Final report

for the CORE Organic Plus funded project

Improving animal health and welfare in organic cattle milk production through breeding and management

OrganicDairyHealth

Period covered:

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Index

1. Consortium

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2) PC = Project coordinator, WPL = Work package leader, WPCL = Work package co-leader, P = Participant

2. Summary

2.1 Post-term project summary suitable for web publication

The performance of local breeds on organic farms was assessed by comparing native/ local and commercial dairy breeds in Austria, Switzerland, Sweden, Poland and Germany with regard to health associated traits, fertility and production traits. Local breeds partly have advantages with regard to many functional traits studied and their potential could be better exploited in future, especially on farms with a medium production level. A high proportion of test day records with elevated SCC appeared in Germany and Poland indicating a potential for further overall management improvement regardless of the involved breeds in these countries.

Analysis across countries and farm types revealed that milking and housing systems were interrelated. Milking parlour was the most common milking system in loose-housed systems and mobile single milking machine most common in tied housing systems. A majority of all farms had cubicles with straw in the lying area. The average proportion of roughage in the winter ratio varied between a median of 56 % and 85 % between major farm types indicating differences in feeding strategies. Median production levels varied from 3000 to 9505 kg energy corrected milk (ECM) per year, with lower production in Polish farm types and high production in Denmark and Sweden. Somatic cell count (SCC) differed widely between major farm types in the different countries. A majority of all farms had one major breed, but kept cross breeds in the herd. A majority of farm types used antibiotics as a routine for treatment of clinical mastitis. The use of homeopathic treatments varied both between and within countries with a higher proportion of farmers in Lithuanian and Swiss farms. The results indicate the development of organic dairy production in Europe would benefit from knowledge exchange at farmer and advisor level.

Three breeding goals for organic dairy production were assessed; one based on the IFOAM organic principles, one focusing on improved health and one focusing on feed consumption and conversion. All three breeding goals included the same 12 traits but with different weights for the different traits. Simulated results indicate that all three breeding goals are potential alternatives to the currently used breeding goals for organic dairy production (conventional breeding goals), but it is questionable whether these breeding goals will give enough favorable genetic change in milk production for an economically sustainable production. Simulations showed increased contribution margin (in total, per cow and per kg milk) for both terminal and rotational crossbreeding strategies. Also for native, local breeds terminal crossing led to increased contribution margin. In this study, the native breed Swedish Polled was used, but the results may be applicable to other native European dairy breeds

Suitable management strategies for the handling of intra-mammary infections (IMI) and reduction of stress levels of organic Holstein bred cows under various management systems were identified based on an observational study in 30 organic dairy herds in Germany and Denmark. The overall pattern emerges that positive stockpersons' attitudes and interactions that build a positive human-animal relationship (HAR) and allow early problem recognition beside appropriate housing and management can be important influencing factors on udder health. The results show that HAR is associated with udder health and should therefore be taken into account in future research and in mastitis control programs without neglecting well-known management and housing factors. In the experimental trial in Denmark, cows subjected to quarter dry-off were compared to cows receiving no treatment. Overall, the results indicate that individual quarter dry-off in management of subclinical mastitis might be feasible for a selected proportion of cows. The effect of grazing on milk production, metabolic diseases and mastitis was assessed in an observational study including Polish and Danish organic dairy herds. Kg ECM/day was 1.0 to 1.3 kg lower during the grazing seasons; primarily due to a significantly lower fat percent in the Danish herds. A significantly higher somatic cell count during summer was found for all three parity groups. No effect of grazing seasons was found on metabolic diseases.

2.2 Short process update of the whole project

Overall, the project was conducted as planned. All seven work packages was completed as planned and the results obtained provided new and relevant knowledge on how to improve health in organic dairy cattle farms through breeding and management. Only minor changes were made. The experimental design in WP5 was reduced from three to two treatments. This was done to simplify the in herd design and in order to obtain enough cows per treatment. The idea to obtain information on individual cow activities on pasture for analysing the relations ship at cow level between cow activity and metabolic diseases planned in WP6 was not conducted. The main reason was that it was not possible to obtain information from the companies providing activity measure equipment in the Danish dairy herds.

3. Main results, conclusions and fulfilment of objectives

WP1	Characterizing and evaluation of health and production traits in local/native dairy cattle breeds with reference to commercial breeds

WP leader: Anet Spengler Neff, Anna Bieber, FiBL
Partners: FiBL (Switzerland), SLU (Sweden), BOKU (Austria), NRIAP (Poland), University of Kassel (Germany)

Overall summary of main results, discussion and conclusions WP1

The aim in WP1 was to map the performance of local breeds compared to commercial dairy breeds on organic farms in Austria, Switzerland, Sweden, Poland and Germany with regard to health associated traits, fertility and production traits. In a study covering the whole population of the selected breeds, managed under organic conditions during the period 1.7.2011 to 30.6.2014, we found lower milk yields for local breeds. In general we found better fertility performance (less days open, shorter calving intervals, lower number of inseminations) for at least one of the local breeds involved in each country. We also detected lower proportions of milk records with somatic cell counts above 100.000 cells/ ml milk for in at least one of the local breeds in Austria, Switzerland and Sweden, but not so for Poland where the commercial breed performed best. Moreover, we found a lower proportion of test day records with a fat: protein ratio above 1.5 in the first 100 days in milk for many local breeds (Grey Cattle (AL) and Original Braunvieh (OB) in Switzerland. AL by trend in Austria, Swedish Red (SRB) in Sweden and Polish Red and White (ZR) in Poland) hinting at a lower risk of subclinical ketosis for some of the local breeds compared to the respective commercial breed. We could not find breed differences regarding overall occurrence of veterinary treatments or those due to fertility or leg/ claw problems in Austrian data, but found that AL had less treatments due to udder problems than the commercial Braunvieh (BV). In Sweden, the local breed SRB had less overall treatments, fewer treatments due to fertility or udder disorders and also showed less remarks on claw or leg disorders than the commercial breed. We did not find breed differences regarding treatments due to metabolic disorders in Swedish data. We analyzed Austrian and Swiss data from culled cows on productive life span and detected a superiority of local breeds for this trait, but higher lifetime production (kg ECM) in the commercial breed. The second study on cows managed under very similar conditions in Sweden (period: 1.7.2011 to 30.6.2014) and Germany (period 1.7.2011 to 30.6.2015) revealed no significant breed differences in total ECM yield in German data, while we found higher milk fat and milk protein contents for the local breed Original Red Angler Cattle breed (AAZ). In Sweden, we found the highest ECM yield in the commercial breed Swedish Holstein (SH). The local breed Swedish Polled (SKB) had the highest fat and protein contents, followed by the second local breed Swedish Red (SRB), both differed significantly from the respective commercial breed SH and also among each other. We could not detect significant breed differences in the German data set with regard to fertility traits, although the local AAZ tended to have fewer days open than the commercial breed HO. In Sweden, we did not find breed differences for calving interval, but both local breeds had fewer days open, and SKB needed fewer inseminations compared to SH. No breed differences in any of the two countries regarding the proportion of test day records with a SCC content of over 100.000 cells per ml milk was found. We assessed the risk of subclinical ketosis during the first 100 days in milk by comparing fat protein ratios (FPR), applying differing thresholds in Germany (AAZ >1.7, HO >1.5) per breed, without detecting breed differences. However, in Sweden (with a threshold of >1.5) where the local SRB performed best, SKB showed an intermedium position, while SH had the highest proportion of FPR >1.5. Occurrence of veterinary treatments and those due to fertility problems did not differ between German breeds. Data on treatment due to metabolic disorders and leg or claw problems had low incidences, but models did not converge. In Sweden, we found the lowest incidence of overall veterinary treatments and treatments due to mastitis in the local breed SRB, but the local breed SKB did not differ from the commercial SH in neither of the two traits. We did not find breed differences regarding veterinary treatments due to fertility problems or diagnosis of claw/leg problems during claw trimming in the Swedish data set. Incidences of treatments due to metabolic disorders were low in all Swedish breeds, but models for this trait failed to converge. From our finding's we conclude that local breeds partly have advantages with regard to many functional traits studied and that their potential should be better exploited in future, especially on farms with a medium production level (most clearly shown in the small study on German and Swedish farms). We also found overall high proportions of test day records with elevated SCC in Germany and even more so in Poland from which we deduct a great potential for further overall management improvement regardless of the involved breeds in these countries.

Report on the results obtained (A), and fulfilment of objectives (B)

A - results obtained:

Local/native breeds are recommended in organic standards but little knowledge is available regarding the suitability of native breeds under organic conditions. The EC (2007) states "the choice of breeds should take account of their capacity to adapt to local conditions". Nevertheless, there is little hard data supporting the claim that local breeds are more suitable under organic farming conditions. Our aim was to map the performance of local breeds compared to commercial dairy breeds on organic farms in Austria, Switzerland, Sweden, Poland and Germany with regard to health associated traits, fertility and production traits.

Our first study was based on big data sets from Austria, Switzerland, Sweden and Poland covering the whole population of the selected breeds managed under organic conditions during the period 1.7.2011 to 30.6.2014. The second study contained data sets from Germany and Sweden limited to selected organic farms with similar management practices from the period 1.7.2011 to 30.6.2014 in Sweden and from 1.7.2011 to 30.6.2015 in Germany.

The breeds compared within the respective country were: Grey Cattle (AL) (n≈ 2'600) as local breed versus Braunvieh (BV) with at least 50 % US Brown Swiss blood (n≈ 16'200) in Austria, Grey Cattle (AL) (n=445) and Original Braunvieh (OB) (n≈ 3'500) as local breeds versus Braunvieh (BV) with at least 60 % US Brown Swiss blood (n≈ 35'500) in Switzerland, Swedish Red (SRB) (n≈ 29'400) as local breed versus Swedish Holstein (SH) (n≈ 30'500) in Sweden and Polish Black and White (ZB) (n≈ 600), Polish Red and White (ZR) (n≈ 1'300), Polish Red (RP) (n≈ 1'200) as local breeds versus Polish Holstein (PH) (n≈ 2'400) in Poland for the first study. For the second study Swedish Red (SRB) (n≈ 700) and Swedish Polled (SKB) (n≈ 60) as local breeds versus Swedish Holstein (SH) (n≈ 400) in Sweden and Original Red Angler Cattle (AAZ) (n≈ 550) as local breed versus Holstein Friesian (HO) (n≈ 1'200) in Germany. We applied generalized linear mixed models in R and performed Tukey tests using the lsmeans package in order to detect breed differences for data from Austria, Switzerland, Poland and Germany (done at FiBL), while Swedish data were analysed with mixed linear models in SAS using the HPmixed or the GLIMMIX procedure (done by SLU).

In the first study on Swiss, Austrian, Swedish and Polish data we found a higher milk production (ECM) per lactation in commercial compared to local/native breeds in all countries. This finding was also confirmed when analysing data on lifetime production, which was limited to Austria and Switzerland where we detected higher lifetime production for the commercial breed BV in both countries.

