

NEWSLETTER of the LowInputBreeds project

Development of integrated livestock breeding and management strategies to improve animal health, product quality and performance in European organic and 'low input' milk, meat and egg production

Editorial

With this third newsletter of the EU-funded project LowInputBreeds we intend to inform our readers about recent project activities and results in cattle, sheep, pig and laying hen production systems as well as in economic and multi-criteria impact assessment. Furthermore researchers from the LowInputBreeds project have compiled two brief articles. The first article describes the use of genome-wide selection strategies for improving functional traits in cattle, the second article describes the concept of integrated control strategies for sheep in mountainous production systems, which will be developed in the LowInputBreeds project.

We would also like to draw your attention to the **first LowInputBreeds Symposium**, taking place on March 15 and 16, 2011 in the Netherlands. Researchers from LowInputBreeds and from the European Consortium for Organic Animal Breeding ECO-AB will present their approaches and breeding methods used. Discussion of ethical aspects will be initiated by invited speakers from relevant stakeholder groups. The first general assembly meeting will take place during the symposium. More information is available at page 12 of this newsletter as well as on our homepage www.LowInputBreeds.org.

Veronika Maurer, scientific coordinator and Carlo Leifert, coordinator

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The LowInputBreeds project is co-financed as a Collaborative Project by the European Commission, under the Seventh Framework Programme for Research and Technological Development (Grant agreement No 222623). The contents of this newsletter are the sole responsibility of the authors, and they do not necessarily represent the views of the European Commission or its services. Whilst all reasonable effort is made to ensure the accuracy of information contained in this newsletter, this newsletter is provided without warranty and we accept no responsibility for any use that may be made of the information.



Use of genome-wide selection strategies for improving functional traits in cattle

Filippo Biscarini,¹ Sven König² and Henner Simianer³

In recent years the DNA sequencing technology has advanced at an unprecedented rate, facilitating the sequencing of genomes of many livestock species.

The genome of the cow was sequenced last year (Bovine Genome Sequencing and Analysis Consortium, 2009).

Such technological advancements are making it increasingly cheaper to genotype many individuals for a large number of 'single nucleotide polymorphisms', or SNPs (pronounced 'snips'): 50'000 SNP panels are now available for identification in cattle at a cost of less than 100 Euros per animal. High density SNP panels with around 800'000 SNPs are just becoming available in cattle for about 250 Euros per animal. In the near future it is foreseeable that whole genome sequence data will be available in cattle at a reasonable price.

The 'genome revolution'

All this is the basis of the current revolution in the field of animal genetics. Until now, genetic analysis and improvement of farm animals has been based on the analysis of phenotypes and pedigree relationships for the estimation of variance components and breeding values (EBVs). This approach has been very successful for the improvement of livestock productivity. Dairy cattle in intensive farming systems have, for example, reached spectacular milk productions of over 10'000 kg per year. However, the drawbacks of such traditional breeding schemes is they need extensive and accurate collection of performance records and pedigree relationships, and, especially in the case of progeny testing for dairy bulls, they have a very long generation interval. Additionally, functional traits (fertility, longevity,

those linked to health etc.) are somehow more difficult to select for with classical techniques, given their generally low heritability and the unfavourable correlations with production traits. In the last couple of decades, a relatively small number of genetic markers have been added to the tools available to animal geneticists: besides their value in theoretical scientific research, they found application almost exclusively in pre-selection of young bulls to be progeny tested, and were therefore of limited efficiency.

Genomic selection

The large amount of genomic data available now allows us to look at a fine scale into the 'black box' of the genome, and to change perspective radically, from phenotypes and pedigrees directly to genotypes. With genomic data the effects of tens of thousands of markers - or of all genomic points in the case of whole sequence data - on any given phenotype can be estimated, and then used to calculate genomic breeding values (GEBVs). GEBVs should in principle be more accurate than EBVs, since they are based on direct observation of the genome, instead of indirect estimation from phenotype. Genetic effects can be estimated in a reference population and used to compute GEBVs for all genotyped animals, including the very young. This can dramatically reduce the generation interval: In fact, it would no longer be necessary to wait for daughters to have milk records and other performance data to estimate the genetic value of their sires; these could be known from birth. This approach is known as genomic selection, and seems to be particularly promising for functional traits such as fertility, longevity, disease resistance and behaviour, which have low heritability. Model calculations (König et al., 2009) have shown genomic selection has the power to improve selection for functional traits with the same level of efficiency as selection for production traits.

