

CHAPTER VI

CONCLUSIONS, PERSPECTIVES, DIRECTIVES AND RECOMMENDATIONS

Vision without action remains a dream...

Action without vision is merely a spending of time...

Vision together with action can change the world!

- Joel Barker

(Finesse: January 2003)

6.1 INTRODUCTION

Pig breeding (production) commences fundamentally at conception ($X + Y = XY$). By nature this phenomenon is manifested/expressed uniquely in every link of the supply chain - thus future orientated. Not only is breeding about the future, but the end product of breeding (namely pork: the product) is moving continuously through the supply chain to the forefront of the chain and eventually the consumer. If the wrong decision is made at conception (the trigger) then the target (a satisfied consumer) can be missed. Hence, genetics is the bullet on it's way (through the supply chain with all it's rigors and effects) to the target (a satisfied consumer).

To reconcile genetics and the prerequisites of a satisfied consumer, the pig producer has two options:

- (i) **Either to link up with value partners** that will enhance the quality of pork in every segment of the supply chain or
- (ii) **To become masters of their own destiny** and get more control over the other segments in the supply chain.

6.2 POSITIONING

Positioning commences with concrete differentiation that a product will give customers more value than its rival products. Any future positioning of pork must essentially be based on the price elasticity of demand. The international success campaign of pork as: "**The Other White Meat**" must uninterruptedly be pursued. Poultry's endless list of positive attributes ranging from ease of

processing to versatility should by means of this campaign have a causal, although indirect, effect on pork. The two foremost critical attributes of pork are image and reputation. The foremost sensory attributes of pork of importance to the consumer are: colour, tenderness, juiciness and flavour.

Positioning cannot be viewed as the magic wand, attempting to solve the complexity of the pig industry instantly. The positioning strategy must be continuously modified to embrace changes, preferences and advances of markets, consumers and technology respectively. One of the main reasons why the South African pig industry should position itself towards a market orient focus is the latter is an important determinant of profitability. SAMIC needs to be congratulated on it's vision to promote the red meat industry internationally through stimulation of demand. This vision should run parallel with a sustainable advertising campaign.

Positioning pork in the future will call for:

- focused differentiation
- a sound genetic basis
- consistent quality which is manifested through wholesomeness, healthiness, safety and value for money.

The **ultimate** objective of the pig producer must be to take cognizance of the pitfalls in the supply chain, to optimize each link in the chain to eventually produce a wholesome branded product of exceptional quality that will satisfy the consumer from a safety, health, welfare and economic perspective and entice him/her to come back. Thus, meat quality as perceived by the producer should (must) be equal to meat quality as perceived by the consumer.

The driving factor behind the changes in the U.S. (United States) pork supply chain is chicken. The U.S. pork industry has recognised that the major competitor for total market share of consumer demand is poultry. Should the South African pig industry set their standards **comparable to or above** poultry on the basis of quality, consistency, reliability, value, food safety and affordability to the consumer, they will be able to compete effectively with leading pork producing countries. A diagrammatic explanation (Vide Fig 6.1) of how an industry in the agrifood channel should position itself, is explained by Wierenga (1998).

