Vision of breeding for organic agriculture

March, 2003

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March, 2003

Contents

Foreword

This project on breeding in organic agriculture led to interesting discussions among farmers and a number of social organisations. The organic livestock farming sector and the research institutions involved in this report recognise that breeding is also an important factor in the development of organic agriculture. The desired end for organic agriculture and breeding is still very much a matter of debate. This report gives an account of the discussions to date and urges further debate about organic breeding in the Netherlands and beyond. It presents a vision for breeding for organic agriculture together with aims and principles for an organic breeding programme and related practical issues. The report ends with recommendations and practical steps which could lead to a more organic breeding system.

This project was carried out by the Louis Bolk Institute in collaboration with the Wageningen University and Research Centre (WUR) and the Ministry of Agriculture, Nature Management and Fisheries (LNV), which commissioned it.
The project team included: Wytze Nauta (researcher in organic livestock breeding and project leader, Louis Bolk Institute), Dr Ton Baars (senior researcher in livestock farming, Louis Bolk Institute), Dr Ab Groen (Head of Education, Animal Science Department, Wageningen University), Rudolf van Broekhuizen succeeded as of January 2001 by Dr Dirk Roep (Expert group on Rural Sociology, WUR) and Dr Roel Veerkamp (Institute for Animal Science and Health, Breeding and Genetics Department).
The project team gratefully acknowledges the input of the advisory team of: Prof. Pim Brascamp (Director of the Animal Science Unit, WUR), Dirk Endendijk (dairy cattle breeder, committee member of the Dutch Friesian Association), Paul van Ham, succeeded by Lenie Lekkerkerk (Expertise Centre LNV, Ede), Prof. Elsbeth Noordhuizen-Stassen (Human-Animal Relations Group, University of Utrecht), Age Opdam (organic dairy farmer at Eindhoven), Dr Hans Schiere (WUR / International Agricultural Centre (IAC)) and Dr Henk Verhoog (ethicist, Louis Bolk Institute).

Prior to the start of the project interviews were held with fifteen organic dairy and chicken farmers in the Netherlands. In total around seventy livestock farmers took part in discussion meetings in different parts of the country and talks were held with representatives of a number of social organisations: Maurits Steverink of *Platform Biologica* (The Organics Platform), Marijke de Jong of *Dierenbescherming* (Society for the Protection of Animals) and Sjoerd van de Wouw of *Stichting Wakker Dier* (the Sentient Animal Foundation).

Much information was contributed by people involved in the breeding organisations: Dr Gerard Albers (Nutreco), Cees Cazemier (ex-COFOK and Dutch Friesian Association), Dr Jan Merks (Institute of Pig Genetics (IPG)), Gerard Scheepens (AI-Samen), Henk Slaghuis (ex-COFOK), Gerard Vosman (AI-Kampen) and Janneke van Wagtendonk (Holland Genetics).

The project team gratefully acknowledges the generous contribution made by all these people.

Wytze Nauta (Project Leader), February 2003

Summary

This report describes the results of research into the vision of breeding systems within organic agriculture in the Netherlands. The purpose of the research was to arrive at a vision for breeding in organic agriculture by means of interviews and discussions with organic livestock farmers and social organisations.
The research was prompted by the fact that, as things stand, organic livestock farmers generally have to rely on the conventional breeding supply. Neither the breeding method not the animal type produced meet the requirements of organic agriculture. Interest in breeding has increased because organic agriculture is expanding, and as yet too little attention has been paid to the development of specific organic breeding programmes and associated legislation.
In recent decades conventional agriculture and breeding have tended more and more towards industrialisation and uniformity with breeding becoming a multinational concern. The breeding organisations have no incentive at present to provide special services for organic agriculture as the market is too small and the costs are too high.

Taking the current breeding situation as the starting point, a number of scenarios are described for each animal sector which could gradually lead to a system of breeding which is more organic both in its aims and in the chain-based approach. The naturalness of the breeding techniques is an important factor in considering the available options. The different scenarios served as a basis for the interviews and discussions with livestock farmers and social organisations.

We have established that the farmers and organisations consider it important for organic agriculture to work on developing a breeding system which follows the principles of organic agriculture. The most important reasons for this are that: (1) consumers expect all production factors in the chain to be of organic origin, (2) most livestock farmers currently use conventional breeding techniques which fall short of the organic requirements on a number of points, such as the use of artificial reproduction techniques and mono-functional breeding for production.
For the development of organic breeding, livestock farmers feel that in the first instance the use of artificial reproduction techniques, including cloning and transgenic techniques, should be restricted. Next the livestock farmers and social organisations want breeding to be adapted to or based on the organic environment. There is a suspicion that owing to genotype-environment interaction (G x E) conventionally-bred animals cannot adapt well to the organic environment, and this leads to health and welfare problems. The farmers would like to see this development taking place within 5 to 10 years. It must however proceed one step at a time since the farmers cannot yet form a complete picture of the impact of all the different factors.

Most of the people involved see the ideal form of breeding, with natural reproduction and regional or farm-specific selection, as a standard to be achieved in the distant future. At the moment most livestock farmers have neither the knowledge nor the socio-economic means to set up such breeding programmes.
The development of breeding and the associated legislation require an international approach, for which suitable contacts must be sought in other countries.

The final chapter of this report looks in more detail at the steps to be taken in each sector. Ideally developments should probably be initiated and supervised by a central body, such as an organic breeding foundation, which could be set up to govern the breeding of all farm animals.

1. Introduction

The scale of organic agriculture has increased rapidly in recent decades. There are now over 1400 organic farms in the Netherlands (*Biologica*, 2001) and the land area devoted to organic agriculture has increased to 1.4%. Around 42% of the organic farms are livestock – and mainly dairy - farms. There is also a growing number of organic pig and poultry farms.

Legislation on organic agriculture was extended in 1999 to include standards for animal production (EU, 1999). One of the points addressed by the standards for organic livestock farming was the origin of the (breeding) stock. Apart from the preclusion of a number of artificial interventions (use of genetically modified organisms (GMOs) and embryo transfer (ET)), there is as yet little consistent thought on desirable breeding systems, breeding methods, breeding goals and related aspects such as diversity, animal welfare and naturalness. Baars and Nauta (2001) attempted to identify elements of a future breeding system, while discussions in other countries have focused on the animal type in dairy farming (Bakels, 1988; Haiger et al., 1988; Postler, 1989, 1999) and in pig (Mathes, 1999) and poultry farming (Müller et al. 1999; Jaresch, 1999; Konrad and Billisics-Rosenits, 1999; Maurer, 2000).

Research has demonstrated that Dutch organic livestock farmers make extensive use of (breeding) animals taken from conventional agriculture (Elbers and Nauta, 2000; Wit, 2001; Bestman, 2001, 2002). This use increasingly raises concerns about ethical, agri-ecological (system) and technical breeding issues in practice. Ethically, one might question how far it is desirable to breed animals with little concern for their integrity (Baars and Nauta, 2001). In particular, the use of modern reproduction and propagation techniques, the associated mono-functional breeding goals focused on production, the type of animal selected for this and the selection techniques based on DNA and genes, raise concerns about the welfare and integrity of the animals (Maurer et al., 1998; Verhoog et al., 2001). The use of GM techniques in farm animals will also soon be a reality, given the experimentation in techniques such as increasing the levels of usable protein in cow's milk, which has already been applied in New Zealand (*NRC*, 2003).
Within conventional agriculture the environment of the animals is increasingly adapted to the requirements of the highly productive animal. The question is whether and to what extent organic agriculture can and or even wants to go along with this in view of its principles, or whether it needs animals suited to the organic production system.
In terms of breeding techniques, questions arise concerning the conservation of genetic diversity (Baars and Nauta, 2001), the role of genotype-environment interaction (Nauta et al., 2002) and the influence of reproduction and selection techniques. In current agricultural practice genetic diversity is coming under pressure because the same breeds and crosses originating from just a few ancestors are used over and over again (Groen, 1998; Hunton, 1998). Genotype-environment interaction means that the same genotypes are expressed in different ways in different environments (Falconer and Mackay, 1997). This can play a role in the use of animals with the same genotype in conventional and organic agriculture. It has not yet been scientifically proven, but it would hypothetically mean that the breeding values of animals based on conventional farming requirements are not compatible with management practices on the diversity of farms in organic agriculture (Nauta et al., 2002).
Issues raised by reproduction techniques for breeding include a possible ban on breeding technologies such as artificial insemination, embryo transfer and associated techniques. This could have a major impact on estimated breeding values and genetic improvement, since without these techniques the current estimate of breeding value would be impossible and the selection intensity would decrease. Opinions are divided on these issues.

In addition to these ethical and technical issues, there is also the issue of how far organic agriculture, in view of its image, can continue to make use of conventional breeding systems. A proportion of consumers demand an organic product which is as pure as possible, which for them conjures up images of naturalness and considerable concern for the welfare of the animals (Wit and Amersfoort, 2001a, 2001b). The European standards for organic production and IFOAM guidelines indicate that organic livestock farming should as far as possible use 'organic' starting material (EU, 1999; IFOAM, 2000). Closed chains are required to ensure the identification and traceability of food for food safety, with products being identifiable from farm to table. Mixing of chains is regarded as undesirable (Wijffels Commission, 2001).

Objective of the report

The purpose of the project "Organic breeding, a way to go" is therefore:

1. to formulate visions of the opportunities, problems and limits of organic breeding which are compatible with the principles of organic agriculture;
2. to guide and support discussions about desirable future breeding practices; and
3. to design a step-by-step plan to achieve an organic breeding system, as desired by the sector.

Implementation

A discussion document was drawn up in advance based on talks with primary producers and relevant organisations and on knowledge gleaned from literature and the knowledge institutes involved in the research (Nauta et al., 2001b). The discussion document describes the current situation in breeding and concludes that breeding practice is still a long way from what is considered ideal in organic agriculture. Next various future scenarios are described. These scenarios served as the basis for discussion meetings with organic livestock farmers.
Several discussion meetings were organised across the country to which all organic livestock farmers were invited. Those who registered an interest were sent a copy of the discussion document in advance. At the meetings the ideas were tested in discussion using the various scenarios as a guide. The organic livestock farmers were asked for their opinions on breeding in organic agriculture and what developments they would like to see in the future. After the debate the farmers could fill in a form indicating which scenario best suited them, with room for comments and a timetable for implementation.
The discussion document was subsequently discussed with a number of social organisations: *Dierenbescherming* (Society for the Protection of Animals), *Platform Biologica* (the Organics Platform) and *Stichting Wakker Dier* (the Sentient Animal Foundation).

