Role of trust and cooperation in the dairy value chain using gaming simulation

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Abstract

The dairy value chain in Tunisia has been facing recurrent problems mostly related to coordination, contracting, pricing and quality imperfections. The policy focus on technology generation and dissemination, without considering the underlying problems related to market imperfections and institutional and socio-economic processes, has contributed to low technology adoption and limited development in the dairy value chain. This paper uses a gaming simulation approach to allow breeders to experiment and consider strategies of cooperation which lead to increased returns and improved quality of milk. The game allows understanding the role of trust and cooperation in improving the performance of the dairy value chain. The experiment was done in four rounds each session. Results show that benefits to breeders are derived from the price of milk which is determined by the number of cooperation in the repeated games strategies. The resulting Nash equilibrium is one where

farmers cooperate without cheating. This solution avoids farmers the risk of rejection of milk and results in price increase as a result of the collective cooperative action. Based on the game and the questionnaires, we studied the factors that affect positively or negatively trust and cooperation in the dairy value chain. According to our analysis opportunistic behavior and the decision to cheat or not in the game affect negatively trust although cooperation, gender and reputation affect positively trust.

Key words: Game simulation, dairy value chain, trust, cooperation, Tunisia

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Introduction

Imperfections in the dairy value chain include pricing mechanism, quality measurement and related information asymmetries, and overall market failure as a result of deficiency in coordination and organization. The lack of organization, coupled with the large number of stakeholders (small breeders, milk collection centers, large private producers, service providers, intermediaries, etc ...), has led to malfunctioning of the value chain. The coordination problem is strongly linked to the absence of organization among the different agents [1]. The narrow policy focus on biophysical technology generation and dissemination, without considering the underlying problems related to institutional and socio-economic processes, has also contributed to low technology adoption and limited development in the dairy value chain.

Tunisia has employed several strategies aiming the development of the dairy sector. These strategies enabled Tunisia to achieve self-sufficiency in milk in 1999. However, in the successive strategies recurring problems (and related actions) remain unresolved. Among these problems the organization of market participants and the institution of a pricing system according to the quality and type of the product remain difficult to achieve. Contracting between the different actors (production and sale of milk and other animal products) stands as a major constraint in the dairy value chain management [2]. The lack of contracting and integration ('horizontal' and 'vertical') explains the failure to account properly for how value-chain analysis are mediated by factors relating to social relations, in addition to local history and environment [3].

The most important socio-economic variables that affect the organization, coordination and overall performance of the dairy sector are trust and cooperation [4]. According to Ramirez [5], participation in producers' associations has a significant impact on agriculture technology adoption and therefore plays an important role in knowledge transfer. Pali et al.[6] examined the influence of networking on knowledge transfer and technology adoption, suggesting that producers' knowledge level depends on the degree of networking in the community and is critical to promote adoption programs.

According to Krishnan and Winter [7] supply chain management rests on the economics of contracts and game theory; imperfections in the economic conditions would be better dealt

with by building contracts that optimally resolve the incentive distortions. The case in Tunisia is a situation where the contract system in the dairy value chain has been very slow. Cooperation through cooperatives and other farmers' associations are instead sought to organize farmers to build market power, bargaining and to face other imperfections. This paper uses a gaming simulation approach to allow breeders to experiment cooperative solutions. Farmers would choose between 'opportunistic' strategies and strategies of cooperation which lead to improved quality and price of milk and therefore increased returns to all participants. We designed this game based on the specificity of the research area. The paper is organized as follows: after this introduction (section 1), we provide a literature review (Section 2), methodology (Section 3). Results and discussion are presented in section 4 and section 5, followed by the main conclusions (Section 6).

1 Game theory and gaming simulations: a review of literature

Economics has been regarded as a non-experimental science. In just a few decades, the landscape of economic research has radically changed. In recent years there has been growing interest by economists to measure actors' behavior, using experimental games. The use of experiments to study human behavior has a long history [8]. Experimental economics involves experimenting with individual and/or collective actions and analyzing the results statistically [9]. It is a science in development, rewarded in 2002 by two winners of the "Nobel Prize" economics, Vernon Smith and Daniel Kahneman, for the application of the experimental methods to economic science thus far used in psychology.

In addition to game theory, economic theory has three other main branches: decision theory, general equilibrium theory, and the theory of mechanism design. All are closely linked to gaming simulation, which is defined as "a methodology for relating the micro-level (agent-level) behavior to the macro-level (system-level) behavior" [10]. In short, game theory can include game theoretic models of agents' behavior and interactions, and considers rules, roles, goals and constraints [11]. The game combines a repeatable experience with the ability to observe actors, transactions and the performance of a value chain. Repeatable experience allows comparing networks composed of different people having the same rules, roles, objectives and constraints. In real situations, farmers and processors are investing in specific relationships to ensure their supply and disposal of their products, especially when players in the value chain do not offer neither price guarantees, nor the agreed quantity and the quality of the products. Such specific relationships give rise to reputation which is acquired through

behavior over time with frequent transactions [12,13]. In the gaming literature we find many examples. In the experiment of Sterman [14], subjects manage a gaming simulation of industrial production and distribution system called “beer distribution game” to minimize total costs. Barreteau et al [15] study simulation and gaming in Natural Resource Management Issues. Balzer and Brendel [16] compare discrete social simulation with other methodologies used in the study of social phenomena.

