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Development of Novel Mineral Licks (Toka) and the Livestock Industry Boom in North-eastern Nigeria

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ABSTRACT

Conventional mineral licks used in livestock production in tropical Africa, are usually imported, highly expensive and their cost/benefit ratio is often questionable. The broad objective of the study is to survey the production technique, utilization and marketing process of novel mineral licks (toka) in Adamawa State, North-Eastern Nigeria. Fifty (50) household producers of novel mineral licks (toka) were purposively selected for oral interviews, discussions and on-field observations. The results indicate that, ninety percent (90%) of novel mineral licks producers are between the ages of 20 and 50 years. Hundred percent (100%) of the people engaged in the business in the study area are women. Ninety percent (90%) of them are married with eighty percent (80%) of them having attended adult education. They had enough experience in the business with seventy percent (70%) having 5 - 15 years and all (100%) of them from minority tribes who are mostly Muslims. The common raw materials used for the production of novel mineral licks in Adamawa State include twelve (12) different plants and fifteen (15) different animal parts. The findings show that, novel mineral licks are utilized by livestock and humans in 6 different ways and, there is no elaborate and well developed marketing structure in the study area. The results indicate that, all the producers (100%) are responsible for retailing and selling of their products to earn additional income to augment the family revenue from sale of their annual farm products.

Keywords: Mineral Supplementation, Ruminants, Nigeria

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INTRODUCTION

Novel mineral licks, also known as toka in Hausa, are locally produced from ashes of crop residues and animal dung indigenous to North-Eastern Nigeria. Mineral licks generally provide bio-metals such as sodium, calcium, iron, phosphorus, zinc, and trace elements required for the development of bones, muscles, growth and functioning of other systems in livestock and wildlife (Hogan, 2010; Black, Mosquera, Guerra, Loiselle, Romo & Swing, 2011). Research has shown other uses and nutritional benefits of mineral licks to include selenium (Se), cobalt (Co) and molybdenum (Mo) (Ayotte, Parker, Arocena, & Gillingham, 2006; Mills, & Milewski, 2007).

Imbalances in mineral profiles in soils and forages in semi-arid and arid regions of tropical countries, is the main challenge in achieving the maximum production and reproduction potentials in livestock (Khan *et al*., 2008, Khan, Ahmad, Ashraf, Valeem & McDowell, 2009). The existing information on the mineral status of soil, forage and animals point out the need for mineral supplementation regimes to improve the reproduction potentials of ruminants under grazing conditions in these arid and semi-arid pasture and range lands. Therefore, the broad objective of the study is to survey the production technique, utilization and marketing process of novel mineral licks (toka) in Adamawa State, North-Eastern Nigeria. While the specific objectives are to: Survey the socio-cultural characteristics of producers and stakeholders of novel mineral licks (Toka) in Mubi-North Local Government Area; Identify the source of raw materials used for the production; Identify utilization of the novel mineral licks (toka) in the zone; Investigate the marketing process of novel mineral licks (toka) in the study area; Identify challenges and prospects of novel mineral licks (toka) in Adamawa State, North-Eastern Nigeria

MATERIALS AND METHODS

The Study Area

Adamawa State is located at the area where the River Benue enters Nigeria from Cameroon Republic and is one of the six states in the North-East geopolitical zone of Nigeria. It lays between latitudes 7^0 and 11^0 North of the Equator and between longitudes 11^0 and 14^0 East of the Greenwich Meridian (Mohammed, 1999). It shares an international boundary with the Republic of Cameroon to the East and interstate boundaries with Borno to the North, Gombe to the North-West and Taraba to the South-West (Adebayo, 1999; ASMLS, 2010a), as shown in Figure Ia.

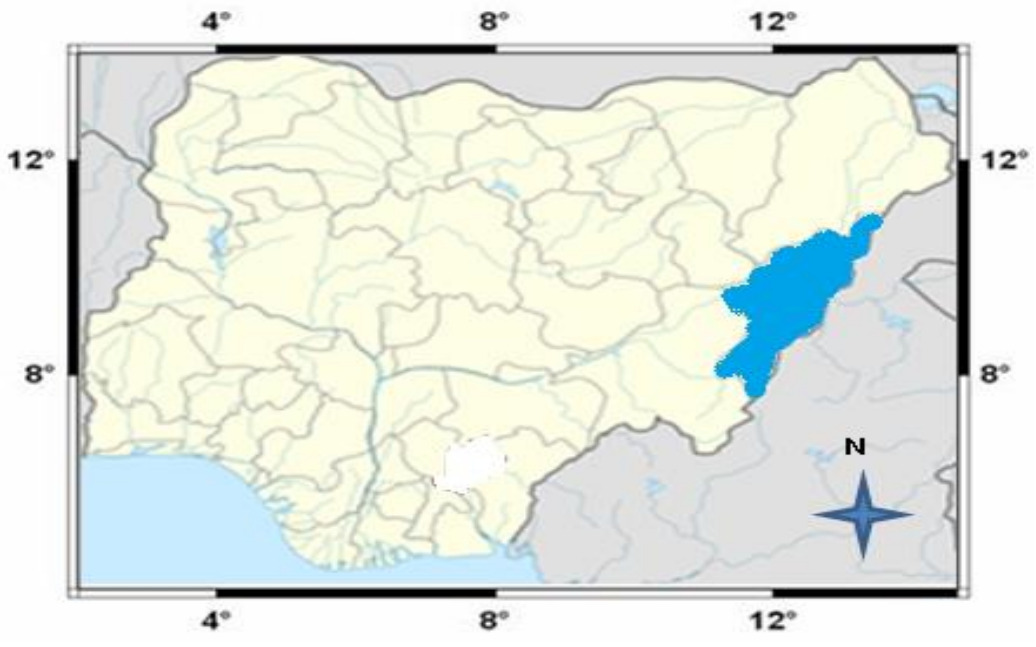

Figure Ia: Map of Nigeria Showing Adamawa State

According to Adebayo and Tukur (1997), Adamawa State covers an area of land mass of about 38,741km². The state is divided into three Senatorial Zones (Northern, Central and Southern) which translates to three agricultural zones as defined by INEC (1996), which are further divided into 21 Local Government Areas (LGAs) for administrative convenience.