Chapter 2 looks at the discrepancy between the aims of organic agriculture on the one hand and current breeding practice on the other. Scenarios for future breeding practice are presented. Chapter 3 describes the outcome of the discussions with the different stakeholders. Chapter 4 discusses the results of the research and leads into a step-by-step plan in Chapter 5. A number of possible courses of action are described for a gradual transition to a breeding system which is in keeping with the principles of organic agriculture.

2. Developing scenarios for organic animal breeding

Discussions on organic livestock breeding programmes concern, on the one hand, organic farming regulations and aims, and on the other hand, current breeding practices in the conventional and organic sectors. Ideally, the rules, aims and principles of organic agriculture would form the basis of a declaration of intent for organic breeding (see section 2.1). In reality, however, breeding in the organic sector still depends heavily on conventional breeding (section 2.2). There is clearly a gap between the principles and aims of organic agriculture, and organic farming practice (section 2.3). We drew up six scenarios which could bridge this gap (section 2.4) and presented them as a basis for discussion with stakeholders.

2.1. Organic breeding: the aims, principles and guidelines

The aims and principles of the International Federation of Organic Agricultural Movements (IFOAM, 2000) and European Commission regulation no. 1804 / 1999 on organic farming (EC, 1999) do not include many provisions specifically concerning breeding (see appendix 1). There are, however, several provisions which are relevant, either directly or indirectly:

1. animals must be able to adapt to local organic conditions;
2. genetic diversity must be maintained or cultivated;
3. organic agriculture must strive for closed minerals cycles and land-dependent production;
4. animals' natural behaviour must be respected.

There are also two clearly restrictive conditions:

5. certain interventions (such as embryo transfer) and amputations (debeaking, tail-docking) are not allowed;
6. no more than 10% of the farm herd may be brought in from the conventional sector.

In effect, the intention of these six conditions is to preserve the naturalness of breeding in organic agriculture. Naturalness is a crucial concept in organic agriculture, but one that lends itself to multiple interpretations (Bartussek, 1991; Verhoog et al., 2001). Verhoog et al. (2001) distinguished three different concepts of naturalness which are all used in the organic sector. The first definition deals only with the natural origin of all substances used in organic production. The second extends to natural processes within the agri-ecosystem, and the third to the intrinsic nature of all things. These three definitions of the concept of naturalness substantiate the above conditions for organic breeding:

Ad 1.
In the wild, natural selection ensures that only those animals which successfully adapt to their environment survive. Selection is geared to specific, local conditions. This process can be mimicked on organic farms by selecting animals which perform best in organic farming conditions.

Ad 2.
In the wild, different populations or subspecies evolve due to natural selection and natural barriers between the different natural environments in which the species occurs. Environmental diversity thus naturally ensures the diversity of the animal species. In agriculture, region-specific breeding programmes could similarly enhance the diversity of a livestock species or breed. This regional approach is not a new innovation: traditional landraces are the result of generations of region-specific breeding, which continued until the middle of the twentieth century (Hagedoorn, 1934).

Ad 3.
The diversity of living organisms is at the basis of natural mineral cycles. Plants mature, are eaten and die. Plant remains and animal manure provide nutrients for the next growing season. On organic farms, closed

mineral cycles most closely resemble the natural cycle of life (Klett, 1985; Baars, 1990; Nauta at al., 2001a). Only mineral outputs which have left the farm via the end products are replaced to prevent depletion of the system. Local circumstances such as soil type and climate play a major role in all natural cycles. It is important that livestock animals are well suited to the imbalances and limitations of every type of natural cycle (Baars and Nauta, 2001).

Ad 4.
Animals' natural behaviour is the species-specific set of behaviours that they exhibit in the wild in order to survive. Every animal has its own specific ecological niche (Baars et al., in prep, 2003). That is why a cow grazes and a pig roots. One of the principles of organic livestock farming is respect for animals' nature. Respect for the integrity of the animal species means that housing and management must be adapted to animals' species-specific behaviour. This applies equally to breeding and breeding goals.

Ad 5.
Amputations are mutilations that violate the physical integrity of individual animals. Amputations severely restrict animals' species-specific behaviour and this causes stress and health problems (De Jonge and Goewie, 2000).

The consequences of a more natural approach to animal husbandry have been described extensively by Van Putten (2000) on pigs, Hierden (1997) and Bestman (2002) on beaked laying poultry, and Baars and Brands (2001) and Waiblinger et al. (2000) on horned dairy cows. Baars (1990b) and Doppenberg (2002) have described how natural reproduction is incorporated into family breeding. Publications on more natural animal housing include those by Rist (1987), Haiger et al. (1988), Bartussek (1991, 1995, 1999) and Sundrum et al. (1994).

2.2. Organic breeding in practice

Organic farming in the Netherlands bears resemblance to conventional farming. Developments in conventional production have left their mark on most organic farms. This effect is strengthened by the large number of farms which have only recently converted to organic production (Skal, 2001).

Recent developments in conventional production have been described extensively in the discussion paper for this project (Nauta et al., 2001b). Briefly, since the second world war the Dutch agricultural sector has developed rapidly into a large-scale industrial economic activity. In order to achieve maximum production, the sector was lifted from its social and ecological context (Roep, 2000). More and more farms specialised on producing a single commodity (milk, meat or eggs).

Breeding, an obvious component of livestock farming, was taken over by specialised breeding organisations. This resulted in a high degree of institutionalisation and concentration of breeding. In the pig and poultry sectors, only a handful of breeding companies remain worldwide.
At the same time, breeding programmes were strongly focused on maximising production per animal. This development was aided in part by new breeding technologies such as artificial insemination and embryo transfer, and computer and selection technologies (estimated breeding values).
In the 1980s the dairy sector experienced a metamorphosis that began with the introduction of the Holstein Friesian breed (Strikwerda, 1998). Animals were selected primarily on milk production, which subsequently rose to nearly 8000 kg per lactation (Strikwerda, 1998).
In pig breeding, production-based selection was made more efficient by separating the father and mother lines. Growth rate and litter size increased to 840 g / day and 12.3 piglets per litter, respectively (Merks, 2001a).
In poultry breeding, there was a division into egg and meat production. Breeding programmes were designed entirely for the production of hybrids from pure lines. This resulted in a 95% increase in egg production, compared to production in 1950, and much faster growth of broilers. In 2000, hybrid broilers reached the slaughter weight of 1.5 kg in just forty days, average (Albers, 2001).

Like conventional farms, most organic farms specialise in either dairy, pigs or poultry production (Skal, 2000). Most organic farmers source their breeding material from conventional breeders. In 1998, 63% of the blood lines of the organic dairy population in the Netherlands was made up by Holsteins (Elbers and Nauta, 2000). Nearly all dairy farmers use AI (Elbers and Nauta, 2000). Organic pig farmers mostly use NL x GY sows (Wit, 2001) and AI is also becoming more common here, in part due to new regulations on disease prevention. Poultry farmers use various hybrids such as Bovans Nera or Bovans Goldline (Bestman, 2002).

2.3. Diversity in organic agriculture

Organic farming is practised in a wide variety of ways. We can distinguish different streams, or styles, of organic agriculture depending on the time since conversion and the farmer's underlying aims (Bloksma, 1991; Verhoog et al., 2001; Baars, 2002). There are farms which still closely pursue conventional aims, as they did before conversion. These farmers continue to strive for scale economies and maximum production efficiency per animal or per hectare. Other farmers make radical changes, for example in animal housing, and produce much more extensively. These different types of farms require different types of animal. In figure 1, we sketch the development of different farm styles in the dimensions of naturalness (y axis) and social functions (x axis). On naturalness, farms can range from a more conventional symptom-focused approach to organic farming to a more preventative total system approach based on animals' nature. The social functions axis represents the possible variations between a singular purpose (e.g. the farm's only goal is to produce milk) to multiple purposes, or multi-functionality (e.g. nature and recreation next to milk production) (Ploeg et al, 2002), which may or may not include a role for the public (Nauta et al., 2001; Ploeg et al., 2002).

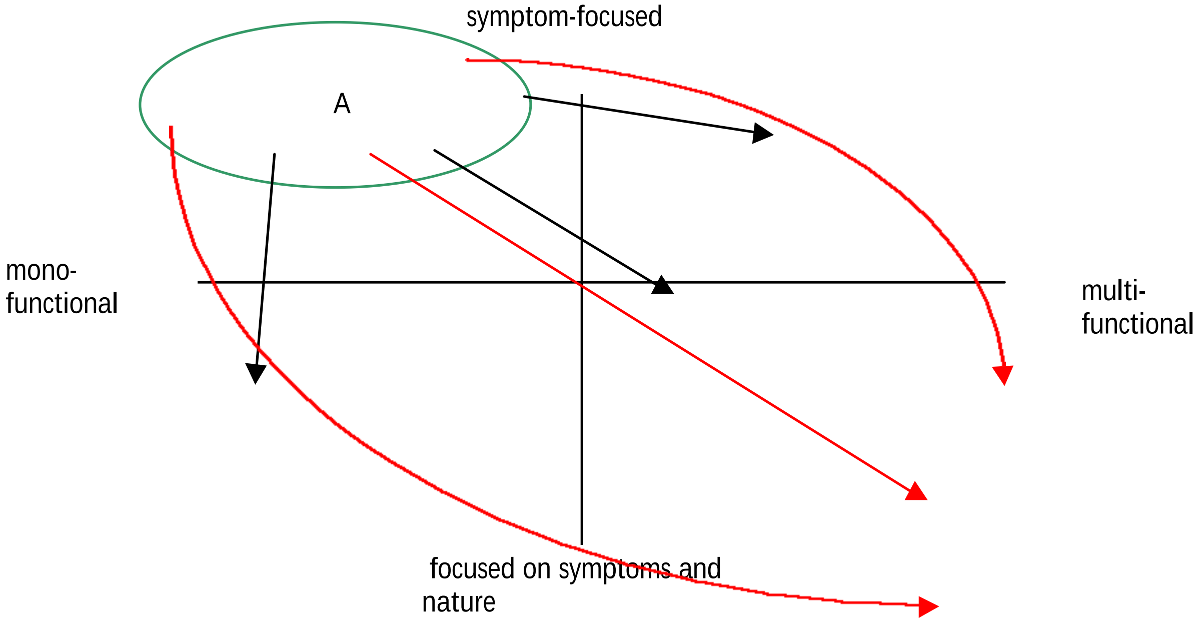

Figure 1: Potential courses of development for a specialised, highly productive, mono-functional farm (A) converting to organic production (arrows)

In the Netherlands, most organic farms converted in the second half of the 1990s (Skal, 2002) and can currently be classified in the 'A' section of the diagram. The development of a farm varies in timeframe and aims. Organic agriculture comprises many different styles of farming, including mainly mono-functional farms with a strong focus on production and mainly multi-functional farms. Several courses of development are possible on the dimensions of naturalness and functionality (see arrows in the diagram). For example, a mono-functional farm could diversify production (broadening its product range, Ploeg et al., 2002), but retain its market-driven, intensive approach. Another farm might continue making one product, but adopt a more extensive management style integrating, as best as possible, the aims of organic production.

