**Running title:** Traceability of Cattle among Nguni Cattle project Beneficiaries

**A Brief Report on the Traceability of Cattle for Commercialization among Nguni Cattle Project Beneficiaries in Eastern Cape, South Africa**

**Authors’ contributions**

Malusi Ndumiso and Falowo A Bamideleconceptualized and design the work; Malusi Ndumiso and Falowo A Bamidele collected and analyzed the data; Malusi Ndumiso, Falowo A Bamideleand Emrobowansan Monday Idamokoro visualized the results; Malusi Ndumiso, Falowo A Bamideleand Emrobowansan Monday Idamokoro wrote the paper; Hosu, Y. Sunday provided intellectual support and logistics for manuscript writing and submission and financial support

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**Novelty statement**

Regardless of the profits derived by cattle, local farmers are confronted with significant number of challenges that limit them from generating revenue from their cattle business.

We found out that there is dearth of information regarding proper traceability of cattle in several parts of Eastern Cape Province of South Africa. This is because most communal farmers are unable to give accurate information about the health and management status of their cattle. This however, impact negatively in the projected income generation from cattle sales for the communal farmers.

**Abstract**

The aim of the present study was to assess the impact of traceability in commercialisation of local Nguni breed of cattle among beneficiaries of Nguni Cattle Project. A total of 120 local Nguni farmers who benefited from the Nguni cattle initiatives were interviewed by the utilization of a semi-structured questionnaire from 6 (six) district municipalities (Amathole, OR Tambo Alfred Nzo, Joe Gqabi, Chris Hani and Sarah Baartman) of the Transkei and Ciskei region of South Africa. Data on cattle records, and identification methods were analysed using Freq and Chi square test of SPSS (Version 24). The results showed that 74.2 % beneficiaries were not keeping cattle records during the study. The Joe Gqabi municipality had the majority (80 %) of beneficiaries who keep farm cattle records, while OR Tambo and Amathole had the majority of beneficiaries who were not keeping records with 87.5 % and 83.3 % respectively. About 49 % of beneficiaries were using Ear-notching as their cattle identification method, while 28 % and 23 % were using Branding and Ear-tagging respectively. Education and formal livestock training had a strong association with record keeping. Many famers were not keeping record, therefore fail to partake in the formal market, thus receiving high returns. It can therefore, be concluded that majority of the Nguni project beneficiaries were not keeping cattle records, however, famers who are land owners keep cattle records. This had negative effect on traceability of several cattle, as there were no details of cattle health status and the location in which the cattle were reared.

**Keywords:** Local farmers, cattle, breed identification, livestock production

**Introduction**

Cattle traceability was developed to enhance ownership, registration in breed associations and record keeping for animal performance and health status (CFIA, 2018). According to CFIA (2018), traceability is said to be the ability to follow the processes that an item or group of items go through from one supply chain to the other. Livestock traceability’s basic elements include animal identification, location identification and animal movement from the point of rearing to market weight. In addition, DAFF (2011) reported that it is compulsory for every livestock species to have identification as per the Animal Identification Act (Act No. 6 of 2002). Cattle identification is one of the crucial ethical aspects as it involves human health, cattle production, preservation and management. Cattle can be reared in different locations and eventually be traded before slaughter. Likewise, the slaughtering process of cattle can occur far away from the animal’s original location, and it will lack the original information about the authentic source of the cattle.

The freedom of animal movement from one location to the other increases the risk of spreading animal diseases, and thus lead to contamination of meat products (Brester et al. 2011). Therefore, knowing the origin of cattle is a significant determining factor about the health status of the cattle and the quality of the meat products. Zhao et al. (2017) in their study argued that confirming the health status of living cattle and identifying diseased animal early is important for increased consumer’s awareness and source demands, food safety in the supply chain. Cattle traceability does not only help in controlling the spreading of diseases, but also increase chances for beef exports. According to Brester et al. (2011), beef importing countries have adopted the use of traceability systems for their products and such systems are emerging as the requirements for market access. However, Musemwa et al. (2008) and Van Schalkwyk et al. (2012), indicated in their study, that the most smallholder cattle famers sell their animals on informal markets where there are no requirements for proper animal records. One of the reasons for smallholder famers to be unable to use formal markets is their inability to meet market standards such as keeping the records of the cattle and rearing less desirable breeds by the formal market.