The State has a population of 2,102,053 persons (NPC, 1990). The main ethnic groups in the state are the Kilba, Higgi, Quadoquado, Lala, Yungur, Bwatiye, Chamba, Mbula, Margi, Ga'anda, Longuda, Kanakuru, Bille, Bura, Yandang, Fali, Gude, Verre, Fulani and Libo (Adebayo & Tukur, 1997; Adebayo, 1999; ASMLS, 2010b). The dominant religions are Christianity and Islam, although some of its inhabitants still practice African traditional religions. The major occupation of Adamawa people is farming. The soil type is ferruginous tropical soils of Nigeria based on genetic classification of soils by the Food and Agricultural Organization of the United Nations (FAO, 1996).

The soils are a function of the underlying rocks, the seasonality of rainfall and the nature of the wood-land vegetation of the zone. The soils are derived from the basement complex, granite and gnesis that form the ranges of mountains. The mineral resources found in the state include iron, lead, zinc and limestone (Adebayo & Tukur, 1997).

The common relief features in the state are the Rivers Benue, Gongola, Yadzaram and Kiri Dam, Adamawa and Mandara mountains and Koma hills. The state has minimum and maximum rainfall of 750 and 1050 mm per annum and an average minimum and maximum temperature of 15^0C and 32^0C, respectively. The relative humidity ranges between 20 and 30% with four distinct seasons that include early dry season (EDS, October – December); late dry season (LDS, January – March); early rainy season, (ERS, April – June) and late rainy season (LRS, July – September), according to Adebayo (1999). The vegetation type is best referred to as guinea savannah (Areola, 1983; Adebayo & Tukur, 1997). The vegetation is made up of mainly grasses, aquatic weeds along river valleys and dry land weeds inter-spersed with shrubs and woody plants. Plant heights ranges from few centimeters (Short grasses) to about one meter tall (tall grasses), which form the bulk of animal feeds.

Cash crops grown in the state include cotton and groundnuts, sugarcane, cowpea, benniseed, bambara nuts and tiger nuts, while food crops include maize, yam, cassava, sweet potatoes, guinea corn, millet and rice. The communities living on the banks of rivers engage in fishing, while the Fulani and other tribes who are not resident close to rivers are pastoralists who rear livestock such as cattle, sheep, goats, donkeys, few camels, horses and poultry for subsistence (Adebayo & Tukur, 1997; Adebayo, 1999).

The Study Site

Mubi-North LGA is located at the northern part of old Sardauna Province, which now forms Adamawa North Senatorial District as defined by INEC (1996). The region lies between latitude 9^0 30´´ and 11^0 North of the equator and longitude 13^0 and 13^0 45´´ East of Greenwitch Meridian. It has an altitude of 696 meters above sea level with an annual mean rainfall of 1,220mm and a mean temperature of 15.2^0C during hamattan periods from November to February and 39.7^0C in April (ADADP, 1986). The LGA has essentially a mountainous landscape tranversed by river Yedzaram and many tributaries, Mandara and Adamawa mountains form part of this undulating landscape (Mansir, 2006). The Gude, Fali, Fulani and other tribes dominate the area which has a lot of pasture land. Mubi region is bordered in the North by Michika LGA, in the West by Hong LGA and in the South by Mubi South LGA, Maiha LGA in the South-East and the Republic of Cameroon in the East as seen in Figure IIb. It has a land area of about 4,728.77 km² and human population of about 759,045 going by NPC, (1991) census projected figures (Adebayo & Tukur, 1991). It has an international cattle market linking

neighboring countries such as Cameroon, Chad, Central Africa, Niger, Mali and Senegal to Southern Nigeria where cattle are consumed as shown in Figure Ib.