Accuracies of GEBVs are in fact less dependent on heritability than EBVs (Lund and Su, 2009). A greater knowledge of the genome could be used to fine-tune selection, capitalizing on genes with known effects on target traits. This might help reduce problems due to unfavourable genetic correlations (as is generally the case, for instance, between functional traits and production in dairy cattle) and to loss of variability. Recent studies (Pimentel et al., 2010) show that despite the general unfavourable genetic correlation between production and functional traits (such as fertility), some genes have positive effects on both types of traits, and could therefore be used in direct genome-

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based selection to help overcome the negative correlation.

Genomic information can also be used to estimate true relationships among animals, through the analysis of the inheritance of chromosome segments between generations. Such relationships would be more accurate than traditional average pedigree relationships. Genomic relationships matrices, providing a better description of the genetic similarities between animals, will help to keep inbreeding under control.

Practical implications

It is important to realize that genomic selection as described is not in the realm of 'gene technology' or 'transgenics': it does not involve the genetic modification of individuals or embryos. Rather, it makes efficient use of gene diagnostics, i.e. identifying the composition of the genome of selection candidates. Then animals with the most suited genetic make up, on the basis of the chosen breeding goal – which is usually a mix of production and functional traits – are selected as parents of the next generation, just as in traditional breeding programmes.

It is also important to point out that the estimation of genomic effects should be updated regularly, and carried out for different breeds, since the same loci might have very diverse effects in one breed compared with the other. This might apply also to populations of the same breed selected under very different farming conditions, such as intensive vs. 'low input' farms, due to genotype by environment interactions that has been shown to be relevant in many species. Besides, different farming systems will have different - and sometimes divergent - needs and interests, leading to different sets of priorities in animal characteristics.

In the context of the LowInputBreeds project, this is exactly what we intend to do in subproject 1 (SP1): apply the knowledge, data and techniques derived from the field of genomics to the characterization of dairy cattle populations in 'low input' farming systems and to the development of genetic evaluation and improvement schemes that best match their needs.

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Concept of integrated control strategies for sheep in mountainous production systems

Hervé Hoste,¹ Felix Heckendorn,² Smaragda Sotiraki,³ and Veronika Maurer⁴

Infections with gastro intestinal nematodes (GINs) remain one of the main threats for the health and the welfare of small ruminants when they are bred in outdoor conditions. Up to now, the usual mode of control of these parasites has been based on the repeated use of chemical (commercial) anthelmintics (AHs). However, the current, worldwide diffusion of resistance to AHs in the worm populations illustrates that such a solution relying on the nearly exclusive use of chemical drugs is not sustainable. The concept of livestock production with low external inputs (such as organic farming or sustainable agriculture) promotes the combination and integration of several solutions in order to reduce the frequency of chemical AHs. These so called 'alternative' solutions aimed either at promoting the rational use of pastures, taking into account local information to minimise their infectivity (i.e. the density of larvae on pasture) or at improving the host response against the parasites. The potential of some 'novel' anthelmintic substances, issued from natural compounds, to kill the worms or to affect their biology represents a third approach.

The EU project LowInputBreeds aims at exploring these different solutions either by themselves or in

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combination, in mountainous areas throughout Europe (Switzerland, Greece and France) and by promoting field/farm studies for repeated years.

In the three countries, the AH efficacy of various plants (sulla and carob in Greece, sainfoin and horse bean in Switzerland, sainfoin in France) which have the common feature to be rich in condensed tannins, will be tested first in indoor controlled conditions. Thereafter, these different plants will be integrated in field studies in order to define what the best period and timing of distribution is depending on the sheep breed and on the grazing management systems.

The role of grazing management strategies will be examined in Switzerland (FiBL) and France (INRA). In Switzerland, the level and diversity of GIN infections in two sheep breeds ('Weisses Alpenschaf' and the local sheep breed 'Engadiner') will be compared in grazing systems which will or will not include a summer transhumance. In France, the effects of grazing either high or low levels of grass will be compared in the Massif Central between organic vs. conventional systems (i.e. receiving or not receiving fertilizers on pasture) on two sheep breeds, 'Blanc du Massif Central' and 'Limousin'.