Fat contents were higher in commercial breeds in Switzerland and Austria, but not so in Poland and Sweden, where at least one local breed showed higher fat content compared to the respective commercial breed (SRB for Sweden and RP for Poland). Regarding protein content, we could not detect breed differences in Austria, in Switzerland AL did not differ significantly from BV, but the local breed OB had the lowest milk protein content. In Sweden, the local/native breed SRB had a higher protein content and in Poland, the RP again had the highest milk protein content. Data on lactation persistency was only available for Switzerland, where we observed the best persistency for the local breed OB.

We analysed fertility performance through data on days open (DO), calving interval (CI) and number of inseminations. At least one of the local/native breeds showed less DO (better fertility) compared to the respective commercial breed in all countries: in Switzerland OB, but not AL, in Poland RP and ZR, but not ZB, in Austria AL and in Sweden SRB. The CI was shorter for AL in Austria and Switzerland, for SRB in Sweden and for all three local breeds in Poland when compared to the respective commercial breed. The number of inseminations was lower for OB in Switzerland, for AL in Austria, for SRB in Sweden, but only for one local breed, namely ZR, in Poland.

In Austria, the local breed had fewer samples with elevated somatic cell count (SCC above 100'000 cells per ml milk) as indicator for subclinical mastitis than the commercial breed. The same was true for OB in Switzerland, but AL did not differ significantly from BV in this country. In Sweden, the local/native breed SRB also showed

fewer records with an elevated somatic cell count when compared to the commercial SH breed. Only in Poland we found fewer records with SCC above 100´000 cells in the commercial Holstein breed, which did not differ from ZB, and the worst performance in the local/native breeds RP and ZR. The overall level of test day records with elevated SCC was by far highest in Poland and lowest in Austria and Switzerland. A fat protein ratio above 1.5 within the first 100 days in milk was defined as risk indicator for subclinical ketosis, which was higher in the commercial breed BV in Switzerland and tended to be higher for this breed in Austria. In Sweden the commercial breed SH also had a higher proportion of records with an elevated fat protein ratio, while in Poland this was not true for the commercial, but for the local ZB breed. We found out that at least one local/native breed had a longer useful lifetime in each country. This was the case for AL in Switzerland and Austria, for SRB in Sweden and for ZB in Poland.

Data on veterinary treatment were only available for Austria and Sweden in the first study. In Austria, we could not find breed differences regarding overall occurrence of veterinary treatments or those due to fertility or leg/ claw problems, but found that AL had fewer treatments due to udder problems than BV. In Sweden, we found the local breed SRB to have fewer overall veterinary treatments, and also fewer treatments due to udder or fertility problems. We also found SRB to have fewer claw or leg problems, which in Sweden are registered during regular claw trimming and do not only include veterinary treatments. We could no detect breed differences regarding metabolic disorders in the Swedish data set.

The second study with limited data sets from Sweden and Germany involved data from farms with similar management practices in Germany. In Sweden only herds with cows of the SKB breed and at least one cow of the breed SRB or SH were included. It revealed the following main results: In Germany, we found that total ECM yield tended to be higher in the commercial HO breed, while we found higher milk fat and milk protein contents for the local breed AAZ. In Sweden, we found the highest ECM yield in the commercial breed SH. The local breed SKB had the highest fat and protein contents, followed by the other local breed SRB, both differed significantly from the respective commercial breed SH and also among each other. Regarding the fertility traits days open, calving interval and number of inseminations we could not detect significant breed differences in the German data set, although the local AAZ tended to have fewer days open than the commercial breed HO. In Sweden we found both local breeds, SRB and SKB, to have fewer days open than the commercial breed SH. The number of inseminations was lowest in the local breed SKB compared to SH, but SRB did not differ from either of the other breeds and we detected no breed differences regarding the calving interval. We could not make out breed difference in any of the two countries regarding the proportion of test day records with a SCC content of over 100.000 cells per ml milk. We also compared the fat protein ratio in both countries as indicator for an elevated risk to suffer from subclinical ketosis, applying differing thresholds in Germany (AAZ >1.7, HO >1.5) per breed, without detecting breed differences. In Sweden, we found SRB to have the lowest proportion of test day records with a fat protein ratio above 1.5 in the first 100 DIM, SKB showed an intermedium position, while SH had the highest proportion.

Overall occurrence of veterinary treatments and those due to fertility problems did not differ between German breeds, but the commercial breed HO tended to have more treatments due to mastitis. Data on treatment due to metabolic disorders and leg or claw problems had low incidences and models did not converge.

Our analysis of Swedish treatment data revealed the lowest incidence of overall veterinary treatments and treatments due to mastitis in the local breed SRB, but the local breed SKB did not differ from the commercial SH in neither of the two traits. We could not make out breed differences regarding veterinary treatments due to fertility problems or diagnosis of claw/leg problems during claw trimming in the Swedish data set. Incidences of treatments due to metabolic disorders were low in all Swedish breeds and models for this trait failed to converge.

B - fulfilment of objectives:
The breed comparison was successfully performed, although later than planned due to complicated plausibility checks, very time-consuming data harmonisation between countries and delays in data analysis in one country.

WP2. Identification of major organic dairy farm types in Europe

WP leader: Vytautas Ribikauskas, LUHS and Anna Wallenbeck, SLU
Partners: LUHS and SLU

Overall summary of main results, discussion and conclusions WP2

The aim of WP2 was to establish a database with information on the major organic dairy farm types in Europe to be used in other WPs in the ODH-project and as an information source in future research and development projects. Major farm types in Austria (AT), Switzerland (CH), Germany (GE), Denmark (DK) Lithuania (LT) Poland (PL) and Sweden (SE) were identified in a way that they represent the conditions under which the majority of milk is produced and number of cows is kept. The number of major farm types identified per country was: AT-5, CH-2, DE-4, DK-1, LT-4, PL-3, SE-3. The information in the database created in this project shows that farm size, in terms of number of cows and arable land varied between major farm types (ranging from a median of 11 to 143 lactating cows in the herd and from 28 to 385 ha of land). The availability of arable land for pasture and access to semi-natural pasture and thus conditions for dairy production varied between regions. The age distribution of the cows in the herd varied between a major farm type median of 16.7% and 35.8% first parity cows in the herd. Age distribution also varied between countries with a higher proportion of first and second parity cows in Austrian, Danish and Swedish major farm types and a larger proportion of cows in parity 3 or older in German and Lithuanian major farm types. Variation was also observed in average age at first calving, which was reported to be higher and to have a larger variation in major farm types in Austria, Switzerland and Germany compared to major farm types in Denmark, Lithuania and Sweden indicating variation in recruitment strategies.

Milking and housing systems were found to be interrelated. Milking parlour was the most common milking system in loose-housed systems and mobile single milking machine most common in tied housing systems. A majority of all farms, across major farm types had cubicles with straw in the lying area. The average proportion of roughage in the winter ratio varied between a median of 56 % and 85 % between major farm types indicating differences in feeding strategies. Moreover, feeding strategies including only hay as roughage was more common in German, Swiss and Austrian organic dairy herds. Median production levels ranged from 3000 to 9505 kg energy corrected milk (ECM) per year, with lower production levels in Polish major farm types and higher production levels in Denmark and Sweden. Somatic cell count (SCC) varied between a median of 135 and 858 x 10^3 cells/mL with higher levels in Polish major farm types. Most farm types had average mastitis incidences between 10 and 20 % of the lactating cows per year and average culling rates varied between 0 and 5.5 percent of the lactating cows per year. A majority of all farms had one major breed in the herd, but kept a few cross-breed cows in the herd, indicating that breeding strategies including cross breeding is wide spread in European organic farming. Major farm types in Sweden had lower proportions of farms with only one breed compared with major farm types in other countries. A majority of farmers across major farm types used antibiotics as a routine for treatment of mastitis. The use of the routines “drying of teat quarters” and use of homeopathic treatments was highly inhomogeneous between major farm types both between and within countries with a higher proportion of farmers in Lithuania and Sweden drying of quarters and a higher proportion of Lithuanian and Swiss farms using homeopathic treatment. Regarding treatment of metabolic diseases, a majority of farms used veterinary treatment for treatment while homeopathic treatment was more commonly used by farmers in Lithuania, Switzerland and by small German farms. The results indicate that knowledge and experiences of organic dairy farmers differ between regions and countries and the development of organic dairy production in Europe would benefit from knowledge exchange on farmer and advisor level.

Report on the results obtained (A), and fulfilment of objectives (B)

A- results obtained:

The aim of WP2 was to establish a database with information on the major organic dairy farm types in Europe to be used in other WPs in the ODH-project and as an information source in future research and

development projects. The development of the WP2 database was performed in a stepwise process aiming to harmonise the work in all partner countries.

Identify major farm types in all project partner countries
Identification of major farm types was based on four criteria: herd size, production level, location and type of housing. The criteria were set at the first project meeting in Cracow, spring 2015. Researchers in each partner country gathered information on the four criteria based on information from e.g. national milk recording, breeding and organic certification organizations. Major farm types in each country were identified in a way that they represent the conditions under which the majority of milk is produced and number of cows is kept. The number of major farm types identified per country was: AT-5, CH-2, DE-4, DK-1, LT-4, PL-3, SE-3

Describe the major farm types – The same questionnaire in all countries
Based on discussions at our first project meeting in Cracow, followed by several Skype working meetings, a thorough protocol for description of farms was developed and finalized in June 2015. The protocol questionnaire included detailed questions in the areas of farm location, structure and size, housing and milking system, production level, animal health and management, feeding strategy, breeding and reproduction. The protocol was translated into native languages and each partner country completed protocol information from at least 10 farms per farm type. The method for completing the questionnaire differed between countries and included either on-farm interviews, paper questionnaires, web-questionnaires, gathering of data from national milk recording or advisory databases or a combination of some of these methods. Data gathering was more time-consuming than planned and was not finished until summer 2016.

Establishment of a database on organic dairy farm types in Europe
Data from all seven partner countries were delivered to SLU, Sweden, where data were merged into an Excel database. Some countries had gathered additional data (outside the basic common protocol) of specific interest in their country. These data are also included in an additional part of the database. The database was completed and delivered to WP 3, 4, 5 and 6 during summer 2016 but with some additional editing left during the finalisation of the database during autumn 2016. The database and the process of setting it up was described in a 2016 EAAP abstract and presented orally at the 2016 EAAP meeting in Belfast.

Analyses of data across country
Milking and housing systems were found to be interrelated. Milking parlour was the most common milking system in loose-housed systems and mobile single milking machine most common in tied housing systems. A majority of all farms, across major farm types had cubicles with straw in the lying area. The average proportion of roughage in the winter ratio varied between a median of 56 % and 85 % between major farm types indicating differences in feeding strategies. Moreover, feeding strategies including only hay as roughage was more common in German, Swiss and Austrian organic dairy herds. Median production levels varied from 3000 to 9505 kg energy corrected milk (ECM) per year, with lower production levels in Polish major farm types and higher production levels in Denmark and Sweden. Somatic cell count (SCC) varied between a median of 135 and 858 x 10^3 cells/mL with higher levels in Polish major farm types. Most farm types had average mastitis incidences between 10 and 20 % of the lactating cows per year and average culling rates varied between 0 and 5.5 percent of the lactating cows per year. A majority of all farms had one major breed in the herd, but kept a few cows of cross breeds in the herd indicating that breeding strategies including cross breeding is wide spread in European organic farming. Major farm types in Sweden had lower proportions of farms with only one breed compared with major farm types in other countries. A majority of farmers across major farm types used antibiotics as a routine for treatment of mastitis. The use of the routines “drying of teat quarters” and use of homeopathic treatments varied more between major farm types both between and within countries with a higher proportion of farmers in Lithuania and Sweden drying of quarters and a higher proportion of Lithuanian and Swiss farms using homeopathic treatment. A majority of farms used veterinary treatment

for treatment of metabolic disease and homeopathic treatment was more commonly used by farmers in Lithuania, Switzerland and by small German farms. The results indicate that knowledge and experiences of organic dairy farmers differ between regions and countries and the development of organic dairy production in Europe would benefit from knowledge exchange on farmer and advisor level.