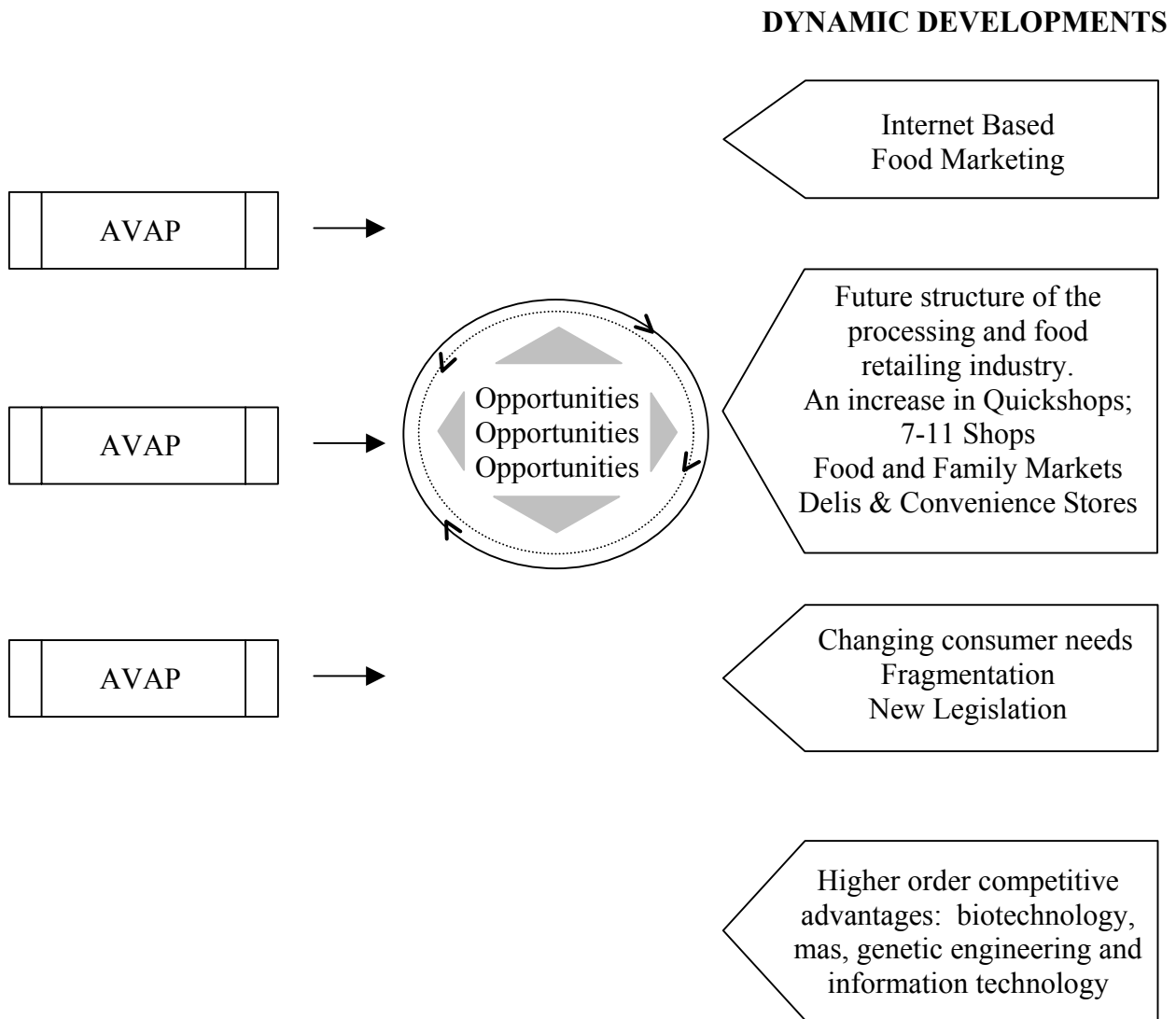


Fig 6.1 Competing for the future in the agri-food channel (Wierenga, 1998)
AVAP = Agri-food Value Adding Partnerships

The positioning challenge for the S.A. pig industry is to produce pork of exceptional quality (**NO** odours, **NO** taint, **NO** residues, **NO** consequences) cost effectively through stringent quality control, traceability and feedback procedures in every link of the supply chain to guarantee the highest standards of food safety and consumer satisfaction both locally and abroad.

6.3 THE QUALITY ROAD

Food quality, within the broader agricultural food chain has unequivocally turned dynamic, multidimensional and complex, including both hidden and visible quality characteristics. Breeders

for instance must take cognizance of the strong relationship between muscle energy metabolism in live animals, metabolic responses to slaughter stress, pre- and post mortem and meat quality. Quality, as perceived from the producer to the consumer, differs at each level in the pig supply chain. For the consumer, meat quality will mean safety, physical appearance and preferred sensory parameters such as tenderness, juiciness and flavour.

The genetic component of pork quality could be solved substantially in the next 3-5 years. What about the other contributors to pork quality (Vide Fig 5.5) such as management, handling, housing, welfare, slaughtering, nutrition, transport, etc. - the so-called extrinsic factors? The latter can be solved comfortably, but calls foremost for an integrated supply chain approach. Intrinsic attributes are attributes of the physical product and extrinsic attributes are regarded as everything else.

Intrinsic attributes**

- The physical product or composition of the product
- Flavour, colour, texture, tenderness, etc
- Cannot be altered without altering the nature (genetic make up) of the product itself

Extrinsic attributes**

- They are product related, but not part of the physical product itself
- By definition they are outside the product
- Product warranties and seals of approval
- Price, brand name, logo, labelling and level of advertising are examples of extrinsic cues to quality

** These attributes should not only be in harmony with each other, but also complimentary to each other to ultimately address quality.

In absolute or industrial terms, quality means "*absence of defects or variation*". Since quality is a major positioning instrument for any product or service, the South African pig stud industry should strive to breed and offer an end product with high levels of quality and quality consistency. However, this product must be packed innovatively, conducive to convenience, must attract attention, describe or romanticize the product, since almost half of all supermarket products are purchased instantaneously.

Quality deviations (hazards) must be identified in time since they could impair (eating) quality and also profitability in certain links of the supply chain. These quality deviations should be regarded as hidden impediments of the aggregate breeding objective. In this regard cognizance must be taken of:

- (i) the *probability* of the quality deviation occurring
 - (ii) the *probability* and *frequency* of occurrence over a time period
 - (iii) the *cost* per occurrence
 - (iv) all *savings*, should this occurrence be counteracted.
- (Vide ANNEXURE V: The extent and scope of quality assurance schemes)

Quality labelling (to further enhance/provide added value to raw products) can in future be used to promote agricultural products including pork. Quality labelling must be seen against the background of quality assurance schemes and especially the ethical aspects thereof (Vide ANNEXURE V). Finally: Two key elements for a Blue Print for pig meat quality are (i) affordability and (ii) acceptability, thus basic consumer value for money.

6.4 CONSUMERISM

Animal food products in agriculture are extremely media sensitive, causing unwanted consumer (over) reaction and invariably consumer hesitance, aversion and rejection. The fact that meat is generally sold unbranded, furthermore renders the product prone to inconsistency and greater variation in terms of appearance, taste and wholesomeness or consumer satisfaction.