The relationship between game theory and gaming simulations goes in both directions. Game theory provides an extremely useful background for the structuring, the building and analysis of games. Yet at the same time gaming provides important evidence for the construction of new solution concepts for games and for the isolation of sociological, psychological and other variables which are not taken into account in game theory such as trust between actors in the value chain. Cooperation in repeated games is primarily motivated by long-term payoff maximization and that even though some subjects may have other goals [17]. Empirically, cooperation rates are systematically associated with Prisoner game theory’ payoff structures [18]. Kreps et al [19] show using the finite repetition of the prisoners’ dilemma that incomplete information about one or both player’s opinions, motivation or behavior can explain the observed cooperation. Guyer and Perkel, [20] studied the n-period game.

Game theory has been widely used in resource management and cooperation. Skardi et al. [21] provide a wide overview of applications of game theory in conflict resolution. Jolly and Wakeland [22] used a game theoretic framework to examine the interactions between individuals in an organization with different preferences, regarding knowledge sharing. Schreider et al. [23] describes the application of game-theoretic approach with specific emphasis on developing optimal strategies of phosphorus applications for soil fertilization. Yaron and Ratner [24] present an analysis of the economic potential of regional cooperation in water resources using cooperative game theory algorithms and shadow cost pricing. Most of the literature on game theory studied the n-period game and sub-games. However, the data generally indicate that cooperation rates drop shortly after the start of play, and after some delay where cooperation is not prevalent, the players move toward more cooperative choices [25]. The importance of repetitions comes from the participants «equilibrium between short-term benefit and log-term benefit. When the game is conducted only once, each participant only concerns about one-time benefit. But if the game is repeated several times, people may

be involved in the long term benefit at the expense of immediate benefit to choose a different equilibrium strategy [26].

2 Trust and cooperation in the value chain

Trust is a complex concept that has elicited the interest of many researchers over the past years, to the extent that it is now often considered as one of the key variables in the success and stability of trading partnerships. Hence, three major dimensions associated with trust can be distinguished: competence, honesty and altruism according to Hess [27]. Gurviez[28] still refers to them as: credibility, integrity and benevolence. The credibility that individuals grant their trading partners is based on the belief that the latter has the know-how and the skills required to reach their goals and carry out an assignment with efficiency and accountability [28],[30].

The high level of trust between partners leads to cooperative behavior. Indeed, trust can promote flexibility, solidarity and the exchange of information and products among the various players in the value chain. In addition, there are risks associated with cooperation, which could be reduced when confidence is high [30], [32]. The credibility of trading partners is therefore centered on their reputation for past transactions. Lack of trust between community members has a crucial impact on the evolution of credible engagement, which is a prerequisite for collective action. Despite these advantages, interaction and coordination have been difficult to obtain for the same reasons that hinder collective action which are opportunistic behaviors; lack of confidence, incentives; and difficulties in enforcing the rules.

Interaction and coordination in the value chain in developing countries are hampered by segmented markets, different technological regimes, lack of collaborative cultures, inappropriate incentives, weak channels of communication, insufficient innovation.

The creation of trust through a process of mutual learning facilitates collaborative attitudes and the monitoring of the behavior of others [32] [33]. Mutual learning can be seen as an empirical and progressive process in which actors interact and access the capacities of their partners. This suggests that one should start with low-risk activities and then move on to more complex ones as mutual trust develops.

The starting point is the creation of a high level of trust between the actors involved: trust enables actors to communicate effectively, develop a common vision and strategically implement activities that put this vision into practice. The greater the degree of confidence, the more the results that can be expected from collaborative processes [34].

Since dysfunctional chains tend to suffer from horizontal and vertical competition between actors, confidence building needs to respond to these two different dimensions of competition explicitly [34]

3 Study area, experimental design, and data collection

The experiment was done in the governorate of Bizerte in the north of Tunisia (Figure 1). The choice of the zone of study can be explained by the performance of the dairy value chain in this region which remains limited despite the abundance of natural resources and the large number of dairy breeders. Bizerte region, which is part of the northern zone, is the main agricultural region with 25% of the country's land area. It is endowed with the most fertile land and rainfall is generally adequate with a tradition of foraging crops in irrigated and natural rain-fed farms Despite these favorable conditions, the average annual production is as low as 2574 liters / animal / lactation against an average of 8000 liters in some European countries (case of France, Holland).

If we compare the organizations set up at the level of primary production, we can see that the performing countries in this area rely mainly on cooperative organizations and / or herders' associations, something that Bizerte lacks. In Tunisia, the large number of actors involved in the sale of milk produced on the farm (collection centers, large private or state producers, service cooperatives, collectors, etc.) has led to a malfunctioning of the value chain and jeopardized the quality of the milk. The State has a policy of milk collection premium conditional on a set of specifications and health certification, so as to guarantee the quality of the milk collected; the results remained below assigned objectives.

