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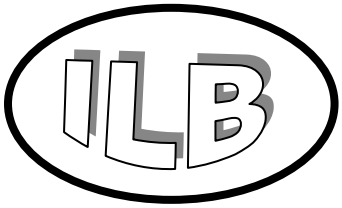

Milk Farmers' Risk Attitudes: Influence of the Dairy Processing Company

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Abstract

European market deregulation is destabilizing the economic environment of French farmers leading to an increase in market risks. In the dairy sector, the 2003 CAP reform has lead to major changes (removal of export subsidies and increase in the European milk quota). The dairy supply chain is now coping with higher production and price risks. The dairy supply chain is thinking of new management tools in order to both maintain stability in dairy farm income and secure supply to industrial facilities. One solution may be to strengthen marketing contracts. In this perspective, the knowledge of dairy farmers' risk attitudes is necessary.

The goal of this paper is to provide empirical insight into: dairy farmers‘perceptions of risk and risk management, and the influence of the relationship between farmers and their dairy processing firm on these risk perceptions. Data originate from a sample of eighty livestock farmers in Normandy, one of the three biggest French milk production areas. The survey was carried out during a face-to-face interview in summer 2008. The questionnaire survey focuses on risk perception and strategies used to manage the risk, by asking the farmers to score risks sources and strategies on Likert-scales as in Bard and Barry (2000), and Meuwissen et al. (2001) and on the elicitation of dairy farmers‘risk preferences using Pennings and Garcia‘smethodology (2001).

As in previous studies (Gunjal and Legault, 1995; Meuwissen et al., 2001; Flaten et al., 2005; Fausti and Gillespie, 2006) we show existence of a diversified spectrum of risk preferences and rank risk sources. Institutional risk and price volatility of inputs and outputs are perceived as the main threat on farm income. However, our main contribution is to examine the influence of dairy processors on farmers‘preferences and the study attempt to establish a link between the type of contractors (eg. private vs. cooperative) and farm managers‘risk aversion.

Keywords: *Market Risk; Farmers' risk perceptions; Expected utility framework; Risk prefe rence elicitation; Dairy Sector*

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Introduction

European market deregulation is destabilizing the economic environment of French farmers leading to an increase in market risks. In the dairy sector, the 2003 CAP reform has lead to major changes (removal of export subsidies and increase in the European milk quota). The dairy supply chain is now coping with higher production and price risks. The dairy supply chain is thinking of new management tools in order to both maintain stability in dairy farm income and secure supply to industrial facilities. One solution may be to strengthen marketing contracts. In this perspective, the knowledge of dairy farmers' risk attitudes is necessary.
To determine a farmer's best risk management strategy, information is needed about his or her risk preferences among the different income distributions generated by those alternative strategies (Harwood et al., 1999). A person who accepts a lower average return to reduce the variability of returns is said to be risk averse.

In France, the dairy industry face evolution of milk price, but, because of the organization of the milk sector, farmers face only a softened price risk of the output. French dairy farmers have been coping with new market risks since the 2003 CAP reform through the dairy companies, which buy the milk. We want to know if the status of dairy processing company (co-operatives vs. private) can explain difference of risk preferences and attitudes of farmers. Cooperatives are owned and managed by the farmers themselves unlike private dairy processing company, which are held by private share-holders: one role of co-operatives is to share the risk with farmers and stabilize the income. Therefore, the management strategies could be different or viewed as different by milk farmers. The aim of the study is to provide empirical insight into: dairy farmers‘perceptions of risk and risk management - mainly economic risks - and their attitude toward price risk, and to provide a focus on the influence of the dairy processing company.

The questionnaire survey focuses on risk perception and strategies used to manage the risk, by asking the farmers to score risks sources and strategies on Likert-scales as in Bard and Barry (2000), and Meuwissen et al. (2001) and on the elicitation of dairy farmers‘risk preferences using Pennings and Garcia‘s methodology (2001) based on certainty equivalent. This technique allows one not only to rank risky alternatives, but also to estimate the cost of risk and the premium that the individual would pay to avoid the risk.

