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Bachelor Thesis

Pig breeding in subtropical conditions of Africa

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8 April 2018 Chisenga Emmanuel Mukosha

Abstract

The aim of this bachelor thesis was to analyse the different types of pig breeding used in the subtropical regions of Africa. Pigs have been described as one of the most prolific and fast growing livestock that can convert food waste to valuable products. Pigs are commonly kept for meat and fat, but also different sectors such as cosmetics industry, pharmaceutical industry, medical sector and so many other purposes. The thesis further on analyses the reproductive and productive traits of pigs. Finally the thesis takes a look at some factors that affect breeding and productivity of pigs. Diseases pose significant challenge to efficient management and profitability of pig production.

Key words: pig; reproduction performance; production performance; breeding; technology; diseases

Abstrakt

Cílem bakalářské práce bylo analyzovat různé způsoby chovu prasat v subtropických oblastech Afriky. Prasata jsou jedním z nejproduktivnějších a rychle rostoucích hospodářských zvířat, která mohou přeměnit zbytky potravin na cenné produkty. Chovají se především pro produkci masa a tuku, ale využívají se i v dalších sektorech (kosmetický průmysl, farmaceutický průmysl, zdravotnictví atd.) a mohou se chovat také v alternativních systémech chovu. Bakalářská práce analyzuje reprodukční a produkční vlastnosti prasat a zmiňuje faktory, které užitkové vlastnosti prasat ovlivňují. Jsou v ní také popsány nemoci prasat, které významně ovlivňují užitkovost zvířat, a tím ekonomiku jejich produkce.

Klíčová slova: prase; reprodukční ukazatele; produkční ukazatele; chov; technologie chovu; nemoci

CONTENTS

1. Introduction

Pig breeding and pork production have been one of the most important sectors since ancient times in the livestock sector. Pork is the most widely consumed meat in the world. Pigs grow fast, have high fertility and have a good feed conversion ratio.

African subtropical region has a tropical climate, whose average temperatures vary from 21 °C to 27 °C. The average minimum and maximum temperatures range from 16 °C to 23 °C and from 24 °C to 36 °C, respectively.

Historically, pig was often seen as a rural scavenger in fields and woodlands and an urban one using human food and waste.

Traditionally, pig breeding programmes have focused on the genetic improvement of production traits, such as growth rate, meat percentage, feed efficiency, and piglet production, because these traits are economically important.

Livestock production plays an important role in Africa as part of agriculture, livestock production is the second fastest growing in the agricultural sector.

In the subtropical regions of Africa pigs are kept not only for pork and bacon, but also for offal, pig fat, bristles and blood and pig skin.

The demand for high quality pig meat products has recently risen world-wide due to the increasing world population and improving human nutritional needs. This has raised the profile of the growth and reproductive characteristics.

In Africa, Nigeria, has the largest pig population (4.86 million), followed by Uganda (1.55 million), South Africa (1.54 million), Cameroon (1.35 million) and the Democratic Republic of Congo (1 million).

2. Aim of study

Pork meat is one of the most important sources of human nutrition. It is due to its high quality and fast growth of pigs. They are also very adaptable to the conditions in which they are kept. The aim of the bachelor's thesis was to provide a review, which will focus mainly on pig breeding in the subtropical climate – focus on the reproductive and production traits of pigs, pig breeds, breeding strategies, technology for pigs and the potential risk factors of keeping pigs in hot climate.

3. Literature review

3.1 History of pig breeding

The pig is an animal found in almost all the regions of Africa. Despite the cultural and religious influences in parts of the continent that limit pork production and consumption, pig farming is generally growing across West, East, Central and Southern Africa. Although the growth of pig farming in Africa is less compared with other parts of the world (AU-IBAR, 2015).

The Local African Pig originates from the Iberian and is roughly the same in all African countries where it exists. The descriptions available in the literature are often very general. The size is small, with a short forehead, a straight tail and an elongated snout, with medium, floppy ears, swept-back small ears carried horizontally or slightly upright. The body, rather narrow, is carried by relatively long legs (AU-IBAR, 2015).

The history of pigs in the sub-Saharan Africa is blurred by the circumstance that very large numbers of European pig breeds were brought to all parts of the continent with European contact, both as part of undocumented subsistence strategies and in conjunction with missionary and colonial agricultural development projects (BLENCH *et al.*, 2000).

Another aspect of the history of pigs in Africa that is crucial when contrasting its distribution today with evidence for its former extension; the presence of Islam. Islam forbids Muslims to eat pork and this is usually interpreted as a prohibition on any sort of contact with pigs (BLENCH *et al.*, 2000).

3.2 Welfare of pig

According to KANIS *et al.* (2005), animal welfare means how the animal copes with the conditions in which it lives. The animal is in a good state of welfare if (as indicated by scientific evidence) it is healthy, comfortable, well nourished, safe, able to express innate behaviour, and if it does not suffer from unpleasant states such as pain, fear, and distress. Good animal welfare requires disease prevention and veterinary treatment, appropriate shelter, management, nutrition, humane handling and humane slaughter.

The animal's welfare, whether on farm, in transit, at market or at a place of slaughter should be considered in terms of 'five freedoms' (FARM ANIMAL WELFARE COUNCIL, 1993). These freedoms define ideal states rather than standards for acceptable welfare. 1) Freedom from *hunger and thirst* – by ready access to fresh water and a diet to maintain full health and vigour. 2) Freedom from *discomfort* – by providing an appropriate environment including shelter and a comfortable resting area. 3) Freedom from *pain, injury or disease* **–** by prevention or rapid diagnosis and treatment. 4) Freedom to *express normal behaviour* **–** by providing sufficient space, proper facilities and company of the animal's own kind. 5) Freedom from *fear and distress* **–** by ensuring conditions and treatment which avoid mental suffering (FARM ANIMAL WELFARE COUNCIL, 2012).

The advantages of the pig farming

- The pig has got highest feed conversion efficiency, i.e. they produce more live weight gain from a given weight of feed than any other class of meat producing animals except broilers.
- The pig can utilize wide variety of feed stuffs viz. grains, forages, damaged feeds and garbage and convert them into valuable nutritious meat. However, feeding of damaged grains, garbage and other unbalanced rations may result in lower feed efficiency.
- They are prolific with shorter generation interval. A sow can be bred as early as 8–9 months of age and can farrow twice in a year. They produce 6–12 piglets in each farrowing.
- Pig farming requires small investment on buildings and equipment.
- Pigs are known for their meat yield, which in terms of dressing percentage ranges from 65–80% in comparison to other livestock species whose dressing yields may not exceed 65%.
- Pork is most nutritious with high fat and low water content and has got better energy value than other kinds of meat. It is rich in vitamins like thiamine, niacin and riboflavin.
- Pigs manure is widely used as fertilizer for agriculture farms and fish ponds.
- Pigs store fat rapidly for which there is an increasing demand from poultry feed, soap, paints and other chemical industries.

- Pig farming provides quick returns since the marketable weight of fatteners can be achieved with in a period of 6–8 month (TNAU AGRITECH PORTAL, 2009).

3.3 Pig breeds

According to BLENCH *et al.* (2000) pigs of subtropical Africa are conventionally divided into two major types – the so-called indigenous pig and the introduced exotic breeds. The exotic pigs in Africa that arrived in the colonial period came originally from Europe, America and the Far East. The indigenous types are usually black or pied with medium, upright, swept-back ears, a straight tail and a long snout. These are only found in remote areas. The exotic pigs in Africa arrived in the colonial period originally came from Europe, America and Far East.

3.3.1 Indigenous breeds

African pig breeds are poorly characterised at the morphological, production and genetic levels and very few conservation programmes are being carried out to preserve them (AMILLS *et al.*, 2013).