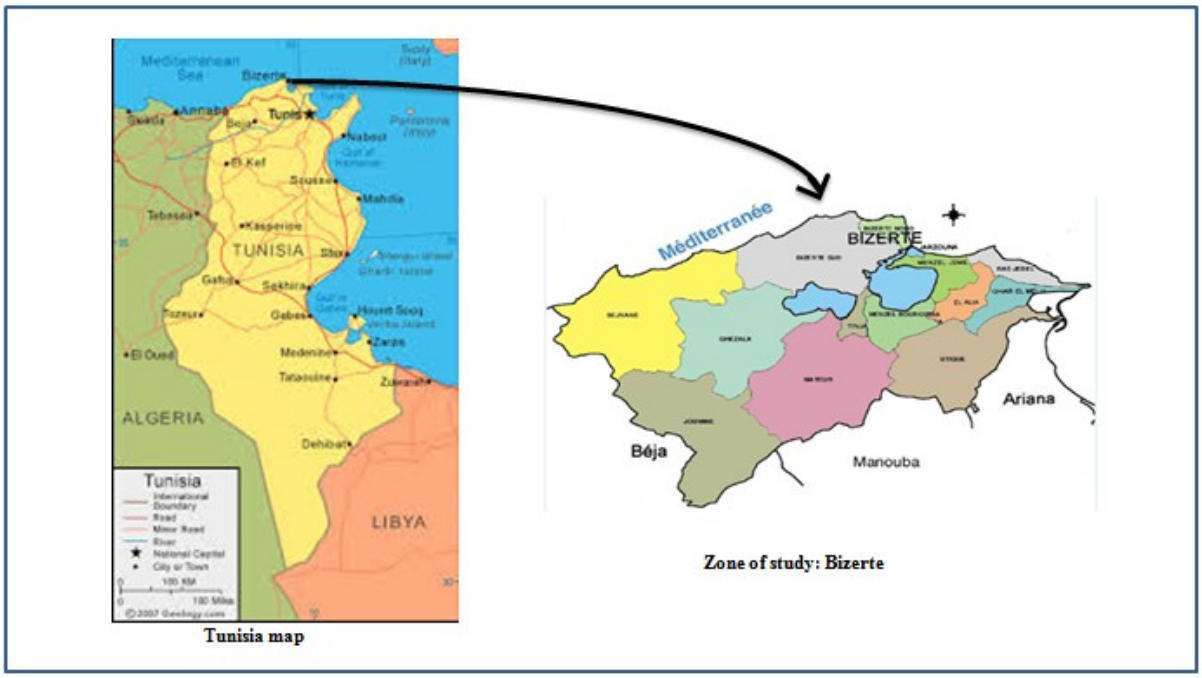


Figure 1. Study area (Bizerte, Tunisia)

This paper uses a gaming simulation approach to allow breeders to experiment cooperation, considering not only 'opportunistic' strategies but strategies of cooperation which lead to increased returns and improved quality of milk. Cooperation is primarily based on the ability of actors in the value chain to identify opportunities to interact with each other, assess issues, access social resources, and learn and share information [35]. The level of trust between partners determines cooperative behavior. In fact, the risks associated with cooperation, could be reduced when trust is high [31].

Along the dairy value chain, we examine cooperation between farmers (the dilemma to cooperate or to sell their milk individually) and trust facing the dilemma (to cheat or not to cheat in the quality of milk). We study the decision making process to examine the behavior of the players and use the output of the game, a pre- questionnaire, and the debriefing of the game to understand the role of trust and cooperation in improving the performance of the dairy value chain. With the help of the game, participants can create a governance system that fits their needs. Usually, they start trading in individual transactions, and the game simulates a normal market. Once some farmers start cooperating horizontally this creates other market structures: for instance, by merging their firms producers can create a monopoly, which creates a hierarchy.

In this experiment, the player is able to make two decisions. The first is to choose to cooperate with which person and the second is to choose the quality of milk she decides to produce. The player who is producing less than 90% of high quality milk is considered to be cheating. The game is repeated 4 times (4 sessions) to study the change of the behavior of players following the previous session, which would show the importance of experience in the farmer's decisions. Although the game is used to simulate a wide range of cooperatives, the most typically used consists of 10 farmers to play the game. All the players are small farmers with a herd of less than 10 dairy cows. If the game leader decides to enlarge the teams, the analysis of the game gets more complicated. One-man teams are equal to one-man cooperative, leaving out the difference between individual decision-making and team (cooperative) performance. Before starting the game, farmers answer a short questionnaire. We ask players questions whether there is a relationship between players; if they know each other and the level of trust following a 10 points Likert scale. There are also questions about the trust in cooperatives and in collection center, and whether or not they were involved in a cooperative.

Players in the game produce two different types of milk: high and low quality milk. We distribute 1000 Tunisian dinars (TD) for each player. In this game, we are playing with fake money. Typically, we used cards where players write the percentage of high quality milk that they decided to produce and their preference to cooperate or not. -if they choose to cooperate, they have to choose their partners in the cooperative. Each player pays the cost of milk produced. The cost of high quality is higher than normal quality. The price of the milk to sell is function of the number of players who want to join a cooperative. This choice can be explained by the formation of coalitions in cooperative games between the players to obtain the best possible result for each of its members. It is more of a competition between coalitions than between individual players. A concept used in cooperative games is the notion of characteristic function ν, which allows specifying a value for each coalition. For a finite set of n players called the grand coalition and denoted N, this function sends 2 N to R, and, for each coalition C (subset of N = {1, ..., n}), ν (C) gives its maximum value.

In the end of the session, a bonus is given to the players or cooperatives that produced the best quality. The person or cooperative that has the best quality will have a bonus of 10 TD. We added this bonus to make use of the quality payment that is missing in the dairy value chain and can encourage farmers to produce good quality.

