

Livestock Genetics Companies

Concentration and proprietary strategies
of an emerging power in the global food economy

Susanne Gura



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of an emerging power in the global food economy**

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League for Pastoral Peoples
and Endogenous Livestock Development**

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The League for Pastoral Peoples and Endogenous Livestock Development (LPP) is a non-profit organisation devoted to advocacy and technical support to marginal livestock keepers, in particular pastoralists. It was founded in 1992 in Germany. Activities focus on research, training, capacity development and networking in cooperation with partner organisations. LPP promotes the concept of endogenous livestock development utilizing indigenous animal genetic resources and building on local institutions.

LPP is a member of the LIFE Network

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Introduction

Consumers are usually not told which breed of chicken, cattle or swine have produced the eggs, milk and meat offered in the supermarkets or the butchery shops. They should get interested, since they are contributing to the development of a global genetic monoculture. Meat processing factories and factory farms want uniform animals. Hardly noticed by the public, a concentration process is taking place not only in livestock production and processing, but also in the livestock breeding industry.

Only four companies supply the majority of genetics for commercial layer hens, broilers, turkeys and other poultry. The production of hybrid end-products and an associated structure, where multiplication and production are separated steps, allow for a de facto proprietary control over the breeding lines. This has strongly contributed to the extremely high concentration. Around two thirds of the world's broiler and half of the world's egg production is industrialized.

Pork, which is the most consumed type of meat in the world, is already industrialized to one third of global production. Hybrid pig lines are increasingly used, again with the separation of multipliers and fatteners, so that breeding companies can make sure that their breeding lines are not used by others for further breeding purposes. Concentration is fast increasing, and the genetic monoculture is increasing as well.

In cattle, although there is no hybrid breeding yet, and the animals are usually owned by farms less large than the poultry and pig factories, genetic monoculture has reached a similar level. A bull, with the help of artificial insemination, can have a million offspring. The dairy and meat producing communities cultivate their stars and pay high prices for a straw of frozen semen. Not surprisingly, the artificial insemination companies want to clone their best bulls. Cloning so far is not primarily meant for the dinner plates but to complement gene technologies.

Over past decades, breeding objectives focused almost exclusively on performance: yearly egg production, milk yields, milk fat content, and growth rates. Efforts were concentrated on only a handful of breeds of cattle, pig and chicken. Substantial production increases were thus achieved – but only if the feed quality and quantity to make use of the better feed conversion rate is also provided.

As a result, high-yielding livestock populations have become genetically very uniform. For most industrial breeds of cattle and pig, the "effective population size", a parameter used by experts to calculate genetic diversity, corresponds to less than the 100 animals required to maintain a breed. Poultry breeding industry insiders maintain that there is sufficient genetic variability within and between the lines. However, there is no such proven information for poultry – the companies are keeping the breeding lines as trade secrets.

With the onset of gene technology, companies who thus far focused on just one species, started to get interested in others. In 2005, the world's largest pig and cattle breeding companies PIC and ABS were merged into one company, Genus plc, which also incorporates shrimps genetics. The size of livestock breeding companies as such are

medium scale, with so far at most 2000 employees, and annual turnovers probably not exceeding 0,5 billion €, where information is available. However, they are usually integrated vertically with feed producing and/or meat processing companies, such as the US meat giant Tyson.

The US company Monsanto, better known for its leadership in genetically modified seed than in livestock genes, may soon dominate gene markets not only with regard to plants but also livestock, thanks to an aggressive policy of acquisition, cooperation and patent policy in cattle and pig genetics.

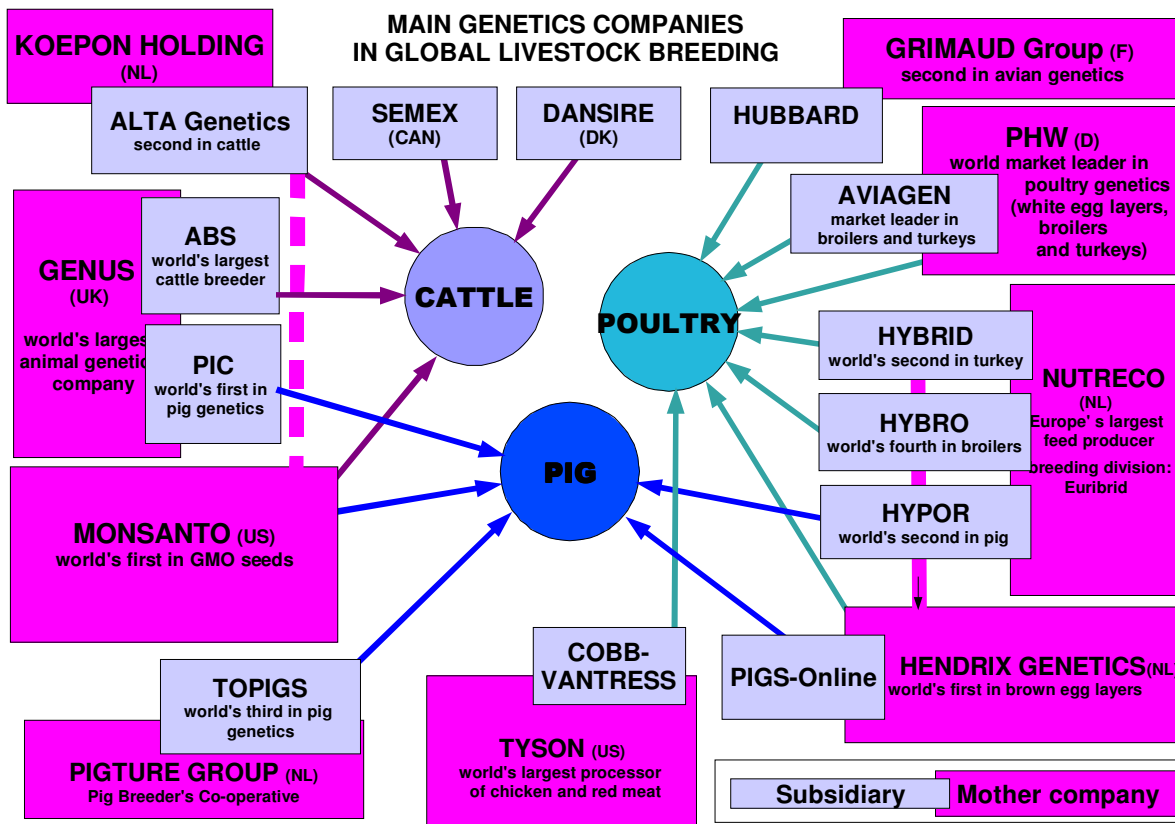
The rate of loss of the world's livestock breeds has recently accelerated to one breed per month, while it was around one breed per year on average during the last century. Trade liberalization contributes to an unprecedented growth in international trade of livestock products, and it is not the products of smallholders that are moved around the globe. In contrary, smallholder products are often wiped off markets, once a trade agreement allows foreign products in, or sanitary standards tighten. Smallholders get a tiny fraction, if at all, of the subsidy support industrial production and trade is receiving. Regulations usually work against smallholders and in favour of industrial production, although smallholders, in some countries, contribute up to one third to the nation's economy.

Alternatives are rather diminishing than increasing. The slowly but steadily growing global organic sector has problems to find livestock adapted to its production systems, especially in poultry. Local breeding in developing countries is usually not supported by national policies or development organizations.

The United Nations are currently raising the issue of the erosion of genetic resources, and the resulting threats for livelihoods and agricultural biodiversity. In Europe, where awareness about the roles and values of breeds has already reached the political level, conservation programmes are being implemented. Thus, no more breeds have been lost in some of the European countries.

However, what is being lost is food and cultural diversity, and food sovereignty. We also experience increased public health problems due to excess livestock based food intake, as well as animal welfare and disease problems, and environmental pollution. A few globally operating genetics companies determine what choice consumers have. Acting as if consumers all over the world want ever larger quantities of ever cheaper meat, milk and eggs without caring for environmental, social and cultural impact, they are expanding their market.

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1. Concentration of the livestock genetics industry

Although the livestock genetics industry still “mainly consists of Small and Medium Enterprises” as the European Forum of Farm Animal Breeders (EFFAB) sees itself, “its influence on livestock production is enormous and vital to the agricultural sector.”¹ Very little independent data have so far been published on the livestock breeding industry and the ongoing developments. The industry has not only dramatically revamped itself by developing new technologies and forming new companies but also changed its name, from “breeding industry” or “artificial insemination companies” to “livestock genetics”. The following provides a first overview over three main business areas: poultry, pig and cattle.

1.1 Poultry genetics industry: Layer hen, broiler and turkey

Between 1989 and 2006, the number of companies supplying poultry genetics at a global scale was reduced from 10 to 2 in layers and from 11 to 4 in broilers. In turkey breeding, only three companies supply the world markets. Entrepreneurs all over the world wanting to produce eggs or poultry meat on a commercial scale buy genetic material – parent chicken for day-old chicks and hatching eggs– from this handful of globally operating producers. The Dutch company Hendrix provides the genetics for the layer hens of 80% of the world’s commercially produced brown eggs. White eggs are produced to almost 70 % by layer hens originating from a German company, PHW.