The Local African Pig is known under many names including – Kolbroek (in South Africa), Somo (in Mali), Bakosi (Gabon), West African Dwarf pig (Nigeria), Ashanti Dwarf pig (Ghana) Bush pig (Togo), Mukota pigs or Zimbabwe Mukota pigs (in Zimbabwe) (AU-IBAR, 2015).

Africa is home to 49 local breeds of which 5 % are endangered and 54 % have an unknown status (AMILLS *et al.*, 2013).

African pigs are well adapted to local conditions and are commonly resistant to a variety of endemic parasitic and infectious diseases (PENRITH *et al*., 2001; ABENGA and LAWAL 2005).

While European and Far Eastern pig breeds have been extensively studied with the aid of many types of markers, African breeds have been systematically neglected (AMILLS *et al.*, 2010).

Local African Pigs have not been characterized and are still listed and designated under ‘indigenous’, ‘local’ or ‘unimproved’ breeds (AU-IBAR, 2015).

Genetic analysis of African pig breeds has revealed a substantial dichotomy between the western and eastern parts of this continent. In West Africa, pigs

harboured alleles that are abundant in European breeds, while Zimbabwean and Kenyan breeds carried Far Eastern alleles at very high frequencies (RAMÍREZ *et al.*, 2009).

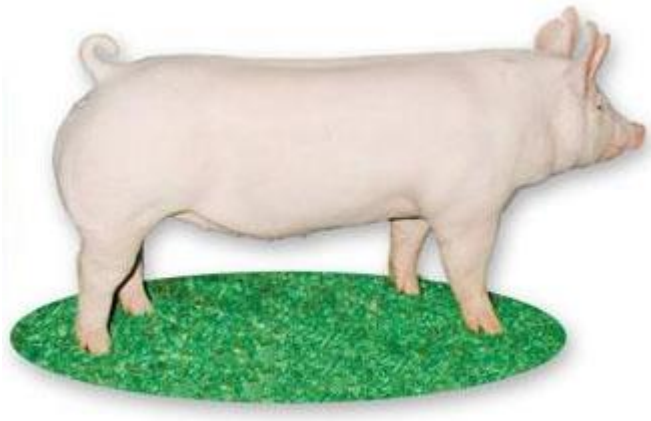
3.3.2 Exotic breeds

Large White (Yorkshire)

First recognised in 1868 the Large White owes its origins to the old Yorkshire breed. Large Whites are distinguished by their right ears and slightly dished faces. They are long-bodied with excellent hams and fine white hair and, as their name suggests they are characterised by large size (THE DIFFERENT BREEDS OF SWINE).

These pig breeds have been exported in large numbers to European and later non-European countries, where they have been mated with native pigs and regional varieties, or, as a matter of course, cross-breeders for the creation of new breeds (HOVORKA *et al.*, 1983).

Picture 1. Yorkshire (http://nationalswine.com)



The weight of a mature Yorkshire boar (227 to 340 kg) and mature sow (204 to 295 kg). They are not only active and lean, but they are also quite sound in legs and feet. Yorkshire pig breeds are recognized for bulky litters, good production of milk and for having outstanding mother instincts. The Yorkshire Pig additional height, or length of legs, help them to stay active and have long lives in the reproduction pen. Yorkshire pig breed has established itself as a rough and strong breed that can endure deviations in climate and other ecological factors (LOOKSEEK YORKSHIRE PIG).

Landrace

According to MCGLONE and POND (2003) this breed is known for its sows mothering ability. These pigs have very large floppy ears, are long-bodied, and have the highest weaned average of any breed, as well as the highest average post-weaning survival rate.

The skin is distorted and firm, the bristles are white, gentle, shiny and close to the body. The claws and dew claws are wax white, the temperament is more vivid (STUPKA *et al.*, 2009).

Pigs of Landrace are a universal breed. It is a breed that comes from cross breeding a Celtic pig with Large White. It was cross-bred for the production of a bacon (MATOUŠEK *et al.*, 1996).

In adulthood boars reach live weight 270–290 kg and sows reach live weight 230–250 kg (HOVORKA *et al.*, 1983). According to MATOUŠEK *et al.* (1996) boars have a live weight of 280–310 kg and sows have a live weight of 240–250 kg.

Picture 2. Landrace (http://nationalswine.com)

Duroc

It seems to have originated from the original red pigs crossbred with red Guinean pigs. This breed is resistant with very high productivity (HOVORKA *et al.*, 1983).

According to MCGLONE and WILSON *et al.* (2003) these pigs are noted for their fast growth and good feed efficiency, are light to dark red colour and have droopy ears. On average this breed needs less feed to make a pound (0.45 kg) of muscle than the other breeds.

According to FAO (2009) adult boars have a weight ranging between 227–340 kg and sows have a weight ranging between 204–295 kg.

Duroc has good meat quality (KIM *et al.*, 2002). Also, fertility and litter size are inherited through the maternal line, and meat productivity and meat quality are inherited through the paternal (KIM *et al.*, 2006).

According to DAVIS Duroc pigs are one of the fastest growing breeds of pig when they are kept on a consistent and nutritious diet. They are also very hardy. Duroc pigs are favoured by hog farmers who want to keep their pigs outdoors because Duroc tend to stay healthy. Durocs are known for producing large litters, especially when Duroc boars are crossed with sows of other breeds. Durocs are very popular for crossbreeding and improving other breeds of swine. Duroc sows are also known for taking very good care of their young.

Picture 3. Duroc (http://nationalswine.com)

Pietrain

This breed is named after the Belgian village of Pietrain located in the Walloon province of Brabant. There are only suppositions about its origin (HOVORKA *et al.*, 1983).

According to MATOUŠEK *et al.* (1996) Pietrain breed is characterized by a medium-sized body frame and a strong meatness of the ham, loin and shoulder. These pigs have an excellent carcass value. Pietrain pigs are characterized by a finer constitution, and in the case of high selection predisposition to stress.

According to MCGLONE and WILSON (2005) Pietrain is a heavily muscled breed imported from Germany and Belgium. The Pietrain is lean and while the origin breed was positive for the halothane gene, some lines are now halothane negative.

According to MATOUŠEK *et al.* (1996) the breed has a characteristic colouring. It is predominantly with spots from black to grey. The colour of the bristles is variable. The ears are upright.

Adult boars weigh 280 kg, sows weigh 240 kg, lean value of meat is 59.5%, and fat percentage is 32.6% and percentage of ham 21.7% (HOVORKA *et al.*, 1983).

Picture 4. Pietrain (http://nationalswine.com)

Hampshire

This breed comes from the English saddleback pigs from Hampshire (HOVORKA *et al.*, 1983).

Hamsphire pigs are characterized by good fertility. They satisfy the parameters of fattening, very good slaughter value and very good meat quality (MATOUŠEK *et al.*, 1996).

These pigs are black with a white belt that extends from one front leg. Over the shoulder and even down the other front leg. They have upright ears and are popular for their lean meaty carcasses (MCGLONE and WILSON *et al.*, 2005).

The average weight of the Hampshire pig male is 300 kg and female is 250 kg (LOOKSEET. HAMPSHIRE PIG.)

Typical feature is steep posture of the legs (MATOUŠEK *et al.*, 1996).

Picture 5. Hampshire (http://nationalswine.com)

Performance traits

According to MATOUŠEK *et al*. (2013) the performance traits of the pigs are divided into 2 basic groups, namely the reproductive traits and the production traits.

3.4 Reproductive traits

According to ROME *et al.* (2001) reproduction traits are key factors and priority in pig breeding, especially maternal breeds of pigs.

Reproductive technologies have dramatically changed the way pigs are raised for pork production in developed and developing countries. This has involved such areas as pigs produced/sow, more consistent pig flow to market, pig growth rate and feed efficiency, carcass yield and quality, labour efficiency, and pig health (KNOX *et al.*, 2014).