In several countries of the world, local cattle breeds have been considered to be of inferior market value when compared with foreign breeds in more developed countries as a result of their small market weight. These assertions have led to a drop in the utilization of local breeds while promoting the utilization of exotic breeds. On the contrary to these assertions, exotic breeds are vulnerable to unfavourable climatic and environmental conditions including feed scarcity, tick borne diseases, and poor animal feed quality that are predominant in most local communities (Muchenje et al. 2008a). It should be mentioned that foreign cattle breeds need a high level of feed supplementation and particularly during winter (dry season) to maintain their body condition. For instance, Nguni cattle is a tested (environmental adaptability) local breed that have been re-introduced into several local communities in the Eastern Cape Province of South Africa as a result of their adaptive qualities such as tick resistant ability, and production of desirable quality beef as compared to exotic breeds (Muchenje et al. 2008b).

Initiations for improvement scheme to repopulate the Transkei and Ciskei regions of the Eastern Cape Province with local cattle breeds in the local communities have received great attention. Among other improvement cattle scheme, the Nguni Cattle Project was founded where a substantial amount of Nguni heifers and bulls are given to selected communities in order to build the nucleus herd from this breed (Fuller 2006). According to Musemwa et al. (2008), it was reported that, the first cattle scheme started in 1998 with the aim of reintroducing the Nguni breed in the Transkei and Ciskei regions of the Eastern Cape Province. Suffice to say, is that, the Eastern Cape Province Nguni Cattle Project comprises of partners from the University of Fort Hare (UFH), Agrarian Reform (ECDRDAR), the Eastern Cape Department of Rural Development and the Industrial Development Cooperation (IDC). Interestingly, this project was enacted because of the good record of high performance of Nguni cattle with their adaptive traits to unfavourable weather conditions. According to Fuller (2006), farmers in chosen for this project were handed 10 (ten) in- calf heifers and 2 two bulls with the sole purpose of building nucleus herd. At the expiry period of five (5) years the beneficiary community return back 10 heifers and two (2) bulls to the scheme before passing it to another community within the Eastern Cape Province (Raats et al. 2004). The conditions for giving out the 10 in-calfs and two bulls to local farmers for this project is that, the receiving community must possess a well-fenced grazing area for the cattle and these receiving farmers must ensure that they practise a rotational system of grazing for their cattle (Mapiye et al. 2007). Furthermore, another requirement was that, the existing bulls within the shortlisted areas must be replaced with registered Nguni bulls either by culling or castration (Musemwa et al. 2008). The sole intention for the Nguni cattle scheme is to create a functional a niche area and market for Nguni products such as hide and skin, and beef; and in addition to introduce local farmers to world market through production and product processing of Nguni cattle (Raats et al. 2004). Furthermore, the Nguni scheme is also targeted at training farmers on cattle management and production. In this scheme, the stake-holders and development committee were saddled with the obligation to train farmers, redistributing Nguni cattle within different local communities and to develop infrastructures such as holding pens in areas where it is lacking in the communities (Musemwa et al. 2008).

Regardless of the profits derived by cattle, local farmers are confronted with significant number of challenges that limit them from generating revenue from their cattle business. These includes lack of cattle records which are commonly required by the formal markets such as; date of birth, pedigree records and animals’ health status. Most communal farmers are unable to give accurate information about when the cattle were dosed and what type of remedy was used. This may impact negatively in income generation from cattle sales for the South African economy, as communal areas is known to have the highest livestock production in the country. The objective of the study was, therefore, to report the current status as it relates to traceability of Nguni cattle as it relates to the commercialization of the cattle across beneficiaries of the Nguni Cattle Project within the Eastern Cape of South Africa.

