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Economy of forage-based cattle beef and milk production

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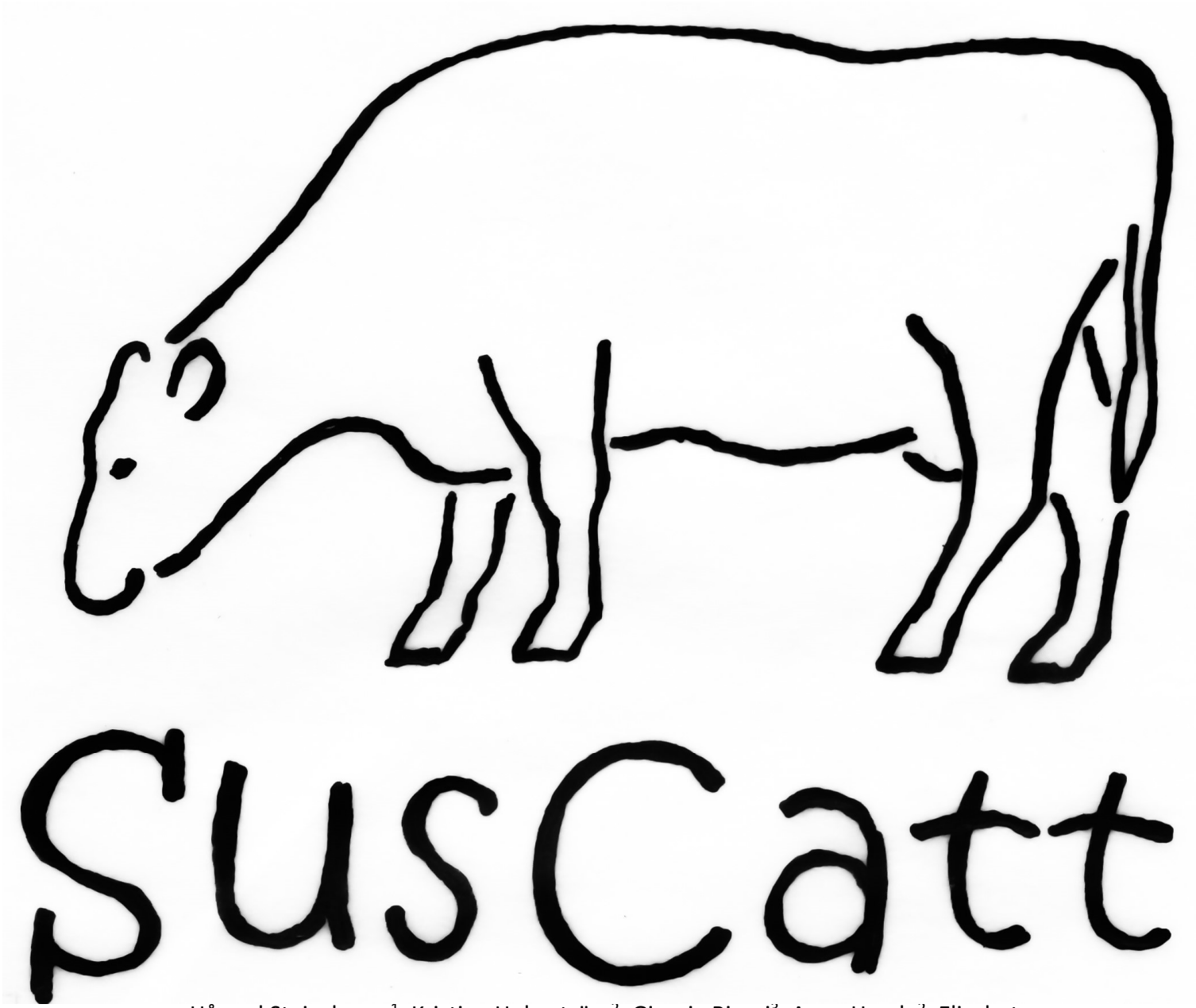

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TITTEL/TITLE

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SAMMENDRAG/SUMMARY:

For nokre av driftsystema vi granska i SusCatt-prosjektet undersøkte vi nærmare korleis ein overgang til meir grovfôrbasert fôring kan ha å seie for lønnsemda. Fem SusCatt-system blei vurdert, inkludert arbeidet i Sverige der en samanlikna effekt av rase og fôrstyrke på storfekjøttproduksjon av både oksar og kastratar frå mjølkekyr, og i Storbritannia med rein grovfôrbasert storfekjøttproduksjon frå ammekyr. I mjølkeproduksjonen, blei effekt av kraftfôrnivå på lønnsemd studert ved bruk av husdyrkontrolldata i Noreg og for italienske gardar effekten av å redusere mengde maissurfôr i rasjonen.

For storfekjøttproduksjonen i Sverige blei resultat frå forsøka, der ein samanlikna rase (kjøttfe eller mjølkekurase) og fôrstyrke, brukt til å modellere 24 scenarier; 12 kvar for oksar og kastratar. Det var liten forskjell mellom dei tre svenske regionane som ble vurdert. Oksar gav høgare inntekter enn kastratar, sjølv om beiting med kastratar ga større subsidiar. Interessant for oksar var at bruken av sæd frå kjøttfe (Angus) hadde større effekt på lønnsemda enn fôringsstyrken. Men for kastratar var denne effekten langt mindre, bruken av Charolais-sæd har liten betydning samanlikna med det å få større slakt ved å fôre 7 månader ekstra for å slakte ved 28 månaders alder.