The primary concerns of the consumer as explained in detail in Chapter 2 (2.2.1.6 - 2.3.3) pertaining to pork, can be summarised in the following phrase: "*Consumers want an animal welfare friendly product that provides value for money, tastes good, is healthy, lean, safe and which can be traced backwards along the supply chain*". Despite these **extrinsic values** and cues with regard to pork consumption, the breeders, producers, processors, retailers, academics and researchers must in future visualise and conceptualize the intrinsic values of the consumer. Intrinsic values are the underlying values that the consumer scrutinizes to eventually decide which information to believe. **Intrinsic values** are often subconscious, are internalised, attitudinal, moral and ethical viewpoints.

6.5 PRODUCT SAFETY

The recent BSE crisis in Britain and Europe, the Dioxin crisis in Belgium, the FMD outbreak in South Africa (Sept 2000) and the 2001 FMD disaster in Britain and France have already (and will progressively more in future) forced livestock production systems to be performed in highly regulated environments. Pork of the future will have to be safe - as viewed by the safety criteria of the consumer (Verbeke & Viaene, 1999).

Food or Product Safety is the joint responsibility of three vital partners: the industry, the government and the consumer. A clear message that arose from the Agricultural Workshop on Food Security and Food Safety in October 2001 in Pretoria, was the following: *"An effective food regulatory framework and a reputation for safe food are also vital to the competitiveness, trade facilitation and survival of the food industry. The latter being one of the major industries and export earners in South Africa"*. Finally: It is estimated that in the United States (US) alone, 12.2 million kilograms or 12 000 tons of antibiotics ($\pm 70\%$ of the total antibiotic production in the US) are fed to the intensive industries (pigs, poultry and dairy) for non-therapeutic purposes like growth promotion/protein deposition (<http://www.ucsus.org/>).

6.6 MARKETING ASPECTS

As early as 1970, South African meat consumers expressed an affinity for convenience, health and quality and simultaneously regarded time as precious. Meat quality *per se* (from a genetic/breeding perspective) should be correctly defined, understood and implemented since this will be the undisputed future of the studbreeder. Appearance and colour (complimented by extrinsic factors such as branding, freshness and packaging) are the frontline sensory attributes of pork. Processors, producers and breeders should take cognizance of this.

Chicken can be regarded as the Princess of all the meat types in South Africa and probably worldwide. In fact, chicken is the meat of choice under most circumstances due to its endless list of attributes (Vide ANNEXURE II). In fact, pork is regarded as a mediocre product at the lower end of the meat chain (with only a few good qualities). Pork, unmistakably, can capitalize on its inherent latent qualities such as: affordability, availability, taste and health aspects. Simultaneously value-adding aspects of pork should compliment the latent qualities of pork. These value-adding qualities are:

- presentation (end products must be clean, fresh and uniform)
- packaging and effective labelling
- branding, awareness and effective marketing.

The internationally acclaimed marketing success campaign: "*Pork the other White Meat*" should continuously be pursued by the South African pig industry and complemented by the South African designed logo/brand name "*New Fashion Pork - light, lean, healthy and versatile*".

Quality certification, branding and labelling is doomed to failure, unless an extensive promotion campaign is implemented with the objective to enhance brand awareness and the unique quality attributes of the product.

The modern consumer, by definition, is inherently health conscious. Therefore, the pig industry must use the Heart Foundation Logo prudently as one of its *unique selling properties*, thus increasing the alarmingly low awareness levels of pork.

The direction of the red meat industry (including pork) in the third millennium will *inter alia* be guided by the spheres of:

- (i) food safety
- (ii) product quality
- (iii) production methods and
- (iv) the environmental impacts of livestock production.

This calls for higher ethical standards/code of conduct and an increased social responsibility towards the environment has now become imperative. Retaining consumer confidence in the safety and wholesomeness²⁷ of red meat is crucial.

6.7 BIOTECHNOLOGY AND TECHNOLOGICAL TRENDS

The advent of DNA-chip technologies has opened new horizons for comprehensive diagnostic and genetic testing methods. The most recent developments in biotechnology, such as genetic engineering and molecular genetics, have far reaching applications for livestock production.

²⁷ According to Venter (2001) wholesomeness should also be viewed from the following angle of incidence: "*There are thousands of other foods competing with meat and the majority of these foods are branded. By not branding red meat, including pork, the industry is handicapping itself. Across the world, there is an increased demand for product identification and traceability. Thus, the domestic industry should be looking at product identification and tracking as marketing opportunities*".

According to Visscher *et al.* (2000), the real impact of biotechnology will come from new and improved reproductive techniques combined with powerful molecular techniques. *"The former will allow rapid turnover of generations, whereas the latter can provide selection which does not need phenotypic information when the final selection decisions are made."* The effective use of molecular genetic information will thus enable the stud breeder of the future to better exploit phenotypic and pedigree information than at present.

The detection of pathogens, residues in drugs and antibiotics as well as undesirable compounds in animal products can now be achieved through modern biotechnology such as monoclonal antibodies²⁸, DNA/RNA probing and PCR (polymerase chain reaction).