Analyses of data within country
Based on more detailed analyses of data from German farms it was concluded that German organic dairy farms were clustered into four major farm types. They differed in production level, breeds used, feeding and preventive health strategies and arable and pasture land available. Despite different conditions between major organic dairy farm types in Germany, there were no large differences with respect to herd health, partly due to large variation within farm types. It was concluded that the consideration of farm types may be a way to better adapt advice on management or breeding to farm-specific needs (Ivemeyer et al., 2017).

In a Master thesis analysing the Swedish data in more detail, it was shown that the majority of the Swedish organic dairy farmers used antibiotics and/or drying off individual udder quarters to treat mastitis. Furthermore, one fourth of the farmers used homeopathic treatment to treat mastitis, although no farmers used homeopathy as the only treatment. Farms with milking robot had higher milk production and higher SCC, while farms with milk line had higher mastitis incidence. Herd size affected milk production, SCC, and mastitis incidence in that farms with large herd sizes had high milk production, high SCC, and low mastitis incidence. The Master thesis concludes that there is a need for development of farm specific management strategies that takes e.g. the specific housing, milking system, and health status of the farm into account (Wingren, 2018).

Establishing cases for simulation of potential effects based on results from WP4, WP5 and WP6
Two case farms from each country; Denmark, Switzerland, Germany, Lithuania, Sweden and Austria representing 11 different farm types were selected for simulation studies. Information of country specific costs and prices were provided. Each farm was calibrated for simulations with the model SimHerd. Relevant results are presented in in the description of WP4, WP5 and WP6 respectively, below.

B. Fulfilment of objectives
Objectives of all three steps of WP2 have been fulfilled, with additional delivery of scientific country specific reports in Germany and Sweden.

WP3	Development of breeding strategies including crossbreeding and genomic information by simulation

WP leader: Anna Wallenbeck, SLU
Partners: SLU, AU-MBG

Overall summary of main results, discussion and conclusions WP3

The aim of WP3 was to assess innovative breeding strategies for organic dairy production in Europe through simulation of different types of breeding strategies. The simulations performed in the work package have been divided into two parts: I) development of relevant breeding goals emphasising farmer preferences, principles of organic agriculture, animal health or roughage consumption and feed conversion, followed by genetic simulations of these breeding goals in the stochastic genetic simulation program ADAM (as a part of PhD student Margot Slagboom's PhD project) and II) development of crossbreeding strategies, including the Holstein, the Swedish Red and the native breed Swedish Polled, followed by simulation of management and economic consequences in the simulation program SimHerd (as a part of PhD student Julie Clasen's PhD project).

I) Simulating consequences of choosing a breeding goal for organic dairy production

We developed a specific breeding goal for organic dairy production based on the organic principles defined by the IFOAM. It differed from a breeding goal based on an economic model. However, a breeding goal based on farmers' preferences was similar to a breeding goal based on an economic model. The breeding goals based on the principles for organic production, focusing on improved health and focusing on feed consumption and conversion developed and simulated in this study are all three potential alternatives for organic dairy production, but it is questionable whether these breeding goals will give enough favorable genetic gain in milk production for an economically sustainable production.

II) Cross breeding in organic dairy production

For Swedish organic production circumstances and in comparison with a pure bred strategy, simulations showed increased contribution margin (in total, per cow and per kg milk) for both terminal and rotational crossbreeding strategies for Holstein based herds crossing in Swedish Red and for Swedish Red based herds crossing in Holstein. Accordingly, terminal crossing in Swedish Polled based herds crossing in Holstein or Swedish Red also led to increased contribution margin, slightly more favourable when Holstein is crossed in. In this study, the native breed Swedish Polled was used, but the results may be applicable to other native European dairy breeds. Increased income from crossbreeding could facilitate the conservation of the pure breed.

Report on the results obtained (A), and fulfilment of objectives (B)

A - results obtained:

I) Simulating consequences of choosing a breeding goal for organic dairy production

The following breeding goals were developed and simulated:

1. Conventional breeding goal based on economic models (BGConvEc).
2. Organic breeding goal based on economic models (BGOrgEc).
3. Organic breeding goal based on a survey of farmers' preference (BGFarmPref).
4. Organic breeding goal based on the principles of organic agriculture (BGOrgPrin).
5. Organic breeding goal with particular emphasis on resistance to mastitis, hoof and leg diseases, and other diseases (BGDis)
6. Organic breeding goal with particular emphasis on roughage consumption and feed efficiency (BGFeed)

Twelve traits were included in the simulations: cow fertility, heifer fertility, calving difficulty, calf mortality, cow mortality, hoof and leg diseases, mastitis, other diseases, milk production, beef production, feed efficiency, and roughage consumption. Breeding goals BGConvEc and BGOrgEc were derived from economic models in SimHerd for a typical conventional (BGConvEc) and organic (BGOrgEc) Danish dairy farm (Kargo et al., 2015). For BGFarmPref, a survey was carried out to study the preferences of organic farmers for breeding goal (BG) traits. A description of the survey can be found in Slagboom et al. (2016). BGOrgPrin was based on the principles of organic agriculture as defined by the IFOAM. To interpret these principles, a questionnaire was sent out to farmers, researchers, and experts in the area of organic animal husbandry. The results of the questionnaire indicated that participants regarded the following eight traits as very much related to the principles: calving difficulty, calf mortality, cow mortality, hoof and leg diseases, mastitis, other diseases, feed efficiency, and roughage consumption. Therefore, for BGOrgPrin these traits were given a weight resulting in as much favourable genetic change as possible without causing unfavourable genetic change in any of the other traits. For BGDis, the aim was to maximise genetic gain for resistance to mastitis, hoof and leg diseases, and other diseases. For BGFeed, the aim was to maximise genetic gain for roughage consumption and feed efficiency.

Correlations between BGConvEc, BGOrgEc, and BGFarmPref were all close to unity while correlations between all the other BGs were lower than 1 and thus differed favourably in genetic change for the traits with extra focus in each specific breeding goal (e.g. health or feed conversion), and unfavourably for production traits compared to the above mentioned breeding goals. The BGOrgPrin, BGDis, or BGFeed breeding goals developed and simulated in this study are potential alternatives for organic dairy production, but if these breeding goals will give enough favourable genetic change in milk production for economically sustainable production depends on the future market for organic products.

II) Cross breeding in organic dairy production

Pure breeding has traditionally been the general rule in dairy breeding, but cross breeding is increasing. In organic dairy production, the use of native and locally adapted breeds are pointed out in the general principles for organic agriculture. In Sweden, Holstein and Swedish Red are the most commonly used breeds. A few herds also keep the native breed Swedish Polled, but the population is decreasing in size. Crossbreeding between these breeds occur. Systematic crossbreeding strategies may create a demand for purebred animals and thus an opportunity to avoid a shrinking population size for the native breed. However, native breeds are often not able to compete economically with modern dairy breeds, such as e.g. Holstein. Thus the creation of crossbreeding strategies must be made attractive to farmers. Terminal crossbreeding of Swedish Polled Cattle with Swedish Red or Swedish Holstein may be a suitable strategy to conserve the Swedish Polled Cattle, whilst maintaining profitable herds that can survive under Swedish conditions. In this study, the native breed Swedish Polled is used, but the results may be applicable to other native European dairy breeds. In terminal crossbreeding, the F1 crossbred animals are only kept as production animals while only purebred animals are used for breeding. In rotational cross breeding, all cows are bred to a sire of the breed they consist least of. Simulation of management and economic consequences of these two strategies in organic farming was performed with the SimHerd program. Input

data on the animals' performance, costs and incomes for organic farms were extracted from Växa and other Swedish databases.

Terminal and rotational crossbreeding for Holstein based herds crossing in Swedish Red and for Swedish Red based herds crossing in Holstein showed an increased contribution margin (total, per cow and per kg ECM) compared to pure bred strategy in organic herds. Terminal crossing with Holstein or Swedish Red in Swedish Polled based also led to increased contribution margin, slightly more favorable when Holstein was crossed in.

B - fulfilment of objectives:
All objectives have been fulfilled.

WP4	Identification of stress effects on mastitis susceptibility and curing capacity

WP leader: Silvia Ivemeyer, Ute Knierim, UniKassel
Partners: UniKassel, AU-AS

Overall summary of main results, discussion and conclusions WP4

The aim of WP4 was to identify suitable management strategies for the handling of intra-mammary infections (IMI) and reduction of stress levels of organic Holstein bred cows under various management systems. Furthermore, in this context we aimed to identify a suitable curing capacity indicator from SCC test day data on herd level, based on a literature search. Impact-patterns of housing and management, human-animal relationship (HAR) and herd stress level on udder health were investigated in a cross-sectional study on 25 German and 5 Danish organic dairy herds. Ten farms used automatic milking systems (AMS), the others milked in fishbone (16 farms) or tandem milking parlours (4 farms). All herds consisted mainly (> 50%) or completely of Holstein Friesian or Red Holstein cows. Herd sizes ranged from 29 to 215 cows (mean = 85.2). All farms participated in official milk recording schemes (11 test days/year). Average herd milk yield was 7,219 kg/cow per year (range: 4,144 – 11,899 kg/cow per year). Cow behaviour (avoidance distance, tolerance to tactile interaction, release behaviour) was assessed in tests, milkers' behaviour recorded during milking. Information on contacts with animals during routine work as well as other housing and management conditions (milking procedures, hygiene measures, feeding strategies) - were gathered by interview, or directly recorded. Stockpersons' attitudes were recorded via questionnaires. Faecal cortisol metabolites were measured in about 30 focal cows on each farm, and used as a proxy to determine the level of distress within the herd. From the focal cows, four repeated faecal samples were collected (farm visits 1 to 4; time interval of 9 days on average (± 2.9), as well as two repeated quarter milk samples (farm visits 1 and 3; time interval of 18 days (± 4.2; Ivemeyer et al., 2018). Herd level parameters from milk samples were averaged from the two consecutive quarter milk samples. Only cows with at least 3 of 4 repeated faecal samples were included in the analyses. In a first step, the median of the three or four repeated FCM measurements was calculated on cow level; in a second step, the median on herd level was calculated from these values. Herd udder health indicators were calculated from quarter milk samples. Prevalence of (1) healthy quarters with somatic cell counts < 100,000 cells/ml (QSCC<100) and (2) mastitis quarters (≥ 100,000 cells/ml, culturally positive: Qmastitis). Milk recording data over one year were analysed retrospectively per herd for: (3) average somatic cell score (SCS), (4) percentage of elevated composite somatic cell counts (elevCSCC), (5) self-curing rates during lactation (CURE). A range of different udder health indicators was used. After univariable pre-selection procedures, multivariable regression models with stepwise selection were calculated at herd level, because improvement strategies usually are applied at this level. Most herd, housing and management factors that stayed in the final models showed associations to udder health that in principle conform to earlier studies. Lower faecal cortisol metabolite levels were related to higher CURE (Ivemeyer et al., 2018). This relation confirms the hypothesis that chronic distress impairs the immune system and consequently self-curing capacity. Although causes of mastitis may vary on farm level according to the farm-specific conditions and the pathogens, general recommendations can be derived: Animal-friendly attitudes are worthwhile: we found positive correlations between better udder health and farmers' agreements to patient moving and positive contact with the animal. Positive contacts should be integrated in the daily work. Farms with a higher quality and quantity of contacts had better udder health and curing rates. Barn controls for observation beyond routine work and a stable milking situation with little change in the weekly routine proved to be beneficial as well. An overall low stress load of cows is highly desirable, as this can increase the mastitis self-curing rate. We confirmed already known housing and management effects: During milking, it is advisable to fore-strip before cleaning and to use fresh cleaning material for each cow. After milking, fixing the cows in the feeding rack can reduce udder infections. Straw yard lying areas can lead to a poorer herd health in comparison to deep-bedded cubicles, likely due to the higher risk for dirty udders. Simulated economic effects: We assume that reducing the stress-level of cows potentially can reduce the number of mastitis cases and SCC by 10%. The economic effects of was simulated on 2 farms from each of 6 countries, using local farm data and prices. The gross margin per cow per year was increased on average 22 € within a range of 6-42 € corresponding to an increase of 0.6% to 2.9% of the gross margin. The economic effect differed more between countries than between the two farms within countries. In countries with a high milk price, the effect of reducing mastitis was higher than in countries with a low milk price. Within countries, the economic effect depended on the initial level of mastitis and SCC.