Materials and Methods

Study area description

This study was carried out in six district municipalities of the Eastern Cape Province in South Africa, including Alfred Nzo, Joe Gqabi, Amathole, O R Tambo, Baartman, Chris Hani and Sarah which originally was set up for the Nguni Cattle Project, where the idea of the scheme was nurtured. The geographical location and pedo-climatic situations of the area of study are shown in Table 1. Permission to conduct the study was approved and Ethical clearance certificate was issued by the University of Fort Hare Ethical Clearance committee.

Data collection

Six district municipalities (Amathole, O.R Tambo, Alfred Nzo, Joe Gqabi, Chris Hani and Sarah Baartman) in the Eastern Cape Province, where the Nguni Cattle Project has been initiated were the selected areas for the study. The sample size for this study comprises of 120 beneficiaries. Every member of the Nguni cattle beneficiaries in the selected municipalities that were willing to participate in the study were interviewed.

However, prior to the commencement of data collection, a pilot study was done, using ten (10) farm aid workers from the University of Fort Hare Research farm who were also local farmers, were randomly selected for the interviews. A structured questionnaires similar to the one that will be utilized to carry out the study target group (Nguni Cattle Project beneficiaries) was used to obtain answers from the farmers in the pilot study. The reason for the pilot study was to ensure that famers were conversant with the concept and the objectives of the main study. Pre-testing of the questionnaire was also carried out in order to achieve the best questioning style and to ensure that appropriate time duration was obtained for the subsequent interviews of respondents in the course of the main study.

After the completion of the pilot study, the questionnaires were ready for the main study. The data was collected from the respondents using a structured questionnaire. The questionnaire was designed in a way that it comprises; cattle record keeping, cattle buying and identification methods. The Enumerators that helped to collect data are conversant with the local language which is IsiXhosa and English because all respondents that were interviewed are fluent in Xhosa speaking, a side from few of them who required explanation in English. Before the actual start of the study, the enumerators were adequately trained on the method and skill of approach of farmers and how they should record all the information gotten from the farmers.

**Data analysis**

All the data obtained from the farmers who benefited from the Nguni Cattle Scheme in the Eastern Cape Province were initially coded for adequate representation after which they were captured in Microsoft Excel. The frequencies of the cattle buying, record received when buying, formal training received by farmers, record keeping and identification methods was analysed using Freq of SPSS. The Chi square test was used to obtain the degree of association between categorical variables; demographic information, livestock formal training and cattle traceability of farmers who benefited from the Nguni cattle scheme.

Results

**Characteristics of demography of the Nguni cattle scheme beneficiaries**

The results obtained from the current study revealed that, out of the 120 Nguni farmers that were interviewed, the proportion of males and females was 85.8% and 14.2%, respectively (Figure 1). The results also showed that the proportion of the ages of the beneficiaries was 60.8% (above 60 years), 28.3% (between the age of 51-60), 8.3 % (between the age of 41- 50) and 2.5 % (between the age of 31-40), respectively. When comparing the different district municipalities, farmers from Chris Hani district municipality was shown to have the highest number of beneficiaries (84.6%) who were above 60 years of age, while farmers from Joe Gqabi district municipality had the lowest number of beneficiaries (40%) at the same age range of 60 years. Likewise, the result showed that high proportion (94.2%) of the farmers that were interviewed were married, with lesser proportions (5% and 0.8%) of the beneficiaries were widowed and singles. A proportion of 47.5% of the respondents had primary education (Grade 1-7), while the proportion of those that had secondary education (Grade 8-12) was 37.5 %. In addition, the results from the present study revealed that the proportion of the beneficiaries who mainly depended on social grants and old pensions from the government was 55 %.