Since 2005, PHW also owns Aviagen, the world’s largest broiler and turkey breeder. Aviagen shares the global broiler genetics market with only three other companies. One of them, Cobb, belongs to Tyson, the world’s largest meat processor. The second, Hybro, is owned by Nutreco, a major animal feed producer, who also owns each the second largest pig and turkey breeding companies.

a) Layer hen genetics

PHW - Erich Wesjohann GmbH & Co. KG, Germany, is the world market leader in layer and broiler genetics. Among its more than 35 subsidiaries are Lohmann Tierzucht Cuxhaven, Hy-line International USA and H&N International. In April, 2005, it acquired Aviagen, the market leader in broiler and turkey breeding with its broiler brands Ross, Arbor Acres, Lohmann Indian River, Nicholas Turkey as well as British United Turkeys. PHW’s turnover is 1,26 billion €². As one of the two global layer companies, it provides the genetics for 68% of white egg production, and 17% of brown egg production. PHW operates in 15 countries (including Germany, Poland, US, Canada, Brazil, Japan, South Africa) with almost 4000 employees, and has a distribution network serving 250 hatcheries in 85 countries. PHW has recently invested in hatcheries in Germany and Poland. Other business includes animal health and nutrition, and eggs for vaccine production. The integration of all production stages in the poultry brand Wiesenhof operates as a closed quality system. In the German broiler market, Wiesenhof has an almost 50% share³. PHW in 2005 increased its turnover by more than 6%; the breeding division had an increase of 18%.

¹ Working Group FABRE Technology Platform, February 2006: Sustainable Farm Animal Breeding and Reproduction- A Vision for 2025”(FABRE-TP Vision) <http://www.fabretp.org>

² Press Release 10.02.2006 http://www.phw-gruppe.de/seiten/untern_news-18.html (accessed 7 November 2006)

³ Dr. H.-P. Dröge, PHW Group (2005): Trade perspectives in the international poultry market. International Poultry congress 2005 in Brazil

Hendrix Genetics B.V., The Netherlands, is majority-owned by the Hendrix family . It was formed end 2005 by Hendrix Poultry Breeders who then acquired 100% of Compagnie Internationale de Volailles, the controlling holding of Institut de Sélection Animale, as well as Nutreco's 50% share. Its strategy focuses on growth and consolidation opportunities in animal breeding including establishment of a network of exclusive distributors in Europe. In Greece, the Netherlands and Belgium, the major hatcheries are contracted. Hendrix sells grandparent and parent layer hybrids under the brand names ISA, Babcock, Shaver, Hisex, Bovans and Dekalb in more than 100 countries with about 490 employees. It operates not only in The Netherlands and France, but also in Canada, Brazil, Venezuela, Indonesia, India and Russia. Hendrix provides the genetics for 80% of the global brown egg and 32% of white egg production. Hendrix entered pig genetics end of 2005 by acquiring PIGS-Online, the first operational internet application for pigs⁴. Recently the company has signed a Memorandum of Understanding with the animal food company Nutreco Holding N.V. regarding the sale of the animal breeding activities "Euribrid" of Nutreco, including its related Animal Breeding Research Centre, to Hendrix Genetics. Euribrid consists of three breeding companies; Hybro (Broilers), Hybrid (Turkeys) and Hypor (Pigs).

b) Broiler genetics

Aviagen International Group Inc. (US/UK) is the global market leader in poultry breeding. It develops pedigree lines for the production of broiler chickens and turkeys, and sells parent stock as well as broiler hatching eggs, through own operations across Europe and the USA, and joint ventures in Europe, Latin America, South Africa and Asia. Aviagen employs 1,500 people and has a distribution network serving 300 multipliers in 85 countries. Aviagen has three chicken breeding brands Arbor Acres, L.I.R., and Ross delivering day old grandparent and parent stock chicks worldwide for the production of broiler chicks, as well as CWT, a US based hatching egg supplier.

Aviagen in preceding years made three significant acquisitions with the purchases of Benelux based distributor Ross EPI, central European distributor Babolna Breeding Farms, and the US facilities and operations of turkey breeder BUTA. Performance has also been improved through the introduction of new products with a resulting significant increase in US market share. In the period from 2002 to 2004, Aviagen's turnover increased by 25%. Aviagen has been acquired by Erich Wesjohann GmbH & Co. KG, the market leader in white egg layer breeding.

The Grimaud Group is specialised in avian and rabbit breeding, and related gene technology for pharmaceutical and agro-industry. With the acquisition in 2005 of Hubbard Group, a major broiler breeder formerly with the pharmaceutical corporation Merial, the Grimaud Group doubled its turnover to reach 150 million € and became the second largest player in avian genetics and the leader in specialty segments (coloured chickens, ducklings, guinea fowls, rabbits, pigeons). Grimaud produces some 55 million day old ducklings, including some 1.5 million breeder day olds, 30 million chicken parent day olds (including over a million grandparents), 200,000 guinea fowl parent day olds and 30,000 breeding rabbits. In global multiplication, hatching and sales of commercial day-old ducklings, it holds a 40% market share. Hubbard held some 50% of each of the Russian and Syrian markets, 45% of the Egyptian and 70% of the Pakistani markets. Hubbard claim to be second in the European, Middle Eastern and African market with 25% of that area's parent stock market. When it comes to coloured bird production Hubbard's share is some two third's of the breeder market. Grimaud Group has 1350 employees in

⁴ PIGS-Online originates from the swine fever outbreak of 1997 when farmers wanted to stop the purchase of breeding gilts and produce their own. If a pure line of animals is distributed over a big number of farms it becomes more difficult to collect data and the quality of the data deteriorates. <http://www.pigs-online.com/> (accessed 9 November 2006)

operations located in the US, Europe (France, Italy, Poland, Netherlands) and Asia (China, Malaysia, Thailand). With the Hubbard Group, the Grimaud Group added major egg vaccine and avian gene technologies to its business. The group is a family business, 70% owned by Fred Grimaud and his family and the remaining 30% is owned by financial institutes⁵.

Cobb-Vantress is owned by Tyson Foods Inc., the world's largest processor and marketer of chicken and red meat. Tyson has 120,000 employees and a turnover of 26 billion USD. Tyson is the US market leader in poultry, and second in pork meat. Tyson „powers America by producing nearly one out of every four pounds of chicken, beef, and pork Americans eat. Tyson is the only company selling all three proteins through all major distribution channels. The company leads domestic chicken production and domestic beef production with a 26 percent share in each market. Tyson holds the number two position in pork production with an 18 percent market share“.⁶

Hybro ranks fourth in the market, with a market share of 8%. The broiler breeding company makes part of Euribrid, the breeding division of the international animal nutrition and fish feed company Nutreco, which also comprises Plumex, a supplier of day-old chicks and hatching eggs, Hybrid, the second largest turkey breeding company, and Hypor, the second global supplier of pig genetics. Nutreco's 50% interest in Hendrix Poultry Breeders, the breeding business for layers, in 2005 was sold at a book profit of 7.8 million €⁷.

c) Turkey genetics

Only two internationally operating turkey breeding companies share the market, and both are integrated in breeding companies that have large international market shares of other genetic products. A third large turkey breeder is focused on the US market.

Aviagen Turkeys was established in 2005 with the acquisition by Aviagen of British United Turkeys (B.U.T.) from the animal health company Merial. With Nicholas (US) and B.U.T., the European turkey genetics market leader, Aviagen has 350 employees and two turkey breeding brands, and delivers day old turkey poults around the world⁸.

Hybrid Turkeys, Canada, is part of Nutreco. Hybrid ranks number two in the turkey genetics market, with a market share of 34%⁹.

Willmar Poultry Company (WPC) covers almost one third of the US turkey breeding market, including integrated food marketing companies and independent turkey growers. Some notable names include: Sara Lee Foods, Cargill Turkey Production, Farbest Farms, and various contract growers¹⁰.

⁵http://www.hubbardbreeders.com/hip/Article_International%20Hatchery%20Practice_2005_vol%208_Hubbard%20perfect%20fit%20in%20Grimaud's%20Portfolio.pdf (accessed 8 November 2006)

⁶<http://www.tyson.com/Corporate/PressRoom/docs/SR2005.pdf> (accessed 8 November 2006)

⁷<http://www.hybrobreeders.com/> (accessed 8 November 2006)

⁸<http://www.aviagen.com/home.aspx?siteId=1> (accessed 8 November 2006)

⁹B.J. Wood, H. Wojcinski and N. Buddiger, Hybrid Turkeys (2006): Company Consolidation And The Responsibility Of The Primary Turkey Breeders, 8th World Congress on Genetics Applied to Livestock Production, August 13-18, 2006, Belo Horizonte, MG, Brasil

¹⁰<http://www.willmarpoultry.com/home.asp> (accessed 8 November 2006)

1.2. Pig genetics industry

Pig breeding is still done partly by associations or cooperative companies in which pig farmers are involved. But international breeding companies are fast increasing their market share. Vertical integration of product line from genetics to pork products is high in North America, and fast growing in many European countries.

In pigs, artificial insemination has been less successful. The yields from deep frozen pig semen are a ten percent lower farrowing rate and one farrow less per litter than from fresh semen.¹¹ Live boars are therefore more widely used, but this is changing rapidly, partly in order to reduce infection risk, partly under pressure of proprietary strategies such as “closed herds”. Concentration in pig genetics is highly dynamic. The most decisive current battlefields seem to be the access to Chinese and Latin American markets as well as, to the pig genome. Monsanto’s non-GMO patent applications are probably just a tip of an iceberg of proprietary strategies. It is not unlikely that Monsanto succeeds to get the pig farmers in the world pay royalties, similar to GMO soybean and cotton.

