). Paying for Privately Installed Irrigation Services in Northern Ghana: The case of the smallholder Bhungroo Irrigation Technology Agricultural Water Management,216,284-293.https://doi.org/10.1016/j.agwat. 2019.02.010

Atsriku, G. E. (2020). The Adoption of Agriculture Technology in Small-Scale Farming in the Adumasa Community in Ghana. Unpublished Master’s thesis. International Institute of Social Studied, The Hague, The Netherlands.

Bai-Tachia, M.,Ahule, B.G.,Zaka, O.K. and llemaye,F.O. (2024).Sociocultural Factors Influencing Adoption of Shea Butter Processing Technologies in Oyo State. UNIZIK Journal of Economics and Extension (UJAIE) 1(1): 56-64.

Baiyegunhi, L. J. S., & Hassan, M. B. (2018). Household wealth and adoption of Integrated Striga Management (ISM) technologies in northern Nigeria. African Journal of Science, Technology, Innovation and Development, 10(1), 48-61.

Balana, B. B., & Oyeyemi, M. A. (2022). Agricultural credit constraints in smallholder farming in developing countries: Evidence from Nigeria. *World Development Sustainability*, *1*, 100012.

Boothby, D., Onfor, A., Tang, J. (2010).Technology Adoption, Training and Productivity Performance. Research Policy 39, 650-661.

Emily, A. (2015). Carbon Dioxide (CO2) Emissions, Human Energy, and cultural perceptions associated with Traditional and Improved Methods of Shea Butter processing in Ghana, West Africa. Unpublished Master’s Thesis, University of South Florida, Florida.

Foster, A. D., & Rosenzweig, M. R. (2010). Microeconomics of technology adoption. Annual Review of Economics, 2(1), 395–424.

Jae, H.P. & Jung, S. H. (2002). The Impact of Technology Advancement Strategies on Consumer Patronage Decision. *Journal of Product Innovation Management,* 19(5):375-383.

Kasirye, I. &Ssewanyana, S. N. (2010). Impacts and determinants of panel survey attrition: The case of Northern Uganda survey 2004-2008," Research Series 127536, Economic Policy Research Centre (EPRC).

Kimaru-Muchai, S. W., Ngetich, F. K., Baaru, M. &Mucheru-Muna, M. W. (2020). Adoption and utilisation of Zai pits for improved farm productivity in drier upper Eastern Kenya. *J. Agric. Rural Dev. Tropics Subtropics*, 121, 13–22.

Leeuwis, C. & Aarts, N.(2011).Rethinking Communication in Innovation Processes:Creating Space for Change in complex systems. *Journal of Agricultural Education Extension*, 17(1), pp 21-36.

Lutomia, A. N., & Bello-Bravo, J. (2017). Communities of practice and indigenous knowledge: A case study of empowering women in processing Shea butter using scientific animations. In *Handbook of research on social, cultural, and educational considerations of indigenous knowledge in developing countries* (pp. 226-243). IGI Global.

Mapila, M. A. T. J. (2011). Rural livelihoods and agricultural policy changes in Malawi. Agricultural Innovations for Sustainable Development, 3, 190-195.

Matanmi, B. M., Adesiji, G. B, Olasheinde, E. M., & Oladipo, F. O. (2011). Assessment of Usage of Upgraded Indigenous Shea Butter Processing Technology by Women Processors in Kwara State, Nigeria. Agrosearch (2010 & 20011) 11 No. 1&2 19 – 30

Michalscheck, M., Groot, J. C., Kotu, B., Hoeschle Zeledon, I., Kuivaanen, K., Descheemaeker, K., & Tittonell, P. (2018).

Model results versus farmer realities. Operationalizing diversity within and among smallholder farm systems for anuanced impact assessment of technology packages. Agricultural Systems,162,164178.

Mohammed, F. Boateng, S. & Al-hassan, S. (2013). Effects of adoption of improved sheabutter processing technology on women's Livelihoods and their Microenterprise Growth. *American Journal of Humanities and Social Sciences*, 1(4), 244-250. DOI:10.11634/232907811301419

Musandiwa, J.T, & Ngwakwe, C.C. (2020).Effect of Technology Adoption in New Product Innovation. Managing Global Transitions, 18(3):177-194

Nwaubani, S. I., Otitodun, G. O., Ajao, S. K., Opit, G. P., Ala, A. A., Omobowale, M. O.&Ileleji, K. E. (2020). Assessing efficacies of insect pest management methods for stored bagged maize preservation in storehouses located in Nigerian markets. *Journal of Stored Products Research*, 86, 101566.

Obayelu, A. E., Adeoti, J. O., & Dontsop, N. P. M. (2017). Technical efficiency and impact evaluation differentials between the adopters and non-adopters of Nerica in the six baseline states in Nigeria. Review of Agricultural and Applied Economics (RAAE), 20(1340-2017-2352), 3-15

Owen, E., Smith, T. & Makkar, H. (2012) Success and failure with animal nutrition practices and technologies in developing countries: A synthesis of an FAO e-conference. Animal Feed Science Technology, 174, pp211-226

Pan, Y., Smith, S. C., & Sulaiman, M. (2018). Agricultural extension and technology adoption for food security: Evidence from Uganda. *American Journal of Agricultural Economics*, *100*(4), 1012-1031.

Rogers, E. M. (2010). Diffusion of innovations. Simon and Schuster.

Sennuga, S. O., Fadiji, T. O. & Thaddeus, H. (2020). Factors influencing adoption of improved agricultural technologies (IATs) among smallholder farmers in Kaduna State, Nigeria. *International Journal of Agricultural Education and Extension*, 6(2), 382-391.

Senyolo, M.P., Long, T.B., Blok, V., & Omta, O. (2018). How the characteristics of innovations impact their adoption: An exploration of climate-smart agricultural Innovations in *South Africa Journal of Cleaner Production*, 172,3825–3840.https://doi.org/10.1016/j.jclepro.2017. 06.019.

Zaka, O. K. (2020). Cultural Beliefs and Adoption of Improved Shea Butter Processing Techniques among Shea Processors in Oyo State. International Journal of Intellectual Discourse (IJIRD), 3(2):331-344