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**194- Are food supply chains in Africa geared for origin based foods:
Evidence from Southern Africa**

by

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ABSTRACT

In a consumer driven world consumers want to experience a connection between the product that they are consuming and the origin of that product. To guarantee the validity of this connection and therefore the product's origin attribute, traceability systems are required. The question is therefore whether food supply chains do incorporate strong traceability systems to guarantee the origin of a product. The paper draws on analysis of South African meat supply chains as well as some secondary evidence from Namibia.

1. INTRODUCTION

One of the latest trends in the market for food products is the desire amongst consumers to know the origin of the food product they purchase and to be physically or emotionally connected to the farm and the producer. This consumer need for origin based food is now playing out in a variety of ways as food processors and retailers are labelling their products according to the origin of the product. Quite often regional names are used for that identification. In order for the origin and history of a food product to become evident a transparent supply chain is needed (Trienekens & Beulens, 2011:2). However, in order for a supply chain to become transparent, traceability systems need to be in place. Traceability is therefore a proactive approach to create, maintain and share the information trail that follows the path of a product throughout the production process to ensure a transparent, traceable supply chain.

From the aforementioned it is clear that traceability systems play an integral part in a product with origin as a credence attribute. The consumer need to know the origin of its food product is probably not relevant to the majority of African consumers but it is so that amongst affluent consumer groups this aspect is more and more becoming an important aspect for consumers. It can therefore be asked whether supply chains on the African continent are able to bring products that carry a strong regional (or origin) identity to these affluent consumers. This question therefore translates into understanding the functioning of traceability systems in supply chains.

2. TRACEABILITY TO GUARANTEE ORIGIN BASED MEAT PRODUCTS

Globalisation of the food market in the past decade has meant that consumers have developed a certain need to acquire the regional identity of a specific food product. Naturally, food products are land based and have a regional or geographical origin, but this association between food and region has disappeared over time (Van Rijswijk, Frewer, Menozzi & Failoli, 2008:453) and consumers are feeling more disconnected from the rural landscape. This disconnect can be re-established by means of products that are linked to their region of origin, thereby offering a mythical connection to the specific values associated with the region in terms of environmental, cultural and social characteristics. The ability to link products to specific regions can also be a valuable tool for producers. This link offers a

valuable differentiation strategy when marketing commodity products and opens up the possibility of entering into a niche market (Kirsten, 2011:40). However, to be able to determine and guarantee the region of origin of a product consumed, a traceability system is needed to track the product back to the country or region where the animal was reared in order to honestly and correctly label the meat product to convey a specific message to consumers. Traceability can therefore be an important tool to help to establish the authenticity of food in order to re-establish consumer trust, to check that claims made by producers are true but also to provide producers with additional marketing options to possibly create added value and obtain a competitive edge in a highly competitive market (Van Rijswijk, Frewer, Menozzi & Failoli, 2008:453).

As a result of the above mentioned reasons, interest in terms of traceability is rapidly growing within the food and agribusiness sector. To keep up with this growth, it is essential for stakeholders to adhere to certain requirements to try and develop a fully traceable supply chain. Industry members will have to invest in a good tracking and tracing system to allow for the tracking and tracing of products throughout the supply chain. By investing in these systems the supply chain becomes transparent, which in turn rebuilds consumer trust in food products, especially in the light of the recent meat scandal in South Africa and some European countries (Trienekens & Van der Vorst, 2006:445).

The main functions and purposes for the implementation of a traceability system, according to Hobbs (2003:37) and Meuwissen, Velthuis, Hogeveen & Huirne (2003:169), can be summarized as:

- Facilitating the trace back of products increases transparency and reduces the costs associated with or minimises the risks of a food safety problem
- Strengthening liability incentives and reducing the risk of liability claims
- Allowing ex ante verification of credence quality attributes, such as origin
- Improving recall efficiency by improving the quality of the recall, thereby reducing costs and enhancing the image of the supply chain
- Improving the control of livestock epidemics, since movements between farms are tracked and epidemics such as foot and mouth disease can be caught in time.

Traceability systems are therefore, built into and developed for supply chains for various reasons. One of these reasons is to enhance transparency within a supply chain. As soon as a supply chain becomes transparent, information within the supply chain is of a higher quality, and information flows are faster.

Beulens, Coppens and Trienekens (in Trienekens & Van der Vorst 2006:451-452) identified the following information arising from a supply chain where a proper traceability system is in place:

- The process properties which constitute the history of what has happened to the product during production or processing
- Properties or means of production used on the product such as labour and machinery used in producing the product
- Origin or provenance data of a product deals with information related to the processes, resources, raw materials and intermediate products used to produce the product
- Actors involved during the lifecycle of the product
- Relationships between the different stakeholders of a supply chain.