Report on the results obtained (A), and fulfilment of objectives (B)

A- results obtained:

The new indicator 'cure rate' (CURE) is calculated as the percentage (on herd level) of changes from a SCC of more than 200,000 cells/ml to three consecutive test day SCCs under 100,000 cells/ml from all initial test day results with ≥ 200,000 cells/ml within one year. This cure rate is a rather strict indicator reflecting a long-lasting curing over three subsequent test days after an intramammary infection (IMI). Possible curing at the end of lactation, during the dry period or at the end of the investigated year cannot be considered, because in these cases three consecutive test day results are not available. Moreover, sequences with antibiotic udder treatments within one month around the elevated test day ≥ 200,000 cells / ml are excluded and not counted as self-cured (Ivemeyer et al., 2018).

From all farm visits in total 3468 faecal samples of 920 focal cows were collected for measuring the cows' stress level by faecal cortisol metabolites (FCM). They were analysed by enzyme-immunoassays (EIA) at the University of Veterinary Medicine Vienna in Austria. About 800 samples of the first winter data assessment period in Germany were analysed during summer 2015, the remaining samples from the second winter period in autumn 2016. Samples from the five Danish farms had been extracted in Denmark and then transported to Vienna for the EIA analyses in 2017. Quarter milk samples from both countries were analysed in the German lab "LUFA Nord-West" to ensure comparability of results. In total 7092 quarter milk samples from 911 cows were collected. In Germany, milk sample were sent to the lab freshly and cyto-bacteriological results were forwarded immediately after analyses to the farmers. Milk samples of the Danish farms were stored frozen and sent to the lab and analysed in summer 2016. Danish management, production and health data were delivered to the German partner in February 2017 and afterwards statistically analysed and published.

The prevalence of mastitis quarters (Qmastitis) was on average 12.3% ± 5.8% (range: 3.4 - 23.0%), the prevalence of quarters with SCC < 100,000 cells/ml (QSCC<100) averaged at 66.3% ± 11.4% (range: 42.8 - 87.5%). Herds' average SCS over one year was 3.22 ± 0.49 (range 2.46 - 4.10). The percentage of herds' test day results within one year ≥ 100,000 cells/ml (elevCSCC) amounted to 51.7% ± 12.1% (range 35.5 - 75.8%). Average curing rate (CURE) was 3.9% ± 2.7% (range: 0 - 11.1%; Ivemeyer et al., 2018).

The following known risk factors were related to impaired udder health (regarding at least one of the five udder health indicators): straw yards, cows not locked in a feeding-rack during feeding, automatic milking system, no breeding selection for docility, higher average lactation number, less antibiotic udder treatments, and more *S. aureus* quarters. All multivariable final models comprised HAR-indicators alongside herd, housing, and management factors showing associations to the different udder health indicators. The following HAR-related factors were associated with better udder health (in at least one of the final models): stockpersons' higher agreement on patience being important when moving the cows, or on necessary contact to cows being pleasant, higher amount of positive interactions with cows during milking (%), more docile cows in the release behaviour test, no routine change of milkers, more contact time during routine work, and performance of barn controls beyond routine work.

Unexpectedly, active heifer habituation to milking was negatively related to udder health regarding Qmastitis, SCS and elevCSCC. Possibly this answer reflects necessary extra efforts to habituate heifers to milking when more nervous heifers are on the farm, rather than to more positive interactions. On farms with less fearful heifers, habituation to milking might have been perceived as less 'active' by the stockpersons. Additionally, the quality of handling during habituation might be relevant, but was not asked for. Lower faecal cortisol metabolite levels were related to higher CURE (Ivemeyer et al., 2018). This relation confirms the hypothesis that chronic distress impairs the immune system and consequently self-curing capacity.

Epidemiological exploratory studies cannot prove causality of relationships or predict effects of single factors on each farm. Nevertheless, an overall pattern emerged that positive stockpersons' attitudes and interactions that build a positive HAR and allow early problem recognition beside appropriate housing and management can be important influencing factors on udder health. The results confirm earlier findings that HAR is associated with

udder health and should therefore be taken into account in future research and in mastitis control programs in addition to preventive measures relating to appropriate housing and management. First indications of negative associations between herd stress level and mastitis curing capacity should be followed up in future studies.

Economic effects of reduced stress-level on mastitis and SCC in different European farm types

Methods: Two different and typical case farms from each country; Denmark, Switzerland, Germany, Lithuania, Sweden and Austria representing 11 different farm types (only one type in Denmark) were selected, and farm specific data from WP2 were simulated with the herd-simulation-model SimHerd. We assumed that empathic stockpersons' attitudes towards the lactating cows, and a positive human-animal relationship has the potential of reducing both the number of mastitis cases and SCC by 10%, and this scenario was simulated for each of the 12 farms.

Results: Gross margin per cow per year was increased on average 22 € within a range of 6-42 € corresponding to an increase of 0.6% to 2.9% of the gross margin. The economic effect differed more between countries than between the two farms within countries because it was very sensitive to the milk price. In countries with a high milk price, the effect of reducing mastitis was higher than in countries with a low milk price. Within countries, the economic effect depended on the initial level of mastitis and SCC.

B- fulfilment of objectives:
All objectives have been fulfilled.

WP5	Handling of mild mastitis without use of antibiotics

WP leader: Jan Tind Sørensen
Responsible partners: AU-AS, UniKassel

Overall summary of main results, discussion and conclusions WP5

The aim of WP5 was to investigate feasibility and consequences for production, economy, welfare and health of drying off quarters as a treatment of mild/subclinical mastitis. The benefits of antibiotic treatment include the chance of cure of the quarter and reduced risk of contamination of other cows, whereas the economic cost associated with the treatment and the risk of development of antimicrobial resistance are major concerns. Drying off quarters could be an alternative to antibiotics with a similar reduction of contamination risk, and the farmer would avoid the negative consequences associated with the antibiotic treatment. A questionnaire-based survey was conducted on 34 Danish and 27 German organic dairy farms regarding reasons for dry quarters and procedures for drying off individual quarters. Thirty-one Danish and seven German farms were drying off quarters as a voluntary strategy. The main reasons for drying off quarters were chronic mastitis and recurrent mastitis in Danish herds and low milk production and recurrent mastitis in German herds.

A controlled experiment within herd has been conducted in five commercial Danish organic dairy herds with automatic milking systems. Seventy cows with elevated cow-level somatic cell counts above 400,000 cells/ml were randomly allocated to one of two treatments: 1) Quarter dry-off (QDO) following a well-described practice (n=34) and 2) No treatment with continued milking (CM) of all quarters (n=36). Repeated milk samples for culture were taken prior to treatment and 1 month after treatment. Quarter milk production was recorded for a 60 days follow-up period after initiation of treatment. Clinical development and signs of pain were assessed by clinical recordings, and behaviour at milking was recorded from video. Predominating culture results were *Streptococcus uberis* (18%), *Staphylococcus aureus* (16%) and Coagulase Negative *Staphylococci* (20%). Clinical implications of quarter dry-off resembled those reported at ceased milking for the dry period. However, a proportion of cows experienced severely negative clinical effects such as fever and signs of pain. No obvious effects on behavior during milking of the quarter dry-off treatment were observed. On average the production loss associated with quarter dry-off was 4.1 kg/day (95% Confidence Interval: 3.1-5.0) greater than for cows receiving no treatment. The production loss depended on parity, days in milk (DIM) and prior yield on the quarter subjected to dry-off (Q1). The production loss increased with increasing prior yield on Q1. Early lactation multiparous cows showed the greatest compensatory potential with regard to yield at quarter dry-off. Overall, the results indicate that individual quarter dry-off in management of subclinical mastitis might be feasible for a selected proportion of cows. However, selection criteria need to be further investigated and further studies into the effect on welfare, cure rates and transmission are needed to determine the feasibility of individual quarter dry-off.

With the Simherd-model, economic effects of this strategy were simulated for two farms in each of 6 countries, based on farm-specific data and local prices. Based on results of this WP, we simulated that 7% of the cows were dried off on one quarter, resulting in a 13.5% loss in individual milk yield. In addition, we assumed that drying off resulted in reduction of either 10% or 20% of both SCC in the tank-milk and clinical mastitis cases. With a 10 % reduction, gross margin was reduced on average 6,7€ per cow per year, but assuming a 20%-reduction, the gross margin per cow per year increased by on average 12,5 € . A large variation was found, and the economic effects of this strategy were very sensitive to the milk price, milk yield, mastitis and SCC. Mainly Danish and Swiss farms could benefit from this strategy due to high milk yield and high milk price respectively. Farms with low level of mastitis, SCC, milk yield and/or milk price did not benefit from this strategy.

Report on the results obtained (A) and fulfilment of objectives (B)

A - results obtained:
A questionnaire-based survey was conducted in 34 Danish and 27 German organic dairy farms on reasons for dry quarters and procedures for drying off individual quarters.

Two reports were made on results from the surveys. One report on results from the 34 herds in the Danish survey was made and one report with results from both the Danish and German survey.. For the second report, results from 25 Danish dairy herds who gave complete answers comparable to the German survey were included.