The genetic components of the sheep response against the worms will be examined first by comparing the possible differences between herds of different sheep breeds grazing in similar conditions. These comparisons will always include a local breed. In addition, the estimation of genetic parameters for performance and for resistance to abiotic stress and also to nematode infections will be performed on the Sfakiano dairy sheep in Greece (NAGREF), and on the various breeds involved in the study in Switzerland and France. This definition of genetic parameters and the seek of genetic markers to improve selection will be performed in close collaboration with Lincoln University (New Zealand) where markers have been recently developed to evaluate the resistance of NZ sheep to foot rot, GINs and cold.

Besides the evaluation of the parasitological parameters, it is worth to underline that, in these different studies, measurements of the quality of carcasses as well as of parameters defining the quality of meat and fat will be performed through a collaborative network which includes also the University of Catania (Italy).

It is expected that at the end of the LowInputBreeds project, a clear, science-based evaluation of the different novel approaches to control GINs will be provided in order to better adapt and combine the various solutions to sheep breeding in a wide range of situations in

European mountainous areas. These integrated approaches should help at reducing the reliance on the commercial AHs and favour the quality of sheep products.

Reports from the subprojects

Subproject 1: Dairy cow and cattle production systems

Filippo Biscarini,¹ Sven König² and Henner Simianer³

Within subproject 1 ('Improving performance, animal health & welfare, environmental impact and product quality in organic and 'low input' dairy cow production systems'), the following activities have been taking place recently.

WP 1.1 Dairy cows and beef cattle: Within breed selection systems

Estimation of genomic breeding values (GEBVs) for bulls

In work package 1.1, with the help of a recently recruited PhD student, Michael Kramer, a methodology for the estimation of genomic breeding values (GEBVs) for cattle is being developed. Fifty-thousand SNP panels of approximately 1200 Brown Swiss bulls and their official EBVs for milk production traits have been used. A Genomic BLUP (Best Linear Unbiased Prediction) methodology has been implemented and will be compared to Bayesian approaches. The developed methodology will be later on applied to genotypic and phenotypic data of Brown Swiss cows from low input herds, which are currently being generated.

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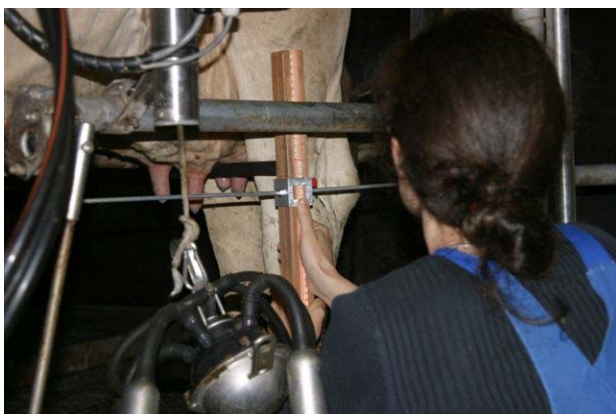
Phenotyping and DNA sampling

Approximately 1300 Swiss Brown dairy cows on 40 farms have been visited during the third (May/June) and fourth (August/September) data sampling tour. All visited cows have been evaluated for several phenotypic characteristics. DNA from 1245 cows has been extracted by now. As some of these animals have already been slaughtered and have only few phenotypic data points, blood from animals which have recently entered the herd (mostly heifers) has been taken within the fourth sampling tour. DNA extraction from these samples might be useful if these animals show more data points than slaughtered animals.

Moreover, the second milk sampling to study the effect of contrasting feeding regimes on fatty acid composition is taking place and will be finished soon.

High density genotyping

Due to advances in technology, Illumina Inc. is able to provide a newly developed high density (HD) SNP chip harbouring almost 800'000 SNPs, thus with more than tenfold the information content compared to conventional chip of 54'000 SNPs. It is planned to do the majority of genotypings in work package 1.1 with this HD chip. This will help to make a better use of the phenotypic information collected in the 'low input' herds, leading to more accurate genomic breeding values for 'low input' relevant traits.



Phenotyping cows: measurement of the udder depth. Picture: Thomas Alföldi, FiBL, Frick



Phenotyping cows: ultrasonographic measurement of backfat thickness. Picture: Thomas Alföldi, FiBL, Frick

Meetings

On March 26th a meeting was held in Zürich (Switzerland) with the Swiss partners of the project (Swissgenetics, Swiss Brown Cattle Breeders' Federation SBZV, Research Institute of Organic Agriculture FiBL) to discuss the collection of phenotypic and genotypic data of Brown Swiss cows.