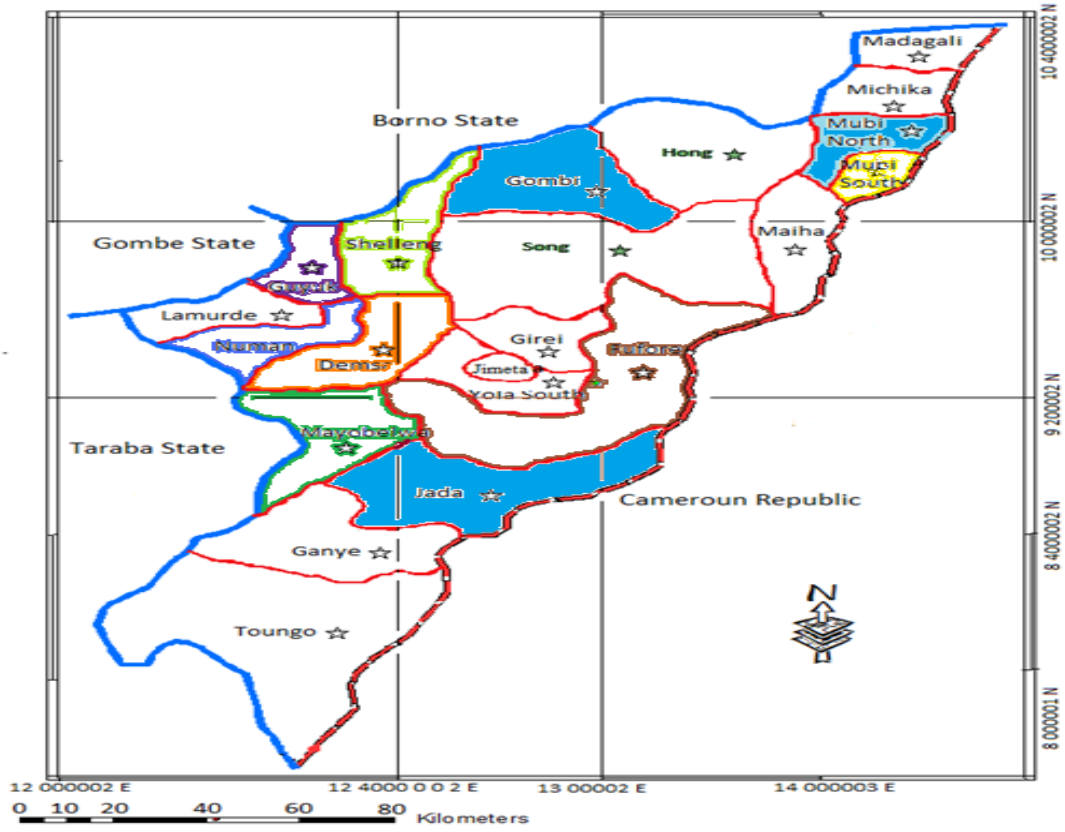

Figure Ib: Map of Adamawa State Showing the Study Area in Blue Colour

Selection of Respondents and Sampling Design

The research covered a period of eight weeks, during the survey, visits were paid to Mubi town and its environs where respondents were identified. The objective of the study was explained to them and their permission obtained to participate in the study. Actual participation in the study was based on the willingness of respondents.

Data Collection

Fifty (50) household producers of novel mineral licks (toka) were purposively selected for oral interviews, discussions and on-field observations. Structured questionnaire were developed in English language and used to collect information on socio-cultural characteristics of producers, source of raw materials, production technique, utilization and marketing processes of novel mineral licks (Toka). Where a farmer does not understand English, vernacular languages were used.

Novel Mineral Licks Production Techniques

Dry crop residues or plant parts and animal dung are the common raw materials used for the production of novel mineral licks in the study area. Raw materials are carefully selected from the field at about 0% moisture content and packed to a floor or open field, usually at the farm. The materials are then burnt to ashes under cool wind-free atmosphere and allowed to cool to room or environmental temperature. The ashes are carefully and gently gathered using a broom and packed into a sack/bag or container. Fine grasses are obtained to serve as sieves which are put into clean iron or clay containers/pots with holes or perforated bottoms. The ashes are packed into the perforated containers/pots full to the brim and mounted on another clean containers/pots that are not perforated but of

the same sizes with the perforated ones or supported with stones if the perforated are bigger than the imperforated. Water is sprinkled on the ashes gradually until it is fully soaked and submerged. More water is added gradually and continually until the containers are filled. The system is allowed to stay overnight and the concentrated mineral solution filtered or leached down slowly into the clean containers as collection chambers. The concentrated mineral solution is then boiled while constantly steering with a long cooking spoon for six to eight hours. The solution then forms paste like product, as the water evaporates leaving only the solid mineral licks. The products are then molded into blocks using small plastic containers polished with groundnut oil to prevent the mineral blocks sticking in them and to ease removal in blocks after sun drying for 2 days. The processes take like 2 to 3 days to complete the production cycle. But when materials are burnt more than can be processed at a time, ashes are stored in clean and dry bags and containers for months or years without any problem provided the bags or containers are kept in dry moisture free store as shown in Figures IIa, b, c, d, e, f, g, h, i and j.

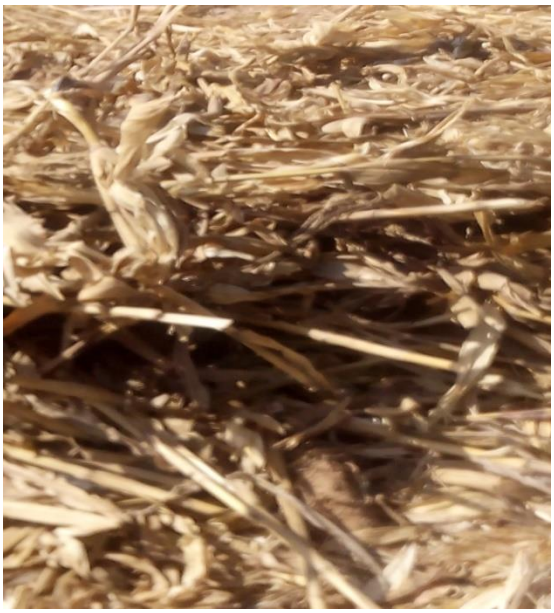

Figure IIa: Gathered Corn Stalks Ready to be Burnt for Novel Mineral Licks Production

Figure IIb: Burning of Corn Stalks to Obtain Ashes for Novel Mineral Licks Production

Figure IIc: Gathering of Ashes after Burning Corn Stalks for Novel Mineral Licks Production

Figure IId: Sprinkling of Water on the Ashes to Filter out Mineral Solution

Figure IIe: Filtering of Mineral Solution into the Collection Chamber

Figure IIf: Boiling of Filtered Mineral Solution for Novel Mineral Block Production

Figure IIg: Steering of Mineral Solution into Paste before Moulding into Blocks

Figure IIh: Moulded and Sun Dried Mineral Blocks

Figure IIi: Excess Ashes Stored in Bags for Future Processing of Novel Mineral Blocks

Figure IIj: Dumped Novel Mineral By-products

Data Analysis

Data generated from the survey were subjected to descriptive statistics such as tables, frequency distribution, percentages and means to explain the processes of production, utilization and marketing of novel mineral licks (toka) indigenous to the study area.