Biotechnology, which is linked to information technology, specifically through bar coding, is likely to enhance the concept of traceability through the entire supply chain. Through this code (biotech coding) the origin of producers, identification of animals, credentials of producers, production practices, slaughtering, processing and packaging details can be traced punctually and instantly. *Just the Internet has become the epitome of openness in the IT industry, so will biotechnology become the epitome of gigantic advancements - the undisputed genetic accelerator in animal breeding.*

Quality payment in the livestock production chain will become increasingly important in future. However, producers will be compelled to comply with stringent quality and food security specifications before products leave the farm gate. It stands to reason that the serious producers of the future are likely to establish "supply blocks". Not only will this enable producers to obtain improved bargaining power, but collectively they will be able to address quality demand through economies of scale.

Slaughterhouses and processing plants have the following production requirements:

- reliability of production
- throughput
- uniformity
- carcass quality.

AI, associated with improved genetic superiority, will in future become more important in all layers of the breeding pyramid. The causal effect of AI will ultimately be manifested in improved

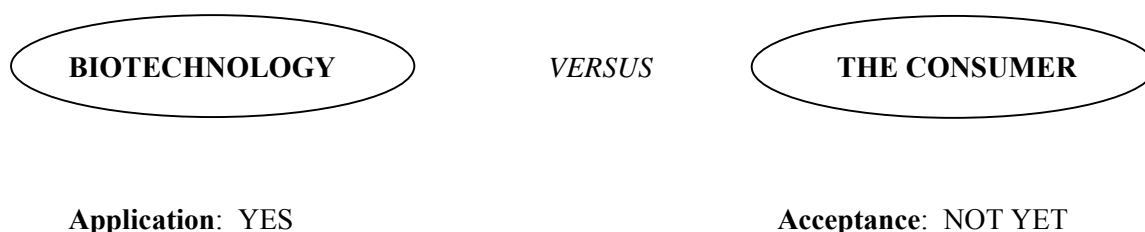
²⁸ Monoclonal antibodies are not only highly specific for their antigens, but can be produced in almost unlimited quantities.

uniformity, desired carcass quality and ultimately - enhanced consumer satisfaction. Processors and retailers will in future prescribe which genes must be present or absent for each product that they process, manufacture or sell.

Ascertaining the quality of raw (input) material and ingredient traceability (including micro feed additives) should be a continuous pursuit along the supply chain. In today's socio-economic and global environment (fuelled by increasing consumer awareness, welfare issues and feed legislation) traceability and *especially quantitative traceability*²⁹ has become imperative and non-negotiable to the feed and premix manufacturer.

In future pharmaceutical companies (as primary providers) and pig producers (as secondary users of the product) will be forced to ensure that only pharmaceutical products, which are safe for the targeted food animal and both safe and wholesome for the consumer will be used in the food/animal production chain. Extended pharmaceutical quality assurance programmes are therefore envisaged.

Fundamentally, the science of GMO's is safe. The challenge, however, is to convince the general public and the consumer that from a business perspective, GMO's are holistically safe and environmentally friendly.



Therefore the application of biotechnology in livestock production must be measured *on the one hand* against the techno-economic benefit to the industry (enhanced efficiency of feed utilization, accelerated muscle growth, lower production costs, reduced losses, reduced fat deposition and transgenic manipulation of rumen organisms) and *on the other hand* to the intensity of the public outcry, despite the ultimate benefit to the general public.

This necessitates a deliberate effort to educate and inform the general public on the prospects and consequences of modern, relevant and applicable biotechnology.

²⁹ Quantitative traceability is a method whereby appetizing compounds and micro feed additives are meticulously identified and quantified when included in a feed product or feed ration.

6.8 RELATED AND UNDERLYING FACTORS PERTAINING TO THE BREEDING OBJECTIVE

This study has conceptualized a new approach to pig breeding or the aggregate genotype whereby the spheres of breeding, the consumer and the supply chain were integrated to be mutually beneficial. For such an approach to be successful, a feedback loop is required (Vide Fig 1.2). Connecting the breeder (who must continuously improve genetic quality) with the consumer will give impetus to a true market driven approach whereby the breeder/stud industry can adapt timeously to the ever changing needs of the customer - **thus a shift from a transactional to a relationship focus**. For an organization (like the South African pig stud industry), to achieve continuous above average performance, it must render sustainable and superior value to its customers. This can be achieved, *inter alia*, through the establishment and nurturing of a long-term strategy and symbiotic relationship respectively between the pig industry at large and its customers. Therefore future-breeding objectives must take cognizance of:

- (i) Present trends within an industry such as biotechnology, technological trends as well as the modern demands, perceptions and moral convictions of the consumer.
- (ii) Trends in genetic evaluation procedures/advancements.
- (iii) Genetic and phenotypic correlation between traits,
- (iv) Lifetime production efficiency.
- (v) Lifetime reproduction efficiency.
- (vi) The degree of maturity of the supply chain.

This study has also endeavoured to address and structure future breeding objectives (CHAPTER V) for the pig industry by virtue of insight into several domains, namely:

- a thorough understanding and analysis of the consumer (CHAPTER II).
- a comprehensive dissection and analysis of the market, the industry and thus the supply chain (CHAPTER III).
- a thorough understanding and analysis of the genetic components (production and carcass) of the live animal (CHAPTER IV).