When farmers convert, they do not usually tackle all the components of the farm together, but realise conversion step by step on the basis of what they consider to be most important and depending on their own interests and skills (Verhoog et al., 2001).
At this time, it is impossible to say how organic farm management will develop in the future, or whether all farms will move from the top-left corner of the diagram to the bottom-right corner. This depends on the market and on organic farming regulations. Current policy is focused strongly on increasing the scale economies of the organic sector, on marketing organic products in supermarkets and on making products more anonymous. The market, that is the lowest price, dictates, making it difficult for farmers to take steps to more socially responsible and more natural organic production (Baars, 2002). In view of the principles and aims of organic agriculture (IFOAM, 2000; EU, 1999), the sector should seek to follow a course towards a more natural and multifunctional agriculture.

2.4. Problems concerning the use of conventional breeding in organic agriculture

On the basis of organic regulations and aims, several objections can be made against the use of conventional breeding in organic agriculture.

Use of artificial reproduction techniques

An organic livestock farmer who uses conventional breeding products indirectly uses artificial reproduction techniques such as artificial insemination (AI), embryo transfer (ET), super-ovulation and in vitro embryo production (IVP). These techniques are unnatural and violate the integrity and welfare of animals (Schroten, 1992; Spranger, 1999). They may result in diminished fertility and, when combined with highly accurate selection methods, may produce one-sided, unbalanced production animals with mixed up male and female traits (Bakels, 1988; Postler, 1998; Haiger, 1999; Spranger, 1999). What's more, genetic diversity of the breed declines when a limited number of sires is used on a large scale. The result is global inbreeding (Groen, 1998; Veeteelt, 2000).

In dairy and beef farming, the objections mainly concern the use of AI and ET (including super-ovulation and IVP). Holstein-Friesian breeding in particular is almost entirely based on these techniques. In pig production, AI is becoming more popular with organic farmers as a method of propagation. By using AI boars, farmers are also indirectly using ET, since ET is used by the elite breeding companies. All multinational poultry breeding companies use AI. Poultry farmers therefore indirectly depend on AI.

Basis of selection and selection techniques in conventional breeding (G x E, estimated breeding value)

In conventional farming, individual animals' production is quite high because of uniformity of management, diet, efficiency and housing. The animals' environment has been standardised to an increasing degree in order to achieve a high production level per animal. In organic agriculture, there is much less scope for uniform environment and management. The animals go outdoors (climate variations) and receive less concentrate feed (less regulation of production). A preventative approach is taken to animal health rather than a curative approach. These differences in conventional farm environment (more uniform) and organic farm environment (greater variation) may cause differences in the expression of equivalent genotypes in these two environments. This is called genotype by environment interaction (G x E) (Falconer and Mackay, 1997). Due to this interaction, it is possible that the progeny of a conventionally bred animal cannot adapt adequately to an organic farming environment, and they may develop health or fertility problems. This can also occur between different conventional farming environments (Buckley et al., 2000).

In conventional farming, it is possible to take a more generalised approach to breeding using large animal populations (estimated breeding values) due to greater uniformity and controllability of the farming environment. In view of the differences between organic and conventional agriculture, however, there are doubts about the use and desirability of this general breeding approach for the organic sector.

2.5. Breeding scenarios for organic livestock production

In view of the current situation in conventional breeding and organic agriculture, we describe six breeding scenarios which could alleviate or lift the problems associated with conventional breeding. These scenarios can be described in the most general terms as follows:

I. continue to use conventional breeding;
II. as in I. but without artificial reproduction techniques;
III. adapt conventional breeding to organic requirements;
IV. breeding based on organic principles;
V. regional breeding: breeding based on specific conditions and requirements of organic farms in a given region;
VI. farm-specific breeding: breeding based on specific conditions and requirements of an individual farm

In the first scenario, the use of conventional breeding continues without any alteration. This scenario is not very likely in the light of the objections described in 2.4. The remaining scenarios present different graduations in which organic ideals are incorporated in breeding, increasing from scenario II to VI. These scenarios result from different choices being made with respect to three important considerations about breeding for the organic livestock sector:

1. should breeding exclude artificial reproduction techniques;
2. should breeding take account of closed organic production chains;
3. should breeding take account of specific regional or farm characteristics.

These questions can only be considered in the order that they are presented above, as each following question is based more strongly on organic ideals. Practical questions concerning animal breed, breeding goals or types of animal apply equally to all of the scenarios. Each type of breeding system can be implemented for any breed or type of animal.

An affirmative answer to only the first question results in a choice for scenario II. In pig production, this would mean ending artificial inseminations on farms. In the dairy sector, scenario II end the indirect use of ET (organic farming regulations already prohibit the use of embryo transfer on organic farms (EC, 1999)). A ban on ET would automatically rule out other techniques such as IVP, embryo cloning and genetic engineering. As for poultry, AI would only be allowed by elite breeding companies. As in pig production, scenario II would not end the indirect use of AI in poultry production.

The second question concerns the context in which breeding takes place. An affirmative answer in this case would result in scenario IV for cattle and poultry breeding and scenario V for pig breeding. Breeding would take place entirely within the organic chain (from breeding farm to production). Breeding animals would also be selected on organic farms and would therefore be more suitable for organic farm environments. In time, the impact of genotype by environment interaction would thus be reduced. This choice would be a logical consequence of the development in organic agriculture towards closed production chains. In a closed chain, each step in the production process is carried out in accordance with the rules of organic agriculture. This type of breeding would, however, still be dependent on AI and the estimation of breeding values.

The third question concerns a special approach to breeding for the organic sector, for example specifically for regions or individual farms. Scenarios V and VI represent the options when choosing to take a specifically organic approach. This choice would increase genetic diversity, as breeding would address many different farm types (Baars and Nauta, 2001). In this way, specific regional characteristics of an animal could become firmly embedded in the genotype. In this type of breeding programme, cows could be served naturally. In principle, every farm could have its own breeding programme (scenario VI), but not every farmer is a breeder. A good alternative would be cooperation between farms of the same type or farms in the same region (scenario V). Scenarios V and VI basically reflect a traditional approach to breeding. This is how breeding originally evolved, with elite breeders and users (Anema, 1950). These scenarios could however benefit from modern, quantitative techniques, such as estimated breeding values, applied at farm level.

The third scenario of the series has not yet been discussed. This scenario results when the answer to question 1 is clearly positive but question 2 remains undecided. In this scenario, breeders strive to limit possible G x E effects between conventional and organic agriculture by providing supplementary data to conventional estimated breeding values. Useful indicators for dairy cattle, for example, might be lifetime production according to the OGZ[1] (Postler, 1998) or the key performance figures of the breeding farms concerned. Another possibility would be to adapt the estimated breeding value itself to take account of the principles of organic agriculture. Breeders could introduce new breeding goals and review the weights given to existing and / or new traits. This third breeding scenario could be the first step to a 'true organic' breeding system.

In drawing up these scenarios, we had to consider differences which are inherent to the specific situations for different livestock species. We designed scenario III, for example, in consideration of the essential role that propagation plays in pig breeding. Clearly, organic propagation had to be an option. In the poultry production sector, farmers buy hybrid stock from breeding companies. We had to include a scenario in which hybrids' suitability for organic production is tested. In chapter 3 we describe the scenarios for each livestock sector.

[1] OGZ = Ökologischen Gesamt Zuchtwert, in which progress in the first three lactations is one of the determinants of breeding value.

3. The vision of the stakeholders

3.1. The scenario choices of the combined livestock farmers

Discussions were held with livestock farmers about their vision for breeding, based on the scenarios for each sector. The results are presented below and described for each sector. This section describes the overall results.

The discussion meetings were attended by 67 livestock farmers: 46 dairy farmers, 15 pig farmers and 6 poultry farmers. The average farm situation of the participants is reflected in a number of indicators in Table 1.

*Table 1. Indicators of farm size and experience of farmers participating in discussion meetings (*only the number of pigs per farm, ** data from 2001,scaled up this represents 60-70 in 2004)*

Specialisation	dairy cows, pigs or chickens (number per holding)	Average no. of animals per holding	Breed experience	years of experience
Dairy cows	48	49	70% HF, 30% other breeds	7
Pigs	70 (20 –120) *	30 **	often GYxNL	4
Laying hens	4900 (400 – 10,000)	4000	Bovans Gold Line, Isa Brown, Nera, Columbian Blacktail, Amberlink, L. Tradition	6

The average holding size of the participants indicates that, based on this criterion, they represent a good cross-section of all organic holdings in the Netherlands. On average the participating farmers have slightly more animals. This is particularly so for the pig farmers as the new farms tend to be larger (Steverink, verbal statement, 2002)

Figure 2 shows the different choices of all the farmers with respect to three important considerations concerning the scenarios (see section 2.5).

Ninety-eight percent of farmers opted to rule out artificial reproduction methods. In the case of the dairy farmers this relates to direct and indirect embryo transfer and in the case of pig farming to AI on the farm. Next 58% of the farmers opted for a breeding and selection system within organic farming itself, i.e. selection based on environmental conditions at the organic holdings and ruling out artificial reproduction techniques. They are motivated mainly by the need to achieve a closed organic chain based on organic principles. They feel this is important to the consumer who expects the final product to have been produced organically (guarantee of organic quality).
At the same time the farmers are of course aware that the development of a fully organic breeding system would still give rise to various problems and dilemmas and that breeding cannot be adapted without a struggle. We assume a development period of 5 to 10 years depending on the growth of the sector. Problems and dilemmas which may arise are not the same for all species of animal, and depend for example on the processors and markets associated with these animal species.