Pig Improvement Company (PIC) markets approximately 2 million breeding animals with a volume of sales approaching US \$400million a year. PIC has 30 to 40 % of the market in North America and 11 % of the market in Europe and is represented in around thirty countries with more than 1500 employees. 1,6 million breeding sows are sold each year, raised on some 40 farms. Gross margin is at 35%. PIC belonged to Sygen (turnover 129 million USD) until in 2005 the UK based Genus plc, owner of the world’s largest cattle breeding company, ABS, bought Sygen, a specialist in quantitative genetics of pig and shrimps, with its daughter, PIC, the world’s largest pig breeding company.

Hypor, the world’s second largest pig breeding company, still belongs to Nutreco, based in NL, which is Europe’s largest animal compound feed and fish feed producer. Its breeding division, Euribrid, also comprises the world’s the second largest turkey breeding company, Hybrid, and the fourth largest broiler breeder, Hybro. Total turnover of Hypor is approximately 35 million €. Hypor has around 250 employees and is represented in Canada, Spain and Belgium, with a market share between 20 and 24%. It also holds substantial market shares in the Netherlands, Italy, Germany, Poland, Japan, Mexico and the Philippines¹².

The Dutch cooperative **Topigs** is globally the third largest pig breeding organization, producing almost 850,000 gilts per year. Topigs is a subsidiary of the Pigure Group Pig Breeders Co-operative which is owned by 3,000 member pig farmers in the Netherlands. Pigure Group Pig Breeders Co-operative owns 77.5% of Topigs; 22.5% are owned by Europe’s largest fresh-meat processor Vion Food Group. Pigure Group has around 400 employees and a turnover of 103 million €. In the Netherlands, Topigs has a market share of over 80%, and with a line well suited for Parma ham, it leads the Italian market. In 2006 it opened nucleus farms in Russia and Croatia. Production and distribution of the breeding material is based on a franchise system. Topigs „highly values its independence and, therefore, makes its genetics freely available.“¹³ Topigs is the first European pig breeding organisation that has been certified for the Code of Good Practice for Farm Animal Breeding and Reproduction Organisations, Code-EFABAR (see chapter 3).

¹¹ www.topigs.com (accessed 8 Nov 2006)

¹² <http://www.meatnews.com/index.cfm?fuseaction=article&artNum=11098> (accessed 8 November 2006)

¹³ www.topigs.com/ (accessed 5 November 2006)

Monsanto's share in the US pig genetics market currently is about 10 %. In 1998, Monsanto acquired DeKalb with, among others, their pig breeding sector, and in 2001, Monsanto purchased the Canadian pig breeding enterprise Unipork. Monsanto also is the exclusive distributor of the "Genepacker" boar of JSR Genetics, UK. Monsanto has license contracts with Metamorphix, which in turn has near to exclusive access to the pig genome.

1.3. Cattle genetics industry

So far, cows for reproduction stayed with dairy farmers who bought high performance bulls semen from Artificial Insemination companies. "The world-wide market for dairy bull semen is increasingly controlled by fewer companies (...). Even when chance alone leads to a farmer bred and tested bull being of world class merit, the marketing of semen is usually through a major company."¹⁴

ABS Global, US, is the largest global bovine genetics company. Founded in 1941, ABS became part of **Genus plc** in 2005. Genus' turnover is 399.7 million €, and ABS contributes to 49% of it¹⁵. The ABS Global sales volume is around 10 million doses of semen, marketed in more than 70 countries. In comparison, all members of the US National Association of Animal Breeders sell some 31 million doses of semen annually, to 92 countries, at a value of US \$48,871,000. The US industry tests some 1,000 Holstein bulls, while ABS tests around 450 Holstein bulls annually¹⁶. The market power pays off with an increase average prices of semen in 2005/2006 by 12% in the beef sector and by 10% in dairy.

The predicted farm concentration process in Europe is an important target for ABS. The Chinese market, where public awareness programs trigger an increasing dairy consumption, is probably the fastest growing cattle semen market. Since 2006, ABS Global has an exclusive representative in China, Alta Exports International.

Alta Genetics Inc., Canada, operates in over 60 countries, with breeding programs in the US, Europe and Canada. In 2000, Alta Genetics was incorporated into the **Koepon Holding** in The Netherlands. Koepon owns five farms with nucleus herds, a real estate division (as many Dutch dairy farmers are leaving the country) and a company offering breeding services in the Netherlands¹⁷. With the merger, a nucleus herd approach („Altagen“) was added to the traditional selection approach. About 80 young bulls are tested, often purchased in the embryo stage. For fear of epidemics, they are kept in five countries in Europe and North America, in areas with low cattle density. Alta works in dairy (Holstein, Jersey and Brown Swiss breeds), as well as beef genetics. A mating program has been designed to prevent negative effects of inbreeding, like mastitis.

Semex Alliance, Canada, sells over 6 million doses annually, and tests 350 bulls per year. It has subsidiaries in Hungary, USA, South Africa, Argentina and Brazil. Its predecessor, Semex Canada was formed in 1973 as international marketing arm for Canadian artificial insemination .

DANSIRE International A/S, owned by the Danish Artificial Insemination Centre, supplies semen and embryos to more than 50 countries and tests 450 bulls of several dairy and beef breeds every year. It covers over 70 per cent of Danish dairy cattle.¹⁸

¹⁴ M. P. Coffey, E. Wall, R. Mrode, S. Brotherstone: Breeding For Novel Traits In Dairy Cattle 8th World Congress on Genetics Applied to Livestock Production, August 13-18, 2006, Belo Horizonte, MG, Brasil

¹⁵ Genus Annual Report 2005

¹⁶ Major Advances in Globalization and Consolidation of the Artificial Insemination. Funk J. Dairy Sci..2006; 89: 1362-1368 (accessed 13 January 2007)

¹⁷ <http://www.koepon.nl/holding/index.htm> (accessed 5 November 2006)

¹⁸ DANISH CATTLE FEDERATION (2004). http://www.lr.dk/kvaeg/diverse/UK-rap04_web.pdf (accessed 5 November

2. Proprietary strategies of the livestock genetics industry

2.1 Integration: From genetics to factory farm to fork

Companies involved in livestock genetics or production seem to follow textbooks on business strategies, by vertically integrating all important elements in the food chain, in order to not only dominate the livestock genetics markets, but to control entire production lines.

Joining genetic expertise across several species is a more recent business approach. A new livestock gene giant was created when in 2005, the UK based **Genus plc**, owner of the world's largest cattle breeding company, ABS, bought Sygen, a specialist in quantitative genetics of pig and shrimps, with its daughter, PIC, the world's largest pig breeding company. Genus plc, now composed by ABS, PIC and SyAqua, brings together the largest cattle, pig and aquaculture gene businesses.¹⁹ Genus plc filed for wide reaching patents, from genes to whole animals and even meat products.

The US food giant **Smithfield** produces 25% of US pork products as well as pigs. In addition to the pig production chain, Smithfield has integrated other meat products. By the end of 2006, it bought a share of APMC, a fast growing UK based pig breeder.

A similar strategy with integrating production lines is followed by **Tyson Foods Inc.**, the world's largest meat processing company, which owns Cobb Vantress, one of the global four broiler genetics companies.

Nutreco, NL, is Europe's largest animal compound feed and fish feed producer. Its breeding division, Euribrid, contributes 7 out of 115 million € turnover. A restructuring was achieved, when Nutreco in 2005 sold its 50% share of layer hen breeder Hendrix and in 2006 acquired the remaining 50 % of the shares of swine genetics company Hypor from Canadian joint-venture partner Investment Saskatchewan. The rationale for the deal was that Nutreco "prefers to have full management control in order to develop its international swine genetics business."²⁰ Euribrid now comprises the world's second largest pig breeding company Hypor, the second largest turkey breeding company, Hybrid, and the fourth largest broiler breeder, Hybro. Recently it was announced that Euribrid is to be sold to Hendrix Genetics in mid 2007.

The US company **Monsanto**, net sales 7 billion USD, is better known for its leadership in genetically modified seed than in livestock genes. But with Monsanto's acquisition, cooperation and patent policy regarding cattle and pig, it in a few years may well dominate gene markets not only with regard to plants but also to livestock. In 2004 it entered a strategic and exclusive collaboration with the genetic research company MetaMorphix, giving Monsanto access to the completest available swine genome data available.

In consequence, Monsanto filed a series of applications to patent the pig.²¹ "The patents

2006)

¹⁹ <http://www.thepigsite.com/swinenews/10041/sygen-international-announces-preliminary-results-for-200405> (accessed 8 Nov 2006)

²⁰ <http://www.meatnews.com/index.cfm?fuseaction=article&artNum=11098> (accessed 8 November 2006)

²¹ GREENPEACE, (2005). Monsanto's pig monopoly; US corporation applies for patents on most breeds of pig, <http://www.greenpeace.org/raw/content/sweden/rapporter-och-dokument/monsanto-uppfann-inte-grisen.pdf>

are based on simple procedures, but are incredibly broad in their claims. In application WO 2005/015989, Monsanto is describing very general methods of crossbreeding and selection, using artificial insemination and other breeding methods which are already in use".²² In another case, the application 2005/017204 (EP 1651777) a method for gene-diagnosis (marker assisted breeding) was filed, covering even the whole pigs. According to Greenpeace research, "the findings of the laboratory analysis of 30 animals of nine different breeds were that almost all the breeds are affected by the patent claims. They possess a genetic combination which according to the patent specification is regarded as Monsanto's invention."²³ The profit expectations of these non-GMO patent applications are huge. Globally, more pork is consumed than any other meat, with increasing consumption levels especially in Asia and Latin America²⁴.