Data and Methodology

Sample

Information on the producers‘risk perceptions and attitudes was obtained by interviews with 80 dairy farmers from Normandy[1] during summer 2008. The sample was extracted from a comprehensive database given by the organization in charge of the census of milk farms, Établissement départemental d‘élevage (EDE), in Normandy. We selected farmers based on two criteria in order to determine the behavior of dairy farmers who would keep on producing milk in the following years:

* The milk unit must includes at least 30 cows,
* The farm decision maker must be less than 55 years.

1. Normandy is the third dairy region in France with 14.5 per cent of the milk production in France

We randomly selected 160 dairy farmers. We sent a letter to each of 160 farmers both to notify the respondent of the interview and introduce the study. Finally, 80 farmers were interviewed. After screening the completeness and checking the consistency of the answers, the data of 77 farmers were available for statistical analyses.

Survey

The survey consists in two parts: a questionnaire survey by itself and computer-assisted interviews. The questionnaire survey is divided in three sections:

* background questions about the farm (size...), the milk unit (quota, yield, number of cows...) and characteristics of the decision maker (age, education...),
* farmers‘perceptions of risk such as the source of risks,
* farmers‘perceptions of strategies to manage risks.

Questions of the second and third sections were closed questions and evaluated using a Likert-scale from 1(not relevant) to 5 (very relevant).

For the second part, we designed software for this interview to determine the risk aversion. Five test interviews were conducted to ensure that it was well understood by the farmers. Moreover, both interviewers were trained on the elicitation procedure.
The whole survey included 79 variables and the interview lasted about one hour: forty minutes for the questionnaire survey and twenty minutes for the elicitation part.

Measure of risk perceptions

To investigate risk perception, we use a large set of indicators based on multi-item scales variables, based on the list used by Meuwissen et al. (2001) since we wanted to transpose a large part of their methodology to present French situation. As we use the elicitation procedure to measure risk aversion, we did not ask the farmers to evaluate directly their perception of the own risk attitude.
We examine 23 sources of risk; two sources were conditional on the farm juridical status. In order to explore the data and detect relationships between variables, we carried out a factor analysis (PCA), revealing the internal structure of the data and reducing the number of variables.

Measure of risk aversion

This part, dedicated to the elicitation process, is based on Pennings and Garcia‘s methodology (2001). We used the expected utility model as a general framework to describe choices under risk (von Neuman and Morgenstern, 1947). Decision makers are assumed to have a preference ordering over the probability distributions. They make choices between alternatives; the expected utility preference function, u(x), is used to evaluated and compared the different possibilities. The risk behavior is measured as the curvature of those utility functions. Several authors provide some conditions to minimize the response bias with direct elicitation techniques, both in agricultural economics and in management literature. Robison et al. (1984) indicate that main sources of biases in the procedure of elicitation come from different interviewers, negative preferences toward gambling, absence of realism in the game setting, and compounding of errors in the elicitation process.
As in Pennings and Garcia, experiments conducted in this study are based on hypothetical but

realistic alternatives for dairy farmers. Previous studies indicate individuals'risk attitudes revealed by hypothetical lotteries are significantly different from those revealed when real money is used (e.g. Holt and Laury, 2002; Kachelmeier and Sheata, 1992). Therefore, the certainty equivalence technique was designed to be as close as possible with their everyday life.
Within this general framework, we estimate the shape of the utility function with the certainty equivalent method (Hardaker et al., 2004). Each farmers were asked to compare the lottery (xl, p, xh, 1-p) with a certain price, xi. The interviewer varies the amount of the certain outcome until the farmers say he's indifferent between the certain price and the lottery. We denote the certainty equivalent by CE. We introduce the von Neumann-Morgenstern utility function in the expected utility model:

$u[\mathrm{CE}(p)] = p.u(x_l) + (1\text{-}p).u(x_h)$

Following Pennings and Garcia, we decided to perform all the lotteries with a probability of 50/50 for two reasons:

1. Financial literature (e.g. Black and Scholes, 1973) have shown that commodities prices go randomly and a 50/50 lottery fit quite well the fact that prices can go up or go down with equal probability.
2. Symmetry implied by this choice is easier to understand by decision makers, another distribution of probability could be not straightforward for the farmers.