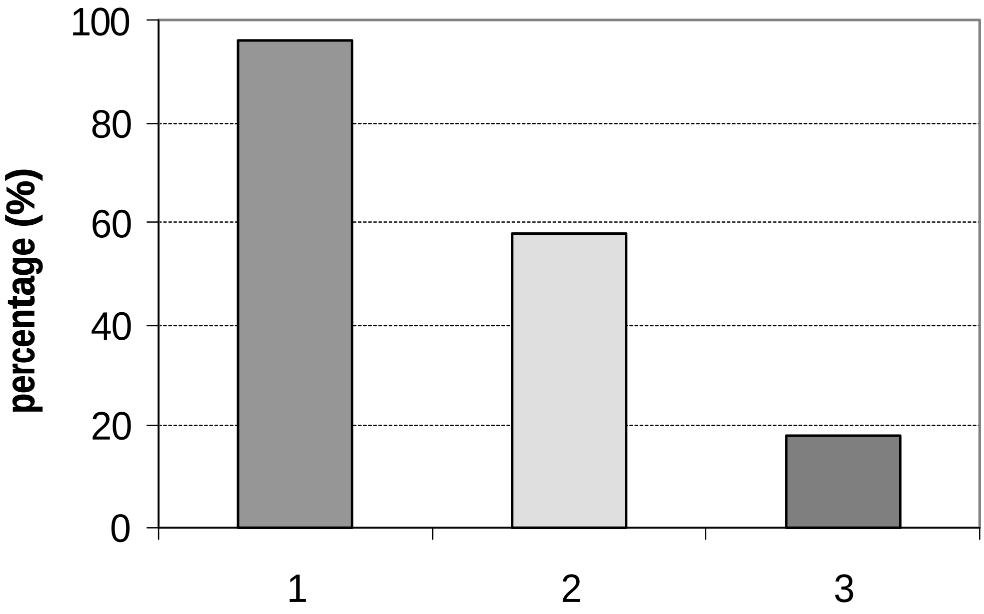

Figure 2. Combined opinions of all organic livestock farmers with regard to three options for more organically-oriented breeding (1 = rule out ET / AI; 2 = organic breeding chain; 3 = regional or farm breeding). N.B. The option to rule out ET or AI under 1 and for an organic chain under 2 are carried through to the following scenarios. The options are added together (1 = 1+2+3, and 2 = 2+3)

It was not always clear what livestock farmers understood by the term 'organic breeding'. Opinions range from a more general approach in which there is still room for estimated breeding values and AI, to a more differentiated approach at regional or farm level based on family breeding and natural reproduction. Among those opting for organic breeding, 18 % were in favour of a differentiated regional or farm-specific breeding programme.

3.2. The vision of the dairy farmers

The scenarios for dairy cattle breeding are described in the box below.

The dairy farmers' choices are shown in Figure 3. Ninety-five percent of them opted for ruling out indirect use of ET. This is because of the unnatural nature of the technique and its use of hormones. The general opinion was that organic agriculture should not really associate itself with this type of breeding technique. At the same time they did recognise that ruling out ET could have serious consequences for cattle breeding. Subsequently many livestock farmers considered that AI could not really be allowed either. However, for logistical and animal welfare reasons the verdict was that it was hard to see past AI in practice for the exchange of breeding material.
Thirty percent of the farmers believed that conventional breeding techniques could still be used, but would have to be adapted. According to these farmers more information would be required, for example about the lifetime yield of the family of breeding bulls and associated management indicators. They also wanted information about the muscular development for more robust cows.
Forty-two percent of the farmers felt that breeding and selection should be based more on the primary principles of organic farming (opting for scenario IV, V or VI). A general approach (scenario IV) could make use of information from extensive conventional farms. It is striking that the farming of AI bulls and AI itself do not generally fall within the organic farmers' field of vision.

Box 1. Scenarios for development of an 'organic dairy breeding system'

I: Conventional breeding
Continuing to use prevailing breeding techniques.

II: Conventional breeding without embryo transfer
Exclusive use of conventional breeding without ET, whereby indirect use of ET is prevented. To this end there is a published list of breeding bulls not produced by ET and extra ET-free breeding bulls might possibly be included and offered in the breeding programme.

III: Adapted conventional breeding
Conventional breeding criteria are weighted differently, supplemented and adapted to the requirements of organic agriculture. Additional data are provided concerning, for example, the lifetime yield of the ancestors of breeding bulls and farm indicators are used to give an impression of the farm management system from which the bulls originate. In addition the estimated breeding value is adapted to include special characteristics and breeding objectives for organic agriculture.

IV: Breeding within an organic chain
In principle as in scenario 3, but the entire chain is organic. The breeding bulls are selected from organic farms and kept in the organic manner and tested on the basis of organic agriculture principles.

V: Regional breeding
To reinforce G x E interaction, breeding and selection is based on a region with similar conditions. Breeding farms produce bulls for the other farms in the region. The most likely option for this is based on family breeding applied by the top breeders.

VI: Family breeding
Each organic farm applies a system of family breeding, so that G x E no longer has any effect.

At the moment there are no additional guidelines for an organic AI programme, which the farmers did not regard as urgent. The general view was that if that were required as well, you could simply adapt the farming of AI bulls to the dairy cow requirements.

Few livestock farmers wanted to work towards a farm-specific or regional breeding system (V of VI). While they appreciate the advantages of regional breeding as more in keeping with organic principles, they also see obstacles to such a development. Most livestock farmers distrust family breeding, since the family system breeders use limited inbreeding to produce animals on a small scale and over generations which are adapted to their conditions. Significant obstacles for the other livestock farmers are the matter of keeping (several) bulls, selecting the bulls themselves and the fear of inbreeding. In this scenario the farmer is required to act as an animal breeder, which is not the way many of the livestock farmers see their future. They do not have the necessary knowledge. However, farm-specific or family breeding does take place on a small number of organic (Dutch Friesian (FH)) breeding farms. In addition there are the livestock farmers who apply family breeding themselves on their own farms. They automatically chose this approach, because it is what they are used to.

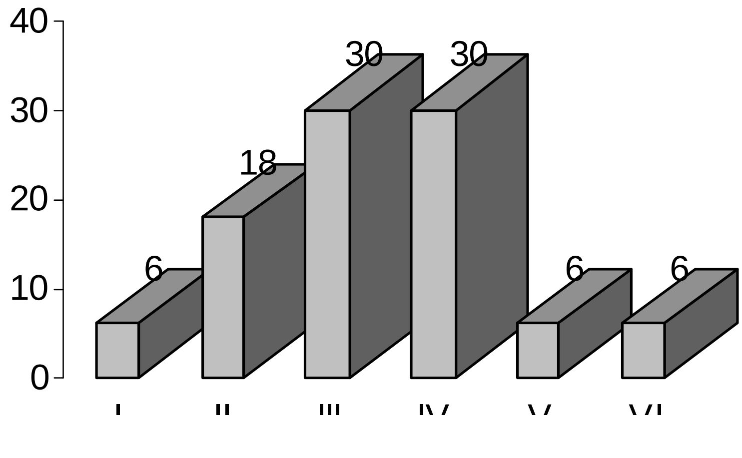

Figure 3: The percentage of the cattle farmers opting for the six breeding scenarios (the numbering of the scenarios corresponds to the descriptions in box 1)

3.3. The vision of the pig farmers

Scenarios were developed for pig farming based on the conditions and breeding techniques in this sector (box 2). The preference of the pig farmers for particular scenarios is represented in figure 4.

The pig farmers see the naturalness of production as an important principle for breeding and thus opted for a breeding system without AI (thus opting for scenarios III to VI). They consider it important to demonstrate to the consumer that there is a boar among the sows for natural reproduction. Most farmers currently use a combination of AI and natural reproduction. The step towards natural reproduction is not seen as a big problem by the pig farmers. By their own account the pig farmers have little to do with ET, but feel a greater threat from other techniques such as marker selection. It is not yet clear whether this technique will be permitted in organic agriculture.
Nearly 30% of the pig breeders appreciate the importance of organic breeding (scenario III). There is currently a shortage of organic gilts. These farmers think that there needs to be an increase in the number of organic breeders to make up this shortfall.
A number of pig farmers (18%) opted for scenario IV and wanted to see conventional breeding adapted to the characteristics which are important in organic agriculture. However, this would require good organisation of the existing organic pig farms.
A small majority (53%) opted for breeding within an organic chain (scenario V plus VI). This means that for most farmers breeding takes place on special breeding farms with Skal licences. In their opinion this could be organised by the existing breeding organisations, so that their knowledge and breeding animals could be used as the starting point. In this way breeding would take place in a closed organic chain. Feasibility studies would be needed in conjunction with the breeding organisations. The pig farmers thought that they could strive for overlap with free range pig production to expand the market.

Box 2: Scenarios for organic pig breeding

I: Conventional breeding and AI
Pig farmers use F1 gilts and ultimate breeding boars from the conventional breeding establishments. After a period of organic rearing these gilts are regarded as organic. The breeding boar is used by means of AI.

II: Conventional breeding with natural reproduction (thus without AI)
Pig farmers use F1 gilts and ultimate breeding boars from the conventional breeding establishments. The breeding boar is bought in for natural reproduction.

III: Organic breeding and natural reproduction
Conventional animals from the male and female line are bred on an organic farm. The F1 gilts are used by the organic heavy baconer farmers.

Within the option for a closed organic breeding chain 6% opted for breeding at farm level (scenario VI). During the discussion about the selection of breeding animals the pig farmers were in favour of selecting sows on their own farm. A number of pig farmers already do this to some extent, partly because organic sows are not readily available, but also because they see this type of selection as more organic and they achieve good results with it. For example, on one farm sows were kept from the heavy baconers they had bred. On this farm they buy in NLxGY sows from time to time and use a GY boar as the ultimate breeding boar. The heavy baconers produced are thus 75% GY. With the sows from this group they can then breed near (82%) GY heavy baconers with a good meat to fat ratio. Thus they opt to carry out some of the breeding on the farm and breed a pure breed for heavy baconers. However a few livestock farmers prefer a breeding system based entirely on the farm, including the selection of the boars. They do not yet always practice this themselves, but they do see it as the way forward, possibly through cooperation between farms. Breeding and working with a pure breed, such as the GY breed could be a serious option to facilitate the reintroduction of breeding on the farms. Keeping various pure breeds on a farm is seen as a great burden. Further research is required on the possibilities of pure breeding.