Twenty-two of the 25 Danish farmers did use drying off a quarter as a procedure for handling mastitis. Each of the farmers was asked for reasons for drying off quarters. Most frequent reasons for drying off a quarter were recurrent mastitis and a chronic high SCC. Seventy-three per cent and 68% of the farmers never dried off due to acute mastitis and slow milkability, respectively. Among the seven German herds, which practiced drying off quarters voluntarily, the most frequent reasons were low milk yield and recurrent mastitis. However, elevated somatic cell count (SCC) was also a relatively common reason.

The farmers were asked what they subsequently decided to do with a cow with a dry quarter. Among the Danish herds many cows actually were inseminated, and only 32% of the farmers claimed that they often culled a cow subsequent to drying of a quarter. It seems that both German and Danish herds doing voluntary dry offs in most cases were successful in milking dried off quarters in the subsequent lactation. Conversely, most of the German herds only doing involuntary dry offs experienced that the quarter could not be milked again in the subsequent lactation. In the majority of the German herds, dried off quarters were not a reason for culling, and the cows were often kept in the herds.

The farmers were asked about their opinions on the drying off as a procedure of handling mastitis. Fifty-nine per cent of the Danish herds did not see drying off as extra work. Also, 64% did not see drying off as a risk of infection. Further 64% did not believe that a cow would suffer pain after being dried off a quarter. However, if the cause of drying off was just a high somatic cell count, then 18% believed that the procedure involved pain. The majority of the German herds did not see cows with dried off quarters as an annoyance, and all herd managers agreed that dried off quarters did not pose an increased risk of infection. The majority also agreed that drying off a quarter was not painful for the cow, whether the reason was mild mastitis or elevated SCC.

In the experimental trial, cows subjected to quarter dry-off were compared to cows receiving no treatment. Quarters were evaluated clinically for atrophy, swelling, firmness, signs of pain and milk run. Additionally, rectal temperature of the cows was measured. Quarter dry-off treatment was significantly associated with quarter swelling (*P=0.01*) and increased quarter firmness (*P=0.01*) around day 10 from treatment start and with quarter atrophy around day 40 from treatment start (*P=0.06*). Quarter dry-off was also significantly associated with signs of pain related to the dried-off quarter (P=0.03). The odds for signs of pain was 4.5 times greater among quarter dry-off cows compared to the odds for cows receiving no treatment. Additionally, milk run was observed more frequently at quarter dry-off (*P<0.001*). The quarter dried-off cows were not more prone to elevated temperature, than cows receiving no treatment (*P=0.19*).

Behavior during milking was assessed as average frequency of hind limp tripping and kicking during milking obtained by registrations from video recordings for 23 cows. Before treatment start, the median frequency of tripping was 0.9 (IQR 1.7) for cows with no treatment and 1.1 (IQR 0.6) for quarter dried-off cows. The median frequency of kicking was 0.2 (IQR 0.5) for cows with no treatment and 0.1 (IQR 0.2) for quarter dried-off cows. After treatment start, the comparable median frequency of tripping was 1.0 (IQR 1.3) and 0.8 (IQR 1.0), respectively, while the median frequency of kicking was 0 (IQR 0.3) and 0.1 (IQR 0.2), respectively. No significant difference in tripping and kicking was observable from these results.
Milk production loss was estimated based on average daily milk yield for 19 days subsequent to treatment start with reference to average daily milk yield in 19 days prior to treatment. The production loss was estimated to be

4.1 kg/day (95% CI: 3.1-5.0), greater for cows subjected to QDO compared to CM cows. The average production loss among CM cows was 1.6 (± 0.3) kg/day corresponding to a production loss relative to prior production of 5% (95% CI: 3-8). In comparison, the average production loss among QDO cows was 5.6 (± 0.5) kg/day corresponding to a relative production loss of 20% (95% CI: 17-23). The production loss depended on parity, days in milk (DIM and prior yield on the quarter subjected to dry-off (Q1). An increase in production loss with increasing prior yield on Q1 was observed, as expected, as the production on Q1 is no longer retrieved at milking. For both primiparous and multiparous cows, production loss decreased with increasing DIM at treatment start. The effect of DIM was more pronounced at lower prior Q1 yield. The production loss of multiparous cows showed less dependence on the prior yield on Q1. The interplay between parity, DIM and prior yield on Q1 suggests that the compensatory production potential is greater for early lactation multiparous cows at quarter dry-off.

Economic effect of strategy drying off quarters with elevated SCC

Method: Two case farms from each country; Denmark, Switzerland, Germany, Lithuania, Sweden and Austria representing 11 different farm types were selected (criteria are described in WP2). The strategy "drying off quarters" was simulated in every individual farm with the simulation model SimHerd by using the farm data collected in WP2 as input. Based on the results from WP5, it was assumed that 7% of the cows in the herd fulfill the requirements for drying off one quarter. The procedure results in a milk-yield reduction on the dried off cows of 13.5% (results from WP5). The effect of using this strategy on somatic cell count and number of mastitis cases was not evaluated in WP5. But we assumed in the simulations that drying off resulted in reduction of either 10% or 20% of SCC in the tank-milk (because subclinically infected quarters no longer contribute to the total SCC) and this reduction was analogous to a reduction in the number of clinical mastitis cases of 10% or 20% (assuming that infection pressure is reduced).

Results: If this strategy resulted in a reduction of SCC and clinical mastitis cases of 10% there was an average loss of 6.7€ per cow per year (ranging from -21€ to 8€). Compared to WP4 the missing production from the dried off quarter reduces the positive economic effect although the cow compensates. However, if this strategy resulted in a 20%-reduction of SCC and clinical mastitis cases the gross margin per cow per year increased by on average 12.5 € (ranging from -3€ to 36€). Like the results in WP4 the economic effects of this strategy were very sensitive to the milk price, level of production, mastitis and SCC. With the assumption of 20% effect, a Danish and a Swiss farms benefit most from this strategy due to high milk yield and high milk price respectively. Farms with low level of mastitis, SCC, milk yield and/or milk price did not benefit from this strategy.

B - fulfilment of objectives:
All objectives have been fulfilled.

WP6	Improving metabolic and udder health through improved pasture feeding management

WP leader: Jacek Walczak and Jan Tind Sørensen
Responsible partners: NRIAP, AU-AS

Overall summary of main results, discussion and conclusions WP6

The aim of WP6 was to estimate the effect of grazing on metabolic diseases and mastitis and further to identify cow level risk factors related to cow activity during the pasture period.

The study was conducted as a cohort study including 9 Danish (5 AMS and 4 parlour herds) and 12 Polish parlour herds. Within each milking system, two different breeds were selected. In Denmark, 6 Holstein Friesian and 3 Jersey herds were included. In Poland, 3 herds with Polish Red, 3 herds with Polish Red and White, 3 herds with Polish Black and White, and 3 herds with Holstein Friesian were included. Within each herd cows were followed during three seasons; summer 2015, winter (zero grazing) 2015/16 and summer 2016. Effect of calving season (summer vs. winter) on metabolic disease and mastitis was estimated.

A comparison between performance during stable and grazing seasons based on 9 organic Danish herds revealed that kg ECM/day was 1.0 to 1.3 kg lower during the grazing seasons; primarily due to a significantly lower fat percent. Regarding udder health this analysis showed a significant effect of the grazing period on the level of SCC in all three parity groups: the SCC was 11-25 % higher in the grazing period depending on parity. No effect of grazing seasons was found for metabolic diseases.

The Danish results were used to evaluate likely consequences across six countries using the herd simulation model SimHerd . Scenarios were set up as follows: Grazing was for each farm set to either 150 days (short season) or 195 days (long season in Nordic countries). Based on Danish findings, each day of grazing was assumed to result in a loss of 1.3 kg EKM per cow, and the risk of dying in the grazing season was reduced by 46%. Risk of claw and leg diseases was assumed to be reduced by 50% in the grazing season in half of the scenarios and by 0% in the other scenarios. Four scenarios were simulated: Short and long grazing season with and without a risk-reduction of claw and leg diseases linked to grazing. In addition a sensitivity analysis of the feed-price was performed. SimHerd simulations indicate that farms in Germany and in countries with short grazing season of around 160 days (Lithuania and Sweden) can benefit economically from increasing the grazing season to 195 days under the assumption that grazing reduces the risk of claw and leg problems by 50% in the grazing season. Their gross margin/per cow/year would increase between 2€ and 43€. The Swedish farms could benefit from an increased grazing season even without a positive effect of grazing on hoof-and- leg-health (17€ and 5€ per cow per year). The farms in the Alp-countries Austria and Switzerland, already have extraordinary long grazing seasons of 201-240 days, and if they reduce their grazing season they would loose up to 214€ per cow per year – also without assuming a positive effect of grazing on claw and leg health. Only the Danish farms can benefit a bit from reducing the grazing season to 150 days (6 € and 8€ per cow per year). Variation between the two farms within each country was small compared to the variation between countries. Except for Denmark, a shortening of the grazing season is economically unfavourable in all countries due to the lower prices of grass compared to winterfeed. That was still the case with a 10% increase in the price of the summer feed/grazing, and Sweden, Germany and Lithuania would still benefit from a prolongation of the grazing season even with this increased price of summer feed. In Denmark the price-difference between summer and winter-feed is smaller than in the Alp-countries.

Report on the results obtained (A) and fulfilment of objectives (B)

A - results obtained:

Milk production: A linear, mixed model was used to evaluate the effect of grazing period versus housing period on the milk production in the Danish herds. Cow level data from the milk recordings with individual registrations of kilos of milk, kilos of energy corrected milk (ECM), fat percent and protein percent were used.

Aggregation was either period (grazing versus housing) or test month. For test month all milk recordings from each month in the experimental period were aggregated. Four different outcomes were tested: Average daily milk production (kg milk and kg ECM), average fat and protein percent. Parities 1, 2 and older cows were modelled separately. The model was corrected for lactation stage (days in milk, DIM) by including a two-piece linear function of DIM. Also, a model was constructed using the test month as fixed effect instead of grazing versus housing period. In total, 19989 test day records of kg ECM were obtained. The mean number of observations per test month was 370 (SD = 104). In Table 1, model estimates of the effect of grazing versus housing period on four different outcomes are presented. The kg ECM was 1.0 to 1.3 kg lower during the grazing seasons; primarily due to a significantly lower fat percent.

Table 1: Effect of grazing period (versus housing period) on the milk production (kg and kg energy corrected milk (ECM)), fat percent and protein percent in parity 1, 2 and older cows. Grazing period comprises grazing seasons in 2015 and 2016. Each outcome modelled with a linear mixed model with grazing +/- as fixed effect together with 2-piece linear function describing days in milk (DIM) and random effect containing animal, DIM and herd.