**Knowledge, record of cattle trace and formal training received by farmers who benefited from the Nguni Cattle Scheme**

As shown in Table 2, the majority of beneficiaries (80%) were not buying cattle during the study. All the famers who were not buying cattle reported that their reason for not buying it was that they have enough stock that breeds itself. The majority of beneficiaries who were buying cattle reported that they buy bulls to breed with their stock. All the beneficiaries in Joe Gqabi municipality were not buying cattle followed by Amathole (88.3%) and OR Tambo (75%) beneficiaries (Figure 2). Likewise, our study revealed that, out of the 120 interviewed beneficiaries, 62.5% did not receive cattle records when buying cattle, while 37.5% claimed to receive records (Figure 2).

Furthermore, the Nguni farmers who obtained formal practical livestock training including health, animal handling, and animal nutrition management were 50 % while farmers who never obtained formal training was also 50 % (Figure 4). Sarah Baartman was the leading municipality with 91.7 % of beneficiaries obtained formal training, followed by Joe Gqabi and Alfred with 80 % and 50 % of beneficiaries as shown in Figure 5. The OR Tambo and Chris Hani municipalities had the highest number of beneficiaries (81.2 % and 76.9 %) who had never received formal livestock training. These municipalities are mostly dominated by remote villages that were far from the town, hence the study have found these implications.

**Record keeping by the Nguni Cattle Scheme beneficiaries**

Figure 6 showed that 74.2 % beneficiaries reported that they do not keep cattle records, while only 25.8 % were keeping records during the study. The types of cattle records that were asked from farmers included; cattle birth date and weight, parent’s performance records and dates of medication application. Figure 7 showed that Joe Gqabi was the only municipality with the majority (80 %) of beneficiaries who were keeping cattle records during the study. OR Tambo and Amathole had the majority of beneficiaries who were not keeping cattle records, with 87.5 % and 83.3 % beneficiaries respectively; therefore, these municipalities are less able to sell their animals to the formal markets.

**Types of identification methods used by the beneficiaries of the Nguni project**

Figure 8 showed that, Ear-notching was the mostly used cattle identification method, with 49 % beneficiaries, while 28 % and 23 % were using Branding and Ear-tagging, respectively.

In the present result, Figure 9 showed that Amathole and Alfred Nzo municipalities had the majority of beneficiaries using ear-notching, with 73.4 % and 50 %, respectively. The beneficiaries in Joe Gqabi using branding and ear-tagging were tied at 50%. Also, the proportions of beneficiaries from Chris Hani and Sarah Baartman who used branding for identification of their cattle was 61.6% and 58.3%, respectively.

**Results of association among districts, farmers’ demography, formal training in livestock, cattle ownership, marketing and traceability**

From the present result, Table 3 showed the association between district, farmers’ demography, formal livestock training and traceability. The results showed that, district had a strong association with the record keeping and types of identification methods used, however district had no association with cattle buying. As shown in Figure 2, all the municipalities had the majority of beneficiaries who were not buying cattle during the study. The age had no association with cattle buying and type of identification methods used. Furthermore, the education level of farmers had a strong association with record keeping and the types of identification method used. Formal skills and practical livestock training was shown to have a strong association with record keeping and the type of identification method used.

**Discussion**

From the result of the present study, it was shown that male farmers were more in cattle farming when compared to their female counterparts. This result is in agreement with the results reported by Gwala et al. (2016) and Idamokoro et al. (2016) who found out that, in the agricultural regions of rural areas in South Africa, male famers are more into cattle and goat farming, respectively than females. Having males rear cattle more than females in most societies may be clearly understood, reasoning being that cattle are large framed animals and local breeds may sometimes be very aggressive which will need a stronger hand to handle.In addition, Oluwatayo and Oluwatayo (2012) indicated in their study that animal husbandry requires both time and energy to manage, of which only few women may be willing to put in their efforts into animal farming. Likewise, Ayodele et al. (2009), in their study reported that, most women are usually engaged in several domestic activities (like cooking, keeping house chores, raising children etc) which could contribute to their lack of interest in livestock farming.