We specified the utility function u(x) by the mean of the negative exponential function:

$$u(x_i) = \frac{1 - e^{-c(x_i - x_l)}}{1 - e^{-c(x_h - x_l)}}$$

With x_l and x_h denoting, respectively, the lower and upper bound of the 50/50 lottery, x_i the assessed certainty equivalent, and c the parameter that indicates the risk attitude. The negative exponential function implies a constant absolute risk attitude and an increasing proportional risk attitude.
We measured the certainty equivalent and have to determine the inverse of the negative exponential utility function:

$$x_i = \frac{\ln\left[0.5 \cdot \left(e^{-cx_l} + e^{-cx_h}\right)\right]}{-c} + \varepsilon_i$$

Results and discussion

All the statistical analyses have been performed under the statistical software R.

The following table examines characteristics between the dairy farmers from Normandy and our sample. Because of the two criteria introduced, we can notice some differences between the sample and the entire population, but those differences remain small. Because we selected dairy farms based on the number of cows (>30) and the decision maker age (<55), we can note, in our

sample, the size of the units is greater than the entire population.

Table 1. Comparison between Norman farmers' characteristics and farmers of the sample

	Normandy[a]	**Sample**
Land area (ha)	77	98
Workers	1.77	2.04
Quota	300 000 L	375 180 L
Milk yield	5 800 L	7 150 L

a: Source: Chambre régionale d'agriculture de Normandie, 2006

In the sample, the median age of farmers is 45. Most farmers (52 per cent) were not concerned by succession, 23 per cent indicated that they had a successor and 25 per cent they do not have one yet. 61 per cent of the farmers had a professional experience in agriculture before settlement, 18 per cent had an experience out of agriculture before settlement, and 21 per cent had directly settled as milk farmer. Some other characteristics are written in Table 2.

Table 2. Socio-economic characteristics of farms and farmers in the sample

Characteristics (*n*=77)	**Average**	**SD**
Number of dairy cows	61.0	22.7
Age of farmers	43.3	8.6
Labour units (full-time equivalent)	2.04	0.69
Family	*1.86*	*0.64*
Employees	*0.18*	*0.32*
Education		
Low	*62%*	-
Medium	*22%*	-
High	*16%*	-

Most farms (70 per cent) are specialized in milk production, the others are mixed livestock farms.

Perceptions of sources of risk

To supplement the previous results, we have gathered some variables by thematic set, based on the classification developed by Harwood et al. (1999) and Hardaker et al. (2004): production or yield risk (Y), price or market risk (M), institutional risk (I), human or personal risk (H), and financial risk (F).

The second and third columns of Table 3 show the average and the standard deviation of the scores of milk farmers' perceptions of each source of risk.

Table 3. Average scores (1=not relevant, 5=very relevant), standard deviation, and factor loadings for sources of risk

Sources of risk		Average	SD	Most important factors[a]						
				1	2	3	4	5	6	7
				*	*situation of the farm family*	*Legislation and production*	***production feasibility***	*technology*	*	*
Elimination of government support	**I**	4.68	0.64	-0.142	0.258	**0.381**	-0.166	-0.165	0.219	-0.143
Epidemic animal diseases	**Y**	4.52	0.66	-0.234	-0.231	0.016	0.176	0.185	-0.104	0.208
Disability of farm operator	**H**	4.42	0.71	-0.138	**-0.377**	**0.337**	0.086	-0.106	0.053	**-0.321**
Cattle feeding price	**M**	4.40	0.88	-0.262	0.193	-0.023	**0.382**	-0.215	0.212	-0.165
Milk price	**M**	4.36	0.86	-0.234	-0.068	0.070	-0.069	**-0.338**	**-0.420**	0.155
Production costs	**M**	4.32	0.95	-0.252	0.187	-0.014	**0.462**	-0.105	-0.046	**-0.307**
Health situation of farm family	**H**	4.14	0.81	-0.079	**-0.460**	0.224	-0.253	-0.064	-0.042	**-0.385**
Animal diseases (non-epidemic)	**Y**	4.00	0.9	-0.225	**-0.354**	0.046	0.107	0.189	-0.013	0.184
Environmental policy	**I**	3.92	1.07	-0.259	-0.002	**-0.301**	-0.161	0.053	**-0.302**	**-0.314**
Meat price	**M**	3.82	0.93	-0.251	0.065	0.002	-0.032	-0.195	**-0.367**	**0.348**
Value of production rights	**O**	3.81	1.09	-0.258	0.087	0.004	-0.248	0.288	-0.259	-0.158
Ability of redeem loans	**F**	3.78	1.05	-0.251	-0.223	-0.028	-0.049	-0.072	**0.326**	**0.388**
Change of interest rates	**F**	3.75	0.96	**-0.308**	-0.127	-0.137	0.026	-0.009	0.18	0.076
Crop yield	**Y**	3.61	0.98	-0.218	0.069	**0.359**	0.024	**0.340**	-0.025	0.002
Animal welfare policy	**I**	3.55	1.08	-0.189	-0.036	**-0.389**	0.051	0.224	-0.048	-0.059
Consumer preferences	**M**	3.48	1.07	-0.190	0.178	-0.003	**-0.547**	-0.062	0.188	-0.060
Family relations (*e.g.* divorce)	**H**	3.42	1.43	-0.082	**-0.305**	-0.278	0.026	-0.234	**0.343**	-0.079
Technology	**Y**	3.31	1.09	-0.221	0.200	-0.087	0.132	**0.301**	0.093	-0.164
Land price	**O**	3.30	1.19	-0.222	0.135	-0.310	-0.281	-0.121	0.223	-0.001
Crop prices	**M**	3.30	1.24	-0.183	0.164	0.133	0.055	**-0.440**	-0.129	0.076
Milk yield	**Y**	3.17	1.12	-0.224	0.175	**0.306**	-0.027	0.251	0.225	0.243
Technical results fattening animals[b]	**Y**	3.15	0.97	-	-	-	-	-	-	-
Death of worker[b]	**H**	2.52	1.48	-	-	-	-	-	-	-
Per cent of total variance accounted for				27.25	10.46	8.22	6.69	5.72	5.32	4.84