	Parity 1		*Parity 2*		*Older*	
Outcome	**Parameter estimates (95% CI)**	**p-value**	**Parameter estimates (95% CI)**	**p-value**	**Parameter estimates (95% CI)**	**p-value**
Daily milk, kg	-0.68 (-0.92,-0.44)	0.000	0.056 (-0.3,0.41)	0.759	0.1 (-0.19,0.39)	0.506
Daily milk, kg ECM	-1.305 (-1.55,-1.06)	0.000	-1.045 (-1.4,-0.69)	0.000	-1.191 (-1.49,-0.89)	0.000
Fat percent	-0.188 (-0.23,-0.15)	0.000	-0.311 (-0.36,-0.26)	0.000	-0.365 (-0.4,-0.33)	0.000
Protein percent	-0.026 (-0.04,-0.01)	0.004	-0.034 (-0.06,-0.01)	0.004	-0.05 (-0.07,-0.03)	0.000

ECM = Energy Corrected Milk, CI = Confidence Interval

Mortality and health: The effect of grazing versus housing period on the mortality risk 0-50 DIM and 51-305 DIM were examined by a logistic regression including period, parity and herd as explanatory variables as well as interaction terms between period and parity, and herd and parity. The mortality risk in early lactation was affected by parity (OR = 2.94, CI = 1.66-6.05) whereas no effects of period was detected (OR = 1.29, CI = 0.57-3.30). The mortality risk 51-305 DIM tended to be higher in the grazing periods. None of the disease prevalences were significantly different between periods in a simple two-way ANOVA. The effect of grazing period on the prevalence of milk fever and retained placenta were also tested but no significant effect of period was found in either outcome.

Udder health: An analysis showed a significant effect of the grazing period on the level of SCC in all three parity groups: the SCC was 25, 11 and 16 percent higher in the grazing period in first parity, second parity and older cows, respectively. In the Danish Cattle Database, veterinary treatments of mastitis (MAST) and interdigital phlegmon (IP) within the experimental period were identified. The first case of each animal in each of the three periods (two grazing and one housing period) was identified. In total, 164 cases of MAST and 49 cases of IP were found from the two grazing periods, and 60 cases of MAST and 12 cases of IP were found in the housing period. The mean incidence rate (IR: N cases/cow year) of MAST in the grazing periods was 0.19 (SD = 2.02) and 0.21 (SD = 2.73) in the housing period. The mean IR of IP was 0.034 (SD = 0.38) and 0.024 (SD = 0.40) for grazing and housing periods, respectively. Estimation of the effect of grazing versus housing period on the IR was done by fitting a Poisson mixed model. Besides period, parity group (parity 1, 2 and older) was modelled as a fixed effect and herd as random effect. The estimated effect of grazing period on the IR of MAST was insignificant (Relative Risk (RR) = 1.22, CI = 0.91-1.64, p-value = 0.19). Also, no significant effect of grazing on the IR of IP was found (RR = 1.66, CI = 0.88-3.13, p-value = 0.11).

Registrations from hoof trimming: At two to three hoof trimmings per herd, hoof lesions were registered. Following lesions were scored: Sole haemorrhage (SH), sole ulcer (SU) and digital dermatitis (DD). Recordings were aggregated at cow level: An individual cow was considered positive if it had a lesion in at least one hoof. Also, data were aggregated into two periods (Grazing, N = 1509, and Housing, N = 837) to evaluate the effect of grazing period versus housing period on the prevalence of the three observed hoof disorders. For each

disorder, a mixed model was constructed testing the effect of period while controlling for parity and DIM and allowing for random intercepts per herd. The odds of SH were significantly lower in the grazing period (OR = 0.24, CI = 0.29-0.29, p-value < 0.0001), while the odds of SU (OR = 3.42, CI = 2.33-5.02, p-value < 0.0001) and DD (OR = 3.13, CI = 2.39-4.12, p-value < 0.0001) were significantly higher in the grazing periods.

Clinical registrations: Each herd was visited three times to score cows for lameness, hock lesions and body condition. The visits were placed immediately after turning the cows in after a grazing period and at the end of the housing period. Only data from the first grazing period and the housing period are presented. Lameness was scored on a 5-point scale (1-5) and afterwards dichotomized with score 1-2 = 0 (not lame) and 3-5 = 1 (lame). Hock lesions were scored on a 4-point scale (0-3) and afterwards dichotomized with score 0-1 = 0 (no lesion) and 2-3 = 1 (lesion). Body condition scoring (BCS) was done on a 5-point scale (separated into 0.25 units). In the analysis, we evaluated the prevalence of thin (BCS < 2.75) and fat (BCS > 3.50) cows. The prevalence of lameness, hock lesions, and thin and fat cows in the grazing period 2015 was compared to the housing period 2015-16 by constructing mixed logistic regression models using the binary outcomes presented above. Parity group (1, 2, older) and DIM group (0-12 weeks, 13-24 weeks, >24 weeks) were fitted as fixed effects whereas random intercepts were allowed for the nine herds. We found no significant difference in the prevalence of lame cows (OR = 1.04, CI = 0.85-1.28, p-value = 0.70). The prevalence of fat cows was higher at the end of the grazing period compared to at the end of the housing period (OR = 4.17, CI = 2.39-7.29, p-value < 0.0001), whereas the prevalence of thin cows only tended to differ between the two periods (OR = 1.79, CI = 0.83-3.87, p-value = 0.14). The prevalence of severe hock lesions (score > 1) was significantly lower in the grazing period 2015 compared to the following housing period (OR = 0.42, CI = 0.33-0.52, p-value < 0.0001). Data from 12 Polish herds showed a higher herd prevalence of cows with SCC>400.000 cells/ml and cows with indication of rumen acidosis (based on fat/protein ratio) during summer than during winter.

Economic effects of prolonged/shortened grazing season: Like in WP4 and WP5 two case farms from six countries; representing 11 farm types were simulated with the model SimHerd. Simulation scenarios were set up as follows: Grazing was set to either 150 days (short season) or 195 days (long season in Nordic countries). Each day of grazing was assumed to result in a loss of 1.3 kg EKM per cow, and the risk of dying in the grazing season was reduced by 46%. Risk of claw and leg diseases was assumed to be reduced by 50% in the grazing season in half of the scenarios and by 0% in the other scenarios. The results of WP5 showed no effect of grazing on claw and leg health, however, several other studies have found a positive effect, and therefore we simulated both situations. Four scenarios were simulated: Short and long grazing season with and without a risk-reduction of claw and leg diseases linked to grazing.

Results: SimHerd simulations indicate that farms in Germany, Lithuania and Sweden can benefit economically from increasing the grazing season to 195 days under the assumption that grazing reduces the risk of claw and leg problems by 50% in the grazing season. Their gross margin/per cow/year would increase between 2€ and 43€. The Swedish farms could benefit from an increased grazing season even without a positive effect of grazing on hoof-and- leg-health (17€ and 5€ per cow per year). The farms in the Alp-countries, already have extraordinary long grazing seasons of 201-240 days, and if they reduce their grazing season they would loose up to 214€ per cow per year – also if there is no positive effect of grazing on claw and leg health. Only the Danish farms can benefit a bit from reducing the grazing season to 150 days (6 € and 8€ per cow per year). Except for Denmark, a shortening of the grazing season is economically unfavourable in all countries due to the lower prices of grass compared to winterfeed.

B - fulfilment of objectives:
The data collected have been used for model simulation of effects of different grazing strategies on metabolic diseases and mastitis in different European organic farm types.

WP7	Coordination and dissemination

WP leader: Jan Tind Sørensen
Responsible partners: All partners

Overall summary of main results, discussion and conclusions WP7

The aim of WP7 was to ensure a fruitful cooperation based on timely and efficient flow of information between the scientific work packages and to ensure an optimal dissemination of results from the project. The seven WP-leaders plus representatives from BOKU met every month at Skype, discussing the progress of the project and securing the needed flow and feedback of information between the six scientific work packages. The activities in WP7 included organisation of three workshops: A kick-off workshop and two subsequent workshops with external input.

Report on the results obtained (A), changes to the original plan/ WP aims (B) and fulfilment of objectives (C)

A - results obtained:
The activities in WP7 included organization of three workshops: A kick-off workshop with all project participants was held 22-24 February 2015 in Balice, Poland. A second workshop was held 22-23 February 2016 in Frick, Switzerland, with a joint programme with a parallel CoreOrganicPlus project; 2-ORG-COWS. A third workshop was held 11-13 June 2017 in Aarhus, Denmark. Preliminary results from the project were presented and discussed. Two external experts, one in dairy herd health management (Dr Isabel Penedo-Blanco) and an expert in dairy cattle breeding strategies using local breeds (Dr Sipke Hiemstra) were invited to the workshop for reviewing our results.

B- fulfilment of objectives:
Objectives were fulfilled.

4. Milestones and deliverables status

Deliverable No.	Deliverable name	Link to the document	Planned delivery month[1)]	Actual delivery month[1)]	Reasons for changes/delay and explanation of consequences
D1.1	Quantification of production, conformation and functional traits in relevant local/native and commercial breeds	Bieber et al. 2016 (EAAP), Bieber et al. 2018a (paper to be submitted) Bieber et al. 2018b (paper to be submitted)	18	36	As data sources differed considerably we decided to split material and write two papers: one covering the whole organic population of the respective breeds in four countries and one focusing on breed comparison within similar farm types in two countries (case studies).
D2.1	Farm types and breeding strategies in organic dairy production	Wallenbeck et al. 2016 Ivemeyer et al. 2017 Wingren 2018, Wallenbeck et al. 2018 (paper to be submitted)	30	36	Delay due to late data delivery from two partner countries.
D3.1	Cross breeding in organic dairy production	Clasen et al. 2018 (EAAP) Clasen et al. 2018 to be submitted	36	36	
D3.2	Simulating consequences of choosing a breeding goal for organic dairy production.	Slagboom et al. 2018 (WCGALP). Slagboom et al. 2018 (paper submitted to Journal of Dairy Science 2017)	34	34	
D3.3	Recommendations on breeding strategies for organic dairy production	Kargo et al., 2018 (WCGALP)	34	34	
D4.1	new SCC indicator for mastitis	internal	24	27-	M8 was internally delivered in

	curing capacity	report (milestone M8); Ivemeyer et al. 2018a Ebinghaus et al 2017		38	time. The identified new indicator CURE was used in WP4 analyses and scientifically (M27) published in combination with D4.2 as well as in the WP4 farmers' feedback (M35) and in the WP4 leaflet (M38).
D4.2	Stress level, management and udder health article	Ivemeyer et al. 2018a	34	39	
D4.3	Recommendations on how to avoid stress and improve udder health in dairy cows	Ebinghaus et al. 2017; Ivemeyer et al 2018b	35	35-38	DE: national farmers' feedback (M35), farmers' workshops (M 38) and national article submitted to the organic farmers' magazine 'Lebendige Erde' (M38)
D5.1	Effect of drying off procedure on cure rate, infection spread and milk production in organic dairy herds	Skarbye et al (in revision 2018)	34	38	Manuscript submitted for Journal of Dairy Science in March 2018 (in revision 2018)
D5.2	Recommendation to handle subclinical mastitis without medication	Rath et al. 2018	35	37	DE: national article submitted to the organic farmers' magazine 'Bioland' (M37) will be published in June 2018 DK: national article submitted to organic farmers' magazine 'Økologi&Erhverv' will be published in May 2018
D6.1	Cow and herd level risk factors for metabolic diseases and mastitis in organic dairy herds	Nielsen et al (to be submitted 2018)	34	40	Manuscript based on the Danish data submitted in 2018
D6.2	Recommendation on preventing metabolic diseases by improved pasture feeding management	Report to be uploaded on web page June 2018	35	35	Results from simulation study uploaded on the project homepage June 2018
D7.1	Project website	http://coreorganicplus.org/research-projects/organicdairyhealth/	3	3	
D7.2	Midterm report		21	21	
D7.3	Recommendations on optimal breeding strategies and best management practices	Report uploaded and the project web-site	35	35	Uploaded June 18
D7.4	National leaflets based on D3.3, D4.3, D5.2, D6.2 and D7.3	To be submitted in 2018	35	37	National leaflets is produced based on D7.3 or other suitable national publications
D7.5	Final report	Submitted June 2018	36	38	