RESULTS AND DISCUSSION

Socio- Cultural Characteristics of Novel Mineral Licks Producers

Table 1 highlights the socio-cultural characteristics of novel mineral licks producers in Mubi North L.G.A, Adamawa State, Nigeria.

(a) Age Distribution of Novel Mineral Licks Producers

Table 1a presents the results of novel mineral licks producers based on age group which indicates that, ninety percent (90%) are between the ages of 20 and 50 years, while ten percent (10%) fall within the age group of 51 years and above. This implies that, young women are more engaged in the business of production, utilization and selling of novel mineral licks in the study area. This is, also, possible because of the hectic and risk taking nature of the business of selecting, packing, burning, sieving or filtering, boiling, steering

(turning) and moulding of the products into blocks which requires strength, experience and knowledge. However, children of school age, also, participate as apprentices or learners to support their mothers since the business is inherited and goes from generation to generation.

Similarly, the aged group (51 years and above), also, successfully participate in the business with support from the younger women in order to earn some meager revenue to complement the income from their farm work. The results of this study agree with the report of FAO (1990) which stated that, youths are more actively involved in the agricultural businesses in Africa. The results, also, corroborated that of Mafimisebi, Bobola, & Mafimisebi (2013), who reported similar findings of 41 to 50 years as major age group of livestock marketers in Akure, Ondo State, Nigeria. This means that, majority of the business men and women in Nigeria are still young and are within the active working class.

Table 1: Socio-Cultural Characteristics of Novel Mineral Licks in Mubi North L.G.A

Parameter	Frequency	Percentage (%)
(a) Age (in years)		
20-50	45.0	90.0
51- above	5.00	10.0
(b) Sex		
Male	0.00	0.00
Female	50.0	100
(c) Marital status		
Married	45.0	90.0
Single	5.00	10.0
Divorced	0.00	0.00
(d) Qualifications		
W/Education	10.0	20.0
Adult education	40.0	80.0
(e) Experience(in years)		
5 -15	35.0	70.0
16 – above	15.0	30.0
(f) Tribe		
Hausa	0.00	0.00
Others	50.0	100
(g) Religion		
Christianity	10.0	20.0
Islam	40.0	80.0
Traditional	0.00	0.00

(b) Sex Distribution of Novel Mineral Licks Producers

Table 1b reveals that, hundred percent (100%) of the people engaged in the business of production, utilization and marketing of novel mineral licks in the study area are women. This is because the business involves selecting, packing, burning, sieving, boiling, steering (turning) and moulding of the products into blocks, which is viewed as a kitchen affair that is associated with women according to African culture and beliefs and therefore, men seldom take part in it.

These women trade novel mineral licks in addition to other food-stuffs like vegetables, dried fish, groundnut paste, salt, cooking oils, grains of all sorts, fruits and pepper. It was observed that, men are the major bread earners of their families and are therefore, more interested in businesses with huge turn over. Men in the study area prefer businesses like tobacco production and moulding, livestock production and marketing, sugarcane production and marketing, buying, storing and selling of farm produce which fetch them more profits compared to business of production and marketing of novel mineral licks in local vegetable markets that give only marginal income. Contrary to the results of this study, Yusuf (2014) reported that, there are more male operators of small- scale business enterprises in Lagos State, Nigeria.

(c) Marital Status of Novel Mineral Licks Producers

Table 1c shows that, ninety percent (90%) of the novel mineral licks producers in the study area are married while ten percent (10%) single. This shows that, majority of the novel mineral licks producers had early marriages because they reside in the villages and are not much interested in Western education. These early marriages hamper their performances, because combining raising children with the business is really hectic. However, there are no cases of indiscriminate divorces and the women are seen as responsible villagers doing their legitimate small scale businesses to earn a living and support their families in their own best way possible. Similarly, Yusuf (2014) reported that, women carry triple burden of home caring, socialization of children and social roles in the community and time invested in taking care of children will in no doubt affect the time allocated for their businesses.

The results agree with Odoeme (2003) who stated that, more frequently mentioned challenge by business women is the combination of the business with family responsibilities, which undermines the success of their business. Women entrepreneurs indicate that, they deploy several strategies to cope with the double workload and challenges deriving from combining business with family. In addition, Williams (2004) also found that, the amount of time spent caring for children is negatively related to success of any business. The location of the business at home may, also, undermine the legitimacy of the business as perceived by customers and creditors (Marlow, 2002). Furthermore, some studies indicate that, women strongly rely on support from husbands, partners, and relatives in order to successfully start and grow a business enterprise (Jennings & McDougald, 2007).

(d) Educational Qualifications of Novel Mineral Licks Producers

Table 1d presents the educational qualifications of novel mineral licks producers in the study area. The results indicate that, eighty percent (80%) had no Western education but attended just village adult education without much influence in their mind set. While only twenty percent (20%) had Western education at primary to secondary school levels. This is because, they could not afford the high cost of Western education and are not privileged to access government scholarship to further their education. This implies that, majority of them are illiterates because of their culture and low economic status which did not support Western education.