According to ČECHOVÁ *et al.* (2015) reproduction is a complex feature that consists of multiple components. The most important component includes the beginning of sexual maturity with the activation of the physiological functions of the reproductive organs, the ability of the female genital organs to mate and complete pregnancy, the ability to deliver piglets and their offspring´s, the reproductive abilities after birth and the ability of the male to matting and fertilize the eggs.

Reproduction has a major impact on the efficiency and productivity of pig production system (KOKETSU *et al.*, 2017).

MATOUŠEK *et al.* (1996) states that reproductive attributes are the characters that include fertility, number of weaned piglets and weight of litter in 21 days.

Reproductive efficiency is usually defined as the number of piglets produced per sow per year. This measure includes two key components the numbers of piglets produced per litters and the number of litters produced per year. Reproductive success in pig breeding focuses not only on the number of piglets produced, but also on the quality of piglets. In this case quality includes the health and wellbeing of the piglets, their suitability for their production environment and the extent to which they meet consumer expectations of quality (ELIASSON and ISBERG, 2011).

Suggested targets to achieve

- Number of weaning piglets per 1 sow per year – 25 or more.
- Number of alive born piglets per 1 sow per year – 28, stillborn piglets – 2.5%.
- Pregnancy rate – first service – 90 % and more (STUPKA *et al.*, 2009).
- Survival rate of about 85% of piglets born alive.
- Growth rate of 90 kg live weight in 170 days with a carcase yield of 77%.
- Sows should have at least 12 normal teats.
- In well-developed farms sows should have 14 teats, preferably 7 on each side.
- Sows should be the biggest and the healthiest of the litter (USER GUIDE ON PIGS, 2011).

3.4.1 Sow's fertility

Fertility is the basic biological and utility trait of animals that enables them reproduction, conservation of the species and at the same time improvement of their utility traits (STUPKA *et al.*, 2009).

Pigs belong among the most fertile livestock species and generally the fertility rate is high. This is due to relatively early sexual maturity, the regularity of the sexual cycle, relatively high conception ability, the number of piglets per one litter, a short cycle of reproduction and the possibility of early conception after weaning and weaning piglets and finally the ability to reproduce for a relatively long time (KOZUMPLÍK a KUDLÁČ, 1980).

According to MATOUŠEK *et al.* (2013) fertility is determined by both genetic and external conditions. Therefore fertility is divided into potential fertility and real fertility.

According to STUPKA *et al.* (2009) potential fertility is the sow's ability to release fertile eggs during the estrus regardless of their further development. During one estrus cycle sows release from 14 to 25 eggs.

Real fertility is characterized by the number of alive born piglets (MATOUŠEK *et al*., 2013). The actual fertility is influenced by the number of mature and released eggs, mating abilities, fertilization possibilities, fertilized eggs, embryonic development, mortality and loss of piglets during farrowing (STUPKA *et al.*, 2009).

According to MATOUŠEK *et al*. (2013) to achieve optimal fertility, it is appropriate to mate the sows at the age of 210–240 days, when they reach 130 kg in live weight.

In sows, fertility is represented by the ability to produce a certain number of piglets in the litter. It is quantified by the number of total and alive born piglets and stillborn piglets, the most important is number of alive born piglets (ŽIŽLAVSKÝ *et al.*, 2002).

Puberty

Pigs usually reach puberty at approximately 180–220 days of age. Moreover, a body weight of 100–110 kg is required. The age of puberty varies depending on genetic and environmental factors including season, social environment, and nutrition (TUR *et al.*, 2013).

According to KNOX (2014) puberty is a complex process. It is based on the maturation of the neural pathways associated with the hypothalamic-pituitary axis (HPX). This axis is responsible for release of hormones that must pulse, that must respond to positive hormonal feedback and also to external stimuli.

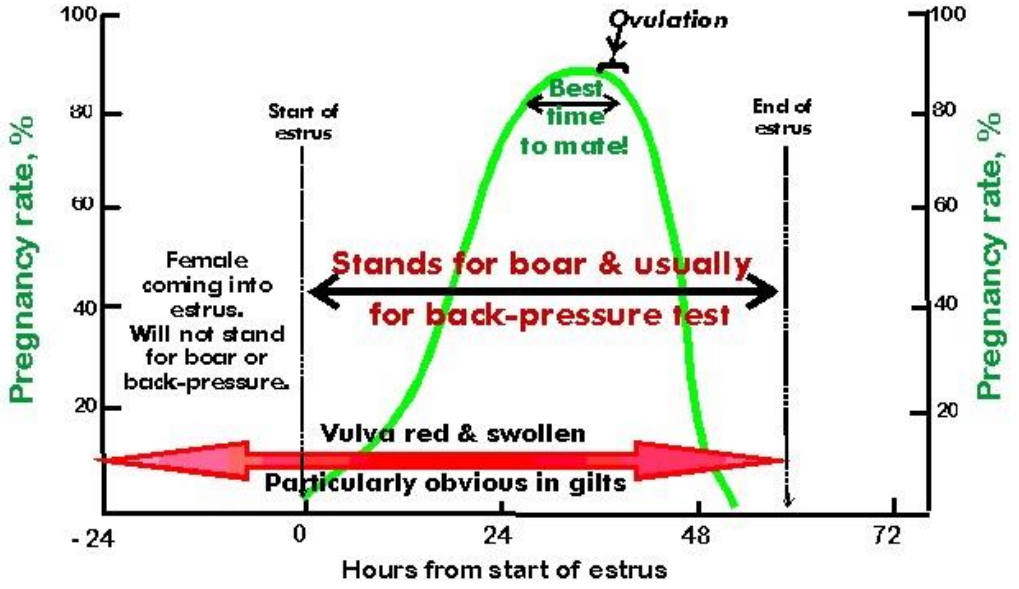
Estrus and ovulation

Estrus is defined as the period when the sow will allow mating. Estrus duration is on average 50–52 hours, but ranges from 32 to 69 hours (BELSTRA *et al.*, 2004; KNOX, 2005b; GILL, 2007).

Ovulation occurs about 36-40 hours after the beginning of standing heat. Optimum insemination is 6–12 hours prior to ovulation. Therefore, mate 24 hours after initiation of standing heat and rebreed 8–16 hours later if female will still accept

the boar or is still showing a positive (standing) response to the ‘back pressure test’ (KING).

Figure 1. Sow's estrus cycle – Timing & number of services (KING).



Sows and gilts are usually mated once during the first day and again during the second day of estrus. Spermatozoa have relatively long survival periods in the female reproductive tract (>24 h) but get tired towards the end of this interval. In contrast, oocytes degenerate soon after leaving their follicles so should be fertilized quickly. Mating during the first and second day should insure that viable spermatozoa are present in the female's reproductive tract, ready to fertilize oocytes very soon after they are ovulated and pass into the oviduct.

Ovulation is defined as the release of oocytes and normally (i.e. in 70% of the cases) occurs within the time of estrus (GILL, 2007). Ovulation start normally occurs from 42 to 44 hours after the beginning of estrus (BELSTRA *et al.*, 2004; KNOX, 2005b), which means during the first part of the last third of the standing heat (GILL, 2007).

Time to estrus after weaning and duration of estrus in sows can be influenced by length of lactation, nutrition, body condition, genetics, and other management practices (ALTHOUSE *et al.*, 2015).

Factors affecting fertility

According to VEJČÍK *et al.* (2001) in the context of fertility disorders, is used the term *SMEDI syndrome* **(**S – stillbirth, M – mummification, ED – embryonic death, I – infertility).

Internal factors affecting fertility

Infertility

According to ALMOND despite domestication, the reproductive performance of female pigs shows strong seasonal trends. The capacity to return to estrus following weaning, the onset of puberty and the ability to conceive and maintain pregnancy are affected by season.

The term ‘seasonal infertility’ or ‘summer infertility’ has been associated with the syndrome of lowered reproductive performance during the summer season (VAN RENSBURG and SPENCER *et al.*, 2014).

Seasonal infertility is a reduction in fertility & fecundity in breeding pigs at a particular period of the year – usually summer and early autumn (HUGHES and VAN WETTERE *et al*., 2010).