Milestone No.	Milestone name	Planned delivery month[1)]	Actual delivery month[1)]	Reasons for changes/delay and explanation of consequences
M1	Workshop 1: Kick-off	1	2	
M2	Full protocol for database and case farm sampling	6	6	
M3	Protocol for traits in local/native and commercial breeds	6	6	
M4	Survey on drying off procedure for handling mastitis	6	18	German results could not be delivered before end of WP4 farm visits to include them with the Danish
M5	Database on herd characteristics and breeding strategies	12	18	Data collection delayed in some partner countries
M6	Workshop 2: Farm type, breeds and measures	12	13	
M7	Simulation scenarios (breeding strategies)	18	18	
M8	SCC indicator of mastitis curing capacity	24	24	
M9	Genetic simulations finished	28	28	
M10	Relations between stress, management and udder health	30	30	
M11	Workshop 3: Optimal breeding strategies and best management practices	30	30	

[1)] Measured in months from the project start date (month 1)

Additional comments on deviations from the original project implementation plan in case there is an impact on fulfilment of the overall project objectives.

5. Publications and dissemination activities

5.1 List extracted from Organic Eprints

WP1

Bieber, A.; Spengler Neff, A.; Fuerst-Waltl, B.; Ivemeyer, S.; Simantke, C.; Stricker, C.; Walczak, J.; Wallenbeck, A.; Winckler, C. und Wojcik, P. (2016) Comparison of native and commercial dairy breeds on organic farms in five European countries. In: Book of Abstracts of the 67th Annual Meeting of the European Federation of Animal Science, Wageningen Academic Publisher, The Netherlands, Book of abstracts, No. 22, 307. [http://orgprints.org/30648/]

21.11.2017. Poster presentation (in German) at the Research day of Profi Lait 2017 on Swiss results by Anna Bieber and Anet Spengler Neff. Title: "Vergleich lokaler und kommerzieller Milchviehrassen im Biolandbau", (Comparison of local and commercial dairy cattle breeds in organic farming), Zollikofen, Switzerland [http://orgprints.org/25082/]

WP2

Wallenbeck, A.; Bieber, A.; Spengler Neff, A.; Fuerst-Walt, B; Winckler, C.; Ivemeyer, S.; Simantke, C.; March, S.; Brinkmann, J.; Rousing, T.; Sorensen, J.T.; Walczak, J.; Wojcik, P. und Ribikauskas, V. (2016) Characteristics of organic dairy farm types in seven European countries. In: Book of Abstracts of the 67th Annual Meeting of the European Federation of Animal Science, Wageningen Academic Publisher, Book of abstracts, No. 22, 306. [http://orgprints.org/30622/]

Ivemeyer, Silvia; Brinkmann, Jan; March, Solveig; Simantke, Christel; Winckler, Christoph; Knierim, Ute (2017b). Major organic dairy farm types in Germany and their farm, herd, and management characteristics. Organic Agriculture, Online since July 2017, 1-17, DOI: 10.1007/s13165-017-0189-3. [http://orgprints.org/32925/]

Wingren. J. (2017). Management practices' effect on milk production, somatic cell count and mastitis in Swedish organic dairy farms. Master's Thesis. Swedish University of Agricultural Sciences, Department of Animal Breeding and Genetics. [http://orgprints.org/33258/]

WP3

Rydhmer, L and Slagboom, M. (2017) Tuning up sustainable organic animal production. ORGANICS for tomorrow's food systems. NJF 4th Organic Conference, NJF 495 seminar. June 19–21, 2017 Mikkeli, Finland. [http://orgprints.org/31605/]

Slagboom, M., Wallenbeck, A., Rydhmer, L., Thomasen, J., Kargo, M. (2018). Breeding Goals for Organic Dairy Farming in Denmark Based on the Principles of Organic Agriculture. Proceedings of the World Congress on Genetics Applied to Livestock Production, Volume Genetic gain - Breeding Objectives and Economics of Selection Schemes 1, ,50, 2018. [http://orgprints.org/33256/]

Kargo, M., Thomasen, J., Wallenbeck, A., Hjortø, L. and Slagboom, M. (2018). Organic dairy breeding lines? - Possibilities and Requirements Proceedings of the World Congress on Genetics Applied to Livestock Production, Volume Genetic Gain - Breeding Strategies 1,536, 2018. [http://orgprints.org/33257/]

WP4

Ivemeyer, Silvia; Brinkmann, Jan; March, Solveig; Simantke, Christel; Winckler, Christoph, Knierim, Ute (2017a). Identifizierung von Bio-Milchviehbetriebstypen sowie deren Betriebs-, Herden- und Managementcharakteristika. Proceedings of 14th Wissenschaftstagung Ökologischer Landbau, Campus Weihenstephan, Freising-Weihenstephan, 7-10 March 2017. [http://orgprints.org/31928/]

Ivemeyer, Silvia; Simantke, Christel; Ebinghaus, Asja; Poulsen, Pia Haun; Sorensen, Jan Tind; Rousing, Tine; Palme, Rupert und Knierim, Ute (2018a). Herd level associations between human-animal relationship, management, fecal cortisol metabolites and udder health of organic dairy cows. Journal of Dairy Science, 101:1-14 (in press), https://doi.org/10.3168/jds.2017-13912. [http://orgprints.org/32926/]

WP5
Ivemeyer, S. and C. Simantke (2015): Einzelne Euterviertel trockenstellen, Projekt zur Milchviehgesundheit – Praxiserfahrungen gesucht [Drying off single udder quarters – Dairy health project – looking for experiences]. Bioland 11/2015, p.38

Simantke, C. (2015): Trockenstellen einzelner Euterviertel während der Laktation [Drying off single quarters during lactation]. Naturland Nachrichten, 6/2015, p.49

Hansen, Alice Puk and Søndergaard, Linda (2017) Afgoldning af enkeltkirtler i økologiske malkekvægsbesætninger. Aarhus Universitet, Institut for Husdyrvidenskab, Denmark. Online at http://anis.au.dk/aktuelt/nyheder/vis/artikel/afgoldning-af-enkeltkirtler-i-oekologiske-malkekvaegsbesaetninger/, accessed on: 2017. http://orgprints.org/31477/

Skarbye, A.P. Krogh, M.A. Sørensen J.T (2018). Afgoldning af enkeltkirtler som strategi til håndtering af mild yverbetændelse Økologi og Erhverv 11 maj 2018 [http://orgprints.org/33278/].

WP6
Poulsen P.H. (2017). Sundhedsstatus i økologiske malkekvægsbesætninger Besætningsrapport fra CoreOrganic projektet OrganicDairyHealth 11 pp

WP7
Sørensen, J.T. (2015). Økologiske køer skal gøres endnu sundere gennem forbedret pasning og avl. *Økologi & Erhverv*, 22 May 2015, 567, p. 12. http://orgprints.org/28750/

5.2 Additional dissemination activities

WP1
Bieber, A., Fuerst-Waltl, B., Leiber,F., Walczak,, J. , Wallenbeck, A., Winckler, C., Wójcik, P., and Spengler Neff, A. Comparison of production level, fertility and health associated traits in local and commercial dairy cattle breeds under organic production conditions in Austria, Switzerland, Poland and Sweden. To be submitted to the Journal of Dairy Science in summer 2018a.

Bieber, A., Spengler Neff, A., Wallenbeck, A., Simantke, C., Knierim, U., and Ivemeyer, S. Comparison of local and commercial dairy cattle breeds under organic production conditions in Germany and Sweden. To be submitted to the Journal of Renewable Agriculture and Food Systems in summer 2018b.

Talks about planning and preliminary results at breeders' meetings of the native breed in Germany (WP1), about 20-25 participants each:

18.02.2015, in German, by Silvia Ivemeyer	„ORGANICDAIRYHEALTH - Unterprojekt: Gesundheits- und Produktionsmerkmale in lokalen und weitverbreiteten Rassen im Vergleich“	AAZ-Breeders' Meeting, Hof Luna, Everode
17.02.2016, in German, by Silvia Ivemeyer	„ORGANICDAIRYHEALTH - Unterprojekt: Gesundheits- und Produktionsmerkmale in lokalen und weitverbreiteten Rassen im Vergleich – Zwischenstand der Ergebnisse 2016“	AAZ-Breeders' Meeting, Hof Luna, Everode

14.02.2017, in German, by Silvia Ivemeyer	„ORGANICDAIRYHEALTH - Unterprojekt: Gesundheits- und Produktionsmerkmale in lokalen und weitverbreiteten Rassen im Vergleich – Zwischenstand der Ergebnisse 2017“	AAZ-Breeders' Meeting, Hof Luna, Everode
20.02.2018, in German, by Silvia Ivemeyer	„ ORGANICDAIRYHEALTH - Gesundheits- und Produktionsmerk-male in lokalen und weitverbreiteten Rassen im Vergleich – deutsche sowie internationale Endergebnisse 2018“	AAZ-Breeders' Meeting, Hof Luna, Everode

20.6.2016. Talk on Swiss, Austrian and Polish results (in German) by Anet Spengler, Title: "Lokale und kommerzielle Milchkuhrassen im Vergleich - Ergebnisse aus europäischen Ländern", (Comparison of local and commercial dairy cattle breeds – results from European countries) at Plantahof, Landquart (Switzerland)

22.9.2016. Talk on Swiss, Austrian and Polish results (in German) by Anna Bieber, Title: "Lokale und kommerzielle Milchkuhrassen im Vergleich", (Comparison of local and commercial dairy cattle breeds) at a national conference on actual topics in cattle and pig husbandry, Zollikofen, Switzerland

Translations "ORGANICDAIRYHEALTH, subproject: Characterization and evaluation of health and production traits in local/native dairy cattle breeds with reference to commercial breeds", "…interim results February 2016/2017", "… final German and international results 2018"; AAZ = Anglerrind Alter Zuchtrichtung = translated: Original Red Angler
Cattle

14.03.2018. Workshop for farmers, breeding organisations, advisors and press on dual purpose breeds together with 2-ORG-COWS (in German), Title: "Zweinutzungsrassen - alter Zopf oder neue Chance?, (Dual-purpose breeds – an outdated custom or a new opportunity?) with approx. 50 participants at Strickhof, near Zurich, FiBL contributors: Anna Bieber, Anet Spengler, Thomas Alföldi (film report on the event available under: http://projects.au.dk/coreorganicplus/currently/nyhed/artikel/dual-purpose-breeds-an-outdated-custom-or-a-new-opportunity/)

21.6.2018. Oral presentation on Swiss and Austrian results by Anna Bieber et al., Title: "Comparison of production level, fertility and health associated traits of native and commercial dairy cattle breeds on organic farms in Austria and Switzerland" at the 1. European Symposium on Livestock Farming in Mountain Areas, Bozen-Bolzano, Italy, 20.-22.06.2018.