From the present study, about half (47.5 %) of the Nguni cattle farmers had their primary learning (Grade 1-7). This findings also agrees with the report by Gwala et al. (2016) and (Khapayi and Celliers, 2016) who found that rural cattle owners from the Transkei and Ciskei regions of the Eastern Cape Province of South Africa have low levels of education. The reason for the low level educational attainment may not be unconnected with the effect of the previous apartheid era that ended in 1994, where most black South Africans were deprived the privilege of enrolling in conventional schools.

With regards to cattle farmers’ major source of income, large proportion of the farmer (55 %) mostly depend on their pension to support their farming activities. This result is in line with the findings of Molefi (2015) in their study who reported that the proportion of cattle owners who mainly depended solely on pension as their primary source of income in Mpumalanga Province of South Africa was 45 %. It could be mention that, although most rural poor farmers rely on their pensions to support their farming activities, this fund may not be enough to improve their cattle farming production as other family needs (feeding, school fees of children etc) may also be competing with the pension money.

Likewise, from our result, we discovered that, a high proportion (80%) of the farmers who benefited from the Nguni cattle scheme were not buying cattle. From private discussions, most of the famers who were not buying cattle indicated to us that, their reason for not buying was because they have enough stock that they breed by themselves. The majority of beneficiaries who were buying cattle recounted that, they buy bulls to breed with their stock at home. It could also be reported that, all the beneficiaries in Joe Gqabi municipality were not buying cattle, this was followed by Amathole (88.3%) and OR Tambo (75%) Nguni cattle beneficiaries as shown in Figure 1. This may be due to the fact that most of the famers in these municipalities owned land with a desirable herd sizes.

Conversely, it was observed from the present study that, out of the 120 interviewed beneficiaries, 62.5% did not receive cattle records when buying cattle, while 37.5% indicated that they receive records of cattle history from their sellers. The implication of not getting sufficient information of cattle history may have negative repercussions on the production performance of cattle bought by local farmers which in turn showed clearly that, traceability is one of the major livestock management aspects that need to be addressed as it contributes to health status of the individual cattle and the herd population at large. In order for local cattle farmers to contribute to both local and international development and transit into the commercial farming sector, proper records of cattle history should be obtain for proper recognition and evaluation of high performing breed that they are buying (Khapayi and Celliers, 2016).

When comparing the different municipalities with regards to receiving basic livestock skills and training (such as health status management, animal handling, and animal diet formulation), OR Tambo and Chris Hani municipalities had the highest number of beneficiaries who had never received basic formal livestock training. From our knowledge, we may infer that, the reason for our findings may be as a result of the fact that, these two municipalities are mostly dominated by remote villages which are very far away from the major towns, hence, the cattle farmers may lack financial resources to support themselves when opportunities for training affords itself. In agreement to our findings Goni et al. (2018) also reported in their study that, among the several challenges faced by local cattle farmers; such as lack of knowledge, lack of livestock off take, and diseases among others, lack of adequate training on best farming practices is still a key constraint to cattle production in South Africa.

A large percentage (74.2 %) of Nguni cattle beneficiary farmers do not keep cattle records. Our findings is in agreement with the study by Mapiye et al. (2009), who reported that about 85 % and 95 % of famers were not keeping records in communal areas of South Africa and Namibia, respectively. All the famers who were not keeping records indicated (from private conversation) that they keep their farm records by hearts without writing them in an official record book. For instance, the record on animal medication, they use their knowledge of withdrawal period before they can consume the meat from injected animal. However, the inability to keeping proper cattle records have negative effect on farmers’ ability to participate in the formal market such as abattoirs and feedlots because these records are required in the formal market. The prospect of local cattle farmers to participate in the formal market is largely untapped as a result, local farmers do not obtain high returns for the sales of their animals (Khapayi and Celliers, 2016). It should be mentioned that, majority (80 %) of the cattle farmer beneficiaries from Joe Gqabi municipality keep cattle records, hence, they have the privilege of selling their cattle in the formal market.