On May 26th the workshop 'Low input livestock farming' was held in Brussels (Belgium). Filippo Biscarini represented the University of Göttingen and presented the work and first results from work packages 1.1 and 1.3. In preparation for the workshop we have been asked to take part in a survey on 'low input' farming systems. This workshop coincided with a meeting on the organization of the first LowInputBreeds Symposium in 2011 in the Netherlands (see page 12 of this Newsletter).

WP 1.2: Dairy cows and beef cattle: Cross breeding strategies

The main part of this work package had to be postponed when we discovered our original plan of using the milk recording services to collect individual milk samples was not possible without the addition of a preservative (bronopol) to the milk. There was no evidence available on the impact this might have on fatty acid determination and a study was carried out to assess this. Thankfully results show that freezing samples (which is standard procedure) has a greater influence over the analysis than adding the preservative. The only significant impact of bronopol appears to be restricted to some of the minor fatty acids which are

present at less than 0.05 percent of milk fat. This outcome has enabled us to go ahead with planning the main part of this work package which will now run during 2011 to 2012. Meanwhile, the study on the impact of the preservative on fatty acid determination has been written up and submitted to a peer review journal.

WP 1.3: Dairy cows and beef cattle: Multi-criteria evaluation

In work package 1.3, the main focus is to simulate day by day operations in 'low input' dairy cattle farms to find the most suitable breeding strategy. A prerequisite for simulation studies is the availability of genetic parameters for a multitude of traits. With the help of a recently recruited PhD student, Tong Yin, variance and covariance components were estimated by applying random regression methodology for production as well as for mostly binary distributed functional traits from 'low input' dairy cattle herds in Switzerland. Results have been shortly presented at the meeting of the German Society for Animal Production DGfZ and the German Society for Animal Science GfT in Kiel (Germany) titled as: 'Application of random regression models to estimate variance components in 'low input' dairy cattle herds' by Yin, T., Bapst, B., Simianer, H, and König, S.

The next step is the estimation of covariance components between production and low heritability functional traits. Tony Yin and Sven König also developed a framework of a simulation program allowing the variation of parameters on the genome level as well as design parameters for a breeding program.

Open call

In the framework of SP1, an open call for the recruitment of additional partners that will contribute with phenotypic and genotypic data of dairy cows has been published. The deadline for the submission of applications was October 6th.

Outlook

In the next months, phenotyping of 'low input' cows will be completed and a sample of around 1'200 cows and bulls will be genotyped. The most important animals will be genotyped with the newly available HD SNP chip, harbouring almost 800'000 SNPs. For the remaining animals which are typed with the usual 54k SNP chip, the high density genotype will be imputed, so that ultimately true or reconstructed HD genotypes will be available for all animals in the sample. In the next step,

different strategies to estimate genomic breeding values (BLUP and Bayesian methods) will be thoroughly evaluated with different traits regarding the reliability of predictions that can be gained.

Subproject 2: Sheep production systems

Hervé Hoste¹

Activities from May 2010 to October 2010 for the subproject on sheep (SP 2)

During these last six months, some of the main experiments which started in spring 2010 and that corresponded to the main tasks within the subproject have been continued. Most of these trials will be completed by the end of autumn 2010. Therefore, most studies are not totally completed and the statistical analyses of the data remain to be performed.

WP 2.1 Within breed selection to improve abiotic and biotic stress resistance

Monthly sampling of sheep by the National Agricultural Research Foundation NAGREF in Crete (Task 2) has been carried out since December 2009 and will cease in autumn 2010. Faecal and milk samples have been collected and milk yield, FAMACHA (an estimation of *Haemonchus contortus* parasite infestation) and body condition score (BCS) have been recorded for each ewe. Milk samples are analysed in collaboration with ELOGAK (Hellenic Organization for Milk and Meat) in an accredited laboratory in Rethymno. Blood collection from ewes and rams has started and FTA cards with samples will be sent Lincoln University, New Zealand, by the end of 2011 to assess genetic variations in the Sfakiano population.

WP 2.2 Management strategies to control endoparasites

A large experiment aiming at comparing different control and management schemes in combination with the transhumance of sheep started in spring 2010 and ended in October 2010 (Research Institute of Organic Agriculture FiBL). Meanwhile, a field experiment was also performed by the National Institute for Agricultural Research (INRA) in Theix to examine the influence of sainfoin to control infections with gastrointestinal nematodes (GINs) in weaned lambs. The National Agricultural Research Foundation NAGREF

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has carried out a control study to quantify the anthelmintic activity of different proportions of tannin rich concentrate (carob) in sheep diets between August and October 2010.