This integrated approach has led the author to the following important conclusion: *"The real establishment of future breeding objectives for the South African pig stud industry (Vide Fig 6.2) will have to be built upon non-negotiable building blocks"*. These building blocks are:

1. Bio-security and Health Protocols.
2. Product Safety (and ethical norms related to it).
3. A Welfare and Environmental Code.
4. A trustworthy and practical Traceability System.

5. Quality Assurance
6. Product Quality (Eating quality)
7. Worker Rights (Labour Laws)

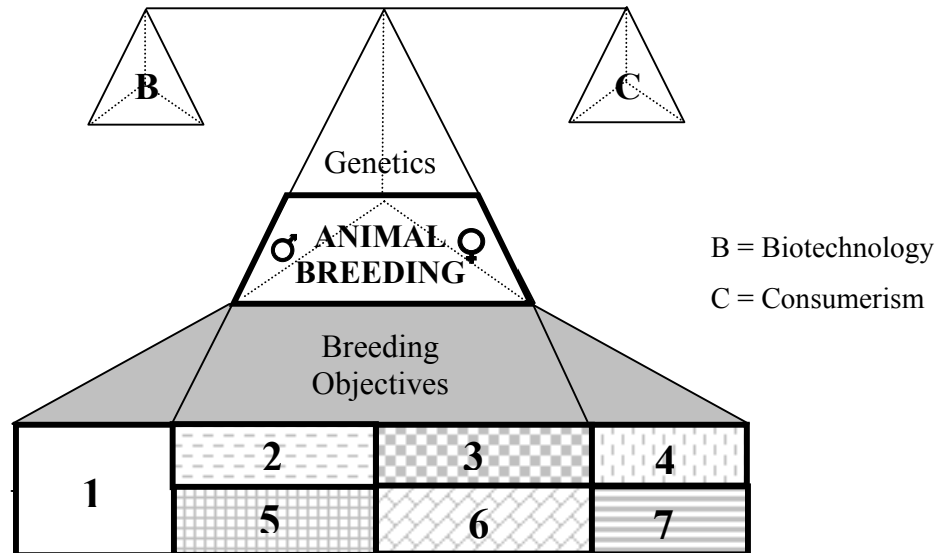


Fig 6.2 A schematic explanation of the components of animal breeding in the future

To be successful and competitive the South African pig stud industry should take cognizance of past, present and future breeding objectives (Vide Table 6.1). The stud industry should embark on the **"high road of pig breeding"** which will encompass aspects such as: ongoing consumer satisfaction, continuous pursuit for quality, innovation, accurate and advanced genetic evaluation and breeding value estimation procedures, biotechnology, aggressive marketing and professionalism.

Future collaboration between practicing geneticists, molecular geneticists, quantitative geneticists and mathematical statisticians (who understand the former fields) will be imperative to:

- (i) search judiciously (cleverly?) for genes affecting quantitative traits
- (ii) analyse and interpret the data from animals/populations which have been genotyped for DNA markers to be incorporated in future breeding objectives (Nicholas, 1997).

The following flow diagram (Vide Fig 6.3) gives a synopsis of the inter-dependency between the producer, the product, triggers and the environment.

