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Order Address:
Department of Food and Resource Economics, University of Bonn
Meckenheimer Allee 174, D-53115 Bonn, Germany
Phone: ++49-228-733500, Fax: ++49-228-733431
e-mail: uf.ilr@uni-bonn.de
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Identifying Expectations for Innovations in Management Practices in Dairy Sector by Using Q Methodology

***Terhi Latvala*[1], *Serena Mandolesi*[2], *Phillipa Nicholas*[3], *and Raffaele Zanoli*[2]**
[1] MTT Agrifood Research Finland, Economic Research, Latokartanonkaari 9, FI-00790 Helsinki, Finland
[2] Polytechnic University of Marche, Via Brecce Bianche 12, 60131 Ancona, Italy
[3] Institute of Biological, Environmental and Rural Sciences, Aberystwyth University, Gogerddan Campus, Aberystwyth, SY23 3EE, Wales, United Kingdom
terhi.latvala@mtt.fi

Abstract

In this paper, expectations along the Finnish dairy supply chain for innovation to achieve more sustainable farming systems are identified. Four focus group discussions and three interviews for low input and organic dairy supply chain members were performed. The Q Methodology was used to highlight common ground and divergence in the expectations that organic and low input dairying can deliver. The common view is that innovation in housing aimed at improving animal welfare should be fostered. Animal welfare innovations were highlighted especially by the consumer group. Other supply chain members encouraged in accordance with consumer group animal welfare, but also innovations linking with the efficiency of production and feed quality. Common understanding between actors is that innovations linking to genetic modification are not acceptable. Many respondents also considered unnaturally those innovations that were linking with acceleration of genetic selection, speeding up calf development, and supporting in 100 % indoor dairy systems.

Key words: organic, low input, milk, dairy, Q method, innovation, sustainability

1 Introduction

Global demand for dairy and meat products is predicted to continue rising at a rapid rate, and solutions are needed to meet the demands for livestock products in an environmentally sound and economically sustainable manner (SCAR 2011). Low external input sustainable farming system and further advancements in the scientifically informed development of organic farming systems show strong socio-technical possibilities and potential for reducing energy use (SCAR 2011).

Organic dairy farming is clearly defined through European legislation setting out principles underlying organic farming and the inputs and management practices allowed (EC/834/2007 and EC/889/2008). Low-input dairying is less clearly defined but the industry defines it in the context of dairy mainly to relate to grazing or forage based systems with low usage of external inputs such as purchased feed, pesticides, fertilizers and fossil fuels.

The acceptance by consumers and others within the supply chain of novel technologies and production strategies are the cornerstones to the competitiveness of any sector. Very little research has been conducted on regarding innovations of organic and low-input food, albeit many studies have focused on consumer intentions, attitudes and determinants of purchasing towards organics (Arvola et al. 2008; Bravo et al. 2013, Zander and Hamm 2010, Zanoli and Naspetti 2002). Even fewer studies exist on the organic supply chain and its members, except for those by Kottila and Rönni (2008) and Naspetti et al. (2011), the latter having focused on a dairy supply chain in few EU countries. None of these studies have further investigated the acceptance of innovative production and processing strategies by all supply chain members. To be successful innovation it should be favored and accepted from farm to fork. In this paper particular emphasis is given on identifying conflicts amongst supply chain members that highlight any potential bottlenecks in the uptake of innovative management practices.

2 Q Methodology

The Q methodology was introduced in 1934 by British psychologist and physicist William Stephenson (1953). Now it is more widely used in a range of social science disciplines including communication and political science (Brown 1980), energy sector and environmental issues and geography (Barry and Proops 1999, Cuppen 2010). However, the use of Q Methodology in the field of agricultural sciences or agro-food marketing is relatively new (Doody et al. 2009, Eden et al. 2008, Hall 2008, Hermans et al. 2011). Q method can be used to reveal different social perspectives that exist on the topic. An advantage that Q method has over other forms of discourse analysis is that the participants' responses can be directly compared in a consistent manner, since everyone is reacting to the same set of statements.

Procedure for conducting Q method

The new method in organic and low input research area, Q Methodology (Brown 1993, Eden et al., 2008), was applied to compare the viewpoints of the different stakeholders. Performing a Q study involves five steps: (1) definition of the discourse around the research topic; (2) collection of various statements and selection of the statements used in the study; (3) development of the sample; (4) Q-sorting procedure done in the different stakeholder focus groups; (5) analysis and interpretation. The analysis of the sorts was carried out using a software package PQMethod. Totally 28 Finnish participants were involved in the Q sorting procedure.