An intensive chain wide traceability system guarantees the quality, origin and traditional production methods of a food product and brings about the following benefits for farmers, the rural community as a whole and consumers (Serra, 2007:10-11):

- The products produced by farmers and producers are protected from exploitation by imitations through the presence of proper chain-wide traceability systems and labelling
- Farmers and producers gain a price advantage if the origin and quality of the food product can be guaranteed through a traceability system, to be sold at a higher price in the market
- The guarantee of the origin of the product contributes to sustainable rural development by safeguarding natural resources and traditional skills for generations to come
- The above in turn leads to an increase in the livelihood of farmers and the rural community
- Labels offer a unique marketing message about high value-added products, and consumers are not exploited by imitations when buying products with a regional guarantee.

All supply chain members must have horizontal and vertical traceability systems in place to achieve chain-wide traceability. Each member can decide on the process to follow to obtain horizontal traceability as long as they are able to collect, record and share the necessary information with upstream and downstream members. For successful supply chain traceability it is important to determine the scope of the traceability system, to identify the supply chain members involved, to clearly identify the boundaries of the traceability system and to map the physical flow of products to identifying the physical locations, inputs, internal processes and outputs. Figure 4 serves as a diagrammatic representation of guidelines for an organisation or supply chain to implement a traceability system and become transparent.