In 2007, Monsanto will market a cattle semen sorting technology that increases the proportion of calves of desired gender from 50 to 85%. Monsanto collaborates with Alta Genetics to market Decisive™ cattle semen in combination with Advantage™ a program in which „170 large, progressive dairies across the US test the genetic merit of sires by evaluating their daughters' performance under intensely managed conditions. The level of partnership with these dairies creates an unmatched source of accurate sire proof."²⁵ Sorted (also called sexed) semen is expected to significantly raise productivity in dairy and beef cattle farming as well as accelerate breeding. Monsanto may be expected to drive this acceleration and become the major all-in-control life science company.

2.2 Technology based strategies

Hybridization and "biological locks"

Hybrid chicken were first developed in the 1940s by Henry A. Wallace, who was the 33rd Vice President of the United States (1941–45). Henry Wallace applied the same breeding methods to poultry that he had used to develop Pioneer Hi-bred corn. When two different lines are crossbred, productivity of the offspring increases considerably. However, this effect gets lost in the next generation, so that farmers in industrial production will buy breeding material for each generation. Within 10 years, all commercial poultry breeders bred poultry hybrids. Since then, hybridization has become common in pig and in aquaculture, and is currently being developed in cattle.

Hybridization is not proprietary in itself, but commercial arrangements are made to achieve the effect. The Genetics company ("primary breeder") breeds the greatgrandparent generation of the terminal animals (laying hens, broilers, turkeys, slaughter pigs). They develop pure lines carrying the traits in demand, e.g. high number of eggs per year, high feed conversion, fast growth, high percentage of lean meat). Some of the traits are linked to either male or female animals, so that "male lines" and "female lines" have been developed. Multipliers receive and grow the offspring and sell the next generation to hatcheries (broilers and turkey), "commercial farmers", or "packers" (pig). In case of poultry, a biological lock is arranged by refusing access to male animals of one of the pure lines (usually the "female line") and to female animals of the other pure line (usually the "male line"). Exclusive contracts with multipliers are made in case of pig boars and gilts.

²² GREENPEACE, (2005). Monsanto files patent for new invention: the pig; Greenpeace researcher uncovers chilling patent plans, <http://www.greenpeace.org/international/news/monsanto-pig-patent-111>

²³ id.

²⁴ Pig Industry, Swine production: a global perspective, http://www.engormix.com/swine_production_a_global_e_articles_124_POR.htm (accessed 11 November 2006)

²⁵ <http://www.monsanto.com/monsanto/layout/investor/news&events/default.asp?level1=InvestorInformation&level2=NewsReleases> (accessed 11 November 2006)

In aquaculture, hybrid salmon and striped bass are established businesses. A two line approach similar to hybridization is recommended as biological mechanism for property protection of shrimp breeding stock. "Pirated" shrimps will have a very low reproduction rate or even die if grown under less favorable conditions.²⁶ Genetic sterilization of breeding stock is another biological control strategy in discussion.

Genetic engineering and cloning

Genetic engineering has been feasible in poultry since the 1980s, and production of transgenic birds is common in laboratory chicken, and those used for pharmaceutical production in eggs. The pharmaceutical poultry companies openly offer their technology to poultry breeding for food production. However, PHW, including its subsidiary Aviagen, clearly reject GMO poultry, while Hendrix Genetics and the Grimaud Group have kept quiet on the subject.

Origen Therapeutics has developed the isolation and culture of avian embryonic cells and has plans to develop "novel and proprietary poultry production methods based on the use of avian embryonic cells, which are in principle scaleable to the needs of the world poultry industry... Origen believes its proprietary technology will enable the company to 'virtually clone' commercially valuable avian strains in large quantity."²⁷

Avigenics Inc. also propagates GMO poultry: "DNA sequences can be engineered and introduced into the poultry genome to indelibly mark valuable transgenic and breeder lines, effectively acting as genetic encryption devices. AviGenics is developing this technology to mark its proprietary lines, for instance in FibrGro™ Advantage broiler lines. This technology may also be made available to poultry breeders." ... "In this way "AviGenics and its partners can control the proliferation of the proprietary genetics."²⁸

Carl Marhaver of Avigenics said: "Avigenics Inc. can make all the genetically altered omelettes they can eat as per their patent award in Europe covering transgenic poultry. The company has been producing genetically altered chickens for the last four years, using a process called Windowing Technology, which introduces genetic material into eggs through a hole or 'window' in their shells. ... The Windowing Technology enables the rapid and efficient production of transgenic chickens." The company had received a \$ 2 million grant from the United States Department of Commerce for the development of the world's first cloned bird.²⁹

But not just birds are increasingly being genetically modified at commercial scale: A transgenic salmon halving the time it takes for salmon to grow to market size is expected to be launched in the US in 2009.³⁰ With high growth opportunities, especially in the North -where the meat, dairy and egg markets are saturated-, a concentration process is expected in aquaculture. The number of aquaculture species that can be farmed is rapidly increasing. Salmon, trout, seabass, seabream, and turbot, as well as other aquatic species such as shrimp and oysters are being adapted to industrial production with conventional breeding by selection as well as biotechnology.

²⁶ Roger W. Doyle, Dustin R. Moss, Shawn M. Moss (April/May 2006): Shrimp Copyright: Inbreeding Strategies Effective Against Illegal Copying of Genetically Improved Shrimp <http://pdf.gaalliance.org/pdf/gaa-doyle-apr06.pdf> (accessed 29 Dec 2006)

²⁷ <http://www.origentherapeutics.com/food-programs.php> (accessed 12.11.2006)

²⁸ <http://www.avigenics.com/agrotrait.html>, October 25, 2000 (accessed 12.11.2006)

²⁹ http://www.biotech-info.net/transoceanic_chics.html "Patent awarded for transgenic chickens", Tim Adams, Biotechnology Newswatch, December 18, 2000 (accessed 12.11.2006)

³⁰ <http://www.hemscott.com/news/latest-news/item.do?newsId=37754910322460> (accessed 2.02.2007)

Cloning is possible in sheep (1997), cattle (1998), pig (2000) and the horse (2006). Its efficiency is still low, and cloned animals may be born with, often fatal, disorders.³¹ However, cloning is expected to accelerate and intensify the activities of the animal genetics industry, especially with regards to delivering semen of top bulls and boars. In pigs, where artificial insemination does not, like in cattle, enable up to a million offspring, but only around 2000 offspring, cloning might be economically more promising.³²

The biotechnology industry oversimplifies a clone to be a mere genetic twin, separated in time³³: Any technical and ethical concerns this technology may entail, are brushed aside. To the proponents, cloning technology will help to spread their genetic products, accelerate breeding and control markets by patented technologies. The composition of the products is not distinguishable from non-cloned foods. Their uniformity makes cloned food products attractive for the meat processing industry.

Clone food is on it's way to the consumer: In January 2007, the US Food and Drug Administration approved food products from cloned animals. The main reason for the approval was cloned foods not being distinguishable from non-cloned foods. Similarly, the European Commission's Novel Foods Working Group decided on 17 January 2007 that in Europe cloned animals should be considered in the same way as any other novel food.³⁴

Cloning will exacerbate most problems associated to the livestock industry, like loss of biological diversity, and exacerbate animal welfare problems.³⁵

Policy advisors, like members of the US-EC Task Force on Biotechnology Research consider the consumers attitude towards risk and benefit as key to acceptability of genetically modified or cloned animals.³⁶ Low public acceptability so far is the main reason why major poultry and pig genetics companies claim not to produce GMO animals.

Genome sequencing and marker assisted breeding

By December 2004 the chicken genome was sequenced; the cattle genome followed in 2004/5. A map of the rainbow trout genome is being prepared at a US public research center. Sequencing the pig genome is also the main objective of a EU funded research program, "Sustainable Animal Breeding", that started in April 2006. It is expected to be completely sequenced by 2007.³⁷ Shortly before, the US Department of Agriculture had approved 10 million USD for the same purpose.³⁸ A Chinese-Danish group is also working on the issue.³⁹

³¹ J Suk et al (2007) Dolly for dinner? Assessing commercial and regulatory trends in cloned livestock. In: Nature Biotechnology 25/1

³² Jan Merks: The European Perspective for Livestock Cloning, presented at BIO2006, Chicago, 11 April 2006 (accessed 8 Nov 2006)

³³ Barb Glenn, Technologies, Applications and Products of Animal Biotechnologies, 18 October 2006 <http://pewagbiotech.org/events/1018/speakers/glenn.php> (accessed 12 January 2007)

³⁴ <http://www.nutraingredients.com/news/ng.asp?n=73418-cloned-animals-eu-novel-food> (accessed 18 Jan 2007)

³⁵ Michael Appleby, World Society for the Protection of Animals 18 October 2006 (accessed 8 Nov 2006) (accessed 12 January 2007)

³⁶ Chris Warkup (Genesis Faraday), John Claxton (EC) and Ronnie Green (USDA), 2006: Report of a Workshop on the Future of Livestock Genomics, 17-18 July 2006, 16th Meeting of the US-EC Task Force on Biotechnology Research (accessed 8 Nov 2006)

³⁷ Chris Warkup (Genesis Faraday), John Claxton (EC) and Ronnie Green (USDA), 2006: Report of a Workshop on the Future of Livestock Genomics, 17-18 July 2006, 16th Meeting of the US-EC Task Force on Biotechnology Research, Modified from van der Steen, Prall and Plastow 2005 J Anim Sc 83: E1-E8 (accessed 8 Nov 2006). Chris Warkup is a main author of the FABRETP Vision 2025. His consulting firm, Genesis Faraday, partly belongs to PIC.