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Lønnsemda var god for dei britiske sertifiserte beitebaserte storfekjøttbruka samanlikna med nasjonale gjennomsnitt av meir konvensjonell storfekjøttsystem. Fråvær av fôrkjøp på dei beitebaserte gardane gav langt lågare kostnader til innsatsfaktorar, og saman med høgare totalinntekter var marginane per ammeku høgare enn dei 'beste' (topp 25%) gardane.
Data frå mjølkegardar i Midt-Noreg over tre år blei brukt til å vurdere samanhengen mellom lønnsemd og kraftfôrbruk, etter rangering av bruka etter kraftfôrbruk per årsku og fordeling på tre like store grupper. Distriktstilskotsnivået var lik i gruppene, men gardane med lågt kraftfôrnivå (med større mengd grovfôr i rasjonen) fekk større areal- og husdyrtilskot per kg mjølk produsert. Dei totale driftskostnadene var like i gruppene, slik at den høgare mjølkeprisen oppnådd på gardar i den låge gruppa, saman med høgare tilskot, gav betre lønsemd per liter seld mjølk. I Italia blei økonomisk lønnsemd for intensive mjølkeprodusentar med rasjonar dominert av maisensilasje og korn samanlikna med alternative produksjonssystem som bruker grassurfôr eller høy. Forskjellane var små, mjølkeavdråtten var høg, spesielt på bruk der mais blei bruka som fôr. Men buskaper med alternativ fôring oppnådde høgare mjølkepris, og til tross for høgare fôrkostnader var marginane per liter noko høgare med desse meir berekraftige fôringssystema. I SusCatt-søknaden, antok vi at det å gå frå intensiv fôring mot ei fôring med mindre bruk av eteleg mat som fôr og bruke meir grovfôr og beite i fôring av storfe, ville gje betre lønsemd. Vi er nå i stand til å presentere resultat som langt på veg stadfester dette.

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GODKJENT /APPROVED	**PROSJEKTLEDER /PROJECT LEADER**
Mats Höglind	Håvard Steinshamn
NAVN/NAME	**NAVN/NAME**

Preface

The main objectives of the research project “Increasing productivity, resource efficiency and product quality to increase the economic competitiveness of forage and grazing based cattle production systems”, with the acronym SusCatt, were to evaluate the productivity, resource-use efficiency and consumers’ acceptability of a transition to high forage and pasture diets for European cattle.

The project focused on dairy, integrated dairy/beef and specialized beef production systems, addressing:

- Productivity, product, animal health and welfare, and economic performance,
- Resource use efficiency and environmental impacts, both assessed experimentally, by modelling and life cycle analysis,
- Consumers’ appreciation of production systems.

The project involved modelling, experimental and participatory R&D activities and covered contribution from SMEs (farmers, advisory service) and pooled expertise from seven academic centres of excellence in six European countries. The research was organised in four work packages; two focusing on beef and milk production, feeding into one on overall assessment of economic, resource-use efficiency and societal acceptance and the fourth was dedicated to disseminating our findings.

This report summarizes the effect of increasing the proportion of forage and pasture in the diet of beef and dairy cattle on economic performance in contrasting European environment and economic conditions.

The research was made possible by funding from SusAn, an ERA-Net co-funded under European Union’s Horizon 2020 research and innovation program (www.era-susan.eu), Grant Agreement n°696231, and the national funding bodies Research Council of Norway (RCN, Norway) Swedish Research Council (FORMAS, Sweden), Department for Environment, Food & Rural Affairs (DEFRA, UK), Ministry of Agricultural, Food and Forestry Policies (MiPAFF, Italy), National Centre for Research and Development (NCBR, Poland), and the Federal Ministry of Food and Agriculture (BMEL, Germany). The Swedish beef studies were co-financed by Region Västra Götaland grants no. RUN-610-0789-13; RUN-612-1042-15, Hushållningssällskapet Sjuhärad, Interreg ÖKS grant no. 20200994, Agroväst and Nötkreatursstiftelsen Skaraborg.

Tingvoll, Norway, 26/01/2021

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Content

Summary

The financial performance was assessed for some farm interventions considered in SusCatt to get an indication of the potential economic impact of a transition to greater reliance on forage feeding. Five SusCatt systems were considered, including the SLU work with dairy bred beef comparing breeds and finishing diets for both bulls and steers and in UK the suckler beef system relying solely on forage feeding. For dairy systems, economic performance linked to overall concentrate use was assessed in the historic records studied by NIBIO and for Italian farms moving to reduced maize silage in dairy diets.

For dairy bred beef in Sweden, performance records from the trials comparing sire breed and feeding intensity was modelled to give 24 scenarios; 12 each for bulls and steers. There was little difference between the 3 Swedish regions considered, bulls tended to return more for meat sales than steers, although grazing steers on eligible grassland brought higher support payment. Interestingly, for bulls the use of beef (Angus) semen had a greater impact on margins than feeding intensity, although this was reversed for steers, when the Charolais breeding was less relevant than getting heavier carcases by adding 7 months to finish at 28 months.