Again, this low level of Western education recorded amongst them in this study, may be connected to their family backgrounds as they are born and brought up in the remote rural areas, majority of whom are peasant subsistence farmers producing farm crops mainly for consumption and very little for sale. This lack of Western education is a great set back to them and their business and it is the reason novel mineral licks have not been in the limelight or popular. This again, may not be unlikely connected to the limited or the negatively biased employment opportunities against the female gender by the formal sector and the conventional disparity in the distribution of educational opportunities and other socio-

political development variables in the African setting, which makes the initial or start-up capital of each gender to differ with the female gender more affected (Ogunsiji, 2013).

This group of village women, also, lacks innovation, which is the generation of new ideas that are acceptable and the implementation of such ideas. These ideas either could be novel, or a modification of existing processes, products or services (Babalola, 2006). Studies showed that, it is one of the most critical capabilities that successful entrepreneurs should possess because it relates to the production or adoption of useful ideas and their implementation (Kanter, 1988; Van de Ven, 1986) including re-structuring of existing or old products. Significant innovations allow businesses to establish dominant competitive brands and afford newcomer industry an opportunity to gain an edge in the market (Erdil, Erdil & Keskin, 2004). Researchers are of the view that innovative behaviour is related to the ability to generate ideas and the skill or where withal to execute with these ideas (West & Farr, 1989). To West and Farr (1989), individual innovation begins with problem recognition and the generation of ideas or solutions, either novel or adopted, as such, making entrepreneurial innovation results in creative expression of individuals. Similarly, West and Farr (1989) defined innovative behaviour as, 'all individual actions directed at the generation, introduction and application of beneficial novelty at any organizational level'. Some studies on innovation collapsed the suggestion and implementation of ideas into a single-measure as opposed to those that separate them into two-measures (de Jong & den Hartog, 2003). The use of two-measures is because the factors that influence successful implementation tend to differ from those that influence the initiation of ideas (de Jong & den Hartog, 2003). As the foundation of innovation is ideas, the study of innovative behaviour among women entrepreneurs should be of importance as 'there has been scanty attention on innovation at the individual and group levels' (West & Farr, 1989). In addition, since there is little or no systematic empirical research on the level of innovativeness among women entrepreneurs', relying on generalized conclusion may lead to systemic error regarding the specific nature of women entrepreneurs.

(e) Experience of Novel Mineral Licks Producers

Table 1c shows that, all the novel mineral licks producers had enough experience in the business with seventy percent (70%) having 5 - 15 years, while thirty percent (30%) had 16 years and above. This, also, implies that, all of them were born into it and the practice of this business has been in their lineage for a long period of time, which is reflected by their ages as majority of them are young women. It was observed that, novel mineral licks production is indigenous to the area and the practice is passed from one generation to the other. Even with this monumental experiences found amongst the novel mineral licks producers, because of their high level of illiteracy and lack of economic power, the production is still at a primitive status. They seldom adopt new technologies to improve their production and packaging as the products are still packaged in the common white ten naira worth polythene bags.

The results support Adebayo (2015), who reported that, cultural orientation and individual attributes such as education, working experience, and risk-taking ability significantly influence women entrepreneurial decision. Studies have shown that, related experience is one of the vital business characteristics (Beneria, 2001) and a minimum of two to three years business experience is sufficient to assess an entrepreneur (Carter & Shaw, 2006). Some other characteristics of women entrepreneurs include: a strong desire for independence, innovation, risk-taking, resourcefulness, business skills, knowledge, and networks (Salman, 2009). Practical business knowledge involves knowledge of competitive nature of the market, top players in

the industry, knowledge of product range, trend of change in technology and market. In the same vein, business skills include conceptual, technical, human relation and managerial skills which may be acquired through training, seminars, workshops and on-the-job experience. Experience could be acquired through formal education, business knowledge or on-the-job. Based on the above, it may be right to argue that, professional experience is a key structural factor that has a major impact on the ability of women to start a business and to improve their business performance.

(f) Tribal Distribution of Novel Mineral Licks Producers

The results show that, hundred percent (100%) of novel mineral lick producers in the study area are from minority tribes such as Margi, Fali, Gude, Higi, Kilba, Lala and Bura, while other major tribes like Hausa/Fulani, Igbo, Yoruba are not found to be involved in the business, as shown in Table 1f. This is because the minority tribes are the ones that take up full time farming activities as occupation and production of the novel mineral licks is associated with crop residues and livestock dung. They do this business after the harvest of crops using the left over residues for the production as an alternative business in the dry season while waiting for the next cropping season.

Other major tribes like the Fulanis, have their women involved in the production, processing and selling of milk, fura da nono, cheese and yoghurt to earn additional income to support their husbands in the purchase of grains, medicines and other food-stuffs while majority of Hausa women are full-time house-wives who are always indoor. They rely on what is brought to them by their husbands. However, few of them participate in knitting and production of caps (damanga), making of ground nut cake, masa, akara etc around local eateries, motor parks, mechanic workshops, schools and by the roadsides. Igbo women in the study area support their husbands in businesses like boutiques, pharmaceutical shops, automobile spare parts shops, restaurants, provisions shops, beer palours, and teaching jobs. While Yoruba women are known to hawk traditional medicines (concoction) in many forms ranging from liquid solution to powdered ones.

However, Nigerian female entrepreneurs face divers problems attributed to socio-cultural factors (Ehigie & Idemudia, 2000; Ehigie & Umoren, 2003; Kitching & Woldie, 2004; World Bank, 1995). This is because some cultures and social traditions play a significant role in determining who becomes an entrepreneur. Nevertheless, women are increasingly showing prospects of upward mobility in business nowadays due to their completion of educational careers and decline of domestic work as an occupation (Ehigie, 2000). In addition, small-scale businesses are perceived as ventures that require less demand (Babalola, 1998). Possibly, this is why Berger and Byvinie (1989) found that, female entrepreneurs are higher in the informal sector than their male counterparts, in Nigeria.