Then following the face that shows the dice and the percentage of high quality that produced the farmer, we accept or reject the milk. The basic data of the game are shown in the guideline

(appendix A). For example, if the face of the dice shows six, the collection center will refuse the milk of players who produce a high quality less than 90%. (Appendix A). The dice game presents the probability of acceptance or rejection of the milk by the collection center. We added the dice game option referring to the problem of the periodicity of the milk production.
The game will be repeated in 4 sessions. After each session, the game leader evaluates trust in a discussion with the participants afterwards. This reveals the reasoning and process of thinking of characteristic participants during the game. At the end of the game, each player count the money left. The winner is the player who made the best profit.

4 Conceptual Model

In the study, our game is a dynamic cooperative game with incomplete and imperfect information. The player has to choose between two couples of decisions (Figure 2):

- Cooperate (sell the milk with other players) or not cooperate (sell the milk individually), and
- Cheat (produce less than 90% of high quality milk) or not cheat (produce more than 90% of high quality milk).

The repetition of a game with knowledge of intermediate results changes often fundamentally its unfolding. For example, it may be useful to occasionally take the risk of losing to test the reaction of others players and thus set up communication strategies by the actions played (in the absence of other means of communication). It also happens that reputation phenomena are developing, phenomena that will influence the strategic choices of other players.
Perfect information refers to the actions in the game and the complete information refers to the structure and winnings of the game.
The information is incomplete because players don't know if their milk will be rejected or accepted by the introduction of a dice game which represents the probability of rejection or acceptance of milk (incertitude).
The information is imperfect because players don't know the quality of milk produced by the other players .

Strategies

In our study, we used the game simulation data to estimate the utilities of players following Schreider et al [23]:
The strategy set S_i, i = 1, 2,… , n, available to each player is given by

$$Si(\alpha i, ti):(\alpha 1, \alpha 2, \ldots, \alpha n; t1, t2, \ldots, tn) \qquad \begin{matrix} \alpha 1, \alpha 2, \ldots, \alpha n; t1, t2, \ldots tn \\ Si(\alpha i, ti): ¿ \end{matrix}$$

(1)

where α_i = the percentage of high quality produced by the farmer and t_i= is the number of persons who choose to cooperate.

We allow α_i to vary continuously within the interval A = [A1, A2] , i.e., irrespective of the player, there is a minimum quality A1 and a maximum quality A2.

We suppose the total quantity of milk produced is 100 liters each session. Similarly, the number of farmers in cooperatives, t_i takes values in an interval T = [t_1, t_2] where t_1 is the minimum time and t_2 the maximum time of application.

For each strategy (α_i, t_i) $\in$ S_i and given the price of milk P(t_i), the utilities are defined as follows:

- If acceptance:

$$U(i) = P(ti) * Qi - (C(\alpha i) * Qhi + C(\beta i) * (Qi - Qhi)) + Bonus$$

$$U(i) = P(ti) * Qi - (C(\alpha i) * Qhi + C(\beta i) * (Qi - Qhi)) + Bonus \qquad (2)$$

- If rejection:

$$U(i) = -C(\alpha i) * Qhi - C(\beta i) * (Qi - Qhi) \qquad (3)$$

where

Qi=total quantity of milk produced by the player i,

Qhi= quantity of high quality milk produced by the player I

P (t_i)= Price of milk, a function of the number of players in cooperatives

C= Cost of milk in cooperatives which is function of the quality of milk

βi = the percentage of low quality produced by the farmer

Table 1 shows the different gains of the players choosing the following strategies (shown also in Figure 1). In Table 1 the different letters are defined as follows:

- A1(or 2) is the gain of the player 1(or 2) choosing to cooperate and to cheat (C-T)
- B1(or 2) is the gain of the player 1(or 2) choosing to cooperate and not to cheat (C-NT) when player 2 (or 1) cooperates and cheats.
- C1(2) is the gain of the player 1 (or 2) choosing to cooperate and cheat (C-T) when player 2 (or 1) cooperates and doesn't cheat.
- D1 is the gain of player 1 and 2 when they choose to cooperate and didn't cheat.

- E1 (or 2) is the gain of player 1 (or 2) when he doesn't cooperate and cheats (NC-T).
- F1 (or 2) is the gain of player1 (or 2) when he doesn't cooperate and doesn't cheat (NC-NT).

Table1

Payoff matrix in the game

			Player 2			
	Strategy 1		**C**		**NC**	
		Strategy 2--	**T**	**NT**	**T**	**NT**
Player 1	**C**	**T**	A1, A2	C1 , C2		
		NT	B1, B2	D1, D1		
	NC	**T**			E1, E2	E1, F2
		NT			F1, E2	F1, F2

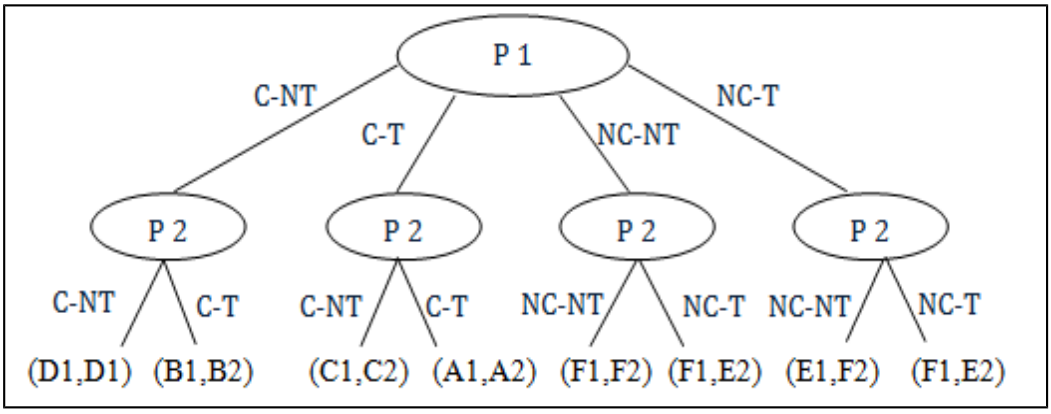


Figure 2. Extensive form of the dairy value chain game

This game study trust between farmers in two levels:

- To trust in the quality of milk and don't cheat.
- To trust other players and cooperate with them.

5 Results of the game simulation and discussion

In the pre-questionnaire, we used a 10 points Likert scale to find out the trust of players in the different stakeholders in the dairy value chain. The results show that the levels of trust in participants (4.06), cooperative (2.77), collectors (3.56) and collection center (4.25) are under the average. However, we note that the most inferior level of trust is given to cooperative with an average of 2.7 which shows that breeders don't trust cooperative. Results show also that breeders trust collection centers more than collectors.

Based on the payoff matrix in Table 1, we regrouped the players per strategies and averaged the utility for each strategy. Results of the game are displayed in Table 2. To find out the best

strategy, we calculate the average of player's utilities of each strategy. The price (Pr1, …, Pr4) is function of the number of players in cooperative. (Appendix A)

The highest utility (Average = 122.9 DT) is found for players who followed the strategies [Cooperate, Not cheat] during all four sessions. The number of players who cooperated increases from 0 in session 1 to 5 players in session 4. The total utility increases with the number of players in cooperative. Also, in the cooperation strategy no one of the players has chosen to cheat in the quality.

Table 2

Payoff matrix

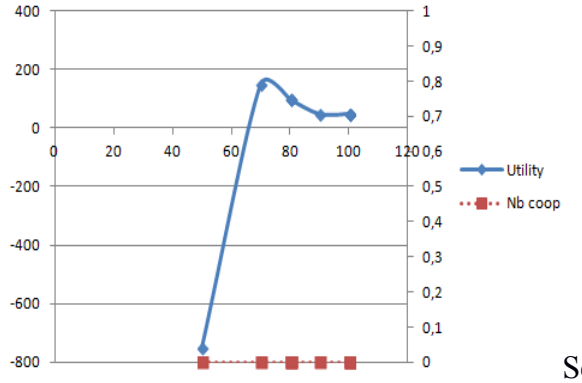
	Cooperation				No cooperation			
	Nb. Players	Price	T	NT	Nb. Players	Price	T	NT
Session1	0	Pr1	0	0	10	Pr1	(100 ; -750 ; 100 ;100 ; 150)	(10 ;50 ;10 ;10)
Session2	2	Pr2	0	(310 ;310)	8	Pr1	(100 ;250 ; 100 ;150)	(10 ;10 ;50)
Session3	4	Pr3	0	(510 ;510 ;510 ;510)	6	Pr1	(150 ;100)	(50 ;50 ;10)
Session4	5	Pr4	0	(550 ;550 ;550 ;550 ;550)	5	Pr1	(-850 ;-950)	(50 ;50 ;10)
Total utility			0	1352.5			-1250	370
Average utility			0	122.9			-96.1	28.4

In sessions where players didn't cooperate and cheat in the quality, their milk was rejected by the collection center and their utilities were negative (Total utility = -1250 DT)

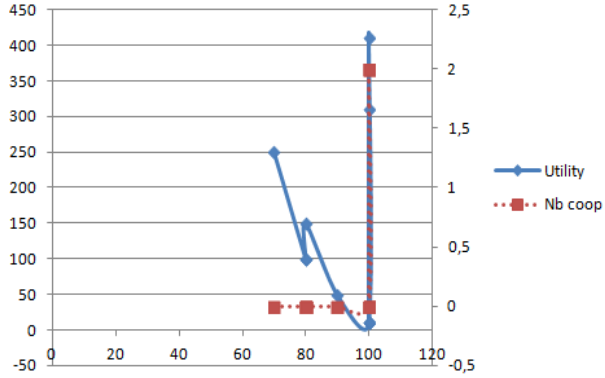
In the four sessions, the high quality of milk increases with the number of players in cooperative (Figure 3). This is show that cooperation reduces cheating and improves honesty and trust between farmers.

In the first session, all breeders behave opportunistic (Number of cooperation = 0) which affect the quality for 50% of players. Besides, for the others players the utility decrease despite of high quality because of the high cost of high quality milk.

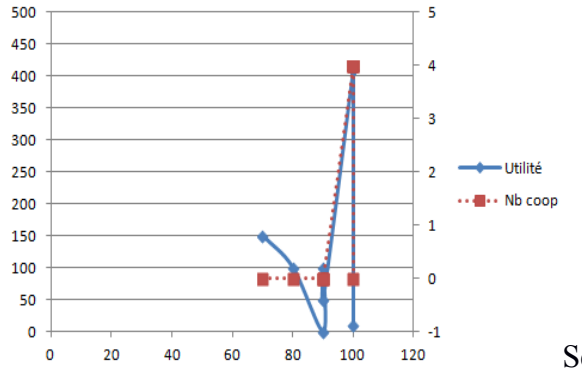
In the second session, the breeders who cooperate (2 players) and produce high qualities (100%) have better utilities (400) than the producers who didn't cooperate and produce less quality. In the third session we have a cooperative of 4 players and in the last session a cooperative with five players with the best qualities and utilities. In this game, the repetition had a positive effect on trust and cooperation since the cooperative overweighs all the sessions in the game.