Step 1: Definition of the "concourse"

Q Methodology, the discourse surrounding a particular subject or topic is referred to as the concourse. Brown (1991) defines the concourse as the ordinary conversation, commentary and discussions surrounding a subject. In this study, the relevant population from which to draw the discourse was quite broad. It included all farmers (particularly those interested in organic and low input farming), food and agricultural supply chain members (including consumers) and experts on innovation dissemination and uptake. This research is part of the large EU project Sustainable and Low Input Dairying (SOLID, project number 266367, www.solidairy.eu). Therefore, a short questionnaire for key experts in each country (UK, IT, FI, BE) and national and international literature were used to generate the required statements. The relevant discourse included materials on innovation uptake across the broad range of dairy farming systems i.e. organic through to intensive as this study was carried out in four different countries. Primary and secondary methods were used to generate the concourse. The statements from both sources were then combined into one concourse for the study.

Step 2: Defining of the Q sample

In this step, the statements from the concourse are refined and a subset that consists of representative statements from the concourse is formed. A Q-sample is a collection of stimulus items, in this study statements derived from the literature and a short questionnaire, which are then presented to respondents for ranking into a Q-sort (McKeown and Thomas 1988). Once statements have been obtained from primary and/or secondary sources, the researcher has to refine them to a smaller sample of statements that are representative of the concourse (McKeown and Thomas 1988). There are two ways of refining statements from the concourse, resulting in “structured” and “unstructured” Q-samples. For this study the refining was based on a structured method, where statements are selected for different categories and a balanced number of statements are used within the categories. From this four categories were derived: (1) Breeds, (2) Feeds, (3) Management and Practice on Farm and (4) Management and Practice in the Supply Chain. A total of 34 statements were chosen and translated and back-translated into the national languages of the countries involved in the study. The statements were further edited and refined by testing the comprehension of the statements in each of the four involved countries. Numbers from 1 to 34 were randomly assigned to the statements and each statement was printed on a separate card. Pilot testing with both farming experts and consumers was conducted in each of the four countries. A full list of the consolidated statement in each of these categories can be found in Appendix 1.

Step 3: Selection of the P-set

Q methodology only requires a limited number of participants, named the P-set, since the interest is in the similarities and differences among the different viewpoints (Brown 1991). Q participants are also selected to be representative of a population like sample of respondents in survey method, but in a different manner. Q participants are selected to represent the breadth of opinion in a target population, not the distribution of beliefs across the population (Webler et al. 2009). In this study, we made sure to include in our Q participants from all the main stakeholders in the dairy milk supply chain: consumers, producers, milk processing industry and retailers and SME retailers. In each each interest group we sought opinions both conventional and organic groups. The actual number of participants in each group was 9 consumers, 11 producers and 8 retailers/processors.

Determining the right number of Q participants means finding the right balance between two competing rules of thumb. Normally a Q study will result in 2-5 social perspectives. For each perspective, it is sufficient to have four to six individuals who “define” a perspective, although plenty of studies involve many more people (Webler et al. 2009). In this study four categories were identified: (1) Breeds, (2) Feeds, (3) Management and practice on farm and (4) Management and practice in the supply chain. Therefore according to this, total number of Q participants should be at least 16-24 participants. However, other rule is to have fewer Q participants than Q statements (Webler et al. 2009). In our study we had totally 28 participants and 34 statements.

Step 4: Q-sorting procedure

The core of the Q methodology consists of a sorting exercise. Participants are asked to rank all 34 statements of the Q set according to their level of liking. Participants first read all statements and sort them into three piles according to the extent they like, dislike or have a neutral opinion about the statement. Second, participants rank the statements on a score sheet ranging from most disliked to most liked (Figure 1).