³⁸ <http://www.csrees.usda.gov/> (accessed 10 Nov 06)

³⁹ <http://www.piggenome.dk/> (accessed 6 January 2007)

After the chicken genome was sequenced, Aviagen started identifying genetic markers for naturally occurring traits. By screening pedigree lines, single base differences (or single nucleotide polymorphisms, SNPs), can be identified which will provide “an insight into what makes one chicken different from another”. The leading technology provider in human genomics will provide genotyping using a specially designed panel of over 6,000 SNPs for a large number of chicken DNA samples. The company is expecting “to build on the new breakthroughs in genomics research as it already has in place many of the foundation resources required, such as a good pedigree population structure, high quality performance data, a DNA bank of pedigree bird samples, and an excellent team of R&D specialists in molecular and quantitative genetics”.⁴⁰

The Grimaud Group’s subsidiary Hubbard agreed with MetaMorphix to jointly develop genetic markers to predict desired broiler performance traits. Under the agreement, MetaMorphix will be entitled to receive a royalty on revenues generated from the new breeds. “The use of GENIUS - Whole Genome System™ will allow Hubbard to ...identify associations of predictive genetic markers with economically important traits, including health, welfare, meat quality, breeder and broiler traits”.⁴¹

The use of genetic markers in on-farm progeny testing schemes as in cattle is likely to be led by breeding companies. “Marker data is likely to be proprietary and confidential...Such data may well be made available under strict confidentiality arrangements and might not be published. Only the owners of the data will know which animals have been genotyped and what the individual animals’ genotypes are. Therefore, the published breeding values might be calculated using marker data but only data owners will be able to make best use of the information. “The use of markers by dairy farmers is unlikely to be widespread until easy to use tools become more freely available and farmers more disposed to using them since the use of marker data at farm level is extremely complex“.⁴²

⁴⁰ <http://www.aviagen.com/output.aspx?sec=338&con=3264> (accessed 11 November 2006). In 2003, Aviagen published the following statement: “In the area of poultry biotechnology transgenesis and cloning have been slower to develop and currently, the benefits remain less clear. Unlike the application of genomics through MAS, these techniques require invasive measures. Access to single celled embryos is only possible through surgery and the male and female pronuclei are not easily visible or accessible. This makes genetic manipulation and cloning in poultry more technically challenging than in farm mammals. Recent progress in establishing embryonic stem cells in poultry will make both technologies more practical. Whilst Aviagen monitors the development of transgenic and cloning technologies, the company believes that real benefits for commercial broiler growers remains some way off. Currently, cloning is only possible on a small-scale experimental basis. At Aviagen, biotechnology research does not use transgenesis for a number of reasons. Ethical issues surrounding the technique remain unresolved and, to date, the company believes that the technology is limited with no genes of desired effect being available. Most importantly our customers are not convinced that transgenic or cloning will deliver real benefits.”

⁴¹ January 26, 2007: Hubbard and Metamorphix Announce Alliance To Produce Predictive Markers For Broiler Breeding <http://www.thepoultrysite.com/poultrynews/10884/hubbard-and-metamorphix-announce-alliance-to-produce-predictive-markers-for-broiler-breeding> (accessed 1 February 2007)

⁴² [M. P. Coffey, E. Wall, R. Mrode, S. Brotherstone](#): Breeding For Novel Traits In Dairy Cattle 8th World Congress on Genetics Applied to Livestock Production, August 13-18, 2006, Belo Horizonte, MG, Brasil

3. Environmental, economic and social impacts

3.1 The loss of biological diversity

50 % of the global production of eggs and 67 % of chicken meat is industrialised. With only two companies providing layer hen genetics and four providing those for broilers, substantial shares of the world's egg and broiler production depend on a small number of breeding lines which are designed to meet the needs of the industrial production. Organic chicken producers have to resort to the same hybrid chicken - even though these meet neither the philosophy nor the needs of organic production. Due to trade secret law, which does not exempt genetic resources, the actual diversity is unknown. FAO assumes that most commercial strains are based on four breeds.⁴³

About 42% of global pig production is industrial, with five dominating breeds (Large White, Duroc, Landrace, Hampshire, Pietrain). According to FAO, 66% of the mothers of European fattening pigs are hybrid crosses of the 'Large White' and 'Landrace' breeds. Effective population size, a parameter used in breed conservation to calculate genetic diversity, in pigs were found to be 71, 74, and 61 animals for the Yorkshire, Hampshire, and Duroc, respectively. While these effective population sizes are somewhat larger than those reported for Holstein, Brown Swiss and Jersey cattle, they are still under the 100 head which is considered as critical level for maintaining genetic diversity.⁴⁴

Globally, 2/3 of milk is produced by high-output breeds. Dairy cattle breeding is focused on very clear but very few objectives: Milk amount and fat content, weight gain, feed efficiency, all under optimum production conditions. "Consistent selection for these traits has led to a genetic narrowing to an extent that, despite the fact there are more than 3.7 million Holstein cows enrolled in milk recording in the USA, the effective population size of the Holstein breed in the USA for 2004 was only 60 animals. Jerseys and Brown Swiss in the USA have 2004 estimates of effective population size of 31 and 32 animals, respectively."⁴⁵ Worldwide only a few thousand bulls are annually tested, and far less included in the reproduction of the millions of heads of industrial dairy and meat cattle. Increasingly, selected mothers of bulls are kept in the companies' nucleus herds, thereby further reducing diversity. Embryo transfer and cloning technologies are expected to exacerbate the genetic monoculture.

While industrial production with the same few breeds is spreading all over the world, local breeds are becoming extinct. Some 8000 breeds have been reported to the United Nations Food and Agriculture Organisation (FAO), by most of its 190 member governments. More than 100 breeds were reported extinct during the past century. The loss is fast accelerating: 60 breeds were reported extinct during the past five years – a rate of one per month. FAO considers the spread of industrial production (from North to South) as one of the main reasons for the worldwide loss of breeds⁴⁶.

In the past fifty years breed development of Southern breeds has largely been neglected because it is considered virtually impossible to catch up: It may take two decades in cattle and 5 to 10 years in chicken to achieve substantial progress. Instead, breeding lines were

⁴³ FAO (2006): Draft Report State of the World's Animal Genetic Resources for Food and Agriculture, Rome p 71 and 145

⁴⁴ H. Blackburn, C. Welsh and T. Stewart (2005) U. S. Swine Genetic Resources and the National Animal Germplasm Program

⁴⁵ L. B. Hansen (2006): Monitoring The Worldwide Genetic Supply For Dairy Cattle With Emphasis On Managing Crossbreeding And Inbreeding, The World Congress on Genetics Applied to Livestock Production (accessed 11 Nov 2006)

⁴⁶ FAO (2006): Draft Report State of the World's Animal Genetic Resources for Food and Agriculture, Rome

imported from the North. The cost to maintain optimum production conditions to keep these animals productive is very high – they would mostly not survive the climate, disease pressure and feed quality the local breeds are used to.

Not having developed the existing breeds and production systems is a lost opportunity to reduce poverty, as about 70% of the world's poor keep livestock. Industrial systems are growing six times as fast as local systems, according to FAO. In general, there are supporting schemes in developing countries for industrial systems and breeds, like subsidies, credits, artificial insemination and veterinary services, but rarely for local breeds.

3.2 Productivity and genetic risks

Since the 1960ies, livestock breeding has led to substantial increases in output of livestock products, ranging between 30 and 100% (Table). The price equivalent of a chicken in Germany, for example, has dropped from a workday to a work hour, and has made more livestock products accessible to more people on the one hand. On the other hand, the high public cost of research (see below), disease control, and environmental damage are not factored into the calculations.

Table: Performance gains of livestock breeding in the USA 1960s to present

Species	Trait	Indicative Performance		
		1960s	Present	% Change
Pig	Pigs weaned/sow/year	14	21	50
	Lean meat %	40	55	37
	Kg lean meat/ton feed	85	170	100
Broiler chicken	Days until 2 kg are reached	100	40	60
	Feed conversion ratio	3,0	1,7	43
Layer hen	Eggs per year	230	300	30
	Eggs/ton feed	5000	9000	80
Dairy cow	Kg milk/cow/lactation	6000	10000	67

Source: Chris Warkup (Genesis Faraday), John Claxton (EC) and Ronnie Green (USDA), 2006: Report of a Workshop on the Future of Livestock Genomics, 17-18 July 2006, 16th Meeting of the US-EC Task Force on Biotechnology Research, Modified from van der Steen, Prall and Plastow 2005 J Anim Sc 83: E1-E8

The selection for high productivity under optimum production conditions has led to problems, for example:

- Turkeys with their large breast muscles cannot mate naturally but depend on artificial insemination. Primary breeders have increased the selection emphasis on walking and leg strength due to skeletal problems that have resulted from gains in body weight. However, they have not placed emphasis on the reaction of the turkey to the

environment, according to industry leaders⁴⁷. A concern is the increase in competitive behaviour that has resulted from a correlated response to selection for body weight and growth.