This has been shown to be a problem in South Africa as well as various other countries in Africa by negatively affecting not only the reproductive performance but consequently the economic efficiency of pig herds (CHOKOE and SIEBRITS *et al*., 2009).

Age and weight

Extreme weakness delays puberty age and has a negative impact on lifelong reproductive performance. Birth rate, live birth rate, and weaning mortality are reduced in piglets with induced early puberty. However, these effects are only observed in pigs mated after 270 days (TUR *et al.*, 2013).

External factors affecting fertility

Climatic factors

The impact of weather on human and animal behaviour is obvious. Scientifically, the weather is an overall term that describes many parameters such as temperature, humidity, cloudiness, precipitation, solar radiation, atmospheric pressure as well as air movement (OLCZAK *et al.*, 2015).

Thermoregulatory behaviour of pigs

Owing to their low sweating capacity, sows are very sensitive to high temperatures (EDWARDS *et al.*, 1968). Negative effects of increased temperatures on

sow reproduction include prolonged weaning-to-service intervals, increased numbers of regular and irregular returns to estrus, reduced litter size (ALMOND and BILKEI, 2005; SURIYASOMBOON *et al.*, 2006) and reduced milk yield (RENAUDEAU and NOBLET, 2001).

Pigs are homeothermic animals which, for various reasons, are prone to overheating. Their reduced ability to transfer heat is mainly caused by the small amount of sweat glands (BRACKE, 2011), a subcutaneous fat layer (ZERVANOS and HADLEY, 1973).

Increased respiration (panting) (HUYNH *et al.*, 2007), decreased activity (HUYNH *et al.*, 2005; JOHNSON *et al.*, 2008), reduced food intake (SILVA *et al.*, 2009a) and increased water intake (SILVA *et al.*, 2009b) are all signs of hyperthermia.

Nutrition

The most important factor influencing sow's fertility is nutrition (MATOUŠEK *et al.*, 2013). Periods of high environmental temperature have an effect on the farrowing rate, litter sizes and number of stillborn piglets in commercial breeding units in South Africa (VAN RENSBURG and SPENCER, 2014).

3.4.2 Milk production of sows

According to VEJČÍK *et al.* (2001) milk production is the ability of the sow to produce milk at the time when piglets are suckling. Milk production by the mammary glands is influenced by genetics and nutrition (INDIANA, MICHIGAN, AND OHIO SWINE NUTRITION GUIDE, 1998). The high production of milk is subject to high daily gains, the homogeneity of the litter and high live weight of weaned piglets.

According to VEJČÍK *et al.* (2001) after farrowing, the sows excrete colostrum which contains more vitamin A, D and C and other protective substances. The main ingredients of the colostrum are the proteins (5.5%), the fat (7.0%), the milk sugar (4.0%) and the ash (0.8%). Compared to the cow's milk, the milk of sows is about twice the amount of proteins and fat, higher mineral content and have the same saccharide content.

The average daily production of sow´s milk with a litter around 10 piglets is 8–10 kg. After farrowing, it gradually rises and reaches the lactation peak at around the 23rd day. After reaching the peak, it drops only slightly until the 30th day,

but after 40 days very fast. One teat excretes 25–50 g of milk from the sow per feeding, and around 800 g daily (ŽIŽLAVSKÝ *et al.*, 2002).

Colostrum and milk

Mammogenesis occurs during prepuberty, puberty and gestation and continues during lactation as long as the teats are suckled (FARMER *et al.*, 2004).

If the teats are not suckled, involution will occur. This involution is especially rapid if the teats are not suckled during the first seven to ten days of lactation (KIM *et al*., 2001).

It is not possible to milk the sow regularly in the same manner as can be done with dairy cows. This is due to the fact that the porcine mammary gland does not contain cisterns for storage of milk, secreted by the epithelial cells of the alveoli (ELIASSON and ISBERG *et al.*, 2011).

Colostrum yield varies a lot among sows (FARMER and QUESNEL, 2009; QUESNEL, 2011). In the study performed on Landrace × Large White sows the average colostrum yield was 3.67 ± 0.14 kg during the first 24 hours after parturition, ranging from 1.91 kg to 5.31 kg (DEVILLERS *et al.*, 2007).

According to FARMER and QUESNEL (2009) colostrum yield is not affected by litter size but can be affected by parity number, the weight of the sow at parturition, the time of farrowing, sow health, sow nutrition and by the genotype of the sow.

Behaviour of sows

Animals' behaviour is partly inherited, but is also affected by environment and the experience of the individual animal (JENSEN and RECÉN, 1989).

The sow's maternal behaviour develops over parities, and the environment affects this development (THODBERG *et al.*, 2002).

3.4.3 Boar fertility

According to STUPKA *et al.* (2009) the ability of breeding boars is influenced by sexual maturity, sexual potency and fertilization ability. It is the ability to produce semen to a high age. Fertilization ability is expressed by the number of offspring produced in the course of 1 year.

Sperm quality of boars depends on both intrinsic (genetic) factors and extrinsic (environmental/husbandry) factors. In relation to intrinsic factors, an increased reproductive efficiency of crossbred boars as compared with purebreds manifests the importance of heterosis in this context (PINART and PUIGMULE, 2013).

Boar fertility should be checked periodically. This is done by collecting ejaculate and examining it under a microscope. Boar semen should be milky white, not pink or yellow. Sperm should swirl under the microscope with minimal broken tails or dead sperm (LAMMERS *et al*., 2007).

According to LAMMERS *et al*. (2007) boar fertility is reduced because of over use and high temperatures. For optimum levels of sperm per mating, boars should be mated no more than 1 to 2 times daily or 5 to 7 times per week.

Quality of ejaculate is 30–60 billion sperm in the ejaculate, 70% sperm activity, 200,000 sperm/mm³, volume – 100 ml, abnormalities up to 20%, lifespan 5 days and optimum pH (STUPKA *et al*., 2009).

The monitored boars fertility rates can be broken down into actual pointers (realized) fertility and indicators of potential fertility. Indicators of real fertility are the size and weight of the litter and the conception rate. Potential fertility indicators can be used include such morphological and physiological features as are proven or proved relationship to actual fertility (SMITAL *et al.*, 2016).

Infertility in boars

Infertility in the boars is caused by a number of factors. These can include failure of sperm production, production of abnormal sperm, overuse of the boar, physical abnormalities of the male genital tract which prevent delivery of semen at mating, physical or psychological factors which prevent mating and, finally, infection of paternal origin which destroys the products of conception (BOAR INFERTILITY).

3.5 Productive traits

Meat production is considered to be the most important utility of pigs (OCHODNICKÝ *and Poltárský*, 2003).

Selection for efficiency and productivity has been the long-term focus of pig breeding programs worldwide leading to considerable genetic gains in production levels of pigs. These genetic improvements in efficiency and productivity, however, have high physiological demands, which may have unfavourable consequences for the robustness of animals (KNAP and RAUW, 2009; PRUNIER *et al*. 2010).

Robustness has recently been described as a central concept in reconciling productivity and feed efficiency with health, adaptation, welfare and reproduction (PHOCAS *et al.*, 2014).

3.5.1 Growth

According to STUPKA *et al.* (2009) growth is the sum of all the modified physiological and chemical processes. These processes begin by fertilizing of the egg and end with a species-characterized body structure when reaching physical maturity.

Growth is divided into 2 periods. The *prenatal period* is defined by the intervals between fertilization and birth. Prenatal period is divided into the period of cleavage of the fertilized egg (fertilization, cleavage, blastocysta), embryonic periods (implantation, embryo formation, placental growth), and fetal period (fetus formation, birth). The *postnatal period* is dived into the period of transition to solid feed (and independence on mother), sexual maturity (puberty, breeding ability), and adulthood (age at finishing of growth) (STUPKA *et al.*, 2009).