(g) Religious Affiliations of Novel Mineral Licks Producers

The results shown in Table 1g depict that, eighty percent (80%) of the novel mineral licks producers are Muslims, while twenty (20%) are Christians.

This results support the assertion that, some religions and cultures in Nigeria do not allow women to be involved in occupations that will take them far from their matrimonial homes; rather they are expected to manage the family and “be submissive to their husbands” (Ehigie & Idemudia, 2000). Similarly, Kitching and Woldie (2004) reported that, female entrepreneurs in Nigeria are hindered by a variety of barriers despite having made considerable advances. However, not all women that are involved in entrepreneurial venture turn out to be successful as their capacity to make good decisions regarding to innovative behaviour do not abound.

Raw Materials Used for Novel Mineral Licks Production in the Study Area

Table 2, shows the common raw materials used for the production of novel mineral licks in

Adamawa State, North-Eastern Nigeria. It was observed that, twelve (12) different plant parts and crop residues, such as cowpea husk, groundnut hauls, guinea corn shafts, maize stalks, maize husks, millet stalks, banbara nut husks, baobab tree trunks and fruits, water lily, palm bunches; plantain trunks and cassava sticks are used for the production of novel mineral licks. Fifteen (15) animal parts and products, such as horns, cow dung, goat dung, sheep dung, donkey dung, horse dung, camel dung, poultry droppings, egg shells, oyster shell, feathers, spines, bone meals, and urine are, also, used. The results of the present study agree with Puto (2015), who reported the use of wood ashes for the production of lye, an alternative name for sodium hydroxide (NaOH) or, historically, potassium hydroxide (KOH).

Table 2: Raw Materials and Utilization of Novel Mineral Licks in the Study Area

S/n	Crop residue	Animal dung	Livestock uses	Human uses
1	Cowpea husk	Horns	Mineral lick	Catalyst
2	G/nut haulms	Cow dung	Medicine	Cooking
3	G/corn chaff	Bone meal	Appetizer	Medicine
4	Maize stover	Goat dung	Branding	Rituals
5	Maize husk	Sheep dung	Dehorning	Appetizer
6	Millet stover	Donkey dung	Behooving	Charms
7	B/nut husk	Horse dung		
8	Baobab tree	Camel dung		
9	Water lily	Urine		
10	Palm bunch	Fish meal		
11	Plantain trunk	Poultry dung		
12	Cassava stem	Egg shell		
13		Feathers		
14		Spines		
15		Oyster shell		
Total	12	15	6	6

Utilization of Novel Mineral Licks in the Study Area

The results of utilization of novel mineral licks by livestock and humans are shown in Table 2. The findings show that, novel mineral licks are utilized by livestock in 6 different ways which include licking the products to provide supplementary mineral requirements in addition to what is obtained from pasture forages. Animals are often sighted licking remnants of ashes left on the field where the mineral licks are burnt, eating of woods, dirty rags and polythene bags, soils where people urinate in an attempt to satisfy their mineral urge.

The results corroborate that of NRC (1980), which reported that, there are at least 17 minerals that are required by cattle for production and maintenance of body functions. Macro-minerals required include calcium, magnesium, phosphorus, potassium, sodium and chlorine, and sulfur. The micro-minerals required are chromium, cobalt, copper, iodine,

iron, manganese, molybdenum, nickel, selenium and zinc. Other minerals including arsenic, boron, lead, silicon and vanadium have been shown to be essential for one or more animal species, but there is no evidence that these minerals are of any particular practical importance in cattle.

A number of elements that are not required (or at least required only in very small amounts) can cause toxicity in cattle. The maximum tolerable concentration for a mineral has been defined as “that dietary level that, when fed for a limited period, will not impair animal performance and should not produce unsafe residues in human food derived from the animal” (NRC, 1980).

According to Mamoon (2008), sheep and goats need certain minerals for their maintenance as well as proper functioning of their physiological systems. Calcium, phosphorus, magnesium, sodium, potassium, sulfur and chlorides are a few of the macro-minerals needed in sheep and goats' diets. The primary sources of these minerals are the diet, various mineral supplements, and in some areas, the water supply. Minerals are needed in only small amounts. Calcium is a necessary constituent of the bones and teeth and is essential for regular heart function and muscular activity. A calcium deficiency results in poor growth and bone development in growing animals. Phosphorus is an essential part of blood and of all cells in the body. It is involved in chemical reactions which release energy in the body. Bones and teeth contain relatively large amounts of phosphorus as well as calcium. Calcium and phosphorus are interrelated, while an adequate supply of each is required, they must, also, be present in the ration in the proper proportions.

Micro-minerals usually supplemented in sheep and goats rations are iron, copper, cobalt, manganese, zinc, iodine, selenium, molybdenum, and others. Feed tags report micro-minerals as parts per million (ppm) and macro-minerals on a percentage basis (NRC, 1981 &1985).

Feeding of calcium and phosphorus (2:1 ratio) is recommended for better structural and bone strength, while other minerals are necessary for other systems like nervous and reproductive activities. Minerals should be added into the feed, keeping in mind the quality of forages as some forages can be high in some of the minerals and low in others. Free choice supply of loose minerals and salts always work well. If the supplied minerals include, enough salts then the producer should be careful in providing separate free choice salt (NRC, 1981 &1985).

It is important to feed enough copper (10-80 ppm) to goats as they have a tendency to be copper deficient. High levels of molybdenum in goats' diets can easily offset the copper levels in the body. Goats are not sensitive to copper, whereas in sheep even 20 ppm of copper can be very toxic. Selenium (0.1-3 ppm) is another mineral required for goats. Most of the soils in Nigeria may be deficient in selenium, and forages from those soils may need selenium supplementation in the form of mineral supplements (NRC, 1981 &1985).