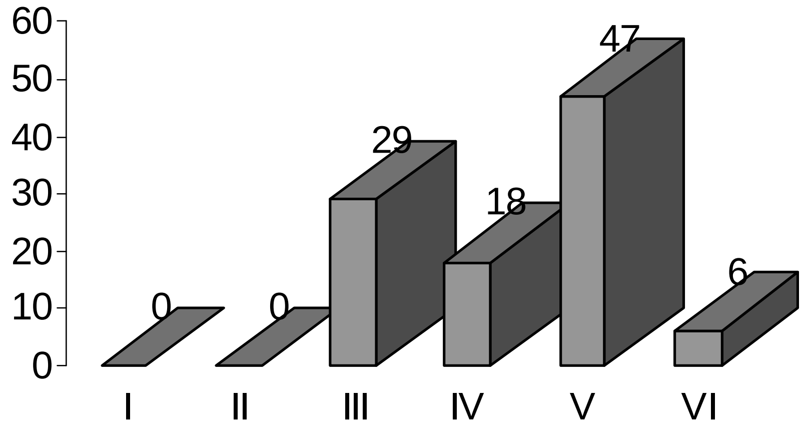

Figure 4. The percentage of pig farmers opting for the 6 breeding scenarios (numbering corresponds to box 2).

3.4. The vision of the poultry farmers

The scenarios for poultry farming are described in box 3. The numbers involved in this discussion were too small to show results in percentages. Six farmers came to the only discussion meeting.

Box 3: Scenarios for organic poultry breeding

I: Conventional breeding
Poultry farmers use hybrids which the breeding organisation designates as suitable for organic agriculture. After a period of organic rearing these hens are regarded as organic.

II: Conventional breeding with tested hybrids
Hybrids from conventional breeding systems are tested in advance for suitability for organic poultry farming.

III: Adapted conventional breeding
The breeding farms develop special lines with traits which are important for organic agriculture (suitable for free-range, dual-purpose hens, several laying cycles).

IV: Breeding within an organic chain
The breeding farms select and breed on organic lines (Skal licence).

V: Organic breeding farms
The hens for organic agriculture are bred on breeding farms which are organic.

VI: Breeding on the farm
Each poultry farm supplies its own rearing requirements by selecting breeding animals and breeding them on the farm using the family method.

The poultry farmers did not opt for scenarios involving conventional hybrids or pre-tested hybrids (scenario I or II). The testing of hybrids is pointless, because more and more new combination crosses are created. There was some interest in scenario III, an adapted conventional breeding system with special lines for organic agriculture, but the poultry farmers say that it is difficult to get the current breeding establishments interested because the organic market is too small.

Many participants opted for breeding based on organic agriculture (scenarios IV, V and VI), despite the current difficulties of breeding for organic agriculture. At the moment breeding is entirely in the hands of a number of multinational companies, which control all the breeding material and keep their knowledge well protected. Under these circumstances it would be difficult for farmers to take breeding into their own hands. However, they would like to see an entirely organic breeding chain. The poultry farmers consider the pure poultry lines used today to be very extremely overbred and kept in highly artificial conditions, making continual use of preventive antibiotics. The egg-production trait is very highly developed and the present brands cannot cope well with fluctuating protein concentrations in the feed. The poultry farmers would rather have more robust animals with a persistent laying habit. The techniques used in selection and reproduction, such as marker selection and AI, and the advent of genetic manipulation also give the organic farmers cause for concern. "*The use of such breeding methods is not good for organic agriculture*", they say.

They think that organic breeding establishments should be set up as in scenarios IV and V, possibly by the existing breeding companies which have the knowledge and the breeding material.

However, the poultry farmers realise that a special organic breeding programme would not be easy to achieve. It would raise the cost price, and in the current market a single penny added to the cost price is insupportable. The low price of conventional eggs means that the organic hens would have to achieve higher production to prevent the prices diverging further. The more organic scenarios (IV, V and VI) must be regarded as a hope for the future. Before that, many problems such as feather pecking can be solved by rearing the chicks from day 1 on the farms themselves. Of the three sectors (dairy, heavy baconer pigs and laying hens) it is the poultry sector which feels the greatest discrepancy between the ideal and what it feasible. On the one hand things should be more organic, but on the other hand it is not possible either financially or within the current situation of dependency.

A few poultry farmers would like to opt for a breeding system on the farm itself (scenario VI). They have a small branch for egg production (a few hundred hens) and see possibilities on this scale to set up breeding and reproduction themselves. The eggs are then incubated by the hen and the chickens are also reared by the hen. For them the costs are less important, because many of the eggs are sold at a higher price door-to-door.
For large farms with several thousand chickens breeding and reproduction of their own hens is a less obvious alternative. Many cocks are required for good fertilisation and the eggs have to be incubated in an incubator. Various integrated quality control rules apply to this which are intended to guarantee the quality of the hatching eggs. Thus it could probably only really be done on a specialist breeding farm. The possibilities must be further researched and experiments supervised. According to the poultry farmers this could be an ultimate goal for the distant future.
The poultry farmers say that a ban on the slaughter of male chicks in the production of laying hens may be an important argument to convince consumers to buy organic eggs. The slaughter of male chicks is an entirely undesirable situation in organic agriculture in terms of respect for the integrity of the animal. A solution could be found in breeding dual-purpose chicks, so that the males could be fattened. However, this means that the hens require more feed, and that puts up the cost price. Furthermore there is a poor market for such young male birds, (as there is for spent hens), since the entire chicken meat market is geared to breast and thigh meat. This problem requires urgent attention.

3.5. The vision of the social organisations

Talks were held with *Dierenbescherming* (Society for the Protection of Animals - DB), *Platform Biologica* (the Organics Platform - PB) and *Stichting Wakker Dier* (the Sentient Animal Foundation - SWD). The talks covered predetermined topics (see appendix III). The discussion document and topics were sent out in advance to the designated representatives of the organisations.

Direct or indirect use of unnatural reproduction techniques such as AI and ET

In principle, from the point of view of the natural behaviour of the animal, it is, DB and PB considered that these techniques were undesirable for organic agriculture. They are not compatible with efforts to develop a 100% organic chain.
DB felt that we should strive for a separate organic breeding system making use of natural reproduction. It also rejected AI. The motivation for a ban on AI is the same as for embryo transfer: the restriction of natural mating behaviour. However, DB could conceive of AI remaining permissible in organic agriculture for health reasons (to prevent the spread of disease). DB also raised the question of whether a ban on AI would be commercially feasible. Without AI farmers would have to resort to a system using farm-specific or regional breeding.
PB agreed, but would like further insight into the consequences. There was some doubt as to whether breeding could be taken all the way back to the farm, for example in the form of family breeding. The sector does however need to take urgent action and therefore the PB recognised the importance of a step by step plan for the short term. This is important when the issue of dependence on conventional farming is raised, for example in the media: “Then as an organic sector you must have some sort of response”. The sector must be given sufficient time, since removing permission for AI and ET will have an enormous impact on the structure of livestock farming. A full ban on AI is thus not yet on the cards. In any case, different measures and solutions will be needed for different species.
SWD was against these techniques insofar as they were detrimental to animal welfare. It would be difficult to stop indirect use, and in any case a ban would not yield any great benefit in terms of welfare. Thus for the SWD this was not a priority. The SWD rejected direct use and alternative techniques were available.

Use of the conventional system with adapted animals

According to DB and SWD it was important for the health and welfare of the animals that they were specifically suited or adapted to organic agriculture. Physical interventions on animals to make it easier to use and house them were undesirable. DB felt that the animals must be able to display their natural behaviour. It is important in this context to be clear about how natural behaviour can be assessed. (De Jonge and Goewie, 2000; Sundrum et al., 1994; Bartussek, 1999). Examples of expressions of natural behaviour are maternal behaviour, social behaviour and reproductive behaviour. In practice nowadays there is not a single farm animal which can exhibit such familial behaviour. SWD considered that more attention must be paid to breeding to solve the problem of non-adapted animals. Changes could easily be explained to the consumer, for example by means of their ‘Cows in the meadow’ project, in which they demonstrate that today’s highly productive cows are no longer able to pull their own grass from the meadow (grazing behaviour in the herd is reduced to food intake). There are also various examples relating to the constitution of modern pigs, which now have difficulty in expressing their natural behaviour in terms of exploration and food intake. Feather pecking and cannibalism are also related to unadapted behaviour associated with the type of hen, although they are also strongly influenced by farm management and rearing methods (Bestman, 2002).

According to PB it might help the organic sector to achieve consensus about welfare and integrity problems if there were a good definition of ‘desirable natural behaviour’. The starting point is that we ‘keep animals’, which precludes entirely natural behaviour (pigs in the forest or in outdoor runs / outdoor grazing and rooting) and so there have to be compromises. PB consequently wished to be able to evaluate which minimum elements of natural behaviour must be respected.

The specific adaptation of animals to the organic system is thus considered important by all three parties in terms of the welfare and integrity of the animals (including being able to display their natural behaviour). Weighed against the naturalness of the reproductive process (point 1) all three parties found it difficult to say what was more important. However, they did expect that “animals suitable for organic agriculture” (from the point of view of welfare) were more important for the animal and ‘society’ than a possible ban on AI and ET. It was easier to make concessions on adaptations to natural behaviour that on welfare. For example, the fact that ET was detrimental to the welfare of animals (donors, hormone treatments) was a less immediate problem than whether or not the animals fit into the organic system.

Diversity

All the organisations considered that the diversity of animal species and breeds was very important. However, for PB maximising production within organic restrictions remained a priority and the ‘need for

diversity' was secondary. Organic agriculture did not need to find a specific solution to the problem of decreasing diversity.
Nor did DB consider diversity at breed level important. It was primarily concerned with the welfare of the individual animals. The extinction of species was indeed regarded as important, but not the disappearance of particular breeds. "You should not impose too many objectives on organic agriculture". Diversity was only considered important in functional terms in its contribution to welfare and health. "Just as long as we are nor forced to go beyond the bounds of health and welfare", said the DB.
SWD considered diversity to be less important than other problems, but it did appreciate the importance of diversity for the image of the organic sector.

Dependency on large companies

PB strongly approved of the trend towards embedding organic breeding programmes in larger (product / trade) organisations to serve the consumer and the development of product uniformity that this requires. PB saw no threats, only opportunities. After all, it was often the supermarkets themselves which put forward an adapted code of conduct for the production of their products. The desired development of uniformity in the market does however lead to a loss of diversity. Farmers are forced to deliver their products within narrow quality margins. But according to PB there is no getting around the fact that farmers have to take account of the wishes of the chain and the consumer. "Farmers each manage their business in their own way, but requirements are set for each product-market combination for the resulting consumer products, and there is nothing wrong with that. The farmer does not have complete freedom of choice; he / she has to take responsibility for the requirements imposed by marketing opportunities"
DB felt that at the moment the scaling up of organic agriculture was important: while there might still be risks attached to this market strategy, there was no alternative.
SWD felt that in scaling up there was a risk that too little would change in the area of animal welfare. For example, there have been attempts for seven years to counter feather-pecking and cannibalism, but the problem is still unsolved. Negative factors like these meant that they no longer saw organic agriculture as a better solution then conventional agriculture in terms of animal welfare.