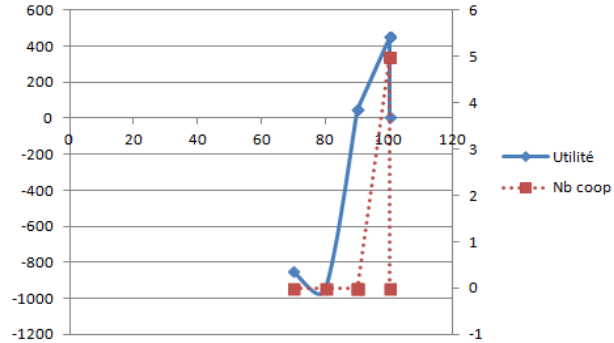
Session1 The utility function of the high quality (0 coop)



Session 2 The utility function of the high quality (2 coop)



Session 3 The utility function of the high quality (4 coop)



Session4 The utility function of the high quality (5 coop)

Figure 3. Utility function and cooperation in the 4 sessions

Based on the pre-questionnaire, the failure of cooperative system in the 1960's in Tunisia could explain the low level of trust attributed to the cooperatives. In fact, at the beginning of 1967, collectivism was in full swing, but the cooperatives had not produced the desired results

for two essential reasons: In the first place, small farmers were against divesting their property for the benefit of a cooperative where their status changed from owner to worker. This led to malpractices where some were enriched while those who had worked hard for the development of their land were overnight divested. This system had not affected the big farmers who had not been affected before. Second, during that period a bad economic situation coupled with a drought also affected the whole country. The indebtedness of these cooperatives was increasing. The situation was deteriorating day after day. Such a failure has had a negative impact on breeders who are now against cooperatives and cooperation.

During the game, players didn't know the decision of each other and all information is hidden in an envelope. The players didn't know if the milk will be accepted or rejected by the collection center since it's linked to a random process like the dice game. It's a game with imperfect and incomplete information. The game is repeated in 4 sessions. Results show that cooperation between breeders increase during the four sessions. These conditions are conforms to finite repeated game. This dilemma results in a Nash equilibrium at the end of the game where no player has interest to deviate.

Cooperation and avoid cheating (C –NT) represents the dominant strategy for the players. Hence, there is no unilateral profitable deviation from any of the players. Therefore, the combined strategy (C-NT, C-NT) is a Nash equilibrium. This could be reasonable if there is a long interrelationship that leads players to form opinions about how others play. It could also be reasonable if there is a social convention or a consensus or an agreement adhered to by the other players. In other words, no player has the interest of unilaterally deviating if he correctly guesses the strategies of the other players. If a player looks at a strategy profile as a social convention, no player would want to deviate when he or she thinks the other players are following the convention.

To analyze the effect of both couple of strategies (cooperation (C), No cooperation (NC)) and (cheat (T), No cheat (NT)), we use the average gains realized by each breeder to determine the Nash equilibrium.

Table 3

Nash equilibrium and Pareto-efficient

	P 2			
	C –T	C-NT	NC-T	NC-NT

	C –T	0 , 0	0 , 123	0 , -96	0 , 28
	C –NT	123 , 0	123 , 123	123 , -96	123 , 28
	NC –T	-96 , 0	-96 , 123	-96 , -96	-96 , 28
P 1	NC –NT	28 , 0	28 , 123	28 , -96	28 , 28

At the end of the game, the combination strategy (C-NT, C-NT) correspond to the payoffs (123,123) which is Pareto-efficient. According to results in Table 3, the amount 123 DT is the highest average of utilities for all players. Even if deviations from reality have been revealed, the farmers consider that this schematic representation of the reality proposed in the game allows them globally to evolve as in the real value chain. They find there a certain number of rules they share with each other. The rules, behaviors, interactions and processes represented are not exhaustive.

5 Trust model

In this model, we used the data from the game simulation played in 5 regions and from the questionnaires with 50 breeders before and after the game.

In our case, trust is the dependent variable and it's between 0 and X which allow us to use the tobit model

$Trust_i=\beta_0+ \beta_1 x1_i+ \beta_2 x2_i+ \beta_3 x3_i+ \beta_4 x4_i+ \beta_5 x5_i+\sum_i$ i=1,..,n

x1= cooperation

x2= Opportunistic behavior

x3= Reputation

x4= Tcheat

x5= Gender

5-1 Variables:

Based on the game simulation and studies of factors that influence trust cited in the conceptual framework, there are a considerable number of determinants affecting the development of trust and cooperation. Because of the broad nature of trust and cooperation and their varied conceptual roots, our literature review will be limited to five antecedents measurable criteria/determinants that either directly or indirectly impact the relationship trust and cooperation.

- Dependent variable: Trust

A trust-based partnership can be benefic for the two parties: stability, lesser organizational conflicts, and inclination and intention of working together and sharing information as well as benefits (Sahay 2003). In his study Lewis (2000) states that the lack of trust is the most important reason why relationships between farms are not working as well as they should. Therefore, trust-building should be emphasized when building strategic relationships.