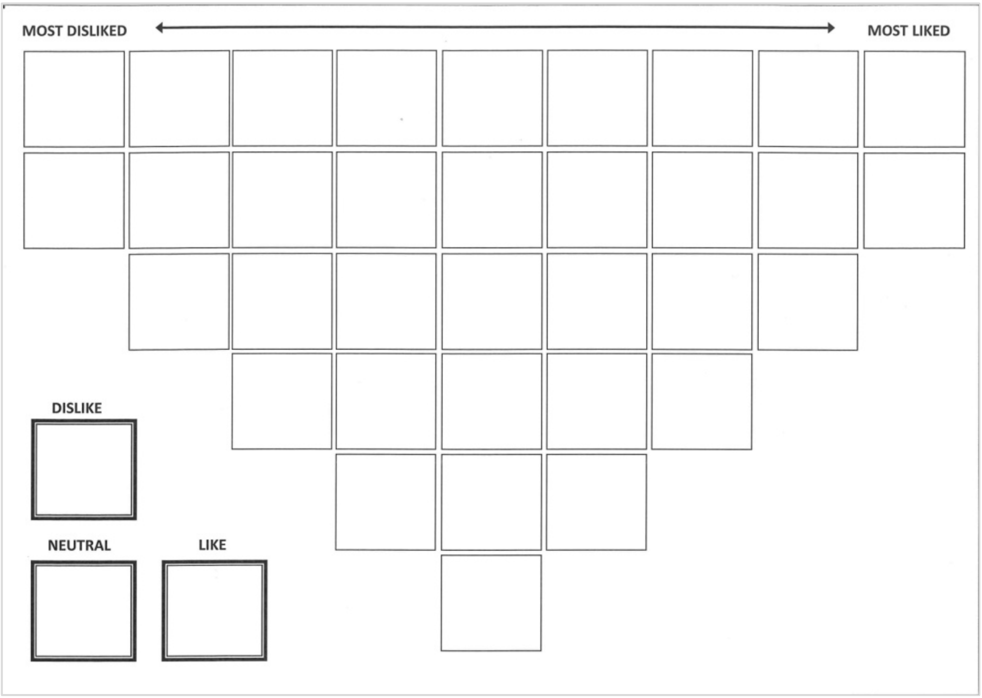

Figure 1. Score sheet for ranking statements.

Four focus group session and three complementary interviews were made to obtain rankings of the statements from each participant. After the completion of the Q-sorting procedure, a focus group discussion is started in which the participants present and discuss their viewpoint among each other. Since it was not possible to gather all retailers in one focus group, three complementary interviews were conducted. The same post sort questions were asked in both cases, i.e. asking participants to explain why they chose the two statements they liked the most and the two they disliked the most. Participants were asked to write their answers down and were then given the opportunity to discuss them with the rest of the group or with the interviewer. In both cases notes and recordings of these interviews were gathered. Differences and similarities among the participants are discussed which provides useful information for the interpretation of the factors.

Step 5: Analysis and interpretation

The Q-sorts of the 28 participants were analyzed using the software PQMethod version 2.32 (Schmolck 2002). The first step in the analysis involved correlating every sort with every other sort. The sorts were then factor analysed and rotated to reduce the data to a smaller number of 3 or 4 defining sort (maximum 8) (Hall 2008). The sorts that emerge from the analysis represent different attitude groups that exist in the discourse surrounding the topic being investigated.

For extracting factors the centroid factor analysis was applied (Watts and Stenner 2012). The number of factors is determined using Brown's rule (1980), which suggests accepting those factors that have at least two significant loadings. According to this rule, significant loadings at p=0.01 are those exceeding ±0.442 (2.58*standard error (SE) and SE=sqrt (1/number of statements)) (Brown, 1980). Each factor thus represents a viewpoint. Following Watts and Stenner (2012), an orthogonal Varimax rotation was applied to reduce the number of Q sorts having high loadings on both factors and thus facilitate the interpretation of the resulting factor structure.

Table 1. Rotated factor matrix by Varimax rotation.

	QSORT	Category	1	2
1	1-C	Consumer	0.3688	0.5932X
2	2-C	Consumer	0.5618X	0.4313
3	3-C	Consumer	0.4583	0.6953X
4	4-C	Consumer	0.7609X	0.4190
5	5-C	Consumer	0.4489X	(-)0.1166
6	6-C	Consumer	(-)0.0002	0.3330
7	7-C	Consumer	0.3600	0.7251X
8	8-C	Consumer	0.3381	0.7300X
9	9-C	Consumer	0.4056	0.6485X
10	1-F	Producer	0.6655X	0.2451
11	2-F	Producer	0.8149X	0.2415
12	3-F	Producer	0.8132X	0.2340
13	4-F	Producer	0.6495X	0.4568
14	5-F	Producer	0.7261X	0.5098
15	6-F	Producer	0.4605	0.6522X
16	7-F	Producer	0.7381X	0.4035
17	8-F	Producer	0.6718X	0.3395
18	9-F	Producer	0.6898X	0.2921
19	10-F	Producer	0.4353	0.5853X
20	11-F	Producer	0.4555X	0.3401
21	1-RP	R&P	0.6270X	0.3041
22	2-RP	R&P	0.1926	0.6951X
23	3-RP	R&P	0.7295X	0.0868
24	4-RP	R&P	0.5815X	0.2351
25	5-RP	R&P	0.5508X	0.5070
26	6-RP	R&P	0.0767	0.7867X
27	7-RP	R&P	0.1296	0.7758X
28	8-RP	R&P	0.5088X	0.1612
%expl. Var.			**30**	**24**