Profitability looked good when performance on the UK certified pasture feeding farms was benchmarked against national records (AHDB) for more conventional beef systems. In the absence of feed purchase on pasture farms, substantially lower input cost together with higher total revenue, left greater margins per breeding cow compared to the 'best' (top 25%) costed farms.

Records from dairy farms in central Norway over 3 years were used to assess the relationship between profitability and concentrate use, after ranking herds and allocating to 3 equal groups. Support payment was similar across the groups, although *Low* farms (with low use of concentates and greater reliance on forage feeding) received higher agri-environment payment. Total operating costs were also similar across the groups (with differing configuration due to the relative balance of forage and concentrate feeding) so the higher milk prices achieved by farms in the *Low* group, gave higher margins per litre of [energy corrected] milk sold.

In Italy, economic returns for intensive dairy farms with rations dominated by maize silage and grain were compared to alternative production systems using grass silage or hay. Differences were slight, milk yields were high, especially on the maize farms although herds with *alternative feeding* achieved higher milk prices and, despite higher feed costs, margins per litre were slightly higher with these more sustainable feeding systems.

In our SusCatt proposal, we hypothesised that moving away from intensive cattle production, feeding less human edible food to our ruminants and using more forage and/or grazing in dairy and beef diets, would improve farm economic performance. We are now able to present evidence confirming many of these assumptions.

1 Introduction

The productivity of milk and meat production from European cattle has increased considerably in recent decades. However, the sustainability of this intensification is questioned due to environmental and animal welfare trade-offs and growing reliance on potentially edible food as supplementary feed. Contrasting strategies have been proposed to improve sustainability of our food system, like 1) intensification, 2) reduced demand for animal product and 3) reduction in the use of food-competing feed components in the livestock diet. High forage and pasture diets associated with option 3 also improve societal credibility, product quality, animal health and welfare and reduce negative environmental impacts. In addition, much of European land is unsuitable for growing vegetables or arable cropping, so ruminant livestock are the only option for food supply and grazing animals are integral to manage and preserve biodiversity on semi-natural pastures. Furthermore, many consumers are willing to pay for traceable milk and meat, produced with home-grown or local feeds. The SusCatt project looked to increase the proportion of the forage and pasture in both beef and dairy production and reduce relience on potentially edible food as feed. This report assesses the economic consequences of these changes in cattle diets, under contrasting European environmental and economic conditions. Due to variation in environmental and socio-economic conditions across the project, our objective was not to compare performance between regions or countries but to assess the effect of change in diet within the prevailing regional conditions – benchmarking our innovative systems with local, maintream or more standard production. However, despite the differences for cattle production across Europe, we believe SusCatt findings are relevant beyond participating countries.

2 Economic performance assessment

This study includes farming systems from four European countries with various and different farm business. In Norway, there are small-scale dairy operations where the family largely carries out the work, with varying degrees of hired contractors. In the other participating countries, some farms are larger with extensive use of contractors. However, we have aimed to do the financial calculations according to the same scheme and principle, and compared the economic performances of similar farm models in each case, regardless of operating system.

Economic performance was expressed slightly different from the standard contribution margin in terms of how the costs were grouped and presented. The income is as in the standard contribution margin calculation and includes sales of milk, meat and other products, status change of livestock and inputs, and public payments.

All costs are considered as either 'production-dependent' or 'production-independent'. Production-dependent costs are typically operating assets for feed production, purchase of feed and animals as well as cost of veterinary treatments. Energy expenditure, hired labour, contractors and costs related to own operating equipment (that can be replaced by a hired contractor) were also classed as production-dependent costs. Feeds produced on farm, which could be sold, were charged as an expense in livestock production, along with its sales value. Costs for administration, buildings and owned land which are irrespective of the production volume were regarded as production-independent costs.

The economic performances calculated were contributing margin 1 (CM1), which is income minus production-dependent costs, and contributing margin 2 (CM2), which is CM1 minus production-independent costs. The performance indicators are expressed per unit of the main products, typically per kg of meat produced, per litre of milk sold or per carcass slaughtered.

3 Results and Discussion

3.1 Dairy and beef × dairy steers - Sweden

In this study we asked if steers born into dairy herds offer grazers a profitable climate-friendly opportunity to maintain landscape biodiversity? We compared the economics of pure-bred dairy and beef-cross steers under two forage and pasture-based production systems, modelled in three Swedish regions, covering a range of conditions for forage, pasture and grain production.

The economic evaluation was based on Task 2.1, an experiment reported by (Hessle et al., 2019) and in SusCatt Technical Note 2.1.1. The performance of 32 pure-bred Swedish Red or Swedish Holstein dairy steers were compared with 32 Charolais cross steers from Swedish Red or Holstein cows – all at two feeding levels. Sixteen calves from each group were fed at a moderately high intensity (Int) and these were compared with 16 from each group fed a lower intensity diet (Ext). The feeding of the Int group included moderately high indoor feed intensity, one summer on grass and slaughter at 21 months of age, whereas the Ext system was low indoor feed intensity, two summers on grass and slaughter at 28 months of age. An enterprise budgeting technique used performance data from these original 4 all-in-all-out systems (2 genotypes X 2 production intensities) to assess profitability of continuous rearing, assuming calves were born throughout the year in a herd producing 150 steers for slaughter yearly. Profitability was assessed for three different geographical Swedish regions:

1. Plain district of southern Sweden, no less-favoured area (LFA) support and steers grazing grass ley.
2. Forest district of southern Sweden, situated in an LFA, where steers solely grazed semi-natural pastures.
3. Northern Sweden within LFA, where the steers grazed 20% semi-natural pastures and 80% ley.