To build trust in the value chain, the parties have to value the benefits and costs of the cooperation. The effects of cheating and staying in the relationship should be determined (Sahay 2003). The parties have to be convinced that their targets are consistent with each other and the incentives to collaborate, not deceive, are high enough for each party.

- Cooperation

Several theories within different disciplines emphasize the role of trust in fostering cooperation in human social life. Despite differences, the core of these notions of trust is affectively motivated loyalty, which makes the individuals feel mutually committed and willing to accept vulnerability because of positive expectations about each other's behavior.

The high level of trust between partners leads to cooperative behavior. Indeed, trust can promote flexibility, solidarity and the exchange of information and products between the different actors in the value chain. In addition, cooperation is at risk, these risks could be reduced when trust is high [31],[32]. Acedo et al [36] show in their paper using game theory that people cooperating no matter what. The most common strategy was conditional cooperation, where trust increases the possibilities to cooperate, and cooperation, in turn, reinforces trust.

H1: There is a positive relationship between trust and cooperation.

- Opportunistic behavior:

In supply chain context it is relevant to study which actions build up trust. When starting a new companionship between organizations, it is necessary to signalize that the relationship is based on a genuine notion of commitment, reliability [36] and mutual benefit, not on opportunistic behavior where one of the parties use the circumstances to exploit the gullibility of the other at the right moment. The parties should not get the feeling that one of them considers opportunism as a morally acceptable behavior in certain circumstances [37]

Trust builds up gradually and slowly, but can be lost in once if one of the parties feel that the other one acts opportunistically [38].

According to [39]"A great deal of time and effort are typically directed at guarding against opportunistic behavior on the part of the other party" in supply chain partnerships.

In the Tunisian dairy value chain, opportunistic behavior is expressed in cases where a breeder does not inform that his milk is infected. As a result, the milk of other breeders who put their milk in the same tank with him is contaminated, which generates a loss for the whole group.

H3: There is a negative relationship between opportunistic behavior and trust

- Reputation

In societies with more collectivistic values, because people are closely tied within relatively small communities (e.g., family) or cooperation partnerships, they have clear preference for people inside these social groups. Such social norm may make it relatively risky to interact with people outside one's close social groups and lead to a relatively low level of generalized trust.

This aspect of trust has a cognitive orientation in the sense that it is based on the reputation of a supplier, especially in terms of quality and price (positive word of mouth, advertising, etc.) and is reinforced when positive purchasing and consumption occur (satisfaction, familiarity, etc.). This belief in the partner's capabilities is built upon the basis of proof that has been gathered directly or indirectly.

Trust is built on consistent and predictable acts over a longer period [40]. An agent with better reputation is considered to be more trustworthy i.e. is trusted more. If the agent "fulfills" his or her reputation and continues to act reciprocally, this again increases the agent's reputation, and so the loop continues as reputation is built step-by-step. Trust creates trust [41]

Empirical evidence supports the link between reputation and trust. Reputation is the extent to which firms and people in the industry believe a supplier is honest and concerned about its

customers [42] favorable reputation is easily transferable across firms and enhances the credibility of the vendor [43]. If a buying firm assumes the partner's reputation is well deserved, trust will be granted on the basis of the partner's history in relationships with other firms. Similarly, [44] find that a channel member's trust in a manufacturer is positively related to the manufacturer's reputation for fair dealings with channel members.

Çerri [42] found that Businesses that consider their partners to be with a good reputation and high competency tend to exert high levels of trust toward them. Companies who enjoy good reputation inspire trust to parties that collaborate with them. Professionalism, expressed by salespersons or employees or by other means, is a good basis for building trust, especially in the first stages of a relationship. In the game, we noticed that players deal with the persons that they know before. In our study, we used the pre-questionnaire to indentify reputation.

We had develop new scales to perfectly suit the present study and be able to conduct high quality empirical research. All constructs were measured through multiple –item scales and a Likert-type response format [45], [46], [10]).

H4: There is a positive relationship between reputation and trust

- Cheating

Butler [47] used a modified trust game to show the impact of trust on the level of cheating in the game. They found that that cheating, notions substantially affect decisions on both sides of the trust exchange.

Wirtz and Kum [48] suggest that a sense of loyalty and trust may reduce cheating. They also refer to Hwang and Burgers who take an economics approach and argue that the high cost of the loss of a trusted partner is an inhibitor of opportunism. Both views indicate that a high-trust relation inhibits deceit and cheating.

H5: There is a negative relationship between cheating and trust

- Gender

Buchon et al [49] compare choices by men and women in the Investment Game and use questionnaire data to try to understand the motivations for the behavioral differences. We find that men trust more than women, and women are more trustworthy than men. The relationship between expected return and trusting behavior is stronger among men than women, suggesting that men view the interaction more strategically than women. Women felt more obligated both to trust and reciprocate, but the impact of obligation on behavior varies.

Using the general social survey, Irwin et al [50] show that women are less trusting compared to men and respond to fear incentives in social dilemmas – they are concerned about being exploited. We test these arguments in the context of environmental behaviors and argue that lower trust and greater responses to fear incentives mean that women's cooperation is predicated on trust. For men, trust does not predict environmental cooperation.

H5: Men trust more than women.