a: Loadings higher than .3 are in bold.
b: those sources of risk were conditional on farm type or organization and were not included in the PCA.

We first show that farmers perceive all of the sources of risk as relevant or very relevant (their average being above 3). The high scores for all sources point out that Norman milk farmers look at most risk sources as important threat on their income.

The most important sources of risks get a standard deviation less than 1, which shows a consensus among respondents. The high score of the elimination of government support may be due to

the upcoming CAP Health Check. Much uncertainty remains as regard as the milk quota system. The next highest scores were given to risks related to epidemic animal diseases, disability of farm operator and to three risks related to market (cattle feeding price, milk price and production costs). Meuwissen et al. described a similar list of major risk sources: the top list is similar except for the elimination of government support. The last sources of risk are the milk yield and the technical results in fattening animals: they are not perceived as significantly increasing risk. As in previous studies (Gunjal and Legault, 1995; Meuwissen et al., 2001; Flaten et al., 2005; Fausti and Gillespie, 2006), we show existence of a diversified spectrum of risk preferences and risk sources ranking. Institutional risk and price volatility of inputs and outputs are perceived as the main threat on farm income.

We performed a factor analysis was performed to detect some trends between the sources of risks and to reduce the number of variables. Technical results fattening animals and death of workers depended on the farm activity and were not included in the analysis. Seven factors, with eigenvalues greater than 1, have been taken into account, explaining a share of the total variance of 60 per cent, satisfactory level according to Hair et al. (1995) and Malhorta and Birks (2006). Factor 1 includes fourteen risk sources that get the same level of loadings: we do not notice obvious interpretation of this factor. Based on the loadings, we can describe the factors 2-5 as, respectively: „situation of the farm family", „legislation and production", „production feasibility" and „technology". Because of the low share of total variance explained by factors 6 and 7, we omit to examine their meanings.

Factor 2, identified as the situation of the farm family, gets a high level of loadings for the non-epidemic animal diseases. Factor 3, called „legislation and production"refers to risks related to institutional decisions and yields. Factor 4,production feasibility, refers to the consumers expectations (market) and production costs. Factor 5, technology, puts together two sources related to technology and two sources related to prices.

Perceptions of risk management strategies

Table 4 shows farmers' perceptions of risk management strategies. The second and the third column reveal the mean and the standard deviation for the different strategies.