In the calculations, 70% of all semi-natural pasture was assumed to qualify for Agri-environmental payment at a basic level (100 Euro/ha) and 30% of high biological values, eligible for a higher Agri-environment payment (280 Euro/ha).

The breakdown of costs and returns for the 12 different combinations of genotypes, systems and locations are presented in Figure 1. The largest cost was for buildings, followed by feed, calf purchase and labour. There were only relatively small differences between the different combinations tested. However, one major difference existed between breeds for calf purchase, as the beef crosses were almost 40% more expensive than purebred dairy calves. Differences between the systems were driven by higher feed consumption and associated costs (33% higher), but also labour (+22%) and building (+26%) for the extra seven months before slaughter for older cattle under the more extensive system. Costs were similar between the regions except for silage making, due to differences assumed in forage yield and harvest machinery chains.

For contribution margins, calculations showed that choice of production system, intensive (Int) or extensive (Ext), was more relevant to income and margins than the breed choice. Despite higher costs, steers which were older and heavier at slaughter, grazing over two seasons, generally gave higher revenue and margins than younger and lighter steers, only grazing one season. Interestingly, in the two LFA eligible regions, payments from Agri-environment supports were almost as high as returns from beef sales, especially for the more extenisve system.

Using beef or dairy semen for dairy cows was not the big question for profitability in these forage-based beef systems. The most important issue is if there are possibilities to utilize existing buildings with no opportunity cost. With respect to overall income, access to agri-environmental payments and supports was highly relevant, where the extensive system with two grazing periods gives 25-35%

higher profit than slaughter young steers after a more intensive rearing. Herd size is also of major importance (data not shown).