WP2.3: Development of strategies to improve lamb meat

For the second year, INRA Theix has started a comparison of the impact of 2 factors (organic farming vs. conventional systems, high or low grass intakes) on the carcass and meat quality and level of parasite infections in four groups of 13 lambs. The study started in June 2010, with half of the animals slaughtered at the time of preparing this report.

Meanwhile, from March to May 2010, the University of Catania, has completed a 72-day field experiment comparing the effect of morning vs. afternoon feeding on lamb meat quality. Preliminary results have been acquired on lamb growth and intakes on pasture, but those on carcass chemical composition are still in the process of analysis

Dissemination activities

A general presentation of the LowInputBreeds project, entitled 'Internationale Projekte rund ums Schaf / Projets Internationaux dans le secteur ovin' has been published by Veronika Maurer and Felix Heckendorn, from FiBL, in the review 'Forum' which is dedicated to breeders of small ruminants and deer.

Lastly, overall information on the use of tannin rich forage and on their control of GI Nematodes have been presented by Hervé Hoste (INRA) to local farmers and producers of Legume forages in Arcis sur Aube (June 2010) as well as during the Festival de la Brebis, which was held in St Affrique, from September 10th to the 12th September 2010, that gathered many farmers working on dairy small ruminants from the South of France.

Relevant SP meeting

On May 26, 2010 a meeting between Partners 2, 3 and 7 took place in Brussels, aiming at i) discussing the design of experiments to measure the parasitic infections; ii) harmonizing the measurements and at exchanging methods and iii) harmonizing the preparations of samples collected by the 3 partners, in particular with regard to participation of partner 19.

Presentation of the subproject in Greece

A press event of subproject 2 presenting the work of the LowInputBreeds project took place in Heraklion, Crete on the 22nd of April 2010. It was organized by the Greek LowInputBreeds partner, the Veterinary Research

Institute (VRI) of the National Agricultural Research Foundation (NAGREF) in collaboration with the Geotechnical Chamber of Greece, Branch of Crete, who also hosted the event.

The aims and objectives of the research project, progress to date and future perspectives were presented by Alexandros Stefanakis and Carlo Leifert. In his presentation Alexandros Stefanakis pointed out the need for research to improve genetic resistant to parasites, mastitis and heat stress in sheep. Carlo Leifert underlined the importance of 'low input' production systems in a changing planet and the need for low chemical residues in milk and meat products.

The meeting was attended by Newcastle University (NEFG) staff, the director and staff of VRI NAGREF, representatives of local farmer associations, representatives of the animal feed industry, local veterinarians and newspaper and television reporters as well as academic personnel of the Veterinary School, Aristotle University of Thessaloniki and representatives of the National Organisation for Milk Quality and Safety (ELOGAK). The presentations were followed by long fruitful discussion between attendants and the organizers. Various articles on the LowInputBreeds project were published in local newspapers.

Outlook

During the period between October 2010 and February 2011 analyses of the results obtained from the 4 main field experiments carried out respectively in Greece (SP 2.1), in Switzerland (SP 2.2), Italy (SP2.3) and France (SP2.2 and SP2.3) will be performed and discussed between partners. This will also help to prepare the experiments for next year.

Subproject 3: Pig production systems (SP 3)

Jascha Leenhouwers¹

Review of the past six months

For pig breeding research in SP3, considerable progress has been made during the past six months:

- › Results of a Dutch study on breeding replacement gilts for organic farms were accepted for publication in a peer-reviewed scientific journal.

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- › Results of a literature meta-analysis and survey on performance of traditional vs. conventional breeds in organic/'low input' production systems were presented at the EAAP Conference in Crete in August. These results are also being prepared for publication in a scientific journal.
- › The relationship between litter size and ambient temperature has been investigated. Research focused on critical moments during the cycle of a sow as well as possible genetic differences in heat stress tolerance.
- › On June 9 and 10, the second progress meeting of subproject 3 (pigs) took place in Amsterdam. Progress of the various work packages was presented.
- › The first gilts of two genetic father lines were born and reared under barren and enriched (organic) conditions in order to investigate their future maternal behaviour. In the end of 2010 they will be inseminated, so the observations during farrowing and lactation will start in the spring of 2011.