From all the municipalities that were investigated, ear-notching was the mostly used cattle identification method, with 49 % beneficiaries, while 28 % and 23 % were using branding and ear-tagging, respectively. The current study, however, contradicts the study of Hangara et al. (2011), who reported that branding was the mostly used cattle identification method than ear-notching and ear-tagging by famers in Omaheke Region in Namibia. The differences of the current study and previous studies may be due to the fact that, the previous studies had many farmers who owned land with high income to buy the machines, while the current study is dominated by poor-resource farmers without enough money to buy branding machines. Ear-notching is less recommended and needs to be reduced as it causes a lot of bleeding, which may lead to infections and more stress to the animal (Leslie et al., 2010). Conversely, Hangara et al. (2011) reported that ear-notching is not scalable and can only identify a few animals, therefore, it is not suitable for large herds.

Amathole and Alfred Nzo municipalities had the majority of beneficiaries using ear-notching, with 73.4% and 50%, respectively from our study. The reason for this is that, these two municipalities are dominated by village owned enterprises, hence, they mostly used ear-notching. Meanwhile, Joe Gqabi municipality have only group owned enterprises (farms), hence, there are no beneficiaries in this municipality that use ear-notching as a means of identification. Furthermore, the beneficiaries in Joe Gqabi using branding and ear-tagging as means of identification were 50%, respectively. Chris Hani and Sarah Baartman district municipalities had the majority of cattle owners using branding with 61.6 % and 58.3 %, respectively. According to Hangara et al. (2011), the branding method of identification does not provide sufficient reliability and accuracy in identifying animals as it can be easily altered, removed and duplicated.

The current study also showed that districts had a strong association with the record keeping and types of identification methods that was used, however, districts had no association with cattle buying. Furthermore, age of farmers was shown to have no association with cattle buying and type of identification methods used. However, the education level of farmers had a strong association with record keeping and the types of identification method used. According to Mudzielwana (2015), education helps famers to enhance understanding and policies, which help to develop their farming skills. The source of income was found to have no association with cattle buying and the type of identification method used. These results suggest that famers with formal livestock training are more likely to keep records than those who have no formal training.

**Conclusions**

Many beneficiaries of the Nguni Cattle Project are not buying cattle as they are satisfied with their cattle numbers, while the majority of those who buy cattle do not receive records from the sellers. This had negative effect on traceability, as there were no details of cattle health status and the location in which the cattle were reared. The majority of the beneficiaries were not keeping cattle records, however, famers who are land owners keep cattle records because of their participation in the formal market. Ear notching is the mostly used identification method by the Nguni beneficiaries, especially by the village-owned enterprises. High level of education and formal livestock training received by the beneficiaries of the Nguni project contributed towards record keeping, and proper farm management for traceability. It is therefore recommended that, policy makers of the Nguni Cattle Project must invest in training famers on traceability aspects as this may affect their participation in the formal market, and therefore affect their level of commercialisation.

**References**

Ayodele J A, H I Ibrahim, H Y Ibrahim (2009). Analysis of women involvement in livestock production in Lafia area of Nassarawa State, Nigeria. *Livest Res Rural Dev* 21: 21-29

Brester G, K Dhuyvetter, D Pendell, T Schroeder, G Tonsor (2011). *Economic impacts of evolving red meat export market access requirements for traceability of livestock and meat*. <http://www.agmanager.info/livestock/marketing/AnimalID/USMEFFinal-Project-Report-Tonsor_03-30-11.pdf>. [14 August 2020].

Canadian Food Inspection Agency (CFIA). (2018). *Livestock identification and traceability*. <http://www.inspection.gc.ca/animals/terrestrialanimals/traceability/eng/1300461751002/1300461804752>. [30 of July 2019].