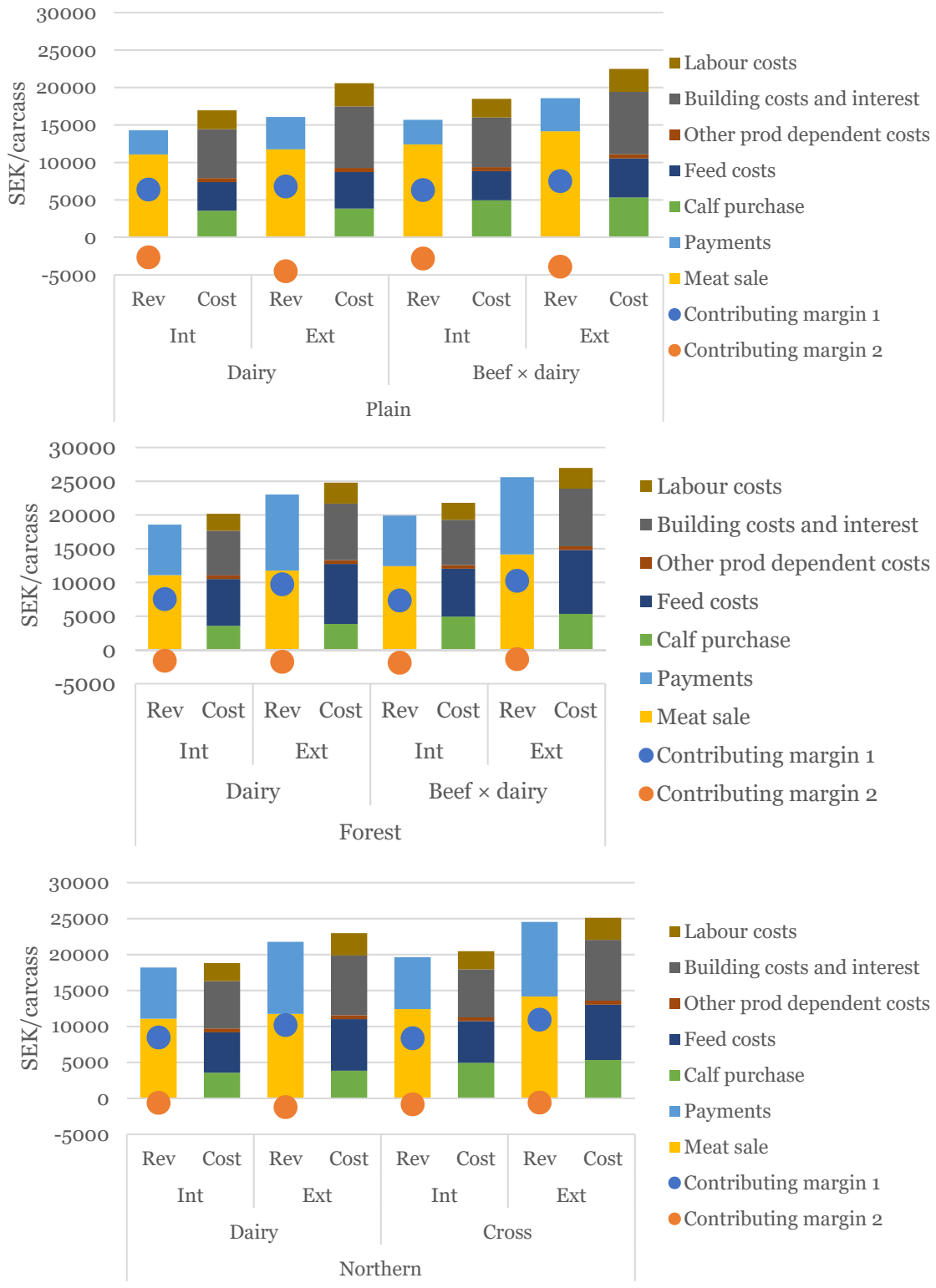

Figure 1. Economic performance (SEK/carcass) of purebred dairy steers (dairy) and beef-dairy cross steers (beef × dairy) reared at a moderately high feed intensity and slaughtered at 21 months of age (Int) or at a low feed intensity with slaughter at 28 months of age (Ext), in plain district (Plain), forest district (Forest) and northern district (Northern) of Sweden. Contributing margin 1 is revenues minus operational costs, while contributing margin 2 is contributing margin 1 minus depreciation, labour and interest

3.2 Dairy and beef × dairy bulls - Sweden

A similar study was conducted with intact dairy bulls this time to compare the economics of pure-bred and beef-cross bulls under two housed forage systems, again in the three Swedish regions covering a range of conditions for forage and grain production.

This study was based on task 2.2, a trial which is reported in SusCatt Technical note 2.2.1. Bulls of two breed combinations (dairy vs. Angus x dairy) were compared in two housed forage feeding systems. The first system was high intensity feeding (36% grass-clover silage of diet dry matter (DM) reaching slaughter conditions at 15 months of age (Int), whereas the other system involved lower feed intensity (56% silage of diet DM) and slaughter at 18 months of age (Ext). As with the steers, an enterprise budgeting technique used data from the original all-in-all-out trial to assess profitability of continuous rearing, assuming calves were born throughout the year in a dairy herd producing 150 bulls for slaughter annually. Profitability was again assessed for three different geographical Swedish regions;

1. Plain district of southern Sweden, no less-favoured area (LFA) support, with facilities for chopped silage and home-grown grain for concentrate.
2. Forest district of southern Sweden, situated in a LFA, with round-bale silage making, and purchased grain for concentrate
3. Northern Sweden (ND), within LFA, with facilities for chopped silage and home-grown grain for concentrate.

In contrast to modelling with data from the steer trial, economic calculations for 12 combinations of genotype, feed intensity and geography show, for bulls, breed choice does influenced incomes more than the production system (Figure 2). Older, heavier bulls at slaughter gave 12% higher revenue compared to faster finished, younger and lighter bulls. In comparison to steers (Figure 1), bulls had a higher income from carcass sales (+15-22%) but lower support payments, especially in areas with potential for higher agri-environment payments. These 'other payments' represented only 14-25% of total income from bulls. In general, CM2 (depicted as the organge dots on the charts) are higher for the bulls than for the negative CM2 values calculated for steers.

The largest costs were for buildings (30-31% of total costs) and calf purchase (23-25%), followed by grain, silage making (feed costs represented 28-30% of total) and labour (12%), with only relatively small differences between the twelve combinations tested (Figure 2). However, as with the steers, there were differences in cost between breeds for calf purchase, as beef crosses were assumed to be 23% more expensive than pure dairy bulls. Differences between the finishing systems were driven by higher feed consumption and associated costs (between 25-35% more), but also labour (+23%) and building (+14-17%) for the extra three months to reach slaughter for cattle on the less intensive system. Costs were similar between the regions except for silage making, due to estimated differences in forage yield and harvest machinery chains, and home grown or purchased grain.

If replacement heifers are not required, using beef rather than dairy semen for dairy cows was a good choice for better profit for fattening bulls with facilities for housed, forage-based systems. Other relevant issues were access to low cost feeds and buildings, where more extensive finishing at 18 months gave better profit than slaughtering young bulls after semi-intensive rearing.