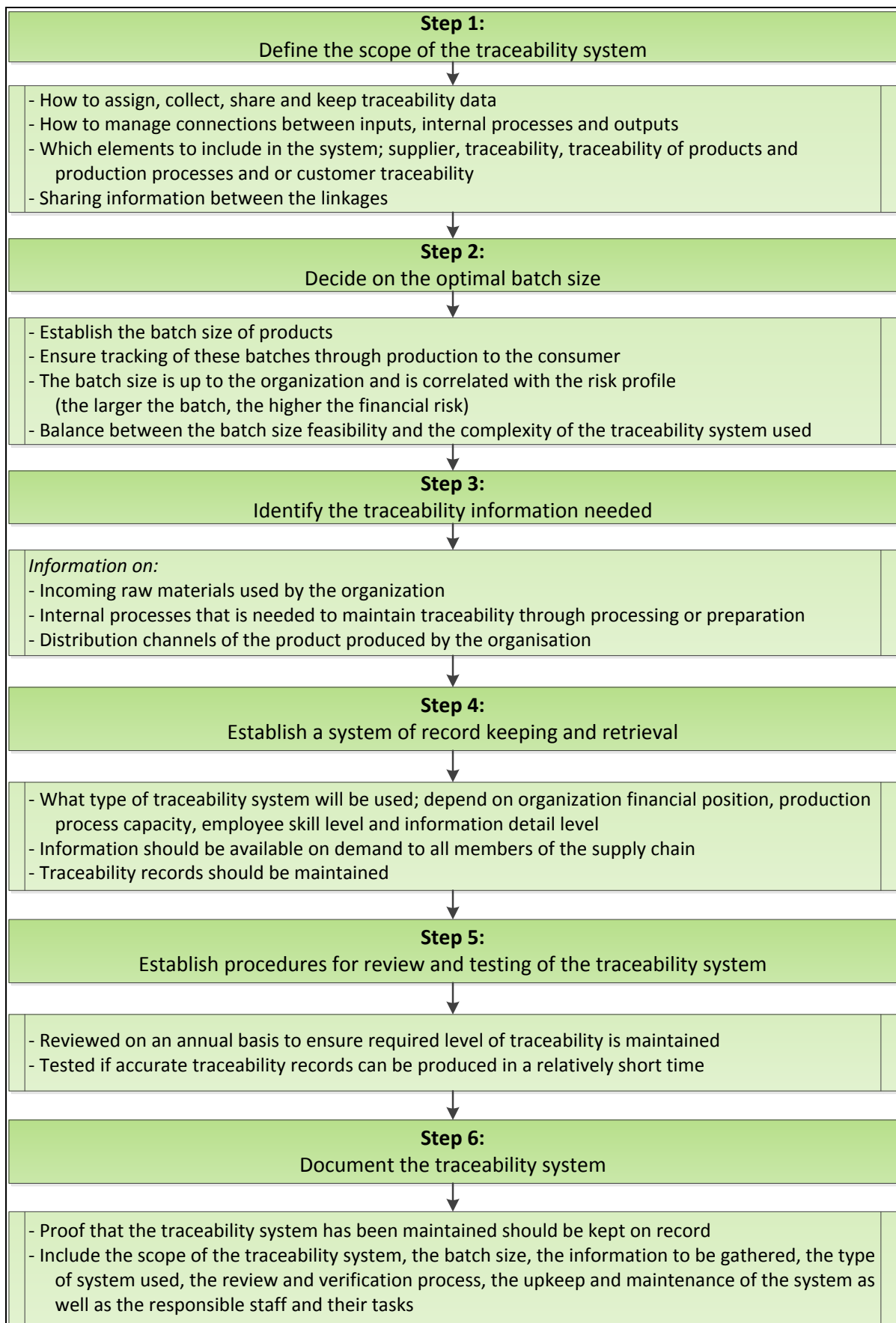


Figure 4: Guidelines for the implementation of a traceability system

Source: Food Safety Authority of Ireland, 2010

Even though the majority of African consumers might not be interested in traceability systems as a guarantee for credence attributes, traceability systems are still required by international customers. It is therefore important for African supply chains exporting fruits, vegetables and flowers to sophisticated markets to incorporate these systems in their local supply chains. Traceability systems can in addition be implemented by African supply chains to unlock markets, specifically with regards to exports to European markets and/or developing a niche market for a differentiated food product to gain a competitive edge in a highly competitive food industry. Traceability systems and the advantages pertaining to these systems become particularly important when high LSM (Living Standard Measurement) groups are concerned. This makes traceability in urban areas extremely important especially were, given the recent meat scandal in some European countries and South Africa, meat content, nutritional content, hygiene and origin are concerned. Two examples of the successful implementation of traceability systems from a Southern African perspective include the MeatCo beef supply chain in Namibia and the Karoo lamb supply chain in South Africa.

2.1 MeatCo beef – Namibia

The Meat Corporation of Namibia (MeatCo) has been the cornerstone of the Namibian Meat Industry for over 20 years. Since then it has developed world-class slaughtering facilities (HACCP and ISO quality management system approved) that deliver products of a consistently high quality to both local and international customers. MeatCo purchases mainly free range cattle, free from antibiotics and growth hormones, from local farmers, to ensure a 100 % natural product. The Namibian beef supply chain consists of supply chain members that are experts in their field with a passion for their product (MeatCo corporate video, 2008). This supply chain is laid out in Figure 2.

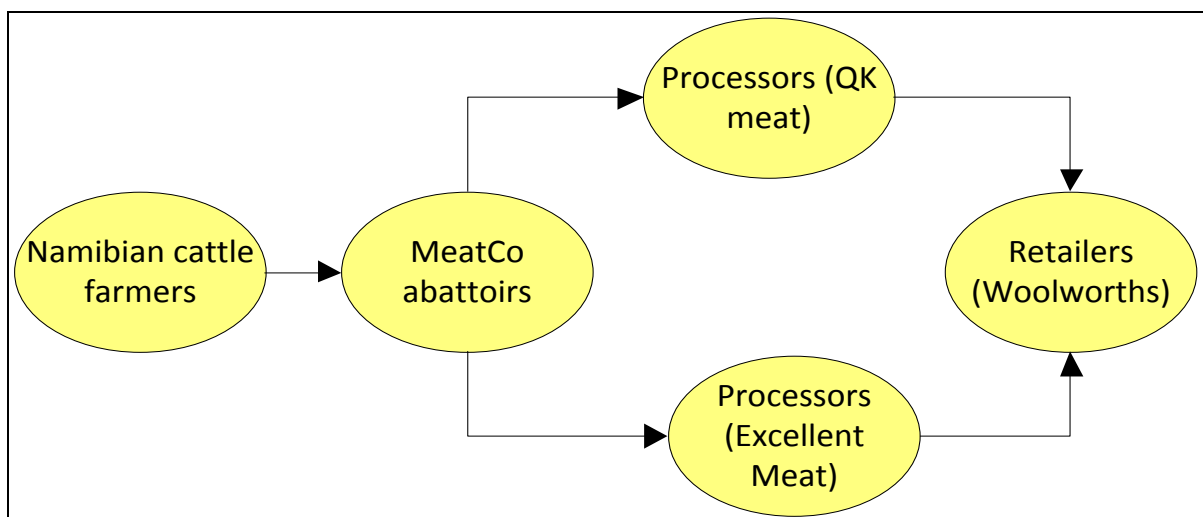


Figure 2: Namibia’s farm assured beef supply chain (SA customer)

Source: MeatCo corporate video (2008)

The main driver for the implementation of traceability systems in the Namibian beef supply chain is the requirements set by their European and South African (Woolworths) customers. MeatCo regards traceability as extremely important to stay competitive in a highly competitive international market (MeatCo corporate video, 2008).

The FANmeat (Farm Assured Namibian meat) scheme is a world-class tracking system that provides traceability from farm to fork and aims to guarantee safe, healthy and quality products from the producer to the consumer. The farm to fork traceability system enables consumers to trace beef products back to the farm of origin providing the link to the region of origin needed by customers to make that physical connection mentioned earlier (MeatCo corporate video, 2008).

Each farmer is required to use both ear tags and RFID (Radio Frequency Identification) tags as animal identification (Meat Chronicle, 2010:2). The farmer is furthermore required to register the cattle at the nearest Veterinary Service Officer by handing in an Animal Registration Card to register the cattle on the NamLITS (Namibian Livestock Identification and Traceability System) database. This should be done within 14 days of tagging. The ear tag number is also recorded in the farmer's documentation system. When the animal is ready to be marketed the animal's unique identification number is used by the abattoir when the animal is slaughtered. This unique number is used for the individual animal as it goes through the slaughtering and processing stages and can then be used by consumers to track the meat product back to the animal and farm of origin (MeatCo corporate video, 2008).