3 Results

The results of the centroid factor analysis of Finland Q sorts were rotated by Varimax rotation and shown in table 1. A two factor solution accounted for 28 Q sorts and 54% of the total variance. Factor 1 explained 30% of the study variance and 17 participants were significantly associated with this factor (marked as x in the Table 1). Factor 2 explained 24% of the study variance and 10 participants were significantly associated with this second factor. Only one Q sort (id no. 6) was not associated significantly with any factor.

Table 2. Distinguishing Statements. (P<0.05; Asterisk (*) indicates Significance at P < 0.01)

		Innovation in Farm & Soil Management		Animal Welfare	
No	Statement	Q-SV	Z-SCR	Q-SV	Z-SCR
5	Develop new forage varieties specific for low input and organic farming.	4	1.47*	0	0.12
19	Minimize the use of purchased feed through efficient use of home-grown feed.	3	1.40*	1	0.45
23	Advances in crop and soil management to improve on farm recycling of nitrogen from slurry and manure.	3	1.24*	-2	(-) 0.42
4	Develop techniques to improve soil biodiversity to increase the feed value of forage.	3	1.04*	0	0
13	Develop organic dairy production systems free of antibiotics.	2	0.79*	3	1.53
2	Identify adapted breeds for organic and low input production systems.	2	0.67	3	1.09
7	Improve milk quality by better use of forage.	1	0.56*	-1	(-) 0.28
21	Improve forage conservation techniques to improve feed quality.	1	0.52*	-1	(-) 0.23
8	Improve the Carbon Footprint of dairy supply-chains through improved logistics.	1	0.42	2	0.81
24	Reduce the nitrogen in slurry and manure through better management of the animal diet.	1	0.40*	-1	(-) 0.18
12	Increase animal welfare by prolonging maternal feeding in an efficient way.	0	0.24*	4	1.77
11	Innovation in automation and robotics in dairy management.	0	0.23	-1	(-) 0.24
29	Innovation in dietary supplements to increase milk yield and quality.	0	0.17*	-2	(-) 0.95
1	Improve breed performance in different natural environments.	0	0.06*	-2	(-) 0.55
6	Develop the use of herbs in pastures for their phytotherapeutic properties to reduce animal health problems.	-1	(-) 0.08*	3	1.44
15	Innovation in on farm processing of raw milk.	-1	(-) 0.42*	1	0.31
17	Selection of breeds for higher levels of desirable fatty acids in milk to produce healthier milk products.	-1	(-) 0.51	0	(-) 0.09
30	Develop feed additives to reduce greenhouse gas emissions without reducing milk yield or quality.	-2	(-)0.76	-2	(-) 0.33
14	Innovation in milk analysis to enable traceability (e.g. access to pasture. place of rearing. quality of feed).	-2	(-) 0.78*	0	0.13
20	Develop management systems that reduce the use of wormers to control parasites.	-2	(-) 0.91*	1	0.39
32	Improving the digestibility of feeds via physical, chemical or other processing.	-2	(-) 1.08	-3	(-) 1.62
27	Improve the efficiency of reproductive techniques acceptable for organic dairying.	-3	(-) 1.12	-1	(-) 0.19

In the tables 2 and 3 the Q-Sort Value (Q-SV) is the relative importance the participants loading to a particular Factor place on the individual statements, the more positive a number the more important the statement and vice versa. The Z-Score (Z-SCR) provides a standardised score on a statement that enables cross Factor comparisons. The distinguishing statements for Factor 1 ranking higher statements related to innovations in crop and soil management (statements 4 and 23) and innovations in feeding for low input and organic systems (statements 19 and 5) (Table 2).

For Factor 2 (Animal Welfare) it was very important that animals can grow in a natural way, free of antibiotics (statement 13). Selecting adapted breeds for low input and organic systems (statement 2) and prolonging maternal feeding (statement 12) were also important.

Consensus statements are those that do not distinguish between any pair of factors (table 3). Factor 1 and Factor 2 both liked statement 16, innovation in housing to improve animal welfare (Table 2). Reducing the risk of GMO contamination is another common aspect (statement 3). Both Factors dislike statements that were seen an unnatural (statements 18, 26, 28 and 33).