Table 4. Average scores (1=not relevant, 5=very relevant), standard deviation, and factor loadings for risk management strategies

Strategies for dairy farm	Average	SD	Most important factors				
			1	2	3	4	5
			Reduction of price risk	*Insurance*	*Diver-sification*	*Strengthen the farm situation*	*Certain income*
Price contracts for inputs	3.79	1.03	**-0.418**	-0.043	0.002	-0.171	0.058
Reducing debt ratio	3.56	1.18	-0.106	**0.325**	**-0.477**	**0.462**	-0.092
Reducing level of feed costs	3.49	1.14	**-0.336**	**0.325**	**-0.347**	-0.087	0.167
Applying strict hygienic rules	3.44	1.08	**-0.338**	-0.213	0.246	-0.010	**0.457**
Price contracts for outputs	3.32	1.22	**-0.427**	0.000	0.040	-0.260	-0.151
Reducing level of fixed costs	3.32	1.17	**-0.387**	**0.320**	-0.183	0.034	-0.002
Buying personal insurance	3.10	1.13	-0.260	**-0.453**	-0.069	**0.401**	-0.107
Buying business insurance	2.87	1.04	-0.296	**-0.401**	-0.001	0.220	0.060
Off-farm investment	2.65	1.29	-0.130	**0.321**	**0.355**	-0.260	**-0.300**
Diversification	2.35	1.33	-0.174	0.298	**0.505**	0.184	0.295
Futures and options market	2.27	1.26	-0.228	-0.129	0.129	-0.010	**-0.721**
Labour organization	1.88	1.19	-	-	-	-	-
Off-farm employment	1.57	0.92	0.020	0.256	**0.392**	**0.608**	-0.127
Per cent of total variance accounted for			27.50	12.93	11.65	9.11	8.53

Dairy farmers perceive price contracts on inputs as a relevant strategy. This result is consistent with the high scores of cattle feeding prices and production costs in the farmers' perception of risk sources. On the contrary, change in labor organization and off-farm employment are not perceived as relevant strategies to manage risks. It means that dairy farmers regard their farm as the main source of income as in Wilson et al. (1988) and Patrick and Musser (1997). Futures and options market received a low score, indicating that farmers have doubt about the effectiveness of this strategy. The lack of knowledge of futures markets by farmers can also explained this score.
We performed a PCA to gather strategies: five factors, with eigenvalues greater than 1, have been taken in account, explaining 69 per cent of the total variance. According to the loadings, we can describe the five factors as: „reduction of price risk", „insurance", „diversification" „strengthen the farm situation"and „get certain income" Factor 1, described as „reduction of price" includes four strategies directly connected to price risk and a fifth strategy, „applying strict hygienic rules".This strategy can be viewed as two kinds of directions: the first aims at reducing production loss or animal mortality, the second aims at reaching the highest level of quality, which is linked to a reducing price risk strategy. Farmers seem to choose this second goal. Strategies which act like „auto-insurance"(reducing debt ratio, reducing level of feed costs and making off-farm investment) are related to factor 2, described as „insurance" Factor 3, diversification, shows different kinds of diversification: diversification of production, off-farm investment and off-farm employment. Those strategies lead to reduce two risks: debt ratio and level of feed costs.

Elicitation of risk aversion

Table 5 shows, in the four first columns, the methodology of the elicitation procedure and the main results (average, median and standard deviation) of the certainty equivalent assessed by dairy farmers.

Table 5. Results of the assessed certainty equivalent (€/1000L)

	Lottery		**EU**	**Certainty Equivalent**			***E(x)***	***E(x)-CE***
x_i	x_l	x_h		**Average**	**Median**	**SD**		
1	200	500	.5	303.4	300.0	58.5	350.0	46.6
2	200	x_1	.250	256.9	250.0	51.4	251.7	-5.2
3	x_1	500	.75	333.8	330.0	66.9	401.7	67.9
4	200	x_2	.125	234.0	220.0	43.3	217.0	-17.0
5	x_2	x_1	.375	275.5	270.0	56.0	280.1	4.7
6	x_1	x_3	.625	316.8	310.0	58.3	318.6	1.8
7	x_3	500	.875	387.4	390.0	65.8	416.9	29.5
8	x_2	x_3	.5	293.6	290.0	60.1	295.3	1.7
9	x_5	x_7	.625	324.8	320.0	63.2	331.4	6.6