3.5.2 Fattening

According ČECHOVÁ *et al.* (2015) fattening is an ability of animal to form valuable products from feeding, meat and fat. It can be monitored by two indicators. An average day growth in a lifetime or feeding time and feeding consumption per 1 kilogram live weight gain (conversion). Average daily gain is an indicator of growth and its value influences the end of fattening process. Feeding consumption per kilogram weight gain expresses the effectivity of the feeding process. Feeding costs make up the majority of expenses related to pig breeding.

3.5.3 Carcass value

According to MATOUŠEK *et al*. (2013) the carcass value is a relatively complex term that changes according to the requirements of the market.

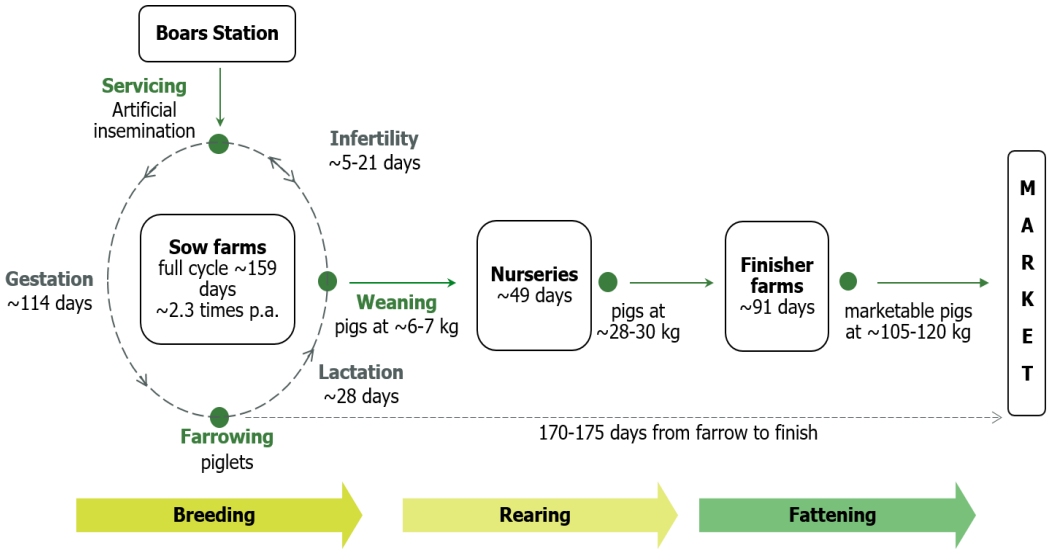
The carcass value and its observation is always actual and an intensive research activity is focused on this problem. This appears according to the consumer's demand and also according to the complex characteristics of the carcass value which concerns many partial parameters (INGR, 2003).

Carcass quality is generally expressed by lean meat content. The SEUROP system is used for the classification of carcasses. Each of the SEUROP classes is characterised by the upper and lower limit for lean meat content and by a specific price/kg of carcass (HOUSKA *et al*., 2010).

3.6 Techniques of pig breeding

Pigs are kept in one form or another almost everywhere in the world. In rural areas of many parts of the world, it is still common to find pigs rooting and roaming freely around communities, which are sold or slaughtered when household needs it. Pig farms are also found in and around towns and cities, and they play an important role in feeding urban populations. The main production systems used are intensive and semi-intensive. However, the common production system is semi-intensive, especially in small-scale pig production (VAN'T KLOOSTER and WINGELAAR, 2011).

Figure 2. Pig production (https://axzon.eu/en/what-we-do/pig-production)



Farrowing sows

Farrows are key events in the life of the sow that have a substantial economic impact on piglet production. The duration of farrowing can vary considerably and depends on several factors such as breed, age of the sow, length of gestation, number of piglets born, environment and body condition (OLIVIERO, 2010).

Farrowing crates were designed to restrict the sow's movement and reduce the risk of her accidentally crushing her piglets, as this is not only a welfare issue, but also an economic one for the farmer. Modern sows have been bred to have much larger litters than their wild boar relatives. As a result, the piglets tend to be much smaller and weaker at birth and therefore more prone to accidental crushing (COMPASSION IN PIG WORLD FARMING, 2013).

After giving birth, the sow remains with her piglets in the farrowing crates until they are weaned, at 2-4 weeks (COMPASSION IN PIG WORLD FARMING, 2013).

According to WHITE (2018) nutrition demands of the unborn litter are such that feed levels should increase by 50–100% from day 90 but must be reduced four to five days before farrowing to avoid excessive udder development and congestion and to reduce farrowing complications.

Weaning

Weaning is a stressful experience for young piglets, affecting them both socially and physiologically (ROESE and TAYLOR, 2006).

Feeding strategies have also aimed to increase the milk yield of the sow in order to better support the growth of all the piglets during the weaning phase (EINARSSON and ROJKITTIKHUN, 1993).

Weaning is usually undertaken in one of the three following categories: *conventional* weaning: 3–5 weeks of age, *early* weaning: 10 days of age to 3 weeks, *specialised* weaning: segregated early weaning (SEW) and medicated early weaning (MEW) (ROESE and TAYLOR, 2006).

Nursery

A nursery is a facility or building designed specifically to house newly weaned pigs until they reach the grower/finisher stage. Nursery management is

critical to a healthy, good performance of pig (SWINE NURSERY MANAGEMENT, 2002).

The average age of weaned pigs entering the nursery is from 18 to 26 days (THE NAHMS REPORT ON NURSERY PIG MANAGEMENT, 2002).

3.7 Pig breeding systems

3.7.1 Free-range scavenging pig keeping

In many parts of the developing world, pigs are kept under low-input systems where they roam freely to scavenge food. These systems allow poor farmers the opportunity to enter into livestock keeping without large capital investments (THOMAS *et al*., 2013).

The main characteristic of this system is that the pigs move freely around the house and surroundings, scavenging and finding for themselves a large part of their food (MUYS and WESTENBRINK *et al*., 2004).

A more or less extensive system that provides a household emergency fall-back fund, whilst also supplying it with a little meat from time to time, with little investment of time or money. This domestic scale is typical of small farmer mixed holdings (MUYS and WESTENBRINK *et al*., 2004).

Local breeds are commonly used, since they can cope with low quality feed and are more resistant to diseases.

3.7.2 Semi-intensive pig keeping

In this system the animals are housed and more attention is paid to their health and feeding. The aims are partly the same as those of domestic pig keeping, but with modest inputs. Production is higher and the pigs are also marketed. Pigs are normally confined to a limited space. This means that most (or all) of them cannot gather their own food and are completely dependent upon their keeper. This system of pig keeping opens up possibilities for improved feeding and disease control, which in turn can result in faster growing and healthier pigs and/or larger litters (VAN 'T KLOOSTER and WINGELAAR *et al.*, 2011).

Some classes of pigs are kept outside the pig shelters, e.g., boars and sows stay within a perimeter fence where water, feeds and shade are provided (MOREKI and MPHINYANE *et al*., 2011).

3.7.3 Intensive pig keeping

This system aims at producing meat for the market efficiently and profitably, usually with larger numbers of pigs. It requires significant inputs of time and money, with careful calculation of the costs and the resulting benefits (VAN 'T KLOOSTER and WINGELAAR *et al.,* 2011).

Pigs are completely housed and fed complete diets. In this system, pigs are shifted from one pen to another according to the production stage, until they reach market weight (MOREKI and MPHINYANE *et al*., 2011).

3.8 Diseases and treatment

Local pig breeds are often more resistant to diseases. The most common problem with keeping any sort of pig in free-range or semi-intensive systems is not disease, but controlling infestation by worms or other parasites (MUYS and WESTENBRINK *et al*., 2004).

In intensive pig keeping systems diseases are a greater risk, because many animals are kept together in a small space. Infectious diseases spread easily and quickly among the animals (MUYS and WESTENBRINK *et al*., 2004).