Outlook with regard to next period

- › In autumn 2010, a paper entitled 'Effect of heat stress on farrowing rate in sows: parameter estimation using within-line and crossbred models' will be submitted to a peer-reviewed scientific journal. The genetic background in heat stress expressed in farrowing rate is discussed as well as the differences in heat stress tolerance in purebred and crossbred sow lines.
- › Data collection will be started on a large 'low input' pig farm (1500 TOPIGS sows) in Mato Grosso, Brazil. These data will be used to design a selection strategy to increase pig survival and to develop the implementation of a flower breeding system.
- › A MSc student project will investigate the usefulness of weather station vs. barn temperature data in genetic studies on heat stress tolerance.
- › Conventional pig farmers have shown interest in the effect of rearing conditions on maternal behaviour.

Results generated in this project may also be applicable in conventional rearing pens.

- › A stakeholder workshop is planned for 2011 with the theme 'How to create a market around local breeds'.

More information

- › Information about subproject 3 is available at the LowInputBreeds project homepage at www.lowinputbreeds.org/sp3.html

Subproject 4: Laying hens (SP 4)

Ferry Leenstra¹

Review of the past six months

Laying hens worldwide are rather uniform and selected for the very large market of intensive (cage) production. In the LowInputBreeds project we analysed the performance of hens and opinions of farmers who keep laying hens in organic and free range systems. We started with a survey among laying hen farmers in France, Switzerland and the Netherlands. Data has been collected and the first results are now available from a total of 276 farms surveyed, 115 with free range and 159 with organic hens.

The research showed that the Swiss farms (2'000 to 3'000 hens) are considerably smaller than the French farms (4'000 to 8'000 hens), and the Dutch farms have the largest flocks (8'000 to 17'000 hens). The farms housed hens of 10 different brown, 3 white and 4 silver crosses. In Switzerland there are quite a lot of mixed herds, especially with white and brown hens. The French have only brown hens.

Average production to 60 weeks of age, showed no differences between countries and systems (organic or free range, all 242 to 247 eggs/hen housed), with the exception of the Dutch organic hens (231 eggs/hen housed). This was due to higher mortality among the Dutch organic hens (12 percent compared to 4.7 to 6.6 for the other groups). We are currently analysing the data more in detail.

Outlook with regard to next period

The second step is to hold workshops for layer farmers in each country to identify their 'ideal hen' for their systems. In the Netherlands the first round of workshops has finished. In three separate groups, previously unknown to each other, farmers indicated unanimously

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a robust hen was much more valuable than those with high peak production. They indicated that in free range or organic systems the farmer cannot avoid stress factors and hens have to cope. Hens with a relatively high initial body weight and a good eating capacity are required. Moreover good feather cover is necessary and farmers report possible differences between types of birds. A third group of characteristics farmers like in hens is quiet, explorative and intelligent behaviour. In this respect, they indicate some genotypes are rather stupid and prone to panic. The farmers are really interested in participating in the project.

Comparable workshops will be held with French and Swiss farmers and partner ISA, a poultry breeding company, will consider findings to create a genotype specifically for free range and organic systems. Farmers are then invited to experiment with this hen.

More information

Further information about subproject 4 is available at www.lowinputbreeds.org/sp4.html

Report from work package 5.1 Economic and multi-criteria impact assessment

Fulya Batur¹ and Tom Dedeurwaerdere²

Work package 5.1 of the LowInputBreeds project aims to evaluate existing accreditation mechanisms and economic approaches related to 'low input' livestock farming systems.

The contribution to sustainable development is assessed through a multi-criteria evaluation of the public goods delivered by different production systems, management techniques and breeding innovations. To this end, we are conducting a comparative analysis of approaches to 'low input' livestock production, based on the performances of production schemes in the delivery of public goods. This analysis operates on the 'best representative' production scheme for which breeding innovations are developed within the scope of the LowInputBreeds Project.

The research thus first identifies the specific production schemes falling within each category of the LowInputBreeds project namely dairy cows, sheep, pigs

and laying hens (Section I), before establishing the specific environmental, food quality, animal health and welfare criteria to be taken into account within the multi-criteria assessment (Section II). The assessment table shall then be applied to develop the simulation models of the economic performance of the best representative of the production systems identified within the first section (Section III). Within a broader mindset, the work package shall also attempt to highlight the possible institutional responses that could be adopted to fuel the production systems under study and the correlative breeding innovations (Section IV). The existing top-down tools and the emerging bottom-up solutions identified through this process shall then be compared, so as to identify the potential contribution of long-term institutional and economic framework that could include the contribution of non-state initiatives and state based policies (Section V).