Table 3. Consensus Statements. All listed statements are non-significant at P>0.01. and those flagged with an * are also non-significant at P>0.05.

		Innovation in Farm & Soil Management		**Animal Welfare**	
No	**Statement**	**Q-SV**	**Z-SCR**	**Q-SV**	**Z-SCR**
2	Identify adapted breeds for organic and low input production systems.	2	0.67	3	1.09
3*	Reduce the risk of Genetically Modified Organism (GMO) contamination in dairy feeds by optimal use of proteins alternative to soy.	2	0.98	2	0.89
8	Improve the Carbon Footprint of dairy supply-chains through improved logistics.	1	0.42	2	0.81
9*	Develop an efficient network for the selling of biogas from livestock manure and slurry.	-1	(-) 0.09	0	0.04
10*	Improve storage and processing methods for organic food products to maximise their nutritional quality.	0	0.16	1	0.20
11	Innovation in automation and robotics in dairy management.	0	0.23	-1	(-) 0.24
16*	Innovation in housing aimed at improving animal welfare.	4	1.64	4	1.86
17	Selection of breeds for higher levels of desirable fatty acids in milk to produce healthier milk products.	-1	(-) 0.51	0	(-) 0.09
18*	Improve forage quality and yields in low-input dairy systems by GM plant breeding techniques.	-3	(-) 1.84	-3	(-) 1.63
22*	Develop systems for reducing water and fossil fuel consumption on organic and low input farms.	2	0.93	2	0.55
25*	Develop approaches to manage health problems during the transition between gestation and lactation.	1	0.39	2	0.69
26*	Develop designer dairy food from transgenic animals.	-4	(-) 2.17	-4	(-) 2.28
28*	Acceleration of genetic selection including recombination in vitro (e.g. semen sexing).	-3	(-) 1.65	-3	(-) 1.36
30	Develop feed additives to reduce greenhouse gas emissions without reducing milk yield or quality.	-2	(-) 0.76	-2	(-) 0.33
31*	Innovative solutions to improve the efficiency and customer convenience of short supply chains in the dairy sector.	0	0.13	1	0.17
33*	Innovations to speed-up calf development so that they can breed earlier.	-4	(-) 1.91	-4	(-) 1.97
34	Innovation in indoor (100% housed) dairy systems to improve animal welfare.	-1	(-) 0.13	0	(-) 0.13

4 Summary of supply chain synergies and conflicts

Of the two Factors identified for the Finnish supply chain participants, the majority of producers loaded on Factor 1 “Innovation in Farm and Soil Management” whilst there was a more even spread of consumers and retailers/processors between Factor 1 and Factor 2. It is perhaps not surprising that the majority of producers loaded on Factor 1 given that the desirable innovations related to improved feeding/ feed quality and nutrient use efficiency – innovations that have a direct impact on the production and performance of a farming system. This group did not, however, like the concept of innovations to improve reproductive efficiency using techniques acceptable under organic regulations (statement 27). There was some discussion in the producer workshop about the definition of "acceptable techniques" and this may be interpreted differently by different participants. Participants loading on Factor 2 "Animal Welfare" liked innovations that related to improving animal health and welfare – many statements that characterised this Factor had a "natural" focus as well e.g. using herbs in pasture, identifying breeds adapted to the system and not using physical or chemical processes on feeds.

Table 4. Summary of Q Analysis ((+) agree, (-) disagree).

	Factor 1	Factor 2
	Innovation in Farm and Soil Management	Animal Welfare
Consumers	3	5
Producers	9	2
Retailers and Processors	5	3
Distinguishing Statements	No. 5 Develop new forage varieties specific for low input and organic farming **(+)** No. 4 Develop techniques to improve soil biodiversity to increase the feed value of forage **(+)** No. 19 Minimise the use of purchased feed through efficient use of home grown feed **(+)** No. 23 Advances in crop and soil management to improve on farm recycling of nitrogen from slurry and manure **(+)** No. 27 Improve the efficiency of reproductive techniques acceptable for organic dairying **(-)**	No. 2 Identify adapted breeds for organic and low input production systems **(+)** No. 6 Develop the use of herbs in pastures for their medicinal properties to reduce animal health problems **(+)** No. 12 Increase animal welfare by prolonging maternal feeding in an efficient way **(+)** No. 13 Develop organic dairy production systems free of antibiotics **(+)** No. 32 Improving the digestibility of feeds via physical, chemical or other processing **(-)**
Consensus Statements	No. 16 Innovation in housing aimed at improving animal welfare **(+)** No. 18 Improve forage quality and yields in low-input dairy systems by GM plant breeding techniques **(-)** No. 26 Develop designer dairy food from transgenic animals **(-)** No. 28 Acceleration of genetic selection including recombination in vitro **(-)** No. 33 Innovations to speed up calf development from birth to maturity so that they can breed earlier **(-)**	