WP2
Wallenbeck, A. Bieber, A. Spengler Neff, B. Fürst-Waltl, C. Winckler, C. Simantke, S. March; J. Brinkmann, T. Rousing, , J. T Sørensen, J. Walczak, P. Wójcik, V. Ribikauskas, S. Wilhelmsson, T. Skjerve, S. Ivemeyer. 2018. Characteristics of major organic dairy farm types in seven European countries. Manuscript submitted to Organic Agriculture summer 2018.

06.04.2018. Talk on project results (in Lithuanian) by Vytautas Ribikauskas. Title: "Ekologiškai laikomų melžiamų karvių sveikata ir gerovė", (Health and welfare of organic dairy cows) at national workshop for farmers on scientific innovations in agriculture organized by Lithuanian Association of Organic Farms, Ukmergė, Lithuania. (Approx. 50 participants).

WP3
Slagboom, M., Wallenbeck, A., Hjortø, L., Thomasen, J., Kargo, M. 2017. Simulating breeding goals for organic dairy production. EAAP 2017.

Clasen J. B., Østergaard, S., Strandberg, E., Fikse W.F., Kargo, M. and Rydhmer, L. 2018. Conservation of a native dairy cattle breed through crossbreeding with commercial dairy cattle breeds in Sweden. EAAP 2018

Clasen J. B., Østergaard, S., Strandberg, E., Fikse W.F., Kargo, M. and Rydhmer, L. Economic consequences of crossbreeding between Swedish Red and Swedish Holstein in conventional and organic herds in Sweden. Manuscript will be submitted summer 2018.

Clasen J. B., Østergaard, S., Strandberg, E., Fikse W.F., Kargo, M. and Rydhmer, L. Conservation of a native dairy cattle breed through crossbreeding with commercial dairy cattle breeds in Sweden. Manuscript will be submitted autumn 2018.

Slagboom, M., Wallenbeck, A., Hjorto, L., Sorensen, C., Rydhmer, L.,Thomasen. J., Kargo, M. 2018. Simulating consequences of choosing a breeding goal for organic dairy production. Submitted to Journal of Dairy Science Dec 2017, revision resubmitted May 2018.

WP4

In Germany, all farmers received a written feedback concerning their farm-specific data including quarter milk sample results in German language after each winter data collection period (15/16 and 16/17). The feedback comprised a national benchmarking with regard to all other investigated German farms in WP4. Based on assessed data during the farm visits and the cyto-bacteriological milk sample results, farmers in Germany were offered to discuss their farm specific herd status regarding human-animal relationship and udder health with the researchers.

Ebinghaus, A., Ivemeyer, S., Simantke, C. (2017) Einflüsse auf die Mensch-Tier-Beziehung und Eutergesundheit bei Milchkühen - Bericht für projektbeteiligte Betriebe [Effects on human-animal relationship and udder health – report for project farms], send as summary to all WP4 project farms via letter and email in December 2017.

Ivemeyer, S., Ebinghaus, A. (2018): Regional Workshops in North and Middle Germany with German WP4 (and WP5) project farmers: 07 March 2018 on Domäne Fredeburg near Ratzeburg, and 12 March 2018 on Domäne Frankenhausen near Kassel (presentation and discussion of the project results with emphasis on human animal relationship and mastitis risk factors).

Ivemeyer, S., Simantke. C., Ebinghaus, A. (2018b): Einflüsse von Mensch-Tier-Beziehung, Stressbelastung und Management auf die Eutergesundheit (Arbeitstitel) [Effects of human animal relationsship, stress nd management on udder health (working titel)], submitted to the organic farmer magazine ‚Lebendige Erde' in May 2018

Presentation of WP4 results are planned at the "Freiland-Tagung" in Vienna, Austria, 27. September 2018 (conference for advisors, researchers, farmers) and the "Ökologische Milchviehtagung" [Organic Dairy Conference], 29 November 2018 at "Haus Düsse" in Germany (for farmers and advisors).
Ivemeyer, S. (2018): Vortrag „Bitte zähme mich"? – Mensch-Tier-Beziehung und Eutergesund-heit", REILAND-Tagung, Wien, 27.September 2018

Ivemeyer, S. (2018): Vortrag zu Mensch-Tier-Beziehung, Stressbelastung und Eutergesundheit, Ökologische Milchviehtagung, Haus Düsse, 29.November 2018

WP5

30-11-2017 Skarbye, A. Håndtering af mild mastitis ved afgoldning af enkelt kirtler. Indlæg på Økologikongressen Kolding 29-30 November 2017

Skarbye, A., Krogh, M.A., Sørensen J.T. (2018) The effect of individual quarter dry-off in management of subclinical mastitis on milk production and behavior during milking in organic dairy herds: A randomized controlled trial. Journal of Dairy Science, in revision

Rath, F., Simantke, C., Ivemeyer, S. (2018): Trockenstellen einzelner Euterviertel während der Laktation: eine Alternative zur antibiotischen Behandlung von Mastitisvierteln? [Drying off single udder quarters during lactation: an alternative to treat mastitis with antibiotics?] Bioland 6/2018

WP6.
In Denmark all nine involved dairy herds has received a Danish report with selected results from the three seasons where we followed cow health. The identity of the nine farms were hidden, but each farmer recieved information to identify his own farm.

Nielsen, B.H. Kudahl, A.B. Sørensen, J.T. Effect of grazing on production and health in organic dairy herds. Manuscript in preparation. To be submitted June 2018

WP7
Alföldi, Thomas (2016) Video: Improving health of organic dairy cows through breeding and management (OrganicDairyHealth). Research Institute of Organic Agriculture (FIBL), CH-Frick, URL: https://www.youtube.com/watch?v=RM10ofxmrsQ

6. Project impact

The breed aspects of production and health at grazing and at relatively low concentrate level is further investigated through characterisation of productivity and health of local/native breeds with reference to commercial breeds in organic and low-input environments. We expected that implementation of the results from the project would increase demand for organic milk production and thereby increase transition from conventional to organic production. Due to the dominant role of dairy cattle in European organic livestock production these opportunities were expected to benefit the organic livestock sector in general. These expectations remains at completion of the project

New site and farm type specific breeding strategies taking into account the potentials of local/native breeds was expected provide long-term health improvement for the benefit of animal welfare and the competitiveness and societal trust in European organic dairy production. Our results indicate a role for local/native breeds promoting animal health and welfare with differences between breeds and countries. The role of cross-breeding including local/native breeds may improve societal trust.

By introducing management procedures for improved resilience towards mastitis and a drug free mild mastitis handling procedure, we expected a significant reduction in antibiotics used in organic dairy production. Our results indicate a possibility to reduce mastitis and support mastitis cure rate by improving stockpersons' attitudes, enabling positive contacts towards the animals in daily handling and minimising stress. Furthermore, we confirmed previous studies that housing and management effects on udder health should not be neglected. Drying off quarters during lactation seems to be a relevant alternative to antibiotic treatment of a group of chronical subclinical or mild clinical mastitis quarters.

Realizing the importance of mastitis for antibiotic medication in organic livestock production, we were aiming at an immediate and significant reduction of medicine application in the organic livestock sector. There seems to be potential for a substantial reduction in mastitis if our results are fully implemented this can lead to a significant reduction in use of antibiotics in organic dairy milk production.

Summer grazing is an important reason for societal trust in organic dairy farming. Management procedures for preventing metabolic diseases and mastitis during grazing was expected to improve animal welfare and competitiveness in organic milk production. Enhanced summer grazing seems not to change cow health and milk substantially. As grazing often is cheaper than stable feeding there seems to be room for making organic milk more competitive by increasing pasture period and long pasture days.

7. Added value of the transnational cooperation in relation to the subject

The research task addressed in WP1 on characterising and evaluation of health and production traits in local/native dairy cattle breeds with reference to commercial breeds was conducted across five European countries. It is the first European report on estimating the performance of local breeds on organic farms in several countries.

The questions addressed in WP2, on characteristic of major farm types in European organic dairy production, can only be assessed by transnational research cooperation. The development of a transnational database on farm characteristics was successful and will be of use in future research projects. Analyses of the results from the interviews and questioners with organic dairy farmers across the participating countries indicate regional, cultural and typographic differences in management strategies as well as differences in resource availability. The results stresses the need of further transnational knowledge transfer on farmer and advisor level.

Within WP3, addressing development of breeding strategies for organic dairy production, the research group has developed a close collaboration between Sweden and Denmark, which has also broadened to Norway in spinoff projects. The research group has had frequent physical meetings and the group has expanded as funding from other funding sources has made it possible to expand the research. The WP started officially in month 12 of the project (February 2016), but the planning started already in June 2015 with a start-up meeting in Viborg, Denmark, where breeding scenarios for simulation were discussed and PhD student Margot Slagboom (Aarhus University) was recruited for the project to do genetic simulations in ADAM. PhD student Julie Clasen was recruited in September 2017 to do economic simulations in SimHerd. WP3 had full-day WP meetings in November 2015 (Uppsala, Sweden), February 2016 (FiBL, Switzerland), September 2016 (Uppsala, Sweden), June 2017 (Viborg, Denmark) and a finalising meeting in December 2017 (Uppsala, Sweden). Results from the WP were presented at the EAAP meeting 2017 and 2018, at the 2017 NJF organic seminar and at the 2018 WCGALP meeting. The planned deliverables of the WP will be submitted to scientific journals and/or have been communicated to relevant targets groups within the academic community, among breeding organisations and with organic farmers. WP3 has contributed to the education of two PhD students with good expectations for future careers within the academy and/or breeding organisations. Closely related, and spin off projects with national funding from Sweden and Denmark, and funding from ECO-AB, has been merged to the project. Thus even when the deliverables of the ORGANICDAIRYHEALTH project are finished, the research on sustainable breeding strategies for organic dairy production continues, through simulation and questionnaire studies.

The studies on prevention and handling of mastitis in organic dairy herd (WP4 and WP5) were conducted in collaboration between Denmark and Germany. The transnational study design strengthened the outcome of our research. The study on effect of grazing on health in WP6 was conducted across Denmark and Poland.

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Annex 1: Cost overview and deviations from budget

Partner no.	Total person months	Spent person months by March 15 2018	Final spent person months (Estimated June 15 2018)	Total budget	Spent budget by March 15 2018	Final spent budget (Estimated June 15 2018)
P1	22.3	22.3	22.3	291,000	291,000	291,000
P2	4.5	4.5	4.5	38,000	38.000	38.000
P3	22.5	21.5	22.5	255,000	237,400	255,000
P4	19.0	18.7	19.4	196,700	227.000	239.000
P5	18.0	18.75	18.75	198,338	194,000	194,000
P6	3.0	3.0	3.0	40,000	40,000	40,000
P7	12.0	12.0	12.0	110,000	110,000	110,000
P8	7.9	7.9	7.9	22,000	22,000	22,000
TOTAL	109.1			1151,038		