Diseases are the major limiting factor in the pig production industry. These diseases are caused by many factors. It might be due to the contact with wild animals, insects also contribute to transmission if diseases.

3.8.1 Malnutrition (poor condition)

Malnutrition literally means ‘bad nutrition’ and technically includes both over- and under- nutrition. The World Food Programme (WFP) defines malnutrition as a state in which the physical function of an individual is impaired to the point where he or she can no longer maintain adequate bodily performance process such as growth, pregnancy, lactation, physical work and resisting and recovering from disease (BAIN *et al.,* 2013).

Pig malnutrition means 10–15% weight reduction compared with normal pigs by not providing enough nutrients protein, starch, fat, vitamins, minerals, trace elements (PHARMAHEAD).

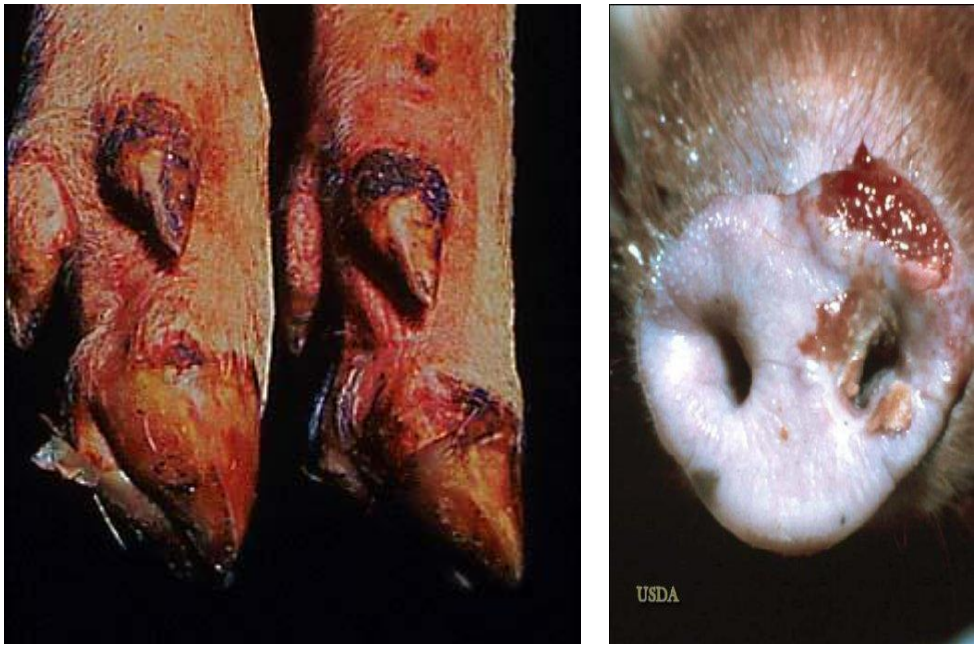
According to PENRITH (2001) malnutrition is one of the most important problems of small pig herds. The pigs will appear thin and show poor growth. The only bones that you should see are the shoulder blades, which should be covered by a layer of flesh so that you cannot actually feel them. If the backbone, hip bones or ribs can be seen, the pig is too thin. There may be a number of reasons for malnutrition. These are – not enough food and poor-quality food. Parasites use all the nutrients or make pigs scratch instead of eating**.**

Feeding management is very important aspect of pig production (CHURCH, 1991).

3.8.2 Foot-and-mouth disease (FMD)

The transmission is commonly by breath in droplets containing the virus (germ) that causes FMD that were breathed out by animals that are carrying FMD. Signs of the disease are found on the mouth and feet. The animal's tongue has vesicles (blisters) filled with fluid and these rupture easily, leaving the tongue with bleeding areas. Blisters are seen on the snout, between the claws, on the heel and just above the claw. FMD is so important because it is highly infectious, spreads rapidly throughout animal populations and over long distances on the wind and hence it is difficult and costly to control. In pigs early signs are lameness a drop in food consumption and some pigs appear depressed and have fevers of about 40.5 °C, (105 °F). In piglets sudden death due to cardiac failure is common as there is no treatment (MUIRHEAD and ALEXANDER *et al.*, 2001).

Picture 6. Foot-and-mouth disease
(http://www.pigprogress.net/Health-Diseases/Health/2012/9/Foot-and-Mouth-Disease-in-Tibet-340-swine-culled-PP009334W/



3.8.3 African swine fever (ASF)

African swine fever (ASF) was first described in 1921 in Kenya when the virus was transmitted from wild African suids to domestic pigs (*Sus scrofa*), causing a disease with 100% mortality (MONTGOMERY, 1921).

African swine fever virus (ASFV) is a large, complex, deoxivirus producing a highly contagious hemorrhagic disease in pigs of all breeds and ages. African swine fever virus (ASFV) can spread very rapidly in pig populations by direct or indirect contact. This virus can also become endemic in feral or wild suids, and transmission cycles between these animals and Ornithodoros ticks can complicate or even prevent eradication. ASF is endemic in more than 20 countries in sub-Saharan Africa, where a number of epidemiological patterns and scenarios have been described. In Europe, ASF is endemic in Sardinia (Italy) (ZIMMERMAN *et al*., 2012).

African swine fever affects members of the pig family (Suidae). Species that can be infected include domesticated swine, Eurasian wild boars (Sus scrofa scrofa), warthogs (*Phacochoerus spp.),* bush pigs (*Potamochoerus larvatus* and *Potamochoerus porcus*) and giant forest hogs (*Hylochoerus spp.)* (AFRICAN SWINE FEVER, 2015).

In the acute form of the disease caused by highly virulent strains, several pigs develop a high fever 40–42 °C but may not show any other very noticeable signs for a couple of days. They then gradually lose their appetites and become depressed. They lie down huddled together shivering, breathing abnormally and perhaps coughing and they do not want to get up. If you make them get up they are unsteady on their legs. Within a few days they become comatosed and die (MUIRHEAD *et al.,* 2013.

In Africa, ASFV is maintained by a complex transmission cycle involving African wild suid species, soft ticks, and domestic pigs (JORI and BASTOS, 2009).

All pigs should be vaccinated against swine fever at the age of 2–4 weeks. Breeding pigs should be tested for brucellosis and leptospirosis. As a routine measure all young pigs at the time of weaning should be inoculated against swine fever. Animals purchased for the farm should be purchased from disease free herds. Newly purchased animals should be isolated from the other animals in the farm for a period of three to four weeks. No visitor should be allowed to visit the farm. Those sites or pig houses cleared of the animals are kept empty for three to four weeks for destruction of microorganisms causing the disease (PIG FARMING).

3.8.4 African animal trypanosomiasis (AAT)

African animal trypanosomiasis (AAT) is a parasitic disease that causes serious economic losses in livestock from anaemia, loss of condition and emaciation. Many untreated cases are fatal. AAT is found mainly in those regions of Africa where its biological vector, the tsetse fly, exists (AFRICAN ANIMAL TRIPANOSOMIASIS 2009).

According to MUYS and WESTENBRINK (2004) it is transmitted by the tsetse fly. The infected animals are feverish, lack appetite, and breathe very fast.

Most trypanosomes must develop for one to a few weeks in tsetse flies (*Glossina spp.),* which act as biological vectors. When an infected tsetse fly bites an animal, the parasites are transmitted in the saliva (AFRICAN ANIMAL TRIPANOSOMIASIS, 2009).

3.8.5 Piglet anaemia

According to SARMA piglet anaemia, also called iron deficient anaemia, is a hypochromic-microcytic anaemia generally associated with young, rapidly growing piglets with lack of Fe in their diet or from their environment.

The piglet is born with limited supplies of iron and if it had been born in the wild would depend on supplementation to its diet from iron bearing soils. Indoors the pig has no access to iron other than to the sows' milk (which is deficient) until it starts to eat creep feed (ANAEMIA - IRON DEFICIENCY).