The present results also indicate that, apart from the mineral content of novel mineral licks, they are, also, medicinal in nature which helps to cure and heal many diseases such as injuries, bloat, constipation and digestion challenges in both animals and humans. The blocks are served to animals as mineral lick which helps in sharpening their tongue taste senses and improves their appetite. Farmers use salt licks in the husbandry of livestock to pin down, attract or maintain animals for examination, treatment, administering drugs, viewing and photography. Contrary to the utilization of mineral licks, it was observed that, many animals suffer terrible traffic collisions as they gather to lick the minerals. The findings also revealed that, the novel mineral licks are used as caustic soda for branding and marking of animals, dehorning and trimming of horn buds, and removal or trimming of hooves, especially in young animals.

It was again, gathered that, novel mineral licks are used by humans in 6 ways. First, it is used

in cooking any type of delicacies indigenous to the study area such as beans potage, cow head, cow leg, cow hide (kanda) pepper soup, vegetable soup, meat, rice where it serves as a catalyst to reduce the time taken for the food to cook. This, also, helps farmers to save money for gas, kerosene, fire wood and electric cooker. The novel mineral licks, also, serve as preservative thereby preventing the food from microbial attack and getting sour. They, also, improve the taste and flavour of food as many alcohol consumers enjoy food prepared with novel mineral licks because of their mouth cleaning and appetite inducing capabilities. They are used as washing agents especially for fresh cat fish to clean or remove the jelly-drawing and slippery substances thereby making the fish odour free and palatable for human consumption. There is no any clear evidence or report of industrial use of the novel mineral licks in the study area.

Marketing of Novel Mineral Licks

(a) Marketing Agents

The results in Table 3 shows that, there is no elaborate and developed marketing structure among the novel mineral licks marketers in the study area. The results indicate that, all the producers (100%) are the ones responsible for retailing and selling of their products to earn additional income to augment revenue from the sale of their farm products which is unlike other businesses that have well organized set ups with various agents having different schedules and functions in the market. This is because of the novelty nature, the low and local level of the production capacity of the products. The findings of the present study contradict that of Ajiya (1998) and Mafimisebi, Bobola, and Mafimisebi (2013), who reported well organized cattle, market structure in South-Western Nigeria.

Usually, in Mubi town and any part of the north east, marketing of novel mineral licks (toka) are carried out in open vegetable markets where other spices and food ingredients are sold as shown in Figure III. Novel mineral licks are not commonly found in big shops like super markets and malls since they are not conventional products. In other local government areas of Adamawas State like Gombi, Hong, Michika, Madagali and some parts of Borno State, the products are always sold by the high ways especially at pot holes where the roads are bad and cars slow down and military check points where cars stop for search operations of the security operatives. Women and children are the ones usually associated with the business of marketing the novel mineral licks and other food products to raise or generate revenue to support the family income. Old men may, also, sell the mineral licks in addition to other items, but, that is usually as an ingredient for preparing concoction for medicinal purposes. Young men in their active productive ages seldom participate in this type of petty business since money realized from the sale of novel mineral licks may not be something to write home about.

Figure III: Markets Where Novel Mineral Blocks are Sold

(b) Membership of Market Association

Table 3b shows that, there is no organized association of novel mineral licks marketers in the study area. The market does not have traders like Brokers, Dealers and Retailers who must be duly registered. The market is usually coordinated in a traditional way and prices are formulated based on speculations. The government may from time to time regulate the affairs of the market based on provision of space, sanitation and other things that affect the generality of the public for orderliness and good health. The findings of the present study disagree with that of Ajiya (1998) and Mafimisebi *et al*. (2013), who reported well organized cattle market associations in South-Western Nigeria.

The results also revealed that, the production system is 100% traditional and manual. There is no modern technology adopted not to talk of mechanization. Farmers only use their spare or leisure time especially after the harvest during the dry season to produce the products for sale or used for their domestic cooking. Most of the producers and marketers of these products are the peasant farmers that have not gone to school and don't have enough capital to develop the business to a commercial scale. There have been no incentives or credit facilities given to them by the financial institutions and government agencies to support and boost their production. Most of them (100%) rely on their personal savings as shown in Table 4b and c.

Table 3: Market Structure and Source of Capital

A	Agent	Frequency	Percentage (%)
	Brokers / Middle men	0.00	0.00
	Dealers/ Wholesalers	0.00	0.00
	Retailers (Producers)	50	100
B	Membership of market association	0.00	0.00
C	Production system		
	Traditional and Manual	50	100
	Mechanization	0.00	0.00
D	Source of capital		
	Personal savings	50	100
	Friends and relations	0.00	0.00
	Bank	0.00	0.00
	Cooperatives	0.00	0.00

Factors Considered in Price Formation of Novel Mineral Licks

The results show that, there are nine (9) factors or qualities put into consideration during selling and buying of novel mineral licks in the study area, as shown in Table 5. Market prices of novel mineral licks are determined by visual evaluation which incorporates all nine characteristics. But, the price indicators viewed as necessary, very important and ranked highest include colour, size/shape and purpose of selling or buying. This is followed by taste, packaging, demand and supply and production system.

Colour is the first quality that attracts or catches the eyes of a buyer. A good novel mineral lick should have a milky to ash colour indicating good handling during production. But when it is black or dark brown it indicates signs of excessive heating or burning of the liquid solution or adulteration which is irritating and suspicious. The size/shape shows quantity and solidness or blocky nature of the product. This, also, helps in proper handling and storage for longer period of time without shattering or

breaking and can be used successfully as mineral lick for livestock production without waste. Small or mal-shaped novel mineral lick will not attract good price or value because of difficulty in handling and fear of not getting value for what is paid for.