Stage of Research: Identification of relevant production schemes and assessment criteria (Sections I and II)

Following a literature review and the multi-stakeholder workshop held on the 26th of May 2010, the relevant and most different organic and 'low input' production schemes have been identified for each of the four livestock categories falling within the scope of the LowInputBreeds project (see workshop report). These production schemes shall now be weighed and analysed in light of the sustainability indicators vis-à-vis environmental protection, public health, safety and animal welfare performance, indicators which have also been identified through a literature review and stakeholder consultation (Table 1).

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Table 1: Environmental, food quality and public health impact assessment

Environmental	Energy Efficiency / input efficiency	Methane Emissions
		Carbon Dioxide Emissions
		Fuel Use
		Carbon sequestration potential
		Fertiliser Use
	Biodiversity and Landscape Conservation	Landscape preservation
		Water use and quality
		Soil nutrient richness
		Nitrogen capturing
Welfare, Health and Quality	Animal Welfare	Open air pastures
		Mutilation prohibition
		Adaptive breeding
		Nutrition (balanced and organic)
		Disease prevention
		Veterinary treatment limitations
	Public Health	Pesticide residue
		Zoonotic Pathogens
		Antibiotic-Resistant Infections (MRSA)
	Food Quality	Sensorial (taste, cooking)
		Nutritional (vitamins, amino acids)

Workshop report

Report from the Workshop 'Economic, Environmental and Food Quality Impact Assessment of 'Low Input' Production Schemes – Consumer Standards and Demands', on May 26, 2010, in Brussels

Fulya Batur¹ and Tom Dedeurwaerdere²

A multi-stakeholder workshop was held in Brussels on the 26th of May 2010 within the scope of the LowInputBreeds Work Package 5.1, focusing on the 'Economic, Environmental and Food Quality Impact Assessment of 'Low Input' Production Schemes – Consumer Standards and Demands'. While providing a discussion forum for the project participants, the main objective of this gathering was the identification of specific organic and 'low input' production schemes within the project's four livestock categories. Indeed, a limited number of relevant production methods had to be identified, allowing for a more poignant multi-criteria assessment of the breeding innovations to be developed within the wider scope of the LowInputBreeds project. To this end, a set of sustainability indicators singled out by the organisers in terms of environmental protection, animal welfare, public health and food quality was circulated amongst the participants before the workshop.

The presentations

The first livestock category to be discussed was *dairy cows*, with the contributions of Filippo Biscarini (University of Göttingen, Germany) and Peter Klocke (Research Institute of Organic Agriculture, FiBL, Switzerland). While portraying the benefits and challenges posed by organic dairy cattle production, emphasis was put on both institutions' activities under their work packages, regarding breeding for longevity and animal health issues within FiBL, and the multi-criteria simulation model developed with the use of genetic parameters at Göttingen.

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With regards to *sheep* production, Hervé Hoste (National Institute for Agricultural Research INRA, France) and Smaragda Sotiraki (National Agricultural Research Foundation NAGREF, Greece) first presented the general characteristics and problems encountered with organic and 'low input' production, as well as the overall goals of the LowInputBreeds work package, while Marc Benoit (INRA) then presented the experimental design used to assess sheep production in terms of economic performance, environmental impacts, social aspects, meat quality and animal welfare within INRA.

With regards to *pig* production, Sandra Edwards (from Newcastle University) operated a distinction between intensive, conventional 'low input', traditional 'low input' and organic production schemes, while stressing the difficulties inherent to such classifications due to disparate management practices. Jan Merks (Institute for Pig Genetics) stressed the importance of genetic progress aimed at responding to societal needs and the challenges of pig production in terms of piglet and finisher vitality, temperature intolerance, the avoidance of boar taint and new breeding structures.

prevention methods in high-input cage systems, free range and organic production, while linking these criteria to awareness issues and recourse to 'alternative' breeds. Stemming away from the study of production systems per se, the second half of the workshop was dedicated to more wide-scoping issues of governmental intervention and labelling standards. Within this mindset, Irene Hoffman (from the Food and Agriculture Organisation) presented the 2009 FAO 'The State of Food and Agriculture: Livestock in the Balance', as an illustration of how trade-offs between public goods delivered by animal production can be managed. Peter Melchett (from the Soil Association) in turn analysed consumer awareness and attitudes vis-à-vis livestock production methods, stressing marketing strategies and the importance of trust in terms of food labels. As a particular form of direct peer-reviewed standard-making mechanism, Jordy Van den Akker (from Nature et Progrès) presented the Participatory Guarantee Scheme, a quality assurance system based on stakeholder participation and certification promoting knowledge exchange, rural development and local markets.