Socio-economic impact of an organic breeding programme, the image of organic agriculture and consumer expectations

All three organisations considered it very important to do something about current evils such as the slaughter of male chicks in the laying-hen sector and the transfer of bullocks and superfluous heifer calves from organic dairy herds into the conventional fattening sector. PB indicated that there still was a long way to go on this point (primarily in the development of different meat products and consumption patterns) and that the consumer and producer would need to come closer together: "We have to be able to give a good account of ourselves". In a large-scale approach to organic agriculture that is a challenge which should be given high priority. For this reason, according to PB, it was necessary to highlight the issue and start researching solutions now. Solutions would depend on how the market and product prices developed; "there is no financial margin now for experiment".
On this point SWD again pointed out a few abuses in animal welfare in organic agriculture. They receive increasing numbers of complaints from members about conditions on specific farms. The organisation is beginning to lose patience. They also appreciate that there are farms which perform well and the SWD consequently likes to highlight such exemplary 'pioneer' holdings in the media. They observe that there is now less integrity in organic agriculture in respect of animal welfare. There are also farmers – many of them biodynamic farmers - who are resisting this trend. The sector should also address these concerns.

Breeding methods

According to PB breeding should ideally address all the characteristics of the animal as a whole (broad range of characteristics instead of just a few). This is already being introduced in conventional breeding programmes. In pig breeding this would mean that a single breed would be used, e.g. York-Z, without crossing breeds and selecting specific male and female lines. It is also important to control inbreeding. If breeding in organic agriculture develops more towards breeding on the farms themselves, great care must be taken to avoid inbreeding problems. It is their opinion that an increase in inbreeding would lead to higher losses and reduced vitality. More research is needed here, according to PB.

The SWD also thought that breeding on the farm could lead to problems. It would have to be carefully monitored.

3.6. Conclusions

The following conclusions can be drawn from the discussions with the livestock farmers and the social organisations:

Livestock farmers (dairy, pig and poultry farmers)

The farmers from the different sectors opt for the development of a breeding system based on organic principles consistent with the natural behaviour of animals and the naturalness of the system.

The farmers feel that direct and indirect use of unnatural reproduction techniques should be phased out. The pig farmers make an exception in the case of AI for the time being on grounds of logistics and animal health.

The process of changing over to organic breeding within the chain will take time. However, some measures can be taken quickly, such as ruling out ET for cattle and AI on pig farms. Further necessary measures must be taken over the next five to ten years.

Often the farmers have no direct knowledge of animal breeding techniques and so cannot tell what the possibilities are or how organic breeding should develop. They would like to be offered a supply from an organic breeding system.

All sectors have questions about the currently available breeding material. As far as availability is concerned all sectors are practically entirely dependent on the choices made by the breeding organisations. There is a need for adapted breeding goals and type descriptions for organic agriculture.

Social organisations (*Platform Biologica, Dierenbescherming* and *Stichting Wakker Dier*)

The social organisations recognise the importance of the discussions held and consider it important that a general guideline be developed on breeding techniques and practice in organic livestock farming.

Neither ET nor really AI are suited to organic agriculture, when evaluated in terms of the natural behaviour of animals and artificial intervention using hormones.

The welfare of animals is important and therefore it is also important to select suitably adapted animals for organic conditions.

Diversity of breeds is not a top priority. If a particular breed is best suited to the purpose, the use of this breed takes priority over diversity.

The scaling up of organic agriculture is important when considering a vision for breeding. For breeding, it is necessary to reach agreements with the conventional processing companies concerning the marketing of products.
Alternatives must be developed to counter evils such as the slaughter of male chicks and the transfer of calves to the conventional fattening industry. It must be explained to the consumer that although there are still problems in the current farming systems, efforts are being made to solve them, and there are sometimes areas where current organic agriculture does not offer any solutions.

Consumers will look more critically at the issue of animal welfare in organic agriculture. Organic farming is no longer regarded as better than conventional farming.

The development of an organic breeding system will have to proceed step by step. It must be further developed in the European context.

Further research is required into the possibilities of a more organic approach to breeding, such as research into G x E interaction, the role of the conventional breeding companies and the opportunities offered by individual breeding farms.

4. Discussion and conclusions

4.1. Discussion

At the request of the Ministry of Agriculture, Nature Management and Fisheries (LNV) we have sought to establish a clear vision on breeding in organic agriculture. This was done through discussions with stakeholders from the organic sector and some social organisations based on a previously drafted discussion document which presented different stages of development. During the discussions it became clear that the development of an organic breeding system is desirable, both as a chain-based approach and as an organic aim. It should be achieved over a period of around five to ten years.

The discussions did not produce any unequivocal definition of 'organic breeding'. Many opinions and visions were advanced and it transpires that the way breeding systems will develop depends very much on developments in organic farming and conventional breeding systems. The livestock farmers and social organisations often have no insight into modern breeding techniques and thus cannot offer any clear alternatives. However discussions generally brought to light a desire to be supplied by a separate organic breeding chain.
Regulations on organic agriculture do not clearly define boundaries in breeding. They indicate that breeding and selection ought to be natural (IFOAM, 2000). However, there is no clarity about concrete concerns: the rules have not, for example, led to a requirement for exclusively natural mating. Nor is it clear whether the farmers are permitted to use mono-functional, overbred animals from conventional breeding programmes which can no longer display their natural behaviour due to physical limitations. Many farmers and the social organisations felt that this was actually unacceptable. The difficulty at the moment is the absence of alternatives.

Ruling out indirect use of artificial reproduction techniques (such as AI, ET, IVP and cloning) is an important requirement on the part of the organic livestock farmers. However, the breeding organisations indicate that it is impossible for them to exclude these techniques. They could not compete internationally and would have to set up a separate breeding programme for organic agriculture. This is too expensive for a relatively small sector. The use of AI is necessary to prevent the spread of disease (Daas and Van Wagtendonk, 1993).
If, therefore, organic agriculture wishes to ban artificial reproduction entirely (including indirect use) a separate breeding system for organic agriculture will be required in all sectors. The question is whether this is possible. Thus it would seem to be more realistic in the first instance to opt for avoiding these techniques where possible. For example, only for the breeding bulls themselves, and not for their ancestors. In pig breeding the option could be to work exclusively with breeding boars, instead of AI. The step is a smaller one on these farms, since they often already keep boars. Further decisions will have to be taken within the sector about how far artificial reproduction techniques can continue to play a role.

Together with artificial reproduction techniques, cloning and transgenic reproduction are gradually becoming a reality in conventional breeding (Webb, 1990; Seidel, 1992; Veeteelt, 2000 and 2001; NRC, 2003). The question is how organic agriculture can be protected from these techniques, when there is still a ban on the use of GMOs (EU, 1999; Lammerts van Bueren et al., 2001). Genetic manipulation is not permissible in organic agriculture on the grounds of the integrity of the animal (Verhoog, 1997; Visser and Verhoog, 1999).

Many farmers wonder whether such a separate organic breeding programme could really produce good quality breeding animals. Many livestock farmers have confidence in the existing breeding organisations with which they have a long association. If the breeding goals and guidelines are to change, they would like to see that happen within the existing structures. However a closed organic breeding chain raises doubts at the genetic level. Due to the small scale of the organic sector there is concern about whether sufficient genetic progress can be achieved. Many organic livestock farmers adhere to aim of high production per animal, motivated by the prevailing economic conditions.

The conventional breeding organisations say that their range includes good breeding material for organic agriculture. However, it is not clear whether this is the case, or that G x E interaction means that the breeding values of the animals are unsuitable for organic agriculture, and therefore other types of breeding animals are required..
There are more and more examples in practice which indicate that the existing breeding animals are not well suited to all organic farms, particularly since the feed is adapted. The requirements to provide more organic feeds are constantly being tightened up (EU, 1999), which means the price of bought-in feed is too high. For this reason farmers often switch over to using less concentrate or poorer-quality concentrates. The protein content of the feed is particularly important. Soya can no longer be used for pigs and hens due to the risk of contamination with GMOs, so the quality of the protein content in the feed is reduced. This affects the health of the animals and creates a demand for animals which can produce well on raw feeds and other cheaper concentrates and by-products. Conventional breeding programmes select breeding animals in an environment with a maximum food supply, which is completely balanced, and possibly combined with the use of antibiotics. We do as yet not know how much these factors affect the usefulness of the breeding values of the animals to organic agriculture. G x E interaction can after all change the breeding values. This will be researched in the Netherlands for cattle breeding (Nauta et al., 2002).

Given the above factors, can organic agriculture can continue to rely on the conventional breeding organisations? This will depend on the scale (i.e. growth) of organic agriculture and how the breeding structure develops in the future. With sufficient expansion it would probably be possible to set up special organic breeding programmes. However, given the current limited growth in organic agriculture, a target of 10% organic by 2010 seems unattainable. It might therefore be better to opt for an international approach. At the same time, new selection techniques, like marker selection (Brascamp, 1992; Rothschild, 1998; Visscher and Haley, 1998) could offer a solution to selection in small populations. This can be important in organic agriculture, particularly for (sustainability) traits with a low heritability (Pryce, 2001).
It should be noted that there have been changes in conventional breeding in the last few decades which are significant for organic agriculture. The breeding objectives pay more attention to sustainability and health (Vollema, 1999; Veerkamp, 2001; Veeteelt, 2000a, 2001a).

The question remains as to whether a general approach is desirable for organic agriculture. Organic agriculture strives for diversity in farms and for closed cycles (Baars, 1990a and 2002, Van Veluw, 1994, Alrøe and Kristensen, 2002). A general approach will lead to loss of diversity because farms (have to) choose the same varieties, because they happen to be offered organically.
More farm-specific breeding, such as the family breeding method (Baars, 1990b) can offer a solution to this problem. A few dairy farms have been breeding cattle in this way for many decades with good results (Doppenberg, 2002). For breeding in small populations it has been demonstrated in pig farming (Roo, 1988), that a farm-specific set-up offers a feasible alternative, in which inbreeding is avoided. Livestock farmers would have to be trained in this method of breeding. The current research indicates that livestock farmers who want to breed entirely organically are interested in the opportunities offered by family breeding. Courses must be developed to help farmers decide whether to adopt this method on their own farms.
At the moment most livestock farmers would not opt for farm breeding. To support the diversity arising from this form of breeding, research is required on the possible role to be played by breeding organisations. Work is currently being carried out in the cattle breeding sector to develop farm-dependent indices (Veerkamp, verbal statement).