Causes of iron deficiency anaemia iron deficiency develops rapidly in nursing pigs reared in confinement because of low body storage of iron in the newly born pig, low iron content of sow's colostrum and milk, elimination of contact with iron from soil, rapid growth rate of the nursing pig (SARMA).

3.8.6 Mastitis, metritis and agalactia (MMA)

Postpartum dysagalactia syndrome (PDS) in sows (which includes the previously-used term mastitis, metritis and agalactia, or MMA, syndrome) is characterised by inadequate and insufficient colostrum and milk production during the first days after farrowing (KLOPFENSTEIN *et al.*, 2006).

A low colostrum intake is related to a low weight gain during first 3 days postpartum (MILLIGAN *et al.*, 2002).

According to KAY (2016) mastitis is the reduction in milk production, loss of appetite and a higher body temperature are symptoms of mastitis in sows. It is caused by a bacterial infection of the mammary glands, where skin discoloration can be

3.8.7 Swine erysipelas

Swine erysipelas is an infectious disease caused by the bacterium *Erysipelothrix rhusiopathiae* seen mainly in growing pigs and characterised clinically by sudden death, fever, skin lesions and arthritis. The fever can induce abortion in pregnant gilts and sow (SWINE ERYSIPELAS).

3.9 Nutritional requirements

Growth rate and nutritional requirement of pigs are two essential factors necessary for maximum pork productivity (NJOKU *et al*., 2015).

An ideal nutritional programme should provide adequate nutrients to maximize pig productivity while minimizing excreted nutrients and feed costs. Since 75% of total feed used in a farrow-finish operation is consumed in the grower-finisher phase (EDWARDS, 2010).

According to NJOKU *et al*. (2015) under tropical conditions, it is therefore logical to adopt a system of feeding that promotes feed intake and lean tissue growth. High temperature leads to decrease in voluntary feed intake, and hence a reduction in growth rate.

According to VAN'T KLOOSTER and WINGELAAR (2011) pigs will not thrive on grazing and fibrous feed alone. For pigs to be healthy and produce well they need to get enough to eat and good quality feed.

Feeding level, feed composition and feeding patterns have been used as tools to manipulate growth rate, weight gain, fat deposition and pork quality (WOOD *et al.*, 2004).

Under tropical conditions, it is therefore logical to adopt a system of feeding that promotes feed intake and lean tissue growth. High temperature leads to decrease in voluntary feed intake, and hence a reduction in growth rate (NJOKU *et al.*, 2015).

In resource-poor areas, the use of good cereals, for example as pig food, should be considered very carefully. Normally pigs will have to eat do with feed that is not directly useful to humans, and with waste products. These include agro-industrial by-products (bran, molasses etc.), kitchen waste, and garden or agricultural waste (VAN 'T KLOOSTER and WINGELAAR. 2011).

Feeding good quality, fresh and nutritious food can make your pigs healthier and ensure proper growth. Good food also help to prevent various types of diseases. You can feed your pigs almost everything including roughage, kitchen garbage, agricultural waste, stalk from beverage companies (PIG FARMING IN NIGERIA).

The body of the pig contains on average 16% protein, 16% lipid, 3% mineral ash and 65% water (KYRIAZAKIS and WHITTEMORE, 2006).

The pig must always be provided with fresh clean drinking water. A sow with young will need 20–30 litters of water (PIG FARMING).

In Uganda, smallholder pig farmers report that feeding management is an important production constraint. Feed scarcity, high cost, seasonal variations in feed quality and availability, food competition between people and pigs and lack of knowledge to formulate low-cost nutritionally balanced rations for pigs are key challenges (CARTER *et al.*, 2015).

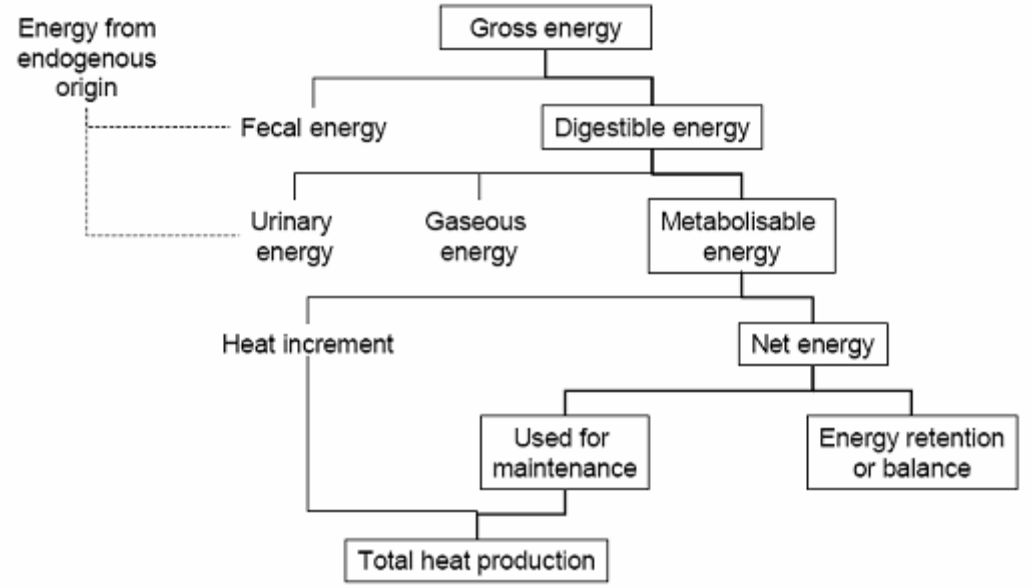
3.9.1 Water

According to KYRIAZAKIS and WHITTEMORE (2006) water is a major structural element giving form to the body through cell turgidity. Water also acts as a transport medium, both in the intestines and in the blood and tissues of the body-proper. It is the medium at metabolic level for enzyme-aided biochemical reactions. The water requirement for pigs is free availability at all times. The calculation of requirement is therefore one of expected rate of intake. The water content of the body of a pig can vary from 80% in the new born to 50% in a fat adult. Water usage for pigs is almost best dealt with independent of aspects of pig metabolism, which the pig can take care of more than adequately, provided that water is freely available at all times. The means of providing free availability for water is a more appropriate subject for systematic study than any factorial estimation of requirement.

3.9.2 Energy

Energy is yielded from oxidation of the carbohydrate, protein and lipid components of feed. Common energy sources are grains (corn, sorghum, barley, wheat, etc.), fats and cereal or processing by products (SWINE CARE HANDBOOK).

Figure 3. The schematic representation of the flow of dietary energy



According to KYRIAZAKIS and WHITTEMORE (2006) feed energy is used by pigs (1) for the basic maintenance of normal body processes such as muscle movement, digestion, respiration, blood circulation, the renewal of worn-out body tissues and the recycling of existing body tissues. (2) For driving the manufacturing activities of milk synthesis, reproductive effort and protein and lipid growth. (3) For maintaining body temperature in the face of a cold ambient environment. And (4) for retention in the body products of secreted milk, the fetal load and lean and fatty tissue growth. All the energy but that which is retained (5) leaves the body as heat.

3.9.3 Protein

Pork is one of the cheapest protein sources that can contribute towards food security in Africa. Pigs are omnivores, and as such are ideally suited to convert non-human edible feed stuffs into high quality food animal protein. Protein deficiency, which may result from suboptimal feed intake or a deficiency of one or more of the essential amino acids, causes reduced gains, poor feed conversion, and fatter carcasses in growing and finishing pigs. In lactating sows, milk production is reduced, excess weight loss occurs, and sows may fail to start post weaning estrus or have delayed return to estrus (CROMWELL).

3.9.4 Minerals and vitamins

Pigs require many minerals for normal biological function. Some minerals are present in adequate quantities in grain or other feed ingredients in the diets and others must be supplemented. Not only are minerals essential in the diet, but many of them also may be toxic in excess amounts (SWINE CARE HANDBOOK, 2002).