Taste and flavour are, also, important characteristics or qualities in selling and buying of novel mineral licks in the study area. Sharp taste and good aroma or flavours are indication of purity and originality of the product. Dull taste and faint aroma or flavour shows mixture or adulteration of the product, which is not good and will not give the desired results. The purpose of selling or buying, also, has an important effect on the prices of the products.

The purpose of selling could be to raise money for a pressing need and not just additional income for the family. If the producers have a patient in the hospital, a court case or a demanding issue they will want to sale the products at a give-away price, not minding the cost of production. The purpose of buying could be for cooking, livestock and or medicinal uses. When it is for medicinal purposes, the buyer can even pay higher compared to when it is for cooking, washing or cleaning and livestock purposes.

Demand and supply, also, affects prices of the products. During dry season at harvest time when the raw materials are readily available and production at its peak, the prices are low. But during the wet periods when all raw materials have been used up either by livestock as dry season feeds (crop residues) and hardly can one find those materials, production would fall and there will be scarcity. When there is low supply of the products, prices will rise at the detriment of the consumer. Production systems, also, affect prices and marketing of these products. Locally produced mineral licks are sold cheaply compared to conventional mineral licks that are produced and packaged in a conventional way.

Table 4: Ranking of Factors Considered in Buying and Selling (Pricing) of Novel Mineral Licks

Factors	VI (4)	I (3)	SI (2)	NI(1)	Ranking
Color	+				4
Size/shape	+				4
Taste		+			3
Flavour			+		2
Purpose of buying	+				4
Purpose of selling	+				4
Packaging		+			3
Demand and supply		+			3
Production system		+			3

VI = very important, I = important, SI = slightly important, NI = not important

Constraints Faced by Novel Mineral Licks Producers and Marketers

Table 5 shows six constraints identified that affects novel mineral licks producers and marketers in the study area. All the six problems are viewed as crucial and constitute bottlenecks in novel mineral licks production and marketing. There is lack of adequate means of disseminating marketing information to both the producers and buyers because majority of actors reside and are based in remote areas, where telecommunication services are seriously lacking. They come to cities or market towns only on market days to

do their transactions and retire back to the villages. Only few of the producers and marketers who stay near towns and cities have access to telecommunication and have enough information on the current state of things in the Nigerian markets.

There are, also, no enough infrastructure in the markets as marketers display their goods in an open field under the scorching sun and rains, especially during the wet seasons of the year. No shelter is provided and many a times, their market locations are not even approved sites not to talk of having permanent structures. These hamper market expansion and development in the study area. There are little or no credit facilities given to novel mineral licks producers and marketers in the study area. Producers and marketers depend solely on the meager personal savings to produce and market the products. Financial institutions and governments are not ready to inject money into this novel mineral licks production and marketing simply because the producers, most of whom are illiterates, do not seek for such assistance and perhaps do not know that such privileges exist.

There are again, no reliable storage facilities and this, affects the demand and supply chain. The production of the novel mineral licks is high during the dry seasons and low in the rainy seasons because of availability of raw materials. It is, therefore, highly difficult to maintain steady production and supply year round and this affects the revenue and income generated from the business. Because the markets are not organized, there is no security around the market areas. Producers and marketers do their transactions at their own risk. They depend largely on God and nature for the protection of their lives and goods.

Table 5: Constraints Faced by the Novel Mineral Licks Marketers

Problems	I(3)	NI(1)	Ranking
Inadequate market information	+		3
Lack of infrastructure in the markets	+		3
Lack of credit facilities	+		3
Fluctuation in demand and supply	+		3
Lack of adequate security	+		3
Illiteracy	+		3

I = Important, NI = Not important

CONCLUSION

Majority of the novel mineral licks producers are young married Muslim women from the minority tribes with enough experiences but no Western education, which highly affected the development of the business. The common raw materials used for the production of novel mineral licks in the study area includes twelve (12) different plant and fifteen (15) different animal parts that are commonly and readily available. The novel mineral licks are utilized by livestock and humans in 6 different ways each, while all the producers' retail and sell their products in open markets where vegetable, spices and other food ingredients are sold.

There are nine (9) factors considered during selling and buying of novel mineral licks in the study area. Market prices of novel mineral licks are determined by visual evaluation which incorporates all the nine characteristics. Six constraints are identified to affect novel mineral licks producers and marketers in the study area. There is, therefore, a greater prospect for novel mineral licks producers and marketers in the study area as sooner or later the livestock industry will key into utilization of the products for livestock production as a cheap and readily available source of mineral supplements. Thus, novel mineral licks indigenous to people of the study area locally produced from ashes of crop

residues and animal dung would conveniently substitute those expensive conventional imported sources and save the livestock farmers a great component of their production costs.

RECOMMENDATIONS

The following recommendations are made to aid in improving the novel mineral licks production and marketing in Adamawa State, Nigeria. Government should identify these producers and marketers and make efforts to encourage novel mineral licks production in the region by providing them modern production facilities, loan or credit incentives through commercial or microfinance banks. Security outfits should be established in all the market areas to prevent the problem of theft, marketers should be encouraged to form strong market organizations to monitor the activities of members and customers. Local Government Councils should assist in forming a body charged with the responsibilities of passing information to producers and marketers on the supply, demand and price of novel mineral licks in the markets. Institutions such as polytechnics, colleges of education, colleges of agriculture and the universities which run animal production courses, local and commercial livestock producers should be encouraged to patronize novel mineral licks as cheaper and readily more available mineral licks for animals.

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