2.2 Karoo lamb – South Africa

The Karoo is the large semi-arid area stretching north eastwards from the Cape and covers almost 50% of the total area of South Africa. The region is typically flat, dry shrub land with grass growth restricted by rainfall in the region. When thinking about the Karoo, what comes to mind is sunsets, windmills, hospitality, free roaming sheep, the smell of earth, freshly brewed coffee and the taste of genuine, fresh from the farm, barbequed under the stars Karoo lamb chops. These images, and the tranquillity and honesty of the Karoo way of life are the reasons why the Karoo concept became synonymous with quality, tradition and wholesomeness. The reputation for quality which is embedded in words such as Karoo has significant marketing potential and is as such already pursued by members of the sheep supply chain often with little or no link to the region (Kirsten, Troskie, Vermeulen, Schönfeldt & Bramley, 2008:1).

Sheep produced in this region graze on the Karoo shrubs year round, as these shrubs are palatable and meet the nutritional needs of the animals. The Karoo shrubs furthermore provide a distinct taste to the sheep meat. Karoo sheep meat is described as "mouth-wateringly succulent, imbued with the subtle, fragrant flavours of the Karoo bush" (Kirsten *et al.*, 2008:1). The diet of the Karoo reared sheep, in combination with the image and reputation of the Karoo, is what makes the concept of Karoo lamb most sought after (Kirsten *et al.*, 2008:1).

Figure 3 illustrates the Karoo Meat of Origin supply chain, which includes sheep farmers, abattoirs, meat packers, retailers and consumers. With this process map, different points of certification are identified and indicated by the Certified Karoo Meat of Origin logo. These points can also be referred to as critical control points in the traceability system, since these points indicate entities or processes where information flow can easily be disrupted or discontinued, but where information gathering and sharing and therefore traceability are of the utmost importance. This logo merely indicates that this particular supply chain member has had to apply, be audited and certified as a Karoo Meat of Origin member to be part of this prestigious supply chain.

Farmers, abattoirs, processing plants, wholesalers, retailers, butcheries, deli's and restaurants can apply to become certified members of the Karoo Meat of Origin scheme. After the application form and application fee are received by the governing body, the Karoo Development Foundation, the applicant is audited by an independent authority, the SAMIC. Every farm, abattoir, value adding meat plant, butchery, wholesaler and retailer or restaurant should adhere to the standards and requirements of the Karoo Development Foundation in order to pass the audit, as set out on the Karoo Meat of Origin website (2012a).

Once the applicant pass the audit, the Karoo Development Foundation awards a certificate stating the successful application of either farms or facilities. The applicant is thereby a proud member of the Karoo Meat of Origin consortium, enabling them to use the Karoo Meat of Origin mark within the regulations of the Karoo Development Foundation. Trust, transparency, traceability and efficient coordination between farmers, abattoirs, transport contractors as well as wholesalers, retailers, butcheries, delis and restaurants are the pillars on which this certification scheme is built (Karoo Meat of Origin, 2012c). It is therefore obvious that traceability can be an important tool to help to establish the authenticity of food and to check that claims made by producers are true (Van Rijswijk *et al.*, 2008:453).