Deficiencies of calcium or phosphorus result in rickets in growing pigs and osteomalacia in mature pigs. Signs include deformity and bending of long bones and lameness in young pigs, and fractures and posterior paralysis (a result of fractures in the lumbar region) in older pigs (CROMWELL).

3.9.5 Local feed resources

According to PIG SECTOR KENYA (2012) the main resources for feeding pigs are cotton seed cake and prairie meal, with gluten feed as a source of protein. Pigs are in competition with humans for maize, their main source of energy. Other energy sources include milled by-products such as the bran from wheat, maize and rice, along with maize grain, wheat grain and semi-refined oil. Limestone is the main local mineral source.

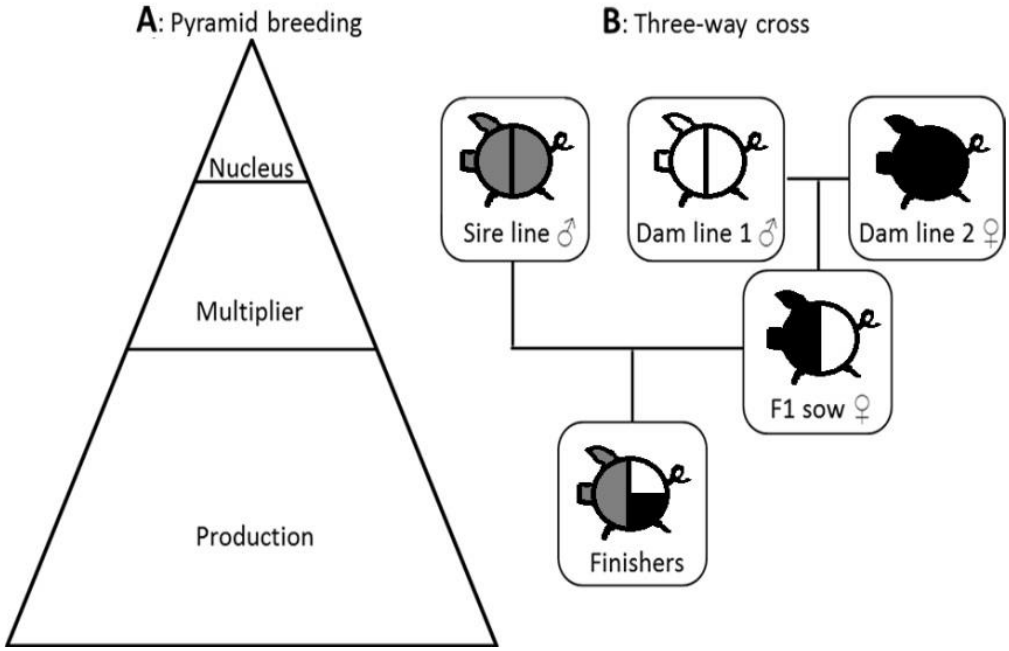
Another source of feedstuffs for pigs is swill from schools, hotels and government institutions. Farmers around these institutions collect the leftovers to feed their pigs. Some institutions, especially schools and prisons, feed their own pigs with the available kitchen leftovers (PIG SECTOR KENYA, 2012).

According to PIG SECTOR KENYA (2012) many commercial pig farmers also grow food crops, the surplus produce or by-products which can be used to feed the pigs. This food source plays an important role in pig feeding, especially in free range and small-scale production systems. Crops and by-products include sweet potato vines, kales, cabbages, Napier grass, sugar cane cuttings, sugar cane tops, garden weeds, mangoes, tomatoes, oranges, avocadoes, peelings and market by products/waste. The use of feeds such as cereal residues, FAO cassava and potatoes has been shown to save up to 20 percent on feed costs for growing pigs and 50 percent for breeding pigs.

3.10 Breeding companies and crossbreeding

Nucleus farms: contain purebred animals (sire and dam lines) which are kept at high health and management level and are sold or provide semen to multipliers farms (Figure 4). *Multiplier farms:* breed and multiply purebred animals from different lines and cross these lines to produce crossbred animals (F_1 sows, two-way cross) that are sold to production farms. *Production farms:* cross the F_1 sows with purebred sires to produce the final crossbred animals (Finishers, three-way cross), which represent the vast majority of animals in the full pig production pyramid (LOPES, 2016).

Figure 4. Pyramid breeding (A) and three-way cross (B) scheme



4. Conclusion

Pig industry in Africa has been increasing at a high rate in the past decade, despite the fact Africa is the a continent with population of about 1.2 billion people it stands as one of the lowest pork consumes in the world and this is due to factors such as poor knowledge on pig farming, poor techniques in pig handling, lack of financial support, diseases and finally in certain parts due to religious affiliation.

Pig production is one of the most thought out strategies to reduce animal protein deficit in the tropics and also as a business investment.

African countries have a low pig consumption rate with Uganda with the consumption of 3.4 kg per year per person, other countries such as South Africa and Nigeria have a slightly lower ratio consumption ratio.

There have been significant increases in the per capita income of South African consumers over the past decade. This has led to improved living standards and increased spending power. As a result of class mobility, consumption patterns have changed and have resulted in a steady growth in meat consumption through the past decade.

The recent increase is mainly due to the increase of the number of exotic breeds that are being used in pig breeding systems across Africa such as the Large White, Hamsphire, Duroc, Landrace and Pietrain.

There are illegal regulations on animal welfare and abattoir operations but compliance to these laws are not fully enforced. This situation leads to excessive pre-slaughter stress and poor hygiene conditions of the slaughter areas. Sources of pre-slaughter stress may range from physical, such as high ambient temperature, vibration and changes in acceleration during transportation, confinement, noise, and crowding.

Slaughter methods vary with geographic location depending on the technology available and/or adopted and may be influenced by cultural or religious orientation of the people. Quality of equipment and training of abattoir personnel have a significant impact on the quality of pork products.

To obtain maximum yield in pig production it is important to divide the productions traits in pig into two groups namely the reproductive traits and productions traits.

Reproductive traits are affected by both internal (genetic) factors and external factors which are induced by natural factors such as climate. Production traits are defined by the growth, fattening and the carcass value of the pigs which are important factors for maximum yield and profit.

Several challenges facing the commercial pig operations include high feed prices, inadequate slaughtering facilities, unorganized marketing, poor breeding stock, transboundary diseases and inadequate extension service.

On the spreading of transboundary diseases there is little done to prevent or reduce the spreading of the disease pig farmers experience the highest loss due to diseases.

Techniques in pig production are also an important factor which requires knowledge on pigs to attain the maximum pig potential which includes the sexual cycle farrowing and weaning periods which require more attention to the piglets during these periods.

The three pig breeding systems practised in the tropics are vital when it comes to nutrition and care of the animals. Pig breeding systems include free range semi intensive and intensive systems.

Good, efficient housing makes management easier and helps the farmer to successfully rear 85% or more of all the live born piglets to market weight in the shortest possible time. Pigs at different stages of growth need different environments (temperatures). If they are to produce and grow to their maximum potential piglets need special protection against very low temperatures. Growing and reproducing pigs must be protected against high temperatures. The houses must therefore be built in such a way that the pigs are protected against extreme temperatures and other bad weather conditions such as cold winds and continuous rain.

To counter the feeding challenge, it is important to analyse and record the proximate compositions of commonly used local nonconventional pig feeding materials to enable well-balanced rations that will supply the required nutrient.

Pigs are able to thrive on feed systems based on by-products: in rice-growing areas only pigs are able to utilize certain by-products of this cereal.

In conclusion, the sustainable development of pig production might require a new form of intensive and complex farming systems on the existing small-scale farms, e.g., pig farming associations, and crop-animal integrated farms. Farmers should be involved in all stages of any research and development program. Given their experiences and willingness to improve their own business endeavours, they should be consulted by the experts in any study or plans they intend to make.

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