Department of Agriculture, Forestry and Fisheries (DAFF). (2011). *Identification of animals in terms of Animal Identification Act* (Act No. 6 of 2002). <https://www.daff.gov.za/vetweb/Animal%20Identification/VPN%20AIDA%20Feb2009.pdf>. [30 of July 2019].

Department of Agriculture, Forestry and Fisheries (DAFF). 2016. Economic Review of the South African Agriculture. <http://www.daff.gov.za/Daffweb3/Portals/0/Statistics%20and%20Economic%20Analysis/Economic%20Analysis/Economic%20Review%202016.pdf>. [30 July 2019].

Fuller A (2006). The sacred hide of Nguni; the rise of an ancient breed of cattle is giving South Africa new opportunity. Miracles that are changing the Nation. Industrial Development Corporation (IDC) Newsletter. pp. 3-4.

Goni S, A Skenjana, N Nyangiwe (2018). The status of livestock production in communal farming areas of the Eastern Cape: A case of Majali Community, Peelton. Appl. Anim. Husb. Rural Develop 11: 34-40

Gwala L, N Monde, V Muchenje (2016). Effect of agricultural extension services on beneficiaries of the Nguni cattle project in the Eastern Cape Province, South Africa: A case study of two villages. *Appl. anim. husb. rural dev*  9: 31-40

Hangara G N, M Y Teweldemedhin, I B Groenewald (2011). Major constraints for cattle productivity and managerial efficiency in communal areas of Omaheke Region, Namibia. *Int J Agr Sustain* 9: 495-507

Idamokoro E M, P J Masika, V Muchenje (2016). Prevailing management practices and perceived causes of mortality in pregnant does under free ranging farming systems in the Central Eastern Cape Province of South Africa. J Anim Plant Sci 3:4272-4281

Khapayi M, P R Celliers (2016). Factors limiting and preventing emerging farmers to progress to commercial agricultural farming in the King William’s town area of the Eastern Cape Province, South Africa. S. Afr. J. Agric. Ext 44:25-41

Mapiye C, M Chimonyo, V Muchenje, K Dzama, M C Marufu, J G Raats (2007). Potential for value-addition of Nguni cattle products in the communal areas of South Africa: a review. *Afr. J. Agric. Res* 2: 488-495

Mapiye C, M Chimonyo, K Dzama, J G Raats, M Mapekula (2009). Opportunities for Improving Nguni Cattle Production in the Smallholder farming system of South Africa. *Livest Sci* 124: 196-204.

Molefi S H (2015). Utilization and management of beef cattle farming as a contributor to income of households in communal areas of Chief Albert Luthuli Local Municipality in Mpumalanga Province. MSc. Thesis, Agriculture. University of South Africa, South Africa.

Muchenje V, K Dzama, M Chimonyo, J G Raats, P E Strydom (2008a). Meat quality of Nguni, Bonsmara and Angus steers raised on natural pasture in the Eastern Cape, South Africa. *Meat Sci* 79: 20-28

Muchenje V, K Dzama, M Chimonyo, J G Raats, P E Strydom (2008b). Tick susceptibility and its effects on growth performance and carcass characteristics of Nguni, Bonsmara and Angus steers raised on natural pasture. *Animal* 2: 298–304

Mucina L, M C Rutherford (2006). *The vegetation of South Africa, Lesotho and Swaziland. South African National Biodiversity Institute*. <https://www.sanbi.org/wp-content/uploads/2018/05/Strelitzia-19.pdf>. [20 July 2020]

Mudzielwana G. (2015). *Determinants of cattle ownership and herd size in Vhembe district of South Africa: A Tobit approach*. Master of Agricultural Economics Thesis. University of Limpopo, South Africa.