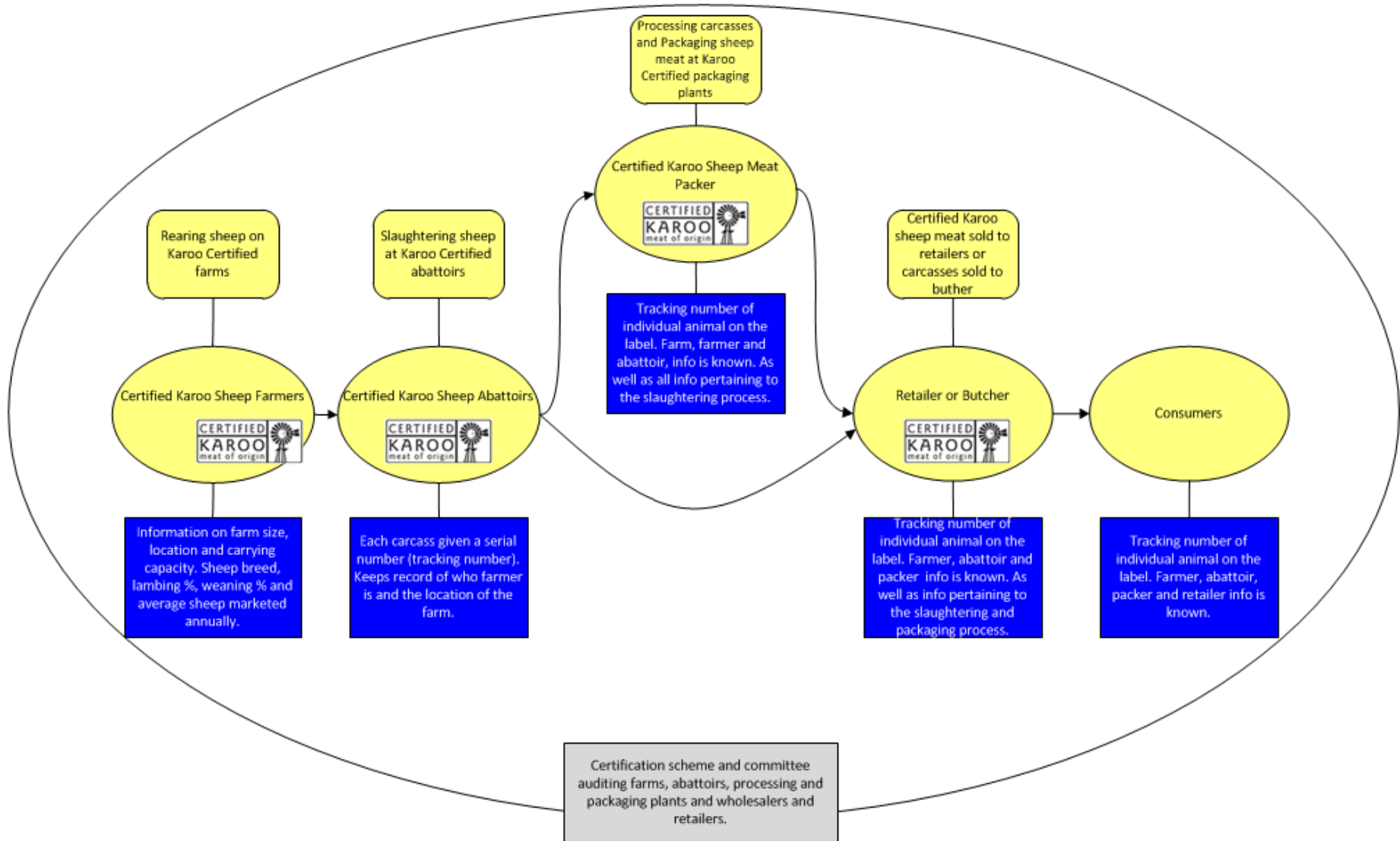


Figure 3: Karoo Meat of Origin supply chain with certification points

The major driver for the implementation of chain-wide traceability systems in the Karoo meat of origin certification scheme is to protect the image of the Karoo from members of society exploiting the marketing potential linked to the Karoo name. The implementation of traceability systems within the Karoo sheep meat supply chain ensure that consumers are guaranteed that sheep meat labelled as Karoo lamb actually originates from the Karoo. By implementing a proper traceability system, all members of the supply chain benefit.

2.3 Summary

This review of both the MeatCo beef and Karoo lamb supply chains, characterised by the region of origin attribute, has seemingly good chain-wide traceability systems in place which contribute to the economic success of such operations.

There are certain strong similarities between the two different supply chains:

- Both products have some unique characteristics, be it the origin or production method
- Traceability systems are in place to protect either the origin or geographic indication of a product and/or the method of production
- In both the Karoo lamb supply chain and the MeatCo beef supply chain the traceability system implemented have the ability to trace not only the carcass back to the farm of origin but also individual meat cuts
- These traceability systems are therefore able to guarantee the origin of the meat products supplied.

Some of the benefits from the implementation of a proper chain- wide traceability system that came to light during the comparison are:

- By having chain-wide traceability systems in place, these supply chains gain a competitive edge in the local and international market
- The industry's collective interests have been enhanced – in the MeatCo beef chain traceability has led to access to European markets
- The Namibian cattle and the South African Karoo lamb industry has gained a competitive edge – the unique traceability system and farming methods are what sets them apart from other producers, both in locally in globally
- Traceability systems therefore lead to value creation throughout the supply chain but it is not yet proven if they lead to value distribution
- The livelihood of farmers and rural communities increased due to the positive effect of traceability on market access which led to higher sales and possible premiums which could possibly be redistributed to farm workers
- Traceability systems also ensured the protection of public interest such as animal health, public health and crisis management in times of an epidemic
- In Namibia the farmers' access to finance has increased since they can put identified animals up as collateral, this supported developing farmers

- Stock theft has decreased in Namibia since all cattle are marked with an ear tag as well as an RFID tag
- Market transactions have been facilitated and the purchasing and slaughtering processes have become more streamlined
- In the Karoo lamb case the presence of a traceability system acted as proof of compliance with meat safety, quality and hygiene regulations by retailers.

It is evident from the preceding discussion of the supply chains that transparent chain-wide traceability systems are present, not only in the sophisticated meat supply chains in Europe, but also in the African meat supply chains. These traceability systems are not only possible but are a necessity to differentiate between supply chains in the same industry, to create and guarantee the unique identity of a specific meat product and to gain a competitive advantage in a highly competitive industry.

The next section will look at traceability systems implemented in the South African red meat abattoirs towards to implementation of a chain wide traceability system to guarantee the origin of a product like Karoo lamb.

3. TRACEABILITY SYSTEMS IMPLEMENTED BY SOUTH AFRICAN ABATTOIRS

The study of South African abattoirs, completed in 2012, established that 92 % of all sampled abattoirs had some traceability system in place. The 3 (8 %) abattoirs that do not have traceability systems in place are situated in the Northern Cape and Eastern Cape, regions where sheep are often marketed as Karoo lamb. Without proper traceability systems in place, this credence attribute cannot be guaranteed.