This report is not explicitly concerned with a discussion of breeding objectives for organic agriculture. In the poultry sector in particular the need for better adapted brands seemed to be the main preoccupation. By and large the organic livestock farmers indicated that they need robust animals which can produce well within the organic environment. Generally they do not, in so many words, choose different traits to the conventional farmers. However the weight given to these traits in the breeding objective is different for organic agriculture (Postler, 1998). This requires research. It could also be said that in a more farm-specific breeding system the type of animal automatically adapts to the conditions on that farm, and that choosing this system of breeding thus leads to the desired animal types.

Alternatives cannot be developed without guaranteed economic feasibility. Many livestock farmers indicated that there is currently little financial leeway for experimentation. Research is therefore needed into the commercial feasibility of the various breeding options. For example, the option of breeding dual-purpose chickens, making it unnecessary to slaughter the male chicks, would require development of the market for the meat of whole chickens. That would take time. Such experiments could probably be carried out on a small scale by individual dairy and poultry farmers who sell the meat door-to-door. Such new marketing strategies could be supported.

Social organisations such as Greenpeace, the Consumer Association and the Alternative Consumer Association, have indicated that they do not have any immediate opinion on breeding. They are not conversant with the problems involved. Social opinion was only tested through discussions with *Platform Biologica*, *Dierenbescherming* and *Stichting Wakker Dier*. Talks with the organisations which could give an opinion indicated that 'the consumer' is often uninformed about breeding practice. The opinions thus came from the organisations themselves, which, like the *Stichting Wakker Dier*, increasingly receive negative comments about animal welfare on organic farms. These organisations are primarily concerned with the welfare of the animals. If breeding affects welfare, then they think that this should be addressed.

It transpired during this research that many questions remain about the interpretation and development of legislation. Current standards and aims in many cases have no direct connection with aspects relating to breeding. Yet the development of organic agriculture, including breeding, is also an international issue. The rules are drawn up in the European context. The results of this research must therefore also be harmonised with other European countries. Existing contacts have already indicated that the debate has not yet begun in other countries. However, research institutions in other countries are working on possible solutions. In Switzerland work has been in progress for a number of years to develop an organic cattle breeding system through the introduction of an ecological index and the use of ET-free bulls (Babst, 2002). Research is being carried out in Great Britain on crossing options for cattle to develop different animal types (Pryce et al., 2001). It is therefore necessary to involve other European countries in the debate on the development of breeding practice. A relevant contribution from the Netherlands would be desirable (Willems, 1997).

4.2. Final conclusion

The discussion document shows that both the social organisations involved and the organic livestock farmers themselves feel that breeding in organic agriculture must be redirected towards a more organically-oriented system. The will is there. The underlying reasons are: the image of the sector, the guarantee of organic quality throughout the chain (from seed to table), the danger that undesirable techniques will be brought in if farmers continue to rely on the conventional breeding sector, and the adaptation of the animal type to organic farming conditions. The livestock farmers indicate that they would like to see an organically-oriented and supported breeding system in place within five to ten years.
However there are still various obstacles in the way. For example, if they rigorously avoid artificial reproductive techniques there is a danger that in the short term the genetic base would be too narrow for organic breeding; the organic sector is too small in scale, so there are doubts about the economic feasibility of a fully organic breeding system; often there is insufficient knowledge to develop an alternative within current practice; farmers have considerable confidence in the current structure of the breeding organisations in terms of genetic progress and the quality of the breeding stock, and would like to seek solutions with them; there is confusion about the role played by genotype-environment interaction in organic livestock farming and the way this can be solved by breeding techniques, and organic legislation and standards are inconclusive about breeding.

5. Possible courses of action for the development of an organic breeding system

The livestock farmers and social organisations would like to see the development of a breeding system which reflects and respects the principles of organic agriculture. Many changes would be needed to develop an entirely organic breeding system, and organic agriculture would probably have to set up an entirely separate breeding programme of its own. This would appear to be unrealistic in the short term – it would take time to develop. Most livestock farmers estimate the time required at five to ten years. In order to guarantee organic quality it is important to exercise control throughout the chain. The steps required to arrive at an organically certified breeding system are described in this chapter.

5.1. General development of organic breeding

Organic Breeding Foundation

Each animal sector could undertake different activities to bring them closer to organic breeding. A central organisation would be needed to initiate and coordinate these activities. An organic breeding foundation ('*Stichting Biologische Fokkerij*' (SBF)) could be established for this purpose. The foundation would have to be established and sustained by people in organic agriculture with a good overview of the breeding situation and the options available in the different sectors. It could work to promote organic breeding, for example by disseminating information (via a website), running courses, fund-raising for research and pilot projects, coordinating research, etc.

European network for breeding in organic agriculture

The development of an organic breeding system is an international matter. We know from contact with breeders and research groups in various European countries that different complementary and mutually supportive solutions are being sought in other countries. It is important that these activities do not continue in isolation from each other. It is also important that similar discussions to those covered by this report be organised in other countries. This could provide an international vision on breeding in organic agriculture, which could contribute to new legislation (see next section).

Development of legislation

New legislation is required for the development of organic breeding. Regulations should be developed nationally and internationally. Consultations will need to be held with national and international organisations concerned with organic regulation (Skal, IFOAM and the European Union) and farmers and breeders. The council of Skal in the Netherlands has already received a request to develop rules for organic AI. Skal indicated it would await the results of this research.

Possible courses of action for each sector are described in Appendix III.

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7. Appendices

Appendix I: IFOAM breeding guidelines, 2000

Appendix II: Reproductive techniques in brief

Appendix III: Concrete courses of action in the different breeding sectors

Appendix I: The Principle Aims of Organic Production and Processing

(source IFOAM website, 2001)

Organic Production and Processing is based on a number of principles and ideas. They are all important and are not necessarily listed here in order of importance.

1. to produce food of high quality in sufficient quantity.
2. to interact in a constructive and life-enhancing way with natural systems and cycles.
3. to consider the wider social and ecological impact of the organic production and processing system.
4. to encourage and enhance biological cycles within the farming system, involving micro-organisms, soil flora and fauna, plants and animals.
5. to develop a valuable and sustainable aquatic ecosystem.
6. to maintain and increase long term fertility of soils.
7. to maintain the genetic diversity of the production system and its surroundings, including the protection of plant and wildlife habitats.
8. to promote the healthy use and proper care of water, water resources and all life therein.
9. to use, as far as possible, renewable resources in locally organised production systems.
10. to create a harmonious balance between crop production and animal husbandry.
11. to give all livestock conditions of life with due consideration for the basic aspects of their innate behaviour.
12. to minimise all forms of pollution.
13. to process organic products using renewable resources.
14. to produce fully biodegradable organic products.
15. to produce textiles which are long-lasting and of good quality.
16. to allow everyone involved in organic production and processing a quality of life which meets their basic needs and allows an adequate return and satisfaction from their work, including a safe working environment.
17. to progress toward an entire production, processing and distribution chain which is both socially just and ecologically responsible.

Animal Husbandry Management

General Principles

Management techniques in animal husbandry should be governed by the physiological and ethological needs of the farm animals in question. This includes:

- that animals should be allowed to conduct their basic behavioural needs.
- that all management techniques, including those where production levels and speed of growth are concerned, should be directed to the good health and welfare of the animals.

The certification body / standardising organisation shall ensure that the management of the animal environment takes into account the behavioural needs of the animals and provides for:

a. sufficient free movement
b. sufficient fresh air and natural daylight according to the needs of the animals
c. protection against excessive sunlight, temperatures, rain and wind according to the needs of the animals
d. enough lying and / or resting area according to the needs of the animal. For all animals requiring bedding, natural materials shall be provided.
e. ample access to fresh water and feed according to the needs of the animals
f. adequate facilities for expressing behaviour in accordance with the biological and ethological needs of the species.
g. no construction materials or production equipment shall be used in a way that may significantly harm human or animal health.
h. poultry, rabbits and pigs shall not be kept in cages.

All animals shall have access to open air and / or grazing appropriate to the type of animal and season taking into account their age and condition, to be specified by the certification body / standardising organisation.
Landless animal husbandry systems shall not be allowed.
Herd animals shall not be kept individually.

Brought-in Animals

General Principles
All organic animals should be born and raised on the organic holding.

Recommendations
Organic animal husbandry should not be dependent on conventional raising systems. When trading or exchanging livestock, this should preferably take place between organic farms or as part of a long term co-operation between specific farms.
When organic livestock is not available, the certification body / standardising organisation may allow brought-in conventional animals according to the following age limits:

a. 2 day old chickens for meat production;
b. 18 week old hens for egg production;
c. 2 week old for any other poultry;
d. piglets up to six weeks and after weaning; and
e. calves up to 4 weeks old which have received colostrum and are fed a diet consisting mainly of full milk.

Certification bodies / standardising organisations shall set time limits (which in any event shall be before 31st December 2003) for implementation of certified organic animals from conception for each type of animal.

Breeding stock may be brought in from conventional farms with a yearly maximum of 10% of the adult animals of the same species on the farm. For brought-in breeding stock the certification body / standardising organisation may allow a higher yearly maximum than 10% in the following cases and with specific time limits:

a. unforeseen severe natural or man made events;
b. considerable enlargement of the farm;
c. establishment of a new type of animal production on the farm; and
d. small holdings;

Breeds and Breeding
Breeds should be chosen which are adapted to local conditions. Breeding goals should not be in

opposition to the animals' natural behaviour and should be directed toward good health. Breeding should not include methods that make the farming system dependent on high technological and capital intensive methods. Reproduction techniques should be natural.

The certification body / standardising organisation shall ensure that breeding systems are based on breeds that can both copulate and give birth naturally.

Artificial insemination is allowed.

Embryo transfer techniques are not allowed.

Hormonal heat treatment and induced birth are not allowed unless applied to individual animals for medical reasons and under veterinary advice.

The use of genetically engineered species or breeds is not allowed.

Mutilations

The animals distinctive characteristics should be respected. Species should be chosen which do not require mutilation. Exceptions for mutilations should only be given when suffering can be kept to the minimum.

Mutilations are not allowed.

The certification body / standardising organisation may allow the following exceptions castrations, tail docking of lambs, dehorning, ringing, mulesing.

Suffering shall be minimised and anaesthetics used where appropriate.