- A well known example among pigs is the high incidence of the MHS gene in Pietrain breeding, which together with excessive muscle size, is responsible for neck muscle necrosis and decreased meat quality.
- In dairy cows, e.g. Holsteins, the functional traits like female fertility, calving ease, calf mortality, health, and survival have declined since they were ignored until very recently.⁴⁸ ABS Global, now aims to „identify bulls that favorably bend normal genetic antagonisms: Calving Ease vs. Growth; Growth vs. Mature Size; Marbling vs. Yield“.⁴⁹

Disease resistance has become a major problem in situations where resistance was neglected as breeding objective and where genetically very similar animals are raised all over the world, like in layer hens and broilers, pigs and cattle, and aquaculture species. Ten to fifteen percent of the potential profit in poultry production is estimated to be lost because of disease.

3.3 Breeding for sustainable agriculture?

With increasing concentration, control and uniformity of animal production, negative environmental impacts may increase as well. Environmental problems associated with industrial production are manifold and include water and soil contamination, and a large need for animal feed, that is produced and transported at high environmental cost. Animal welfare and especially consumer health are increasingly raising public concern and are turning into political issues. In the debate on livestock genetic resources it is argued that industrial animals with their high feed conversion rate are saving the rainforests by using less feed per unit of product. While there is little data available that actually compare production systems, taking into account all environmental costs, it is now well established that local breeds have multiple uses, possess the capability to adapt to their environments and even contribute to environmental sustainability – much different to what was the mainstream thinking of one or two decades ago. All over the world there are signs that changes – at least first steps - are being made.

Norway and Sweden for example have embraced selection indexes that have included the lowly heritable traits related to fertility and health for many years. Geneticists with the breeding organizations in Scandinavia have been permitted to monitor pedigree diversity systematically because of less competitive pressure. The Scandinavian countries have red dairy cattle with slightly less genetic gain for production compared to the global Holstein breed, but less accumulation of genetic relationships.⁵⁰

The Code-EFABAR was set up by the European Forum for Farm Animal Breeders (EFFAB). It covers standards in the areas of animal health and welfare, product quality, biodiversity and economic sustainability. It was developed with the support of the European Union and applies to pig, poultry, cattle and aquaculture. Various interest groups

⁴⁷ B.J. Wood, H. Wojcinski and N. Buddiger, Hybrid Turkeys (2006): Company Consolidation And The Responsibility Of The Primary Turkey Breeders, 8th World Congress on Genetics Applied to Livestock Production, August 13-18, 2006, Belo Horizonte, MG, Brasil

⁴⁸ M. P. Coffey, E. Wall, R. Mrode, S. Brotherstone: Breeding For Novel Traits In Dairy Cattle. 8th World Congress on Genetics Applied to Livestock Production, August 13-18, 2006, Belo Horizonte, MG, Brasil

⁴⁹ <http://www.absglobal.com/beef/programs/ptp.phtml> (accessed 8 November 2006)

⁵⁰ L.B. Hansen. Monitoring The Worldwide Genetic Supply For Dairy Cattle With Emphasis On Managing Crossbreeding And Inbreeding. 8th World Congress on Genetics Applied to Livestock Production, August 13-18, 2006, Belo Horizonte, MG, Brasil

were involved in the development of the voluntary code. So far, only four companies have joined (Topigs and the Spanish pig breeder Batalle; Cobb Vantress Europe and the UK duck breeder CherryValley.)⁵¹

The highly concentrated poultry breeding sector is not in the position to adjust to new requirements. The ban on battery cages for layer hens planned by the EU from 2012 did not influence the breeding strategies. The only reaction so far is to provide adapted poultry lines, e.g. by evaluating groups, not individual animals.

No specific breeding lines are available for organic and other low input production. Organic poultry keepers use the hybrid lines offered for battery production systems. For broilers, there is a hybrid line available that suits organic production, but not for layer hens. Furthermore, independent breeding efforts are made almost impossible because of the proprietary strategies. The only way forward for the organic and other sustainable production systems to become independent seems to establish a complete research and breeding initiative.⁵²

Some of its goals could be:

- two purpose chicken breeds, which would also end the killing of one-day-old chicks with the “wrong” sex.
- to use more vital and disease resistant animals with the capability to adapt to different outdoor conditions.

Similar criteria are necessary for pigs and cattle as well, for example yield achieved during lifetime. It does not make global economic and environmental sense to breed cattle that delivers 10.000 litres of milk per year for just two or three years, with the help of extremely high concentrate feed supplies, for which valuable landscapes like Amazonian rainforests, are sacrificed, while at the same time, local landscapes that offer feed, are abandoned.⁵³

3.4 Public funding of livestock biotechnology

While there is a rationale for public-funded research, it should be ensured that the objectives meet the needs of society at large, instead of reflecting the priorities of industry and scientists. This is clearly not the case with respect to the relevant parts of the European Union’s new Research Framework Programme.

The European Parliament in December 2006 approved the largest ever European research programme, the Seventh Research Framework (2007-2013). Investing 55 billion € over seven years, it puts a main emphasis on biotechnology. The European Commission has created seven industry-led strategic stakeholder groups (Technology Platforms, TP), one of them in livestock genetics, to prepare and implement strategic activities. In the case of the “Sustainable Farm Animal Breeding and Reproduction- A Vision for 2025”⁵⁴, six dozens of stakeholders participated. The responsible Director of Biotechnology, Agriculture and Food Research at the European Commission, Christian Paterson, considers a breakthrough that industry who is a large beneficiary of the Research Framework, could be convinced to formulate the funding strategy!

⁵¹ www.code-EFABAR.org (accessed 15 November 2006)

⁵² Project reports poultry breeding of Zukunftsstiftung Landwirtschaft <http://www.zs-l.de/projekte/netzwerk-tierzucht/geflgelzucht/geflgelzucht-projekt.html> (accessed 15 November 2006)

⁵³ http://www.greenpeace.de/fileadmin/gpd/user_upload/themen/landwirtschaft/greenpeace_hintergrund_milch.pdf

⁵⁴ Working Group FABRE Technology Platform, February 2006: Sustainable Farm Animal Breeding and Reproduction- A Vision for 2025”(FABRE-TP Vision) <http://www.fabretp.org> (accessed 15 November 2006)

Research success is measured by economic gain. "A conservative estimate of the gain from animal breeding to the animal agricultural sector in Europe is almost € 2 billion each year."⁵⁵ This means that the new programme will invest almost as much every year into breeding as the livestock industry gains every year from breeding, a very generous public support to private industry.

To this public expenditure through the new research programme, the cost arising to society with regard to environmental pollution, animal disease and human disease caused by overnutrition should be added.

Also in 2006, a four year programme on genomics for Sustainable Animal Breeding (SABRE) was started. A sum of 23 million € has been allotted to almost 200 scientists to complete the sequencing of the pig genome, among other tasks that are meant to develop sustainable systems for animal husbandry. A European Master of Science course in Animal Breeding and Genetics is also part of the package, training most of the hundreds of new scientists needed to implement the FABRE TP Vision for 2025.

One of the reasons for such massive public funding is that the USA invests three times the amount of the EU; and a few billion € are invested by the governments of China, India, Argentina and Japan.⁵⁶ European livestock genetics companies have managed to convince the EU administration that there is too much competition from the USA. So far, European companies are dominating the poultry, pig, and cattle genetics industries. They see a "very close concordance between the USDA Animal Genomics Strategic Plan and EU Scientists' views of priorities", one of them being "genome enabled animal improvement."⁵⁷

Regulations in the EU with regard to gene technology have been stricter than in some other places, especially the US. The EU Commission is under massive industrial pressure to create a level playing field.

Consumer and Animal Welfare organizations as well as an organic agriculture research organization have been consulted in the FABRETP Vision process. European citizens' opinions will be carefully managed during the implementation of the 7th Research Framework Programme: "High standards for governance i.e. attention the way public authorities prepare, decide and explain policies and actions - is therefore needed."⁵⁸ However, one might question whether putting the biotechnology industry in charge of drafting the public research strategy, corresponds to "good governance".

⁵⁵ id.

⁵⁶ Ch. Paternmann, Paris, 2 March 2006, http://www.fabretp.org/images/fabre_launch_paternmann.pdf (accessed 8 Nov 2006)

⁵⁷ Chris Warkup (Genesis Faraday), John Claxton (EC) and Ronnie Green (USDA), 2006: Report of a Workshop on the Future of Livestock Genomics, 17-18 July 2006, 16th Meeting of the US-EC Task Force on Biotechnology Research, Modified from van der Steen, Prall and Plastow 2005 J Anim Sc 83: E1-E8 (accessed 8 Nov 2006)

⁵⁸ Ch. Paternmann, Paris, 2 March 2006, http://www.fabretp.org/images/fabre_launch_paternmann.pdf (accessed 8 Nov 2006)

Conclusions

The livestock breeding industry has experienced an enormous degree of concentration in recent years, and cloning and gene transfer as well as other emerging technologies including proprietary arrangements can be expected to further speed up concentration. These developments are not in the interest of the general public and will exacerbate prevailing problems associated with high performance breeds and industrial production: large public expenditure caused by animal diseases, environmental pollution, and human diet-related diseases, as well as animal welfare problems.

What is needed:

More public awareness: The increasingly narrow genetic base of the small number of industrial breeds, is a danger that has been known for many years, but only now starts to be addressed. Instead of paying lip service to sustainability in public statements, countries and companies need to fundamentally revise their approach to breeding. The experiences of Scandinavia show that different methods are possible: Scandinavian farmers have long selected their cattle, not only for performance, but also for vitality traits. Aware of the problems associated with too narrow breeding objectives, they have accepted somewhat lower milk and meat yields in return for long-term sustainability.