In terms of innovations that the majority of the supply chain participants agreed on, statement 16 "innovation in housing aimed at improved animal welfare" was seen as desirable. This statement may reflect the need for prolonged periods of housing typical in many Finnish dairy systems. Finnish supply chain participants did not like any innovations using GM technologies in plants or animals and also disliked the concept of speeding up calf development to enable animals to breed earlier. Overall there appeared to be few real conflicts between supply chain participants in terms of acceptable innovations and there was a high degree of synergy over what technologies were unacceptable.

5 Conclusions

Results indicate that in consumer discussion there appeared to be a strong positive emphasis amongst the consumers towards high animal welfare and low levels of what is perceived to be interference with nature (genetic manipulation, treatment of feeds, speeding up animal maturity). In the producer group overall animal welfare and feeding/new forage varieties seemed to be the most important issues for the both producer groups. GMO technologies were commonly disliked by most of participants. Animal welfare issues also seem to be highlighted.

In terms of innovations that the majority of the supply chain participants agreed on, statement “innovation in housing aimed at improved animal welfare” was seen as desirable. This may reflect the need for prolonged periods of housing typical in many Finnish dairy systems. Finnish supply chain participants did not like any innovations using GM technologies in plants or animals and also disliked the concept of speeding up calf development to enable animals to breed earlier. Overall there appeared to be few real conflicts between supply chain participants in terms of acceptable innovations and there was a high degree of synergy over what technologies were unacceptable.

Appendix 1. Complete list of Q statements.

1. Improve breed performance in different natural environments.
2. Identify adapted breeds for organic and low input production systems
3. Reduce the risk of Genetically Modified Organism (GMO) contamination in dairy feeds by optimal use of proteins alternative to soy.
4. Develop techniques to improve soil biodiversity to increase the feed value of forage.
5. Develop new forage varieties specific for low input and organic farming.
6. Develop the use of herbs in pastures for their phytotherapeutic properties to reduce animal health problems.
7. Improve milk quality by better use of forage.
8. Improve the Carbon Footprint of dairy supply-chains through improved logistics.
9. Develop an efficient network for the selling of biogas from livestock manure and slurry.
10. Improve storage and processing methods for organic food products to maximise their nutritional quality.
11. Innovation in automation and robotics in dairy management.
12. Increase animal welfare by prolonging maternal feeding in an efficient way.
13. Develop organic dairy production systems free of antibiotics.
14. Innovation in milk analysis to enable traceability (e.g. access to pasture, place of rearing, quality of feed).
15. Innovation in on farm processing of raw milk.
16. Innovation in housing aimed at improving animal welfare.
17. Selection of breeds for higher levels of desirable fatty acids in milk to produce healthier milk products.
18. Improve forage quality and yields in low-input dairy systems by GM plant breeding techniques.
19. Minimize the use of purchased feed through efficient use of home-grown feed.
20. Develop management systems that reduce the use of wormers to control parasites.
21. Improve forage conservation techniques to improve feed quality.
22. Develop systems for reducing water and fossil fuel consumption on organic and low input farms.
23. Advances in crop and soil management to improve on farm recycling of nitrogen from slurry and manure.
24. Reduce the nitrogen in slurry and manure through better management of the animal diet.
25. Develop approaches to manage health problems during the transition between gestation and lactation.
26. Develop designer dairy food from transgenic animals.
27. Improve the efficiency of reproductive techniques acceptable for organic dairying.
28. Acceleration of genetic selection including recombination in vitro (e.g. semen sexing).
29. Innovation in dietary supplements to increase milk yield and quality.
30. Develop feed additives to reduce greenhouse gas emissions without reducing milk yield or quality.
31. Innovative solutions to improve the efficiency and customer convenience of short supply chains in the dairy sector.
32. Improving the digestibility of feeds via physical, chemical or other processing.
33. Innovations to speed-up calf development so that they can breed earlier.
34. Innovation in indoor (100% housed) dairy systems to improve animal welfare.

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