Appendix II: Reproduction techniques

AI
Artificial insemination means adminstering a dose of semen to a cow using a pipette. The semen is collected at special AI stations. The sperm from each ejaculate is diluted and divided into several hundred doses in straws which are frozen and stored in liquid nitrogen at -196^{0}C. Under these conditions the semen can be stored indefinitely. The freezing and thawing processes kill around 30 to 40% of the sperm cells. To achieve good fertilisation results 10 to 12 million sperm cells are frozen per dose. This brings the conception rate to around 70% non-return after 56 days. This can vary from bull to bull (Den Daas and van Wagtendonk, 1993).
With boars the sperm is collected, diluted and refrigerated, then used within three days. Freezing would kill too many cells. However, boar semen is frozen for storage in the gene bank.

ET
Embryo transplantation or transfer refers to non-surgical transfer of an embryo from the uterus of a donor to that of a recipient. The embryos are flushed out of the uterus using a catheter containing a physiological saline solution. With sows this method only works if the uterus has already been surgically reduced. Otherwise the sow must be slaughtered before embryo collection.
The embryos developed in vivo are flushed when they arrive in the uterus and before they are implanted. They are then at the morula or blastocyst stage. These stages in cattle lend themselves well to freezing and storage in liquid nitrogen. In pigs this is not yet practicable.
Fresh or frozen embryos are then (after thawing) non-surgically transplanted into the uterus of the recipient animal by means of a pipette. In cattle this produces a conception rate of around 60%. The technique is still in the development stages for pigs.

IVP
In vitro embryo production is a combination of “ovum pick up” (OPU), in vitro fertilisation (IVF) and embryo cultivation (in vitro cultivation IVC).
OPU involves introducing a needle into a follicle via the vaginal wall using an analgaesic with rectal and echo guidance and aspirating the contents. This treatment takes around 20 to 30 minutes and is repeated twice weekly.
The ovum is then cultivated in vitro for 24 hours and then fertilised with thawed sperm from a breeding bull. The fertilised eggs are grown on for 5 to 6 days until they reach the morula or blastocyst stage. In this way five to seven embryos per week can be collected from a cow. Fresh transplanted embryos give a conception rate of 50 to 60%. After freezeing the rate drops to around 40%. With sows eggs can only be removed surgically or after slaughter of the animal. IVF is not yet practicable in pig breeding. Fertilisation often results in polyspermy.

Superovulation
Embryo transplantation is sometimes used in conjunction with a natural ovulation. However, it is more often combined with superovulation to increase efficiency. For this purpose the donor is treated beforehand with folicle stimulating hormone (FSH) preparations which precipitate several ovulations. Following ovulation the donor is inseminated two to three times to fertilise as many eggs as possible. The fertilised eggs develop in the oviduct in 5 to 6 days into transplantable embryos (morulae and

Appendix III. Concrete courses of action in the different breeding sectors

III.1. Courses of action in cattle breeding

Organic AI organisation

For cattle breeding the possibility of setting up an organic AI organisation with Skal certification should be investigated. SKAL would have to develop additional regulations for certification. The farming of the bulls could be required to meet organic requirements, following the example of organic dairy farming.
This organisation could in the first instance regulate the supply of all ET-free bulls from the conventional breeding sector. It could proceed as an AI organisation to develop an organic breeding programme and to select and test bulls from organic agriculture.

Supply of ET-free bulls

ET-free bulls can be selected from the current stock of bulls from breeding organisations and traders / importers. The ET origin is not always clear due to inadequate registration by the breeding organisations. For further development of ET-free status the ancestors of the bulls must not originate from ET. For this purpose the ET free status of the ancestors must be known. For Holstein breeding this will probably mean that the selection range will be small, because many ancestors come from breeding lines in which ET has been much used. It will not always be possible to determine ET-free status with certainty. A pragmatic option therefore would be to disallow ET from now onwards and to guarantee ET-free status in future generations. For effective selection the breeding organisations must reinstate ET-free status as a standard. However, for ET-free breeding there will have to be consultation with the breeding organisations concerning their options and their willingness to ensure a good selection and supply of ET-free breeding bulls. An ET-free bull list could be compiled annually.

The breeding value and origin of ET-free bulls requires further investigation. It is important for organic farmers that a good genetic supply and a spread of pedigrees remains available.

Limited use of AI

To limit the use of AI it would be possible to opt for new breeding bulls born by natural reproduction. In the current conventional breeding system however, bulls and cows are often kept separately (bulls at AI stations and cows on farms). We need to find out whether there are still breeding farms which keep their own bulls and whether these breeding farms would be of interest to organic agriculture. The same problems apply to the selection of bulls from organic farms.
AI can also be restricted by extending the useful life of each breeding bull. In the Scandinavian system breeding bulls are retired after producing a certain volume of semen.

Adaptation of conventional breeding data for organic cattle farming

The options for adapting the breeding data can be split into two strands: (1) Supplementing the estimated breeding value with additional data considered desirable by organic livestock farmers, and (2) adapting the estimated breeding value using information about G x E interaction.

(1) Supplementing the estimated breeding value with additional data on the lifetime production of female ancestors of the bull, as used in the German breeding system for lifetime production (Haiger, 1998; Postler, 1999). The dam + maternal granddam and bull dam must collectively have produced at least 150,000 kg milk[2].

[2] While this information is often known, it is not readily available. These data are published in addition to the normal breeding values.

Farm-specific indicators on the management system and environment from which a breeding bull originates, e.g. kg concentrate / cow, kg maize in the feed ration, type of land, number of cows on the farm and type of housing. The livestock farmer can then use these indicators to determine whether his or her farm is compatible with the origin of the bull.
External data such as Triple A Code and breeding value data on conformation and condition. This gives the livestock farmer the opportunity to breed a better balanced productive animal, or to consider the robustness of his dairy cows.

(2) adapting the estimated breeding value for organic agriculture
Adapting the weighting factors of the individual traits in the breeding objective based on the principles of organic agriculture (e.g. in accordance with the German overall ecological index (ÖGZ)).
Providing relative breeding values per trait for the relevant characteristics instead of an overall index.

Development of breeding based on organic agriculture and regulations

For this the breeding organisation must select bull dams and breeding bulls on organic farms. These breeding bulls must be reared on an organic farm and tested for growth and development. The breeding value of the bulls must be calculated on the basis of data on daughters milked on organic farms.
To set up an organic breeding system a commission is required to select the bull dams and have the bulls tested by an AI organisation. In the Netherlands this can be done at AI-Kampen. The sale of semen from the experimental bulls must be arranged in advance, so that sufficient daughters of these bulls are produced for the estimated breeding value.
It is currently difficult to set up such a breeding system following the conventional model because the organic population is small. It is only possible on a small scale with the Holstein breed. In 2003 around 12,000 Holsteins are in milk on organic dairy farms. We need to determine how many bulls from this population can be tested annually.
For smaller populations this system can be used to test for productivity traits, assuming that the genetic disposition of the selected bulls is good enough for organic agriculture.

Regional or family breeding

The organic breeding organisation can also promote and support the development of regional or family breeding. This requires knowledge support for the livestock farmers. Courses could be set up to familiarise farmers with the techniques of farm-specific breeding. A distinction can be made here between the farm's own breeding system and / or a 'user breeding system' for livestock farmers who use the breeding bulls of elite breeders for their own herd. Armed with the necessary information, the livestock farmers can decide for themselves whether they want to use their own breeding system on their farm (elite breeder) or whether they wish to use the breeding services of others (user).
The opportunities offered by this system under the current (EU) rules for the exchange of breeding bull semen will have to be examined. Currently bulls must spend a period in quarantine with a qualified AI organisation prior to exchange. AI-Kampen provides this service in the Netherlands.

III.2 Courses of action for pig breeding

Organic Pig Breeding Organisation

For pig breeding the possibility of setting up a breeding and AI organisation with Skal certification should be investigated. SKAL would have to develop additional regulations for certification. The organisation could in the first instance promote natural reproduction with boars from conventional breeding programmes and could proceed as a breeding organisation to develop organic pig breeding programmes.

Breeding without AI on farms

For this purpose boars would again have to be kept on farms. Many farms still have boars because they make partial use of natural servicing. By providing information and guidance this practice could be promoted throughout the organic pig sector.

Joint approach using field data (Jan Merks, IPG)

With the aid of the IPG in Beuningen data on production farms (breeding and meat production) can be collected and used for the selection of suitable boars for elite breeding programmes. In pig farming / breeding this is not currently common practice. Expertise needs to be built up. In this way a breeding programme can be developed in collaboration with IPG. In this case selection is supported by data from organic production.

Sow selection on the farm

Many farms already rear their own sows, sometimes from their own crosses, but also from the heavy baconer populations. To help them set up their own sow selection, courses could be held and support developed, for example in the form of selection software at farm level and / or personal guidance.

Pure breeding and farm-specific breeding

The organic pig breeding organisation could promote on-farm breeding. Research is required into the feasibility of breeding entirely on the farm, and thus also the selection of boars. It is also important to boost knowledge by holding courses. This knowledge can be gleaned from the family system used in cattle breeding (see section 5.2); see also De Roo, 1988.

III.3 Courses of action for poultry breeding

Research is needed to determine whether it would be possible to set up organic breeding farms for poultry breeding with the conventional breeding organisations These farms would have to meet Skal standards for the breeding material to have an organic label. Skal would have to develop regulations for this purpose. At these holdings chickens can be bred for organic agriculture in collaboration with organic poultry farmers and conventional breeding companies.
A breeding organisation could be set up to develop breeding programmes for organic poultry farming.

Production of breeds/hybrids for organic poultry farming

Using a combination of existing breeds and lines, hybrids can be bred which are more suitable for organic farms. The parent animals are kept under organic conditions so that they are selected within organic agriculture.

Breeding dual-purpose chickens (meat and eggs)

Dual-purpose chickens must be bred to counter the slaughter of male chicks after hatching in layer hen breeding. For this purpose laying and meat breeds need to be combined, as done by the ISA in collaboration with Fibl Zwitserland (Maurer et al., 1998) or Tetra and Hendrix (Brodman et al., 2000). This requires consultation with the breeding organisations and feasibility studies for the Netherlands. Special attention and research should be devoted to the marketing of the meat.

Pure breeding and farm-specific breeding

On small farms farmers could experiment with rearing their own chickens. The family system in cattle breeding can be used as an example. A start was already made at the end of the eighties when Andreas Wijgmans, who had been a biodynamic poultry extension worker, managed to breed a pure line from three existing breeds (including Barnevelder and New Hampshire) over a ten-year period. Information is needed on the feasibility of farm-specific breeding on individual farms and what it would require.