Internalise the hidden costs of industrial livestock production

Industrial livestock impresses with its high yields and enormously improved feed conversion rates. However, the economic efficiency of industrial livestock production looks very different if public costs are factored into the equation. Although meat, eggs and dairy products are cheap to purchase, society must also consider the following hidden costs:

- Costs for cleaning up the environment (water, soil, and air) from livestock production effluents.
- Costs for treating human diseases caused by overconsumption of livestock products
- Costs for containing the spread of zoonotic diseases that increase in virulence when passing through dense, genetically similar livestock holdings.
- Costs for ex-situ and in-situ conservation programmes necessary to maintain genetic diversity.

Redirect research funds from industrial production to support for sustainable breeding: Support for conventional breeding has almost vanished and almost all research funds are now directed towards the “Life Sciences”, i.e. bio- and gene-technology. The very industry that benefits from the biotechnology research programmes, carries out much of this research. To top it all, the livestock genetics industry prepares the research grant cornerstones – the programmes along which research projects will be selected for funding.

No patents on animals or on genes: Historically, animal breeders have benefited from trade and the exchange of genetic material. Patenting of genes and traits as is envisioned by biotechnology companies will disrupt this exchange and be detrimental to small-scale livestock keepers. At the very least, it must be ensured that patents on genes do not interfere with the use and breeding of animals by the people that developed the breeds in the first place.

Abolish subsidies to industrial livestock production: For the past fifty years or so, national subsidies, development projects and other support measures have been used to establish industrial breeds all over the world. In environments similar to the North, they contributed strongly to the decrease of local breeds. In more difficult environments, the local breeds survived.

Start investing in local breeding now: In the South, very little has been done to develop breeds, since faster results were expected from imported breeds. In chicken, much can be achieved in less than ten years; while cattle breeding needs closer to two decades. Why waste another fifty years?

Address trade liberalisation and industry concentration as main reasons for the breed loss:

Imports of cheap – usually subsidized - livestock products to a developing country following a free trade agreement can outcompete local products and thus wipe out local breeds within very few years. This is probably a major reason for loss of breeds and needs to be urgently addressed.

Use the occasion offered by the United Nations: Local livestock breeds are considered a vast potential resource by the United Nations that must be protected for the future. At a meeting to be held in Interlaken, Switzerland, in September 2007, the 190 member governments of the Food and Agriculture Organisation of the United Nations (FAO) will decide on a common strategy for managing the world's animal genetic resources. Although industrial livestock production is expected to be addressed in some rather general way, the focus of concrete actions proposed so far is on livestock genetic resources conservation, frozen in gene banks, and alive in conservation projects. Efforts must also be made to limit the increasing power of the livestock genetics industry.

Patents on farm animals

A research by Christoph Then, patent expert, Greenpeace Germany, February 2007

Multinational corporations acquiring swine and cattle

Corporations want to safeguard claims to entire animal herds with patents. The seed sector has for years faced pressure from international corporations in a process of amalgamation. Now there are increasingly signs of a parallel development in animal breeding, as can be seen in the steady growth in company takeovers and cooperation agreements and the increasing number of applications for patents. Breeders and farmers are getting caught in a hitherto undreamt-of dependency on patent owners and licence fees. In the seed sector this has already led to the sentencing of numerous US farmers unable to keep up their payments. Similar developments could occur in animal breeding. Patenting and monopolising breeds of farm animals may at the same time lead to a loss in biodiversity and accelerate the development of genetically modified breeds.

Loss of biodiversity – increasing corporate control

Industrialised agriculture is based on fewer and fewer breeds of farm animal, with especially highly-bred, high-performance breeds being used. More and more breeds of farm animal are becoming lost or are just deep-frozen in the freezers of gene banks. In losing these animals we are also losing the option of having long-life breeds which can be productive while being less of a burden on the environment. Whereas old breeds are robust and adapted to their specific habitats, highly-bred animals often suffer from disease and stress. If multinational corporations now spread out into animal breeding, there is a threat that the situation will get worse, and regional breeds which are finely adapted and undemanding will be lost.

But farmers who are becoming more and more dependent on big corporations are losing out too. The latter may be able to control the use of their animals in the future as well. How rapidly this development might become really acute for consumers and farmers can be seen from the current patent applications for breeding pigs being made by the US agrochemical corporation, Monsanto (see below).

It is not only genetically manipulated farm animals that are in the foreground now. Processes like cloning or 'marker-assisted selection' (a kind of genetic diagnosis on an animal) are being increasingly used in order to make monopolistic claims on animals' genes, the animals themselves and their offspring. Discussions on the marketing and consumption of cloned animals in the US and Europe show that commercial interests behind the patents do in fact aim to be active on the market.

The 'inventors' of animal breeds

Corporations like PIC and Genus, who are among the biggest international players in the animal breeding sector, are especially active in buying up other firms and patent applications filed. Monsanto is on the other hand entering this business as a relative outsider, having been basically active in a different area. This company has not only bought its way into pig breeding and filed patents having a broad coverage, it has also concluded extensive licensing agreements with the genome company, MetaMorphix, which has for its part filed numerous patent applications in this sphere.

Patent agencies - accomplices of corporations

The patenting of forms of life is supported by patent agencies and political bodies. The ban on patenting animal varieties laid down in European patent law (Art. 53b of the European Patent Convention) has for years been systematically eroded by the European Patent Office in Munich – which finances itself from granting patents. Starting with the patent on the so-called 'onco-mouse' in 1992, the European Patent Office has gone on to grant over 200 patents to animals (indeed, 538 according to the EPO's own classification), and another 5,000 have already been filed for. Most of the patents cover animals in experiments – but many too are for cloned farm animals and normal breeding processes. Even patents on genetically manipulated cattle, fowl and fish have already been issued.

Patents can also be granted on normal animals which have merely been subjected to certain techniques like a gene diagnosis, or a process for determining the animal's sex, for example - European patent law may prohibit patents on "essentially biological processes for the production of plants or animals" (Art. 53b, EPC), but this ban is defined in such a way that it can easily be got around.

Patents in which only certain processes are claimed are also controversial. According to the EU patents directive (98/44, Art. 8, 2) even the offspring of the animals ("any biological material") can in such cases be covered by the patent.

Examples of patents on farm animals already granted in Europe

1. Dolly the cloned sheep

The European Patent Office granted the Roslin Institute in Edinburgh patent application EP 849 990 in 2001. A process of cloning mammals in which cell cores and oocytes are recombined was patented. Originally intended mainly for medical research, processes for cloning farm animals are becoming increasingly important in agriculture. There are now discussions in the US and Europe on marketing cloned animals as food.

2. Super-salmon

The Canadian company, Seabright, also obtained a patent in 2001, when the patent with the number EP 578 653 being granted for salmon and other fish which have been manipulated with growth hormone genes. The patent specification shows that the fish grow eight times as fast as normal salmon. If such super-salmon escape into the environment there is a substantial risk they will displace natural salmon of the same species.

3. Sex selection in humans and animals

The US company XY Inc. was in 2005 granted patent EP 1257168, which covers a method for selecting semen by sex for the artificial insemination of mammals – including people. Cattle, pigs and horses, in particular, are singled out in this patent. The deep-frozen sperm itself is also claimed as an invention. Greenpeace has filed an objection to the patent on ethical grounds. A second objection was made by Monsanto – the company claims similar processes to be its invention.

4. Genetically manipulated dairy cows

The first European patent on genetically manipulated dairy cows was granted in 2007. Under patent number EP 1330552 "inventors" from Belgium and New Zealand claim processes for breeding cows which give more milk or milk with altered constituents. The cows are produced either by genetic diagnosis ("marker assisted breeding") and bred normally, or by having more milk genes additionally incorporated into their genome.

Examples of patents on farm animals filed for / other patents already granted in Europe

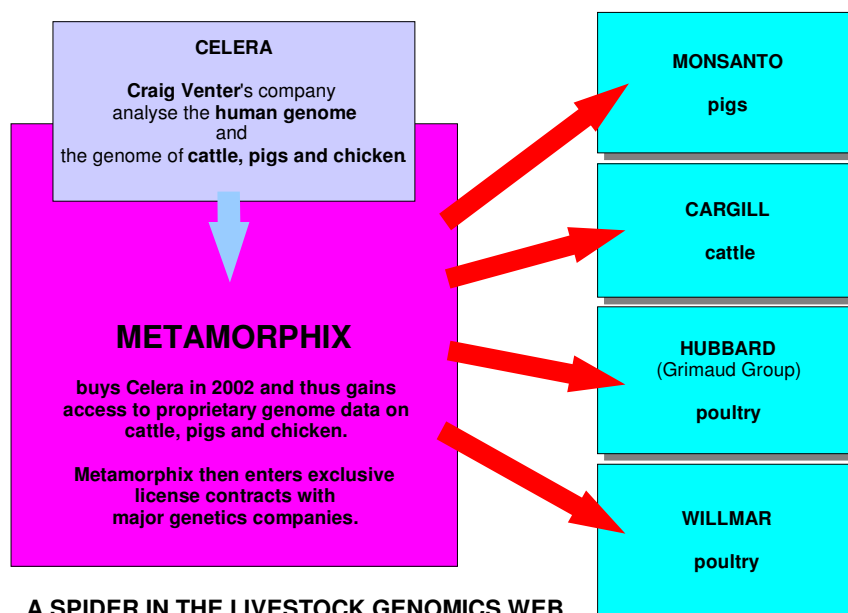
1. Monsanto's herd of pigs

Monsanto in 2005 filed two applications for extensive patents on breeding swine with the world intellectual property organisation in Geneva. One patent, WO 2005/015989 (EP1651030), is concerned with business ideas for combining breeding methods already commonly practised. The processes specified are claimed, but the animals bred are themselves to be patented too. In patent WO 2005/017204 (EP 1651777) processes for genetic diagnoses on swine are described which are based on genetic information which is very broadly distributed—processes which are supposed to achieve improved growth. Here too the animals and "a pig herd" are themselves claimed. The applications were the subject of controversial discussion in Europe and the US after Greenpeace had made them public. The public criticism led to the European patent application, EP 1651777, being considerably watered down. The claims on swine were removed from the application. But in the meantime a dozen other pig-breeding patent applications by the US company have become known. Monsanto's EP 1673382 application is in addition partly about breeding cattle.