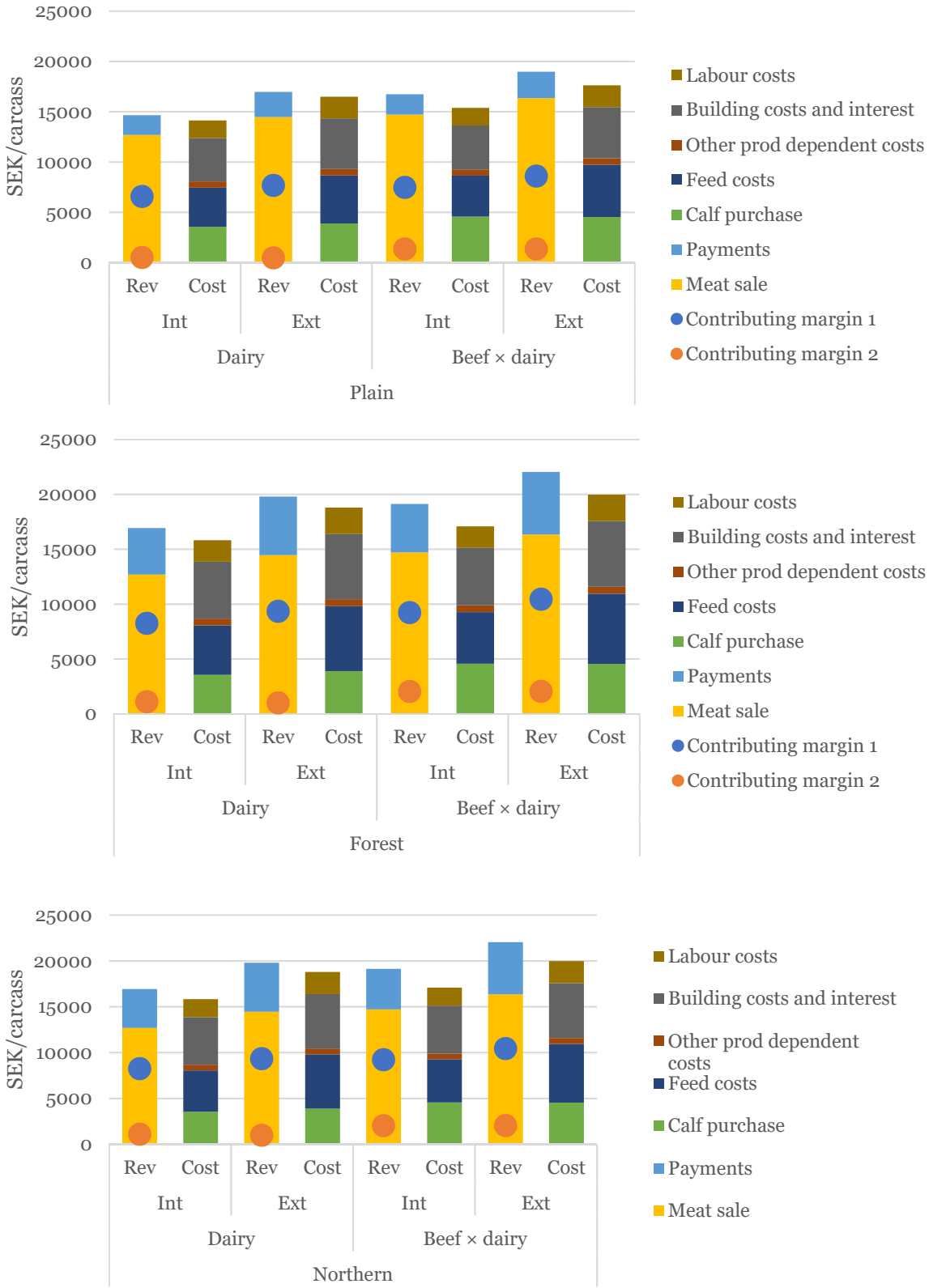

Figure 2. Economic performance (SEK/carcass) of purebred dairy bulls (dairy) and beef-dairy cross bulls (beef × dairy) reared at a moderately high feed intensity and slaughtered at 15 months of age (Int) or at a low feed intensity with slaughter at 18 months of age (Ext), in plain district (Plain), forest district (Forest) and northern district (Northern) of Sweden. Contributing margin 1 is revenues minus operational costs, while contributing margin 2 is contributing margin 1 minus depreciation, labour and interest

3.3 Pasture-based beef - UK

Meat and farm records were collected from 2 beef farms certified to the Pasture Fed Livestock Association (PFLA; https://www.pastureforlife.org/) standards under Task 2.4. Performance figures for the PFLA farms were compared with records for AHDB (Agriculture and Horticulture Development Board; https://ahdb.org.uk/) *Farmbench*, with respect to financial costs and returns using top 25% and average performance (for farms ranked on net margins). Both PFLA farms were selling beef direct to consumers, through a farm shop, internet sales and/or farmers' markets. The returns for meat sales on the PFLA farms (per breeding cow) differed. For Farm A this was 6% higher than the average for AHDB farms and 10% higher than the top25%. Farm B income per cow was approximately 35% less than both groups of AHDB recorded herd. However, 'other' payments were considerably higher on the PFLA farms, compared with AHDB recorded farms, mostly for Agri-Environment payments and Feed-in-Tarif for PFLA farms. As a result, both PFLA farms had higher total income per cow compared to the benchmarked farms (+29% compared with the average and +25% relative to the top25% herds). However, the most striking aspect of the economic analysis was the discrepancy in input cost, with incremental increase going from PFLA, the top 25% farms (+80%) and the AHDB average (+40% relative to top 25%), largely driven by feed purchase and labour. Relying solely on home grown forage feeds (only buying in mineral supplements) means there were only negligible feeds cost. The bottom line was that the average bottom line, or contributing margin, on PFLA farms was twice that of AHDB's top 25% recorded farms and over 3 times the margin of average farms.