Figure 4 illustrates the different types of traceability systems that are in place at the abattoir level in South Africa; Abaserve, Meat Matrix, Beef Tech, Excel or paper based systems. It was noted that high throughput abattoirs are more likely to have electronic traceability systems, such as the Abaserve system, in place.

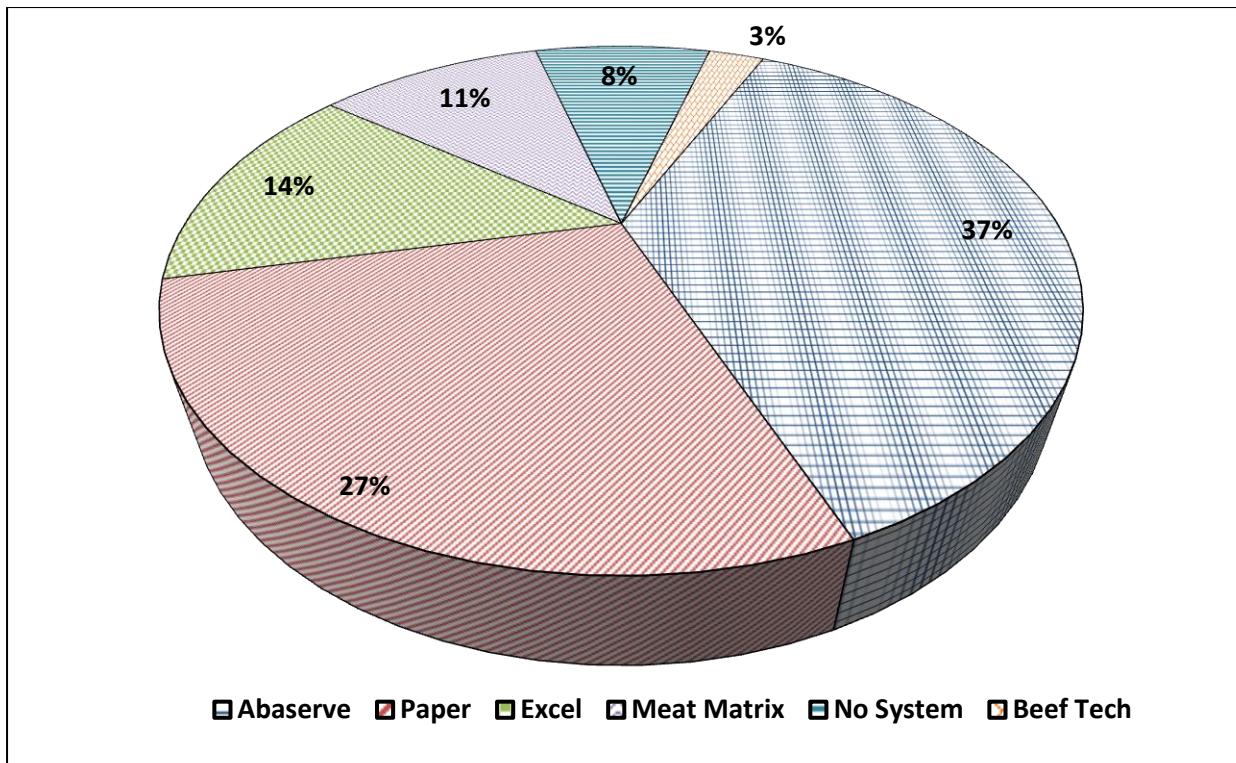


Figure 4: Traceability systems at the South African abattoir level

These sampled abattoirs identified the key drivers for the implementation of traceability systems throughout the sheep supply chain as; retailers, consumers and the South African government.

Only 33% of the abattoirs knew exactly what their traceability costs are. From the study it can be concluded that, a typical abattoir with a slaughtering capacity of 1000 sheep per day, that has a traceability system such as Abaserve in place, spend approximately R70 000 (USD 8540¹) start up fees on hardware and software to get the system in place. Thereafter R5 000 (USD 610²) per annum are spent on the Abaserve licencing fees.

The abattoirs indicated that, given the choice, they will not have traceability systems in place. The majority (97%) of the abattoirs feel that the South African abattoirs are the sole carriers of the cost to implement a traceability system in a supply chain whilst 75% of these abattoirs feel that the benefits mostly befall the South African consumer.

The question was raised; “Why implement traceability systems when all the costs but very few of the benefit befall you?”. Most abattoirs argued that they had to implement traceability systems as it is a requirement to supply the retail market. The following section provides more detail and statistically test the statement made by the sampled abattoirs.

^{1&2} Average ZAR/USD exchange rate 2012 (R8.20/USD)

For quantitative analysis the Fisher's exact test was used to test, in STATA, the formulated hypothesis. It was initially thought that the fact that abattoirs delivered their product to retailers might influence the presence of a traceability system at the abattoir level since this act as a product quality and safety guarantee. This idea was supported by the Fisher's exact test. The conclusion drawn for the hypothesis was that the implementation of a traceability system is dependent of the fact that abattoirs supply carcasses to the retail market.