2. MetaMorphix trading with pig genes

MetaMorphix in 2002 bought the Celera genome company's section dealing with genome analyses on animals. Celera was originally founded by the US researcher, Craig Venter, to analyse the human genome using high-performance computers. MetaMorphix thus received data on the genomes of cattle, swine and fowl. Monsanto and MetaMorphix announced they were cooperating in 2004. Monsanto will by a licensing agreement have exclusive access to the company's data, which include some 600,000 genetic sequences for pigs. MetaMorphix has entered into similar cooperative agreements with the US agricultural multinational, Cargill, in the cattle-breeding sphere, and with the Willmar company in the sphere of breeding fowl. MetaMorphix has also registered patents itself. Some examples are:

- WO 0043781: growth factors and hence manipulated farm animals
- WO 2005052133: cattle genes for horn formation, analytic procedures for giraffes, cattle, sheep, buffalo and deer
- US 2003065137: genes to increase weight, muscle mass and milk yield in farm animals
- WO 9956771: inoculation against formation of sex hormones (partly to increase meat yields).
- WO 9950406: egg cells manipulated with growth genes



3. Pig Improvement Company (PIC) and Genus

PIC has transformed itself from a breeding company to an international monopoly, with pig breeders becoming "inventors of pigs". The company, which maintains a global network of collaborations and national branches (like PIC Deutschland), often works with the university of Iowa in the USA in making patent applications. The applications cover genes, whole animals and even meat products, which are of commercial interest. PIC was bought up in 2005, and Genus is now regarded as the biggest cattle-breeding corporation in the world. In 2005 Genus bought Sygen International, one of the leading companies in agricultural farm animal biotechnology, to which PIC also belongs. Genus thus controls large parts of cattle and pig-breeding, and aquaculture, worldwide. Genus' patent portfolio is accordingly diverse.

Examples of Genus/PIC group patents are:

- EP 0879296 (issued in 2002): genes to influence the size of litters in pigs and analyses of breeding animals with these genes
- WO 2006099055: genes for increased growth
- WO 2004 081194: processes for analysing farm animals for desired genes like muscle growth
- EP 1425414: genes for resistance to disease
- WO 0220850: genes for meat quality, reproduction rates and larger litters (EP 1354061)
- EP 0739412: clones of pigs, horses, cows, antelopes, goats and sheep and resultant embryos (issued on 27 Feb 2002)

Greenpeace demands

- A complete overhaul of European patent laws with the goal of prohibiting patents on animals and their genes, just as with patents on plants and seed.
- Access to genetic resources must be ensured for breeders and farmers; monopolisation of seeds and animals must be stopped.
- No patents on Life!

Glossary

Artificial insemination	<p>Introduced some 50 years ago in cattle, allows to increase the number of offspring of one bull to one million. Since frozen cattle semen technology is very efficient, AI is practised in most countries.</p> <p>In pigs, AI increases the possible number of offspring of one boar to around 2000. Frozen semen technology is less efficient in pigs, and was therefore not very common until recently. Infection risk, but also proprietary strategies have led to an increased use of AI instead of live boars.</p> <p>AI is also used in poultry, e.g. in turkeys, where the bodyweight of the industrial animals impedes natural service.</p>
Boar	Adult male pig
Breed	A breed, defined along visible external characteristics, is accepted as a separate identity, due to geographical and/or cultural separation (adapted from FAO, SOW p.300)
Breeding pyramid	Shows how pig and poultry production is organised in steps separating primary breeders, multipliers and producers.
Clone	Duplication of an individual animal by various biotechnological processes.
Closed herd	Introduced by Monsanto and PIC: Complete pig production packages in which gilts and semen are provided by a breeding company that also supplies other services, such as company-contracted veterinarians, as well as evaluation support for the selection of breeding sows. Information on the animals, identified by ear tag, is transferred with the help of barcode scanner and computer to the breeding company. The closed herd system is part of Monsanto's series of pig patent applications.
Cross breeding	<p>Mating of animals of different breeds. The incentive for cross breeding is the exploitation of hybrid vigour or heterosis.</p> <p>Several systems of cross breeding are applied (Maree and Casey, 1993):</p> <ul style="list-style-type: none"> □ <i>Single cross</i> – This is the crossing of any two breeds selected on the basis of their performance traits to produce cross-bred offspring with considerable hybrid vigour. Heterosis is fully expressed. □ <i>Back cross</i> – A cross-bred female (F1 cross) from a single cross is mated in alternate generations to unrelated pure-bred males belonging to the original parental breeds (some heterosis may be lost in later generations). Heterosis expression is half that of the single cross between breeds. □ <i>Rotational crossing</i> – A third or fourth breed is systematically introduced into a backcross programme to maintain heterosis. Pure-bred males are used on cross-bred females. □ <i>Three-breed terminal cross</i> – The F1 cross-bred females are mated to males of a selected third breed and all offspring (F2) slaughtered for meat production. More heterosis can be achieved with this method than with a three-breed rotational cross.⁵⁹
Effective population size	A parameter used in breed conservation to calculate genetic diversity. 100 head level is considered as critical levels for maintaining genetic diversity.
Genome	A term composed of “gene” and “chromosome”, meaning the sequence of

⁵⁹ Improving artificial breeding of cattle in Africa. Guidelines and recommendations. A manual prepared under the framework of an IAEA Technical Cooperation Regional AFRA Project on Increasing and Improving Milk and Meat Production, with technical support from the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture. April 2005

	the DNA (the material of which genes consist) on the chromosome
Gilt	immature female pig
GMO	Genetically Modified Organism, by introducing a gene from a different organism into a genome.
Heterosis	Genetic effect also existing in plants where the performance of cross-breeds exceed the average of the parental breeds. This is due to the fact that parental animals differ in gene composition and that dominant genes carry more favourable traits than recessive genes. Dominant genes are those that are inherited more often than recessive genes. In the next generation, however, the heterosis effect is lost.
Hybrid animals	Result of cross breeding of two or more specifically developed lines
Line	A line is a product of selection within a breed for specific characteristics (traits), usually with regard to productivity
Litter size	number of farrows born in one litter
MAS	Marker assisted selection. Genetic markers are used to predict phenotype, especially for low heritability traits. Markers must be reappraised for their economic value after just a few generations under selection since they may become fixed by selection. From the point of view of ABS, for traits like marbling, genetic prediction information available currently does a much better job of describing these quantitative traits than any of the individual DNA markers that have been validated so far. However, for traits like tenderness where little genetic evaluation data is currently available, DNA markers provide information that has more relative value and is a positive first step in selection for these traits (www.absglobal.com)
Nucleus herd	Group of animals (cattle, pigs) used by companies for reproduction, including males and females. To avoid infection, nucleus herds are kept far off livestock producing areas, and new animals are increasingly introduced as embryos.
Piglet/farrow	juvenile pig
Sire, bull	Adult male cattle
SNP	Single nucleotide polymorphisms. SNPs are genetic variations that provide information about an animal's genetic value and can be used in breeding programs.
Sorted semen, sexed semen	Several technologies in development to allow to separate to some extent semen carrying male and female genes (X and Y chromosomes), so that in cattle and pigs it is possible to predetermine the sex of the offspring to a higher than the normal 50 % probability. Increases efficiency of breeding and production.
Sow	Adult female pig

Selected LPP Publications

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Köhler-Rollefson, Ilse. 2004. Livestock keepers' rights: Conserving breeds, supporting livelihoods. Farm animal genetic resources

Köhler-Rollefson, Ilse. 2004 Safeguarding national assets for food security and trade Summary of four workshops on livestock genetic resources held in Mozambique, Angola, Zambia and Swaziland. GTZ, FAO, CTA 2004

Livestock diversity. Keepers' rights, shared benefits and pro-poor policies. Documentation of a workshop with NGOs, herders, scientists, and FAO. Organised by the League for Pastoral Peoples and German NGO Forum on Environment and Development, in cooperation with CENESTA/CEESP

Geerlings, Ellen. 2004. The black sheep of Rajasthan. *Seedling*, October 2004. pp 11-16. League for Pastoral Peoples, Ober-Ramstadt, Germany. 20 pp

Susanne Gura and LPP. 2003 Losing livestock, losing livelihoods Seedling, January 2003. pp 10-14.

Geerlings, Ellen, Evelyn Mathias and Ilse Köhler-Rollefson. 2002. *Securing tomorrow's food: Promoting the sustainable use of farm animal genetic resources: Issues and options*. League for Pastoral Peoples, Ober-Ramstadt, Germany. 4 pp.

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