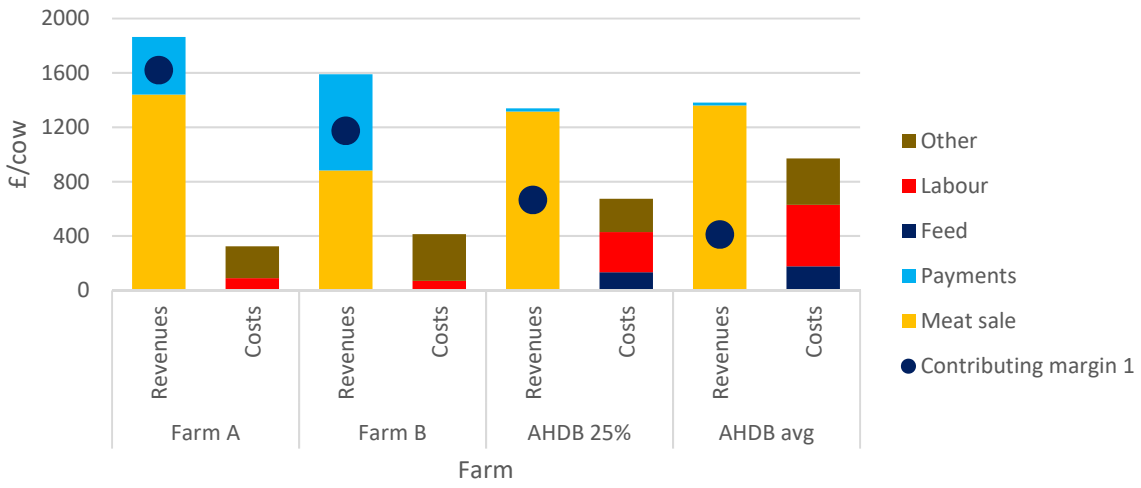

Figure 3. Economic performance (£/cow) of beef farms in UK.Contributing margin 1 is revenues minus operational costs

3.4 Concentrate level in the diet of dairy cows - Norway

Increasing milk production from individual cows is questioned for several reasons; higher yields need greater reliance on purchased concentrate and lower use of grazing and other home-grown feeds. The motivation for higher yields is profitability or better feed efficiency, and it is claimed that higher production reduces the environmental impact of every litre of milk produced. However, less is known about the impact of the proportion of forage in the cows' diets and how, in practice, this affects profitability.

We set out to assess how the proportion of concentrate feeds in dairy diet, affects profitability on traditional combined milk and beef farms in Central Norway. The study under Task 3.3 was based on records from dairy farms participating in national dairy herd recording system of TINE, the dairy cooperative, see also SusCatt Technical note 3.3.1. Data from 200 recorded dairy farms in Central Norway, were categorised into 3 nearly equal sized groups; '*Low*', '*Medium*' and '*High*', according to the level of concentrate feed in the cows' diet. Annual concentrate supplementation averaged 2.2 ('*Low*'), 2.7 ('*Medium*') and 3.1 ('*High*') metric tonnes DM per cow with corresponding forage intakes estimated as 63, 56 and 52% of total net energy intake, averaged across three fiscal years (2014-2016). The economic results are expressed per kg energy corrected milk (ECM) and beef delivered, where 0.42 kg beef meat is equivalent to 1 kg ECM, based on the edible energy content.

Milk and meat subsidies were similar across all groups, although farms in the 'Low' group had higher Agri-environmental, livestock farming and animal payments per kg of milk and beef than the other groups (20% more than the middle group and +28% compared with the high group). This, combined with higher milk prices (possibly due to lower cell counts), resulted in '*Low*' farms having 8-9% higher revenues than the other two groups (Figure 3). Total operating costs were similar although the '*Low*' group spent less money on concentrate but more on forage production than the other groups. Farms in the '*Low*' group had higher total production dependent fixed costs, mainly because of the costs involved with forage production and machinery maintenance. Overall, on average '*Low*' farms performed financially better, with higher contributing margins than farms in both the '*Medium*' (+7-9%)and '*High*' (+15%) groups. However, it is important to note that farms' own labour was not recorded and hence not accounted for in this analysis. Farms in Central Norway, feeding more forage and pasture to their dairy cows, achieved lower milk yield per cow but higher profitability than farms feeding more concentrate feeds, mainly because of more governmental subsidies per kg of milk and meat produced.

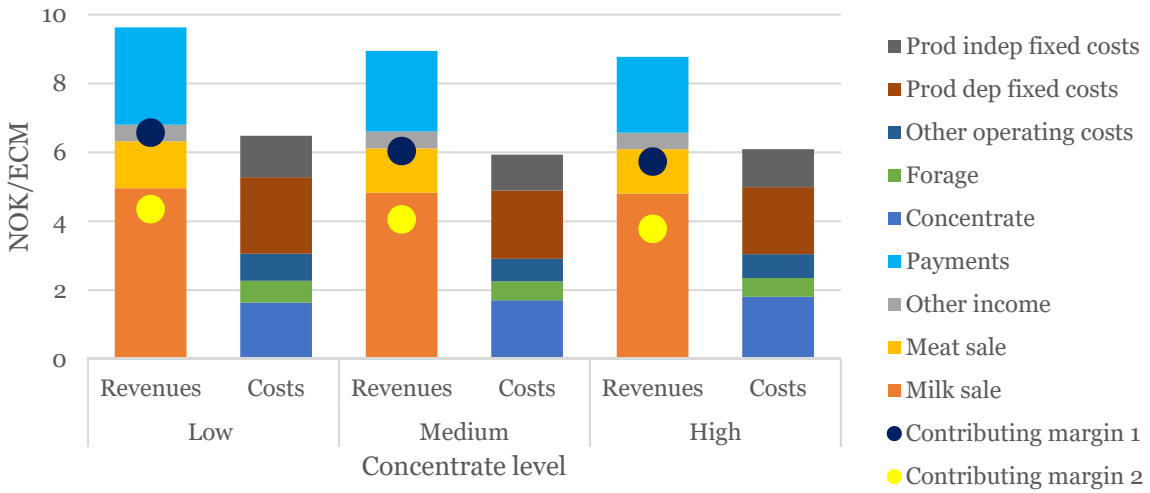

Figure 3. Comparing the economic performance (NOK/kg ECM delivered) of farms with different concentrate levels in the diet of dairy cows in Central Norway. Contribution margin 1 is revenues minus operational costs and production dependent fixed costs. Contributing margin 2, is Contributing margin 1 minus Production independent fixed costs