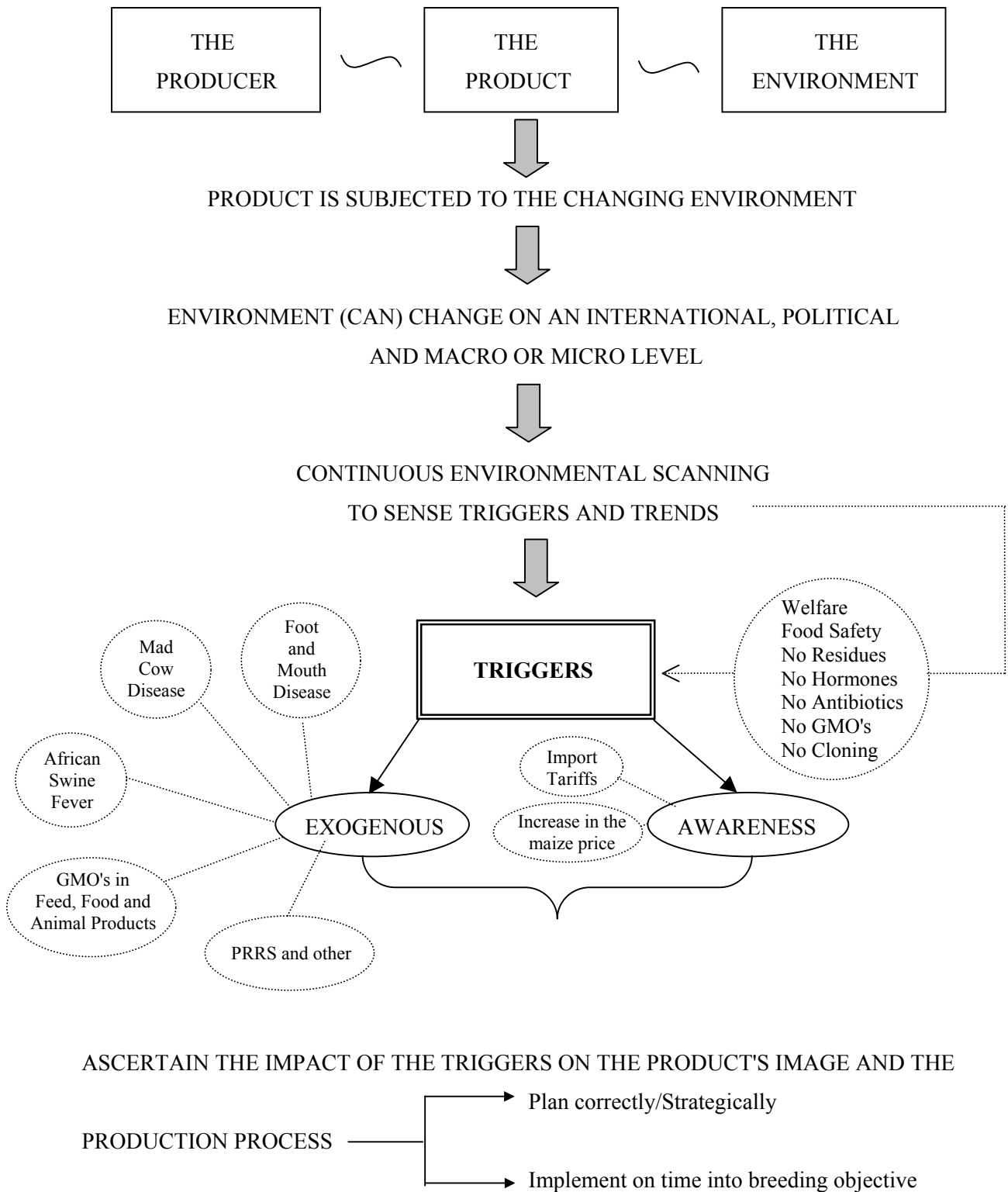


Fig 6.3 The interdependency between the producer, the product, triggers and the environment on the breeding objective

Table 6.1 Breeding objectives in pigs: past (1980's), near past (1990's) and the future (2000 and beyond)

Reproduction and Production traits that are considered	Breeding objective per decade		
	1980's	1990's	2000 and beyond
Reproduction Traits			
• Litter size born alive	✓	✓✓	✓✓✓
• Sow productivity	✓ / ?	✓✓	✓✓✓
• Longevity and uterine capacity	?	✓	✓✓
• Mothering ability* (including milk production and piglet survival)	✓	✓✓	✓✓✓
Production Traits			
• Growth rate	✓✓	✓✓	✓✓
• Food conversion	✓✓✓	✓✓	✓✓
• Lean content	✓✓✓	✓✓	✓✓
• Meat quality	✓	✓✓	✓✓✓
• Fat quality	?	?	✓
Other Traits			
• Soundness & bone structure	✓	✓	✓✓
• Behavioural (Temperament and feed intake)	?	✓ / ?	✓
• Health related / Disease resistance	?	✓	✓✓✓
• Histochemical	?	✓ / ?	✓✓ / ?
• Technological quality (meat)	✓	✓	✓✓
• Organoleptic quality (meat)	?	✓	✓✓
?, ✓, ✓✓, ✓✓✓ = increasing or relative emphasis on trait in the aggregate genotype			

Source: Adapted from Ollivier (1998). The Other Traits (below the double line) as well as Mothering ability* were included by the author.

6.9 MARKET INTELLIGENCE SYSTEM(S)

The quest for thorough co-ordination and strategic re-orientation in the pork supply chain, commencing at the production or input level, will become more important in future. This quest will be driven by quality control programmes, consistency of product quality and product safety guarantees as demanded by processors, pork purchasers (wholesalers and retailers) and ultimately the consumer.

A credible and aggregate market intelligence system is lacking in the South African pig industry, which should incorporate vital aspects such as:

- ◇ local and international driving forces
- ◇ visible and invisible factors influencing the maize price
- ◇ a candid and trustworthy price reporting system
- ◇ official production norms and consumption trends
- ◇ accurate producer and sow herd dynamics
- ◇ consumer and processing trends, etc.

A total market intelligence system, via the Internet, linking all the links of the supply chain electronically, whilst simultaneously making provision for input (ingredient) traceability and output (end product) traceability could become a reality in future through PISSA. The internal metric, as part of the market intelligence system, is of utmost importance - an opportunity for rapid feedback in the quality improvement process. The question still remains: "*How swiftly do you want to meet your client's needs?*". Within a day, a week, a month or within two months?

6.10 VULNERABILITIES: FINAL ANECDOTES

The vulnerabilities, pertaining to pig production have been discussed in detail (Vide Chapter III). Suffice to conclude this heading with a few final anecdotes:

- **Food safety** is a key risk, which is inherently difficult to manage. Food safety therefore is beyond that of consistent product quality. Pork producers must give present and future consumers the assurance that they can (do?) produce pork of superior quality. This approach necessitates a comprehensive evaluation of food safety, the environment, animal welfare and animal health. Consumers are likely to reject a technology, which has negative effects on animal welfare like the production of transgenic livestock. In future product safety will be media tested (triggered) against environmental aspects, animal welfare, traceability and quality

assurance - a quartet of future responsibilities. In this regard, Windhorst (2001) indicated that product safety, an irrefutable necessity for selling pork in global markets, can only be guaranteed in closed supply chains.