We show in the previous table the difference between the expected value of the lottery, named E(x), and the average of the certainty equivalent assessed by the farmers, CE. A positive difference points out a risk-averse; a negative difference points out a risk-lover or risk-seeking behavior.
Dairy farmers usually reveal a risk-averse attitude. With very low levels of utility, the farmers point out a risk-seeking behavior. But, for higher levels of utility, the respondents clearly exhibit

a risk-averse behavior. This can be linked to the feeling of milk farmers to be surrounding by risks.
To clarify this first conclusion, we have computed a coefficient of risk attitude. Arrow and Pratt have used two measures of risk aversion, which is independent of a linear transformation of the elements of the lottery. To calculate the coefficient c, we have transformed the assessed price vector by dividing all the data by 100, in order to keep computable numbers. Thus we performed a non-linear least squares method[1] to estimate the coefficient of risk attitude.
The following table examines the descriptive statistics of the parameters. We synthesize the average and the dispersion of the parameter c. The exponential function fits well the data: the R^2 are very high.

Table 6. Estimation of the risk attitude for the negative exponential function

	Exponential
Parameter	
Mean	0.770
Median	0.697
St. dev.	1.339
Fit indices	
Mean R^2	0.979
Median R^2	0.986
Classification of respondents on the basis of p-value	
Risk averse	55%
Risk neutral	41%
Risk seeking	4%

According to the results, dairy farmers in Normandy are mainly price risk averse or risk neutral. The dispersion is high, however similar levels are found in other studies (Gunjal and Legault, 1995; Pennings and Garcia, 2001).
To explore the relationships between farmers‘perceptions of risk, risk management strategies, attitude toward risk (measured by theparameter c) and characteristics, we carried out a large number of regression analyses. We focused specifically on the nature and the size of the dairy processing company. All models exhibited a very low goodness-of-fit: we cannot find any link between socio-economic characteristics and risk-attitude. This result is consistent with other studies (Wilson et al., 1993; Gunjal and Legault, 1995). Wilson et al. (1988) point out that „perceptions varied so much among individuals that a risk classification based on socio-economic variables was not possible.“

Table 7. Rank and scores of risk management strategies according the status of the dairy processing

1. We use the nls Function of **R** software, which is based on the Gauß-Newton algorithm.

company

Private dairy processing company			Co-operative dairy processing company		
Strategies	**Average**	**SD**	**Strategies**	**Average**	**SD**
Price contracts for inputs	3,85	1,03	**Price contracts for inputs**	3,61	1,04
Reducing debt ratio	3,59	1,18	**Reducing debt ratio**	3,44	1,2
Reducing level of feed costs	3,56	1,15	**Applying strict hygienic rules**	3,39	1,09
Applying strict hygienic rules	3,46	1,09	**Price contracts for outputs**	3,28	1,13
Reducing level of fixed costs	3,41	1,19	**Reducing level of feed costs**	3,28	1,13
Price contracts for outputs	3,34	1,25	**Buying personal insurance**	3,11	1,08
Buying personal insurance	3,1	1,16	**Reducing level of fixed costs**	3,06	1,11
Buying business insurance	2,88	1,07	**Off-farm investment**	2,89	0,83
Off-farm investment	2,58	1,39	**Buying business insurance**	2,83	0,99
Diversification	2,49	1,41	**Futures and options market**	2,67	0,97
Futures and options market	2,15	1,32	**Diversification**	1,89	0,9
Labour organization	2	1,25	**Off-farm employment**	1,39	0,61
Off-farm employment	1,63	1	**Labour organization**	1,36	0,67

This conclusion seems to be valid even for the choice of the contract partner: our intuition concerning the role of the dairy processing company is not confirmed by the data. For instance, the rank of the two groups (co-operative vs. private) is not significantly different (Table 7). Moreover, we found no link between status of the dairy processing company and the level of the parameter c.

Conclusions and Perspectives

This paper described risk perceptions and risk attitudes of milk farmers from Normandy, France. We used two different methods, based on two articles. Unlike other studies, we found that milk farmers exhibit a risk-averse attitude. But all our attempts to find a link between socio-economic characteristics and risk attitude coefficient were unsuccessful. The study shows that the choice of the dairy processing company is not determined by farmers' attitude toward risk.
In future, we want to precise the risk-attitude by eliciting it with quantification methods from observed behavior. Moreover, we want to explore other outlooks on the content of a potential agreement or contract between milk farmers and dairy processing companies.

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