3.5 Alternative forage in the diet of dairy cows - Italy

Intensive dairy farms in the Pò Valley, Italy, base their feeding on maize silage. For numerous reasons this practice is questioned and there is increasing interest in alternative, more competitive and sustainable feeding strategies. In particular, there is interest for greater use of home-grown feeds, especially hay, and non-edible by-products from food processing.

The study under Task 3.4 included 14 specialized dairy farms, all in the Veneto region feeding diets typical of the main agronomic dairy systems in the Pò Valley. Farms were grouped into two systems where one, described as conventional, is typical for intensive dairy farms with maize silage as the dominating forage source. The other group, labelled alternative, was more heterogenous, using hay produced from permanent meadow and rotation grassland and cereals other than maize.

The average daily milk yield was similar at 33.5 and 31.7 kg energy corrected milk (ECM) per cow for the Conventional and Alternative system, respectively. However, the "Alternative" farms achieved on average higher milk price and despite higher feed costs, their margins were 1.6% higher per kg ECM delivered (Figure 4). The 'alternative farms' higher revenues coming from milk sale may be due to the fact that they sell to cheese factories that award them with higher prices because of the higher milk quality, especially coagulation properties. Probably, these cheese factories award farms whose milk has good qualities not only considering fat and protein content but also of casein and other parameters related to cheese production. Most of the milk produced in Italy is used to make high quality cheeses with Protected Designation of Origin (PDO). Therefore, farmers and cheese factories put a lot of attention on the coagulation properties. All the strategies that help improve these milk characteristics are priced with additional payments. Higher costs on alternative farms are due to higher labour costs for cultivation of home-grown hays and because these farms purchase more concentrates to compensate for lower energy density in their forage compared to maize silage (maize silage has both fibre and starch).

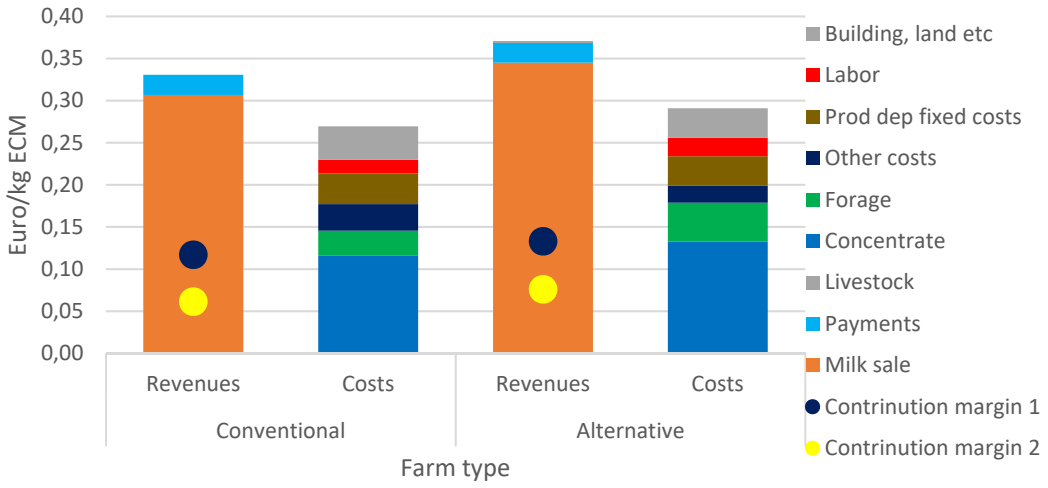

Figure 4. Comparing the economic performance (EUR/kg ECM) of farm groups with different forage type in Po valley, Italy. Contribution margin 1 is revenues minus operational costs and production dependent fixed costs. Contributing margin 2, is Contributing margin 1 minus production independent fixed costs

4 Conclusions

In our SusCatt proposal, we hypothesised that moving away from intensive cattle production, feeding less human edible food to our ruminants and using more forage and/or grazing in dairy and beef diets, would improve farm economic performance. We are now able to present evidence confirming many of these assumptions.

Under very contrasting environmental and socio-economic conditions, Pó valley in Italy and Central Norway, dairy farms with less intensive, and more environmentally sustainable diets had higher contributing margins than comparable farms with more intensive management, feeding higher proportion of edible food in the diets. In both cases with less intensive feeding, total costs were similar and differences were driven by higher returns; in Norway mainly from higher governmental subsidies, while in Italy it was due to higher milk price.

On the beef farms, again differences in farm income influenced margins, driven by 'other payments' for grazing steers in both Sweden and UK. In all beef examples, greater use of forage and/or grazing resulted in better economic performance, especially in UK for farms with minimal inputs giving a very low cost system. In Sweden, however, the Agri-environmental payment and support were not enough to make the grazing steers more profitable than the indoor bulls.

References

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