- **Applied research** is an industry related necessity, financed mostly by the State and best practiced through (i) sufficient funds (ii) a culture for research and (iii) dedicated and visionary research institutions. Financing of research, through public funding has been declining on an international level since the mid 1980's. This is an awesome constraint, impacting negatively on long-term profitability, sustainability, competitiveness and positioning of the South African pig industry.
- The **liberalization of international trade** barriers hold(s) certain implications, namely:
 - (i) What implications (distortions) will reduced meat tariffs have on the local red meat industry?
 - (ii) What beneficial effects will international liberalization of world red meat prices have on the local red meat industry?

Trade liberalization under the auspices of GATT and WTO will have a decided effect on global production/trade and trends as well as on agricultural product prices including meat. Developed countries which are supported by agricultural commodity subsidisation will gain significantly more than developed countries without (or limited) agricultural commodity subsidisation.

6.11 A FUTURISTIC PERSPECTIVE: MIGRATING FROM AN IMMATURE TO A MATURE SUPPLY CHAIN

1. A strong supply chain is built upon superb supplier relations and outstanding supplier networks, which could become an alliance³⁰. The question is: How many alliances do exist in the South African pig industry? [(Vide Future Research Directives (6.13) point iii)]. The right alliance will enable a company (the pig industry?) to focus on product quality and to apply integrated supply chain management. Pig producers must align themselves to value partners on both the input (raw materials) and output (end product and value added products) end of the supply chain.

³⁰ An alliance (originally a Japanese practice) entails that a supplier (pig producer) enters into a close working arrangement with a company, linked to a flexible long-term contract.

2. Vertical co-ordination, vertical integration and contract production guarantees will become more important in future for the South African pig industry in their journey from the present (an immature supply chain) to the future (a mature supply chain). Contract production specifically should be mutually beneficial to both the producer (guaranteed markets and consistent product prices linked to quality) and the consumer (consistency of quality and value based marketing³¹). Contract production through thorough auditing would also enhance traceability and quality assurance.
3. To embrace the concept of quality (a consumer demand principle) all levels in the production chain (at the genetic level through the breeding objectives, at the farm level through the entire production system, in transit and at the slaughterhouse and processing levels) should be optimized and integrated (Van Oeckel, 1999).
4. An integrated (mature) supply chain approach calls unequivocally for:
 - a very rapid response (thus a feedback loop) to consumer demands, preferences and trends
 - continuous improvement in product consistency and quality
 - continuous measuring of quality and compliance with all desired quality attributes
 - identifying and perfecting the critical control points between conception and consumption
 - greater accountability and traceability
 - consistent production levels
 - transparent and a non volatile payment system.

6.12 IMPLEMENTING A "BEST PRODUCTION AND VALUE SYSTEM" FOR THE SOUTH AFRICAN PIG INDUSTRY

A chronological framework for accomplishment
(Converting the vulnerabilities into achievable and outcome based possibilities)

1. Ascertain precisely the present status of maturity of the South African pig industry with special reference to the different pig supply chains.
2. All role players in the pig supply chain [from seedstock suppliers, producers, raw material and input suppliers, organised agriculture, the Government (Department of Agriculture, Veterinary

³¹ Value Based Marketing is where payment is made, based on true customer value. Such a system rewards or penalises producers in accordance with compliance to customer specifications.

Services and Animal Health, Trade and Industry, Foreign Affairs, etc), abattoirs, processors, packers, exporters, wholesalers and retailers to other stakeholders] must buy in and assimilate the Best Practice and Value System in their mind and spirit.

3. The Best Practice and Value System must be preceded by an industry core value, mission and vision statement.
4. The stud industry, being at the apex of the animal breeding pyramid and indirectly the production process, must ensure that their efforts are optimized in each of the links further down the supply chain.
5. To position itself further (Vide 5.4), the stud industry should incorporate an array of technologies (ranging from modern information technology, e-commerce, satellite communication, robotics to DNA and molecular biotechnology) in its future breeding vision. The true seedstock (genetic) suppliers of excellence should form strategic value adding partnerships in the agri-food chain.
6. This will entail that seedstock suppliers of excellence will develop and bio-engineer desired genetic material, purchased or used by commercial producers of excellence.
7. Commercial producers of excellence will apply Best Production Practices covering the spheres from:
 - farrowing to marketing
 - housing, health, hygiene, biosecurity to animal care and welfare
 - environmental to waste management
 - safe use of pharmaceuticals to utilization of GM cultivars
 - traceability to quality assurance
8. These producers will in turn link up with manufacturers of excellence (feed companies, pharmaceutical companies and other input providers, committed or compelled to the ethos of quantitative traceability).

9. Slaughter pigs, produced under these precisely defined conditions and circumstances should be transported and slaughtered at abattoirs of excellence (where ³²HACCP procedures will form an integral part) and processed by processors of excellence (embracing branding and quality certification). In this regard a Code of Practice for the pre-slaughter handling of pigs, based on Denmark's 13 point plan should be considered so as to address aspects such as collection, transport, abattoir conditions, guidelines for abattoir personnel, producers and haulers (Barton Gade, 1997).
10. A genetic information system (APIIS and known as PISSA in South Africa as discussed under 3.4.3) with national impact and credibility is imperative. This system should become moderately operational, within two years, integrating various databases (pork chain integration) and forming an integral part of the market intelligence system.