Hypothesis:	The proportion of abattoirs with traceability systems is independent of if they deliver to retailers or not.
Fisher's exact test:	1 sided = 0.0000004
Rejection rule: (p-value > 0.05)	Hypothesis 3 can be rejected on a 5% level of significance.
Conclusion:	The fact that abattoirs deliver to retailers does influence the presence of a traceability system.

The descriptive statistics act as further confirmation of this statement; 95% of retail delivering abattoirs had traceability systems in place, the other 5% of abattoirs were abattoirs situated in remote rural areas. Retailers in these areas do not have access to alternative suppliers and meat is therefore bought from these rural abattoirs regardless of the presence of a traceability system.

4. CONCLUSION

During the study it was decided to compare the MeatCo beef supply chain with its high tech traceability system fit for European standards, with the new kid on the block; South African Karoo lamb to determine not only the importance of a traceability system in an origin based meat product's supply chain but also the readiness of African food supply chains to successfully implement a traceability system that guarantees the origin of a product.

In a study done by Bulut and Lawrence (2007) abattoirs and meat processing plants were identified as the weak links when it comes to traceability. It was therefore decided to start the investigation of the presence of traceability systems at the South African sheep abattoir level to establish the readiness of the abattoirs to be able to guarantee the origin of a product like Karoo lamb and to ultimately lay the foundation for further research towards a traceable lamb supply chain.

It was conclusively found that the South African sheep abattoirs have the ability to guarantee the origin of a meat product such as Karoo lamb by means of their traceability systems. From the data gathered it was clear that the majority of the abattoirs have proper traceability systems in place that makes it possible for these abattoirs to at least distinguish between batches from different farmers and therefore possibly different regions. The sampled abattoirs were however of the opinion that the traceability system is compromised as soon as the carcasses are processed; it is much easier to trace a single carcass than to trace different meat cuts, from different carcasses, packed for different markets, back to the farm or region of origin.

The fact that 92 % of the participant abattoirs had traceability systems in place, even though they were uncertain about the economic implications of these systems was interesting. This did not make sense from an economic viewpoint. The main reason why abattoirs had traceability systems in place soon came to light: retailers require traceability systems before an abattoir is even considered as a supplier to a retailer. Consequently, 95 % of retail delivering abattoirs had a traceability system in place. This statement is supported by applying Fisher's exact test to the study's findings. This test concluded that the hypothesis; the proportion of abattoirs with traceability systems is independent of the outlet market, can be rejected at a 5 % level of significance. This means that the fact that an abattoir delivers to a retailer significantly affects the traceability system implementation decision. This furthermore shows the tremendous power that retailers have in the sheep meat supply chain.

A chain-wide traceability system is therefore considered a competitive factor. It provides consumers with information about the production process of a specific product and it connects the consumer with the region of origin of that product. These systems improve the reputation of the company the supply chain and the products they supply. When comparing the two supply chains, the Karoo lamb supply chain stood its ground and compared well with the MeatCo beef supply chain and both these supply chains compared well with European meat supply chains. It can therefore be concluded that Southern African supply chains have the potential to, with the proper traceability system in place, guarantee origin based products.

It is however important that all role players in the supply chain adhere to the principles and values of the traceability system. An internationally respected, chain wide traceability system will not be accomplished if only the abattoirs are on board with the implementation of a traceability system. It is of the utmost importance that the whole supply chain is on board to truly make something like this work to the benefit, of not only for the role players of the supply chain, but also for the community, the country and in this case the African continent as a whole.

REFERENCES

Bulut, H. & Lawrence, J. D. (2007). Meat slaughter and processing plants' traceability levels evidence from Iowa. In Proceedings of the NCCC-134 Conference on Applied Commodity Price Analysis, Forecasting and Market Risk Management, Chicago. <http://ageconsearch.umn.edu/bitstream/37576/2/confp20-07.pdf>

Food Safety Authority of Ireland. 2010. *Guidance Note No. 10. Product Recall and Traceability (Revision 2)*. Food Safety Authority of Ireland. Abbey Court, Lower Abbey Street, Dublin. [Online] Available from: [http://www.google.co.za/#hl=en&site=&source=hp&q=Guidance+Note+No.+10.+Product+Recall+and+Traceability+\(Revision+2\)&oq=Guidance+Note+No.+10.+Product+Recall+and+Traceability+\(Revision+2\)&gs_l=hp.3...2324.2324.0.2808.1.1.0.0.0.374.374.3-1.1.0.les%3B..0.0...1c.1.qHcPIVITkVw&bav=on.2,or.r_gc.r_pw.&fp=5916ceb4c9d179de&bpcl=38093640&biw=2276&bih=1039](http://www.google.co.za/#hl=en&site=&source=hp&q=Guidance+Note+No.+10.+Product+Recall+and+Traceability+(Revision+2)&oq=Guidance+Note+No.+10.+Product+Recall+and+Traceability+(Revision+2)&gs_l=hp.3...2324.2324.0.2808.1.1.0.0.0.374.374.3-1.1.0.les%3B..0.0...1c.1.qHcPIVITkVw&bav=on.2,or.r_gc.r_pw.&fp=5916ceb4c9d179de&bpcl=38093640&biw=2276&bih=1039). [Downloaded: 2012-11-13].