Figure 1: Subproject 2 of the LowInputBreeds project on sheep production systems at a glance

With regards to *laying hen* production, Ferry Leenstra (from Wageningen University) reviewed differences in feed and manure utilisation, labour, product quality and environmental standards such as emissions and land use that exist between conventional cage systems, 'low input' and free-range barn or aviary systems with outdoor access. Veronika Maurer (from FiBL) covered animal health and welfare, emphasising several criteria related to housing conditions, nutrition, health risks and

Workshop results: Identification of relevant production schemes

As a result of these presentations, discussion was opened on the identification of most-different production schemes relevant to the breeding innovations that are being studied within the LowInputBreeds project. Beside the inherent difficulties of such an exercise, the first general conclusion was that the criteria upon which this categorisation was to be established showed major differences between the dairy cows and sheep production on the one hand, and pigs and laying hens on the other. Indeed, the production systems found within the former two livestock were rather differentiated on considerations related to feed and geography, while systems related to pigs and laying hens showed distinctions through animal welfare considerations, especially that of housing conditions and access to outdoor areas. Having due regard to the LowInputBreeds breeding objectives in each sector and to the production characteristics underlined through the presentations and further discussion, a total of four or six production methods have been identified within each segment. These production systems are currently being circulated amongst the project partners for final fine-tuning and approval.

Forthcoming events

March 15 and 16, 2011: First LowInputBreeds Symposium on Ethical Consideration in Livestock Breeding

The first LowInputBreeds Symposium on Ethical Consideration in Livestock Breeding is organised by the EU project LowInputBreeds in cooperation with the European Consortium for Organic Animal Breeding ECO-AB.

This two-day symposium will address two perspectives of breeding which are associated with ethical questions: Breeding goals and breeding methods suitable for livestock breeds used in low external input systems (organic and non-organic). The main discussion points will be biodiversity, discarding male animals, molecular techniques such as genomic selection, and economic impacts.

Researchers from LowInputBreeds and ECO-AB will present their aims and breeding technologies used. Discussion of the ethical aspects will then be initiated by invited speakers from relevant stakeholder groups.

General issues will be discussed across species in plenary sessions and more detailed issues in parallel sessions specific to ruminants (dairy cattle and sheep) and mono-gastrics (pigs and laying hens).

Ideas for presentations are welcomed and the final program will be compiled based on these ideas and invited papers.

A background paper on the ethical issues identified within the project LowInputBreeds (work package 5.2: Ethical Impact Assessment) and ECO-AB will be available for participants and guidelines for

contributors will try to focus discussions.

During the symposium, time is reserved for internal meetings and for the general assembly of the LowInputBreeds project.

Provisional programme outline

March 15, 2011

- › 11 am to 1 pm: Overview, across species, on advantages, disadvantages and ethical acceptability of breeding and reproduction methods
Overview, across species on ethical acceptability of breeding goals
- › 2 to 3.30 and 4 to 5.30 pm: Parallel sessions with contributed papers on breeding and reproduction methods, effects on inbreeding/biodiversity/utilization of local breeds included and on breeding goals
- › Evening: General assembly of the LowInputBreeds project

March 16, 2011

- › 9 to 10.30 am: Plenary session
- › 11 to 12.30 am: Parallel sessions
- › 1.30 to 2.30 pm: Plenary session: Reflection on ethical issues
- › 3 to 5 pm: Internal meetings of the LowInputBreeds project

For programme updates please see www.lowinputbreeds.org.

Contributions

Contributions will be on invitation, but suggestions are welcome. Please write to Ferry Leenstra (see address).

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Further information

Further information on the symposium is available at www.LowInputBreeds.org, which is continually updated.

Imprint

The LowInputBreeds newsletter is published by the Research Institute of Organic Agriculture FiBL and Newcastle University, Nafferton Ecological Farming Group on behalf of the LowInputBreeds Consortium. The LowInputBreeds project is co-financed as a Collaborative Project by the European Commission, under the Seventh Framework Programme for Research and Technological Development (Grant agreement No 222623).

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This newsletter is available at project website www.lowinputbreeds.org. The newsletter is published every six months.

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