Musemwa L, A Mushunje, M Chimonyo, G Fraser, C Mapiye, V Muchenje (2008). Nguni cattle marketing constraints and opportunities in the communal areas of South Africa: Review. *Afr. J. Agric. Res* 3: 239-245

Oluwatayo I B, T B Oluwatayo (2012). Small Ruminants as a Source of Financial Security: A Case Study of Women in Rural Southwest Nigeria. *Inst Money Technol Finan Inclus* 2: 1-2

Raats J G, A M Magadlela, G C G Fraser, A Hugo (2004). ‘Re-introducing Nguni Nucleus Herds in 100 Communal Villages of the Eastern Cape Province’. A proposed co-operative project between the University of Fort Hare, Agricultural and Development Research Institute (ARDRI) and the Eastern Cape Department of Agriculture and the Kellogg Foundation.

Van Schalkwyk H D, J A Groenewald, G C Fraser, A Obi, A Van Tilburg (2012). *Unlocking markets to smallholders: Lessons from South Africa*. Springer Science & Business Media. <https://www.springer.com/la/book/9789086861682>. [30 July 2020].

Zhao J, C Zhu, Z Xu, X Jiang, S Yang, A Chen (2017). Microsatellite markers for animal identification and meat traceability of six beef cattle breeds in the Chinese market. *Food Control*. 78: 469-475

Table 1: The geographical coordinates and pedo-climatic conditions of the study areas

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **District Municipalities** | **Coordinates**  | **Vegetation Type** | **Yearly rainfall (mm)** | **Yearly mean temperature (**$℃$**)** | **Altitude (m)** |
| **Alfred Nzo** | 30.54°S, 28.85°E | Sour |  600-950 | 14-15 | 600-1400 |
| **Amathole** | 32.58°S, 27.36°E | Sweet |  400-700 | 15-20 | 400-700 |
| **Joe Gqabi** | 30.98°S, 26.98°E | Sweet-Sour |  400-700 | 12-16 | 1100-1600 |
| **O R Tambo** | 31.46°S, 29.23°E | Sweet-Sour |  450-750 | 17-18 | 600-850 |
| **Chris Hani** | 31.87°S, 26.79°E | Sweet-Sour | 400-700 | 12-16 | 400-1450 |
| **Sarah Baartman** | 33.57°S, 25.36°E | Sour | 600-945 | 12-14 | 800-1350 |

Source: Mucina and Rutherford (2006)

Table 2. Cattle buying by farmers who benefited from the Nguni Cattle Scheme in Eastern Cape (n=120)

|  |  |  |
| --- | --- | --- |
| **Cattle buying** | **No** | **%** |
| Buying | 24 | 20 |
| Not-buying | 96 | 80 |

Table 3. Association between district municipalities, farmers’ demography, livestock training, cattle ownership, marketing and traceability

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Record keeping** | **Cattle buying** | **Type of identification method** |
| District | \*\* | NS | \*\*\* |
| Age | \*\*\* | NS | NS |
| Education level | \*\*\* | NS | \* |
| Source of income | \*\*\* | NS | NS |
| Livestock training  | \*\*\* | NS | \*\*\* |

\*\*\*p<0.0001; \*\*p<0.01; \*p<0.05

Figure 1. Information of farmers’ demography of the Nguni cattle scheme recipients (No = 120)

Figure 2. Representation of Nguni cattle beneficiaries who buy cattle and those who do not buy cattle across six districts

Figure 3. Cattle records received by the recipients of the Nguni cattle scheme when buying cattle

Figure 4. Livestock formal training for the Nguni cattle beneficiaries

Figure 5. Livestock formal training for the Nguni cattle recipients across six districts

Figure 6. Keeping of cattle record by the recipients of the Nguni cattle scheme

Figure 7. Keeping of cattle records by the recipients of the Nguni Cattle scheme across six districts

Figure 8. Types of identification methods used by the recipients of the Nguni cattle scheme

Figure 9. Types of identification methods used by the recipients of the Nguni Cattle scheme across six districts