Finally: Supply chains and vertical integration is likely to dominate competitive pig production across the globe. According to Wierenga (1998) competition, especially in the agricultural food chain, will not be between individual rivals, but rather between the effectiveness of supply chains that are competing against each other.

6.13 FUTURE RESEARCH DIRECTIVES

- (i) The emphasis of this study was fundamentally based on the consumer orientated/associated quality characteristics of pork. However, processed meat represents approximately 50 % of the total share of pork meat. This segment of the market was not adequately addressed and warrants similar research.
- (ii) The price reporting system in the pig industry is clouded in uncertainty. The basis and basic fundamentals of payment, pricing structure and contracts need to be further researched and investigated (Vide ANNEXURE X).
- (iii) An investigation into the different alliances in the South African pig industry, their extent, impact and contribution to overall competitiveness is recommended.

³² HACCP = Hazard Analysis Critical Control Points (A hazard is any event that could impact negatively or impair the economic vitality of a business). HACCP normally consist of seven key stages: (1) Identification of the process (2) categorising the risks (3) Defining the critical control points (4) Setting of critical limits (5) Defining the corrective actions to be implemented (6) Endorsing an effective recording system (7) Regular verification.

- (iv) Future research into the cost and benefit effects of new breeding strategies on the supply chain should be conducted.
- (v) De Vries (1989) indicated that the absolute economic values of traits in the breeding objective are required for the design and optimization of breeding programmes. This is an area that was not covered in the present study. An overall evaluation of the economic values of traits applicable in the stud and commercial industry, is required.
- (vi) Estimation of the genetic parameters for the reproductive traits of the S.A Large White, Landrace and Duroc pig breeds was not conducted (has never been). A comprehensive research/study in this field is urgently required.

6.14 FINAL RECOMMENDATIONS

- (i) In South Africa, pork is predominantly consumed by the white population group (Nielsen, 2000). The real disposable income of this group as well as their population growth rate is unlikely to improve in the immediate future - thus inhibiting their demand for pork despite positive economic growth scenarios for South Africa. A spirited effort must be orchestrated to take and promote pork amongst the other cultural groupings and the bulk of the population. Similarly the ever changing consumer trends should be monitored carefully, but consistently. It should be timeously discounted into the breeding objective.
- (ii) Continuous lobbying and the building of mutual trust and understanding with the Provincial Department of Agriculture, National Department of Agriculture and Department of Trade and Industry should become a top priority of the organised agricultural fraternity and SAPPO specifically. This will emphasise SAPPO's commitment to contribute towards internal (national) pig matters, as well as enabling them to defend and position themselves towards turbulent international trade developments. A pork industry business plan (a joint SAPPO and PBS initiative) is also urgently required.
- (iii) All the AI boars in the official AI-stations should be screened for reciprocal translocations (chromosomal abnormalities) at the DNA Laboratory of the ARC-AII. This genetic defect impairs litter size and is normally transmitted to approximately 50 % of progeny.
- (iv) Scrotal volume benchmarking must be implemented as a selection criterion for the three breeds to improve the semen quantity and semen quality of breeding and AI boars. (Points

iii and iv are recommended in view of the high probability that AI will have an increasing impact on the future of breeding and commercial pig production in South Africa).

- (v) Despite the continuous limitation (reduction) of research funds (which is unlikely to disappear instantly), it appears unequivocally that strategic partnerships be activated between research institutions and the private sector furthering the essentiality of research and technology development by international standards.
- (vi) The establishment of the ARC-Irene Pig Breeding Chain (based on supply chain principles) to further genetic advancement of pig breeding through theory, academic involvement, post graduate research/qualifications whilst simultaneously addressing the most important practical and industry related breeding problems, is strongly recommended.
- (vii) The South African pig industry should focus more of it's future efforts on the export market due to:
 - Substantial earnings of foreign currency for the South African economy.
 - The creation of a window of opportunity where demand in the local market is stimulated.
 - The input-output disparity [inputs are Dollar based and outputs are Rand based].
 - An envisaged increase in the world market price of pork in the medium term, which should also have a causal relationship on the domestic pork price.

The export scenario should be pursued with diligence, long-term commitment, value adding partnerships and inter continental vision. Such an export drive must go hand in hand with the price competitiveness of S.A. pork on a unit value basis. Such an export drive should essentially be targeted at value and secure niche markets, always satisfying all the international standards (pertaining to safety, continuity, consistency, quality and consumerism, etc.).

- (viii) An Enterprise Resource Planning System (which ideally should coincide with PISSA) is recommended for the South African pig industry. All business related applications of a progressive industry should be integrated in a uniform systems environment, with access to a centralized database residing on a common (LINUX) platform. Compatible data fields and formats are used across the whole enterprise. In such a system, data are entered once and once only.

"As the circle of light broadens in which the seeker after knowledge stands, so does the encircling darkness appear greater. What is known, compared with that which remains unknown, seems infinitesimal."

- Kenneth Walker

*"Religion and science are not at odds.
Science is simply too young to understand".*

- Leonardo de Vitro

"But, my son, be warned: there is no end of opinions ready to be expressed. Studying them can go on forever and become very exhausting! Here is my final conclusion: fear God and obey his commandments, for this is the entire duty of man."

- Ecclesiastes 12:12-13