Hobbs, J.E. 2003. Traceability in meat supply chains. *Current Agriculture, Food & Resource Issues: A Journal of the Canadian Agricultural Economics Society*, 4:36-49. [Online] Available from: <http://ageconsearch.umn.edu/bitstream/45725/2/hobbs4-1%5B1%5D.pdf> [Downloaded: 2011-03-31].

Karoo Meat of Origin. 2012a. *How it works*. [Online] Available from: <http://www.karooorigin.com/howitworks/> [Accessed: 2012-05-15].

Karoo Meat of Origin. 2012c. *Newsletter #1*. [Online] Available from: <http://www.karooorigin.com/newsletter/> [Downloaded: 2012-05-15].

Kirsten, J.F. (johann.kirsten@up.ac.za) 2012. Karoo meat of origin labels and photos. [E-mail to:] Van der Merwe, M. (melissa.vandermerwe@up.ac.za) 2012-03-27

Kirsten, J.F. 2011. Protecting a product's unique qualities. *Farmer's Weekly*, Volume 11037:40. 7 October 2011.

Kirsten, J.F., Troskie, D., Vermeulen, H., Schönfeldt, H.C. & Bramley, C. (2008). The potential for Karoo lamb as origin based meat and a Geographical Indication. Research Report, Department of Agricultural Economics, Extension and Rural Development, University of Pretoria, South Africa.

MeatCo Corporate Video: Meet the team MeatCo. Namibia: Mamokobo Video and Research by Botelle, A. and Scott, R. 2008. [Video clip].

Meat Chronicle. 2010. *FANMeat Scheme upgraded*. [Online] Available from: www.nammic.com.na/jdownloads/Chronicle/chronicle-082010.pdf [Downloaded: 2012-06-13].

Meuwissen, M.P.M., Velthuis, A.G.J., Hogeveen, H. & Huirne, R.B.M. 2003. Traceability and certification in meat supply chains. *Journal of Agribusiness*, 21(2):167-181. [Online] Available from: <http://ageconsearch.umn.edu/bitstream/14666/1/21020167.pdf> [Downloaded: 2011-03-31].

Serra, R. 2007. European Union policy for high quality agricultural products. Paper presented at the International Symposium on Geographical Indications, Beijing, 6-28 June. [Online] Available from: http://www.google.co.za/url?sa=t&rct=j&q=PROSCIUTTO+DI+PARMA+improving+traceability&source=web&cd=8&ved=0CGgQFjAH&url=http%3A%2F%2Fwww.wipo.int%2Fedocs%2Fmdocs%2Fgeind%2Fen%2Fwipo_geo_bei_07%2Fwipo_geo_bei_07_www_81757.doc&ei=5V-zT_WjC8iChQexub3nCA&usg=AFQjCNFx9bkAXbvSlyLG0R-Cbnuz3a0BWA [Downloaded: 2012-05-16].

Trienekens, J. H. & Beulens, A. (2011). Boundaries for transparency in food chains. In proceedings of the System Dynamics and Innovation in Food Networks Forum, IGLS (Austria), 14-17 February 2011.

Trienekens, J.H. & Van der Vorst, J.G.A.J. 2006. Traceability in food supply chains. In: Lunning, P.A., DeVlieghere, F. & Verhè, R. (eds.) *Safety in Agri-Food Chains*. Wageningen Academic Publishers, Wageningen. [Online] Available from: http://books.google.co.za/books?id=S1i6nSVK4cEC&pg=PA439&lpg=PA439&dq=Traceability+in+food+supply+chains+Trienekens+and+van+der+Vorst&source=bl&ots=Lf4aiiskCs&sig=pYfk-hBvlxJ3dOeCLflizUPKpM&hl=en&ei=CScUTpD6NcnEtAbJq_jqDg&sa=X&oi=book_result&ct=result&resnum=7&ved=0CDcQ6AEwBg#v=onepage&q=Traceability%20in%20food%20supply%20chains%20Trienekens%20and%20van%20der%20Vorst&f=false [Accessed: 2011-07-06].

Van Rijswijk, W., Frewer, L.J., Menozzi D. & Failoli G. 2008. Consumer perceptions of traceability: A cross-national comparison of the associated benefits. *Food Quality and Preference*, 19(2008):452-464. [Online] Available from: http://www.sciencedirect.com/science?_ob=ImageURL&_cid=271256&_user=59388&_pii=S0950329308000190&_check=y&_origin=&_coverDate=31-Jul-2008&view=c&wchp=dGLbVIB-zSkWz&md5=74f279fcefe84fde03c3dd6f3d458b46/1-s2.0-S0950329308000190-main.pdf [Downloaded: 2011-11-07].