5-2 Variables description

Variable	Description	Value
Trust	Is the dependent variable. We asked the players after the game to attribute a score to the level of personal trust that they give to people	Data from the questionnaire A Likert scales (0-10)
Cooperation	0= no cooperate 1= cooperate	Data from the game Numeric
Opportunistic behavior	The frequency when the players behave opportunistic.	Data from the game Numeric
Reputation	We asked the players after the game to attribute a score to the level of personal trust that they give to people who had a good reputation	Data from the questionnaire A Likert scales (0-10)
Cheating	The frequency of low quality milk produced by the farmer	Data from the game Numeric
Gender	0= Male 1= Female	Data from the questionnaire 11 female and 39 male

5-3 Results of the trust model and discussion

Table 4

Descriptive statistics of and inter-correlation matrix among independent variables

	Tcheat	Gender	Cooperation	Opportunitic Behavior	Reputation
Tcheat	0.422				
Gender	-0.126	0.347			
Cooperation	-0.123	0.234	1.054		
Opportunistic behavior	0.114	-0.018	0.067	0.298	
Reputation	-0.139	-0.005	0.298	0.004	-0,003

Table 5

Regression results

Variables	Regression coefficient	z-statistic
Tcheat	-1.754	-2.698170
Gender	1.898	3.222206
Cooperation	2 .635	2.565903
Opportunistic behavior	-1.092	-2.001497
Reputation	0.229	1.898235
Constant value	4.062	3.066627

* $p < 0.10$

The objective of the study is to determine the critical factors that influence trust between partners in dairy value chain relationships and find the impact of trust in relationship quality. Trust construct contains five main factors, the average of cheat in the game, gender, cooperation in the game, opportunistic behavior and reputation.

Cooperation was found to be the most important factor influencing trust, with the value of its standardized regression weight being 2 .635 (p<0.1). Cooperation provides a basis for reducing the perceptions of risk toward business partner and building a solid trust. The experience that get farmers from the cooperation help in better understanding each partner's needs and in increasing the benevolent intentions of the relationship.

The gender was found to be the second most important factor influencing trust. gender has a significant effect (1.898; $p<0.1$) on trust. This result show that women trust in others less than men. In fact, in the game, women didn't want to cooperate. They played individually but they were honest and they didn't cheat during all the session. "Cheating" was found to be the third important construct that affect trust but negatively (β=-1.754; $p<0.1$). Cheating influence the relationship between traders and can lead to distrust. The fourth important factor is "opportunistic behavior" which affects negatively trust. "Reputation" was found to be the least important criteria related to trust between farmers in the dairy value chain. Businesses that consider their partners to be with a good reputation and high competency tend to exert high levels of trust toward them. Firms who enjoy good reputation inspire trust to parties that collaborate with them

Conclusions

Game theory is a rapidly advancing approach for analyzing conflicts. Game theory applications in resolving imperfections in the dairy value chain cover a range of problems in diverse categories and types and allow simulation of the self-centered attitude of the involved players with a fairly realistic manner. In the context of the dairy sector, game theory methods compared to other conventional methods of strategic analysis, such as linear programming, provide better understanding of issues describing the competition and cooperation between players and make better estimations of the conflict outcomes. The application of gaming simulation as a research method can be of value for gathering data about the real behavior of real participants in a simplified environment. In this paper, we demonstrate that a cooperative as an institutional arrangement can improve the quality of milk and increase the breeder's income.

The dairy value chain in Tunisia has been facing recurrent problems mostly related to coordination, contracting, pricing and quality imperfections. The failure of cooperatives in the past had a big impact on the behavior of farmers who have lost confidence in cooperatives despite the many benefits they offer. The policy focus on technology generation and dissemination, without considering the underlying problems related to market imperfections and institutional and socio-economic processes, has contributed to low technology adoption and limited development in the dairy value chain.

The approach used in the paper is a gaming simulation where breeders consider strategies of cooperation in repeated sessions. Despite their background farmers formed cooperatives

changed their strategies during the game sessions. For the first session, all farmers have a timely opportunistic behavior, but during the game they gradually communicated and cooperated to earn more profit and win the game. In fact, the success of the cooperatives from one session to another encouraged other farmers to cooperate. This study is not only intended to study the impact of cooperation on milk quality and profit but it is a method of popularizing farmers to think in the future to cooperate in the aim of reducing costs and improving their income.

The repetition in the game simulates experience and reputation in the real world. In fact, the number of repetitions affects positively the level of cooperation and high quality milk. Hence, cooperation and collective action improve trust between breeders. Indeed, the combination of strategies (cooperated and not cheated; cooperated and not cheated) corresponds to a situation of Nash equilibrium and Pareto-efficient. As a participatory approach, players were convinced in the debriefing that cooperation can improve their milk quality and profit. This cooperation can be facilitated, legitimated and institutionalized by a social contracts and consensus.

Our findings have significant policy implication which can improve the management of the dairy sector and value chain; farmers are now willing to improve the quality of milk according to the payment to quality scheme. During the debriefing, breeders reclaimed this option (which is the bonus attributed to the best quality in the game). Our study focused on cooperation and trust related to quality of milk, but cooperation can be affected by other social factors. This implies a need for further empirical research that includes other characteristics, norms and values explaining the choice to cooperate and the governance mechanisms in general. This empirical research shows that factors which influence positively trust are cooperation, gender and reputation and factors which influence negatively trust are cheating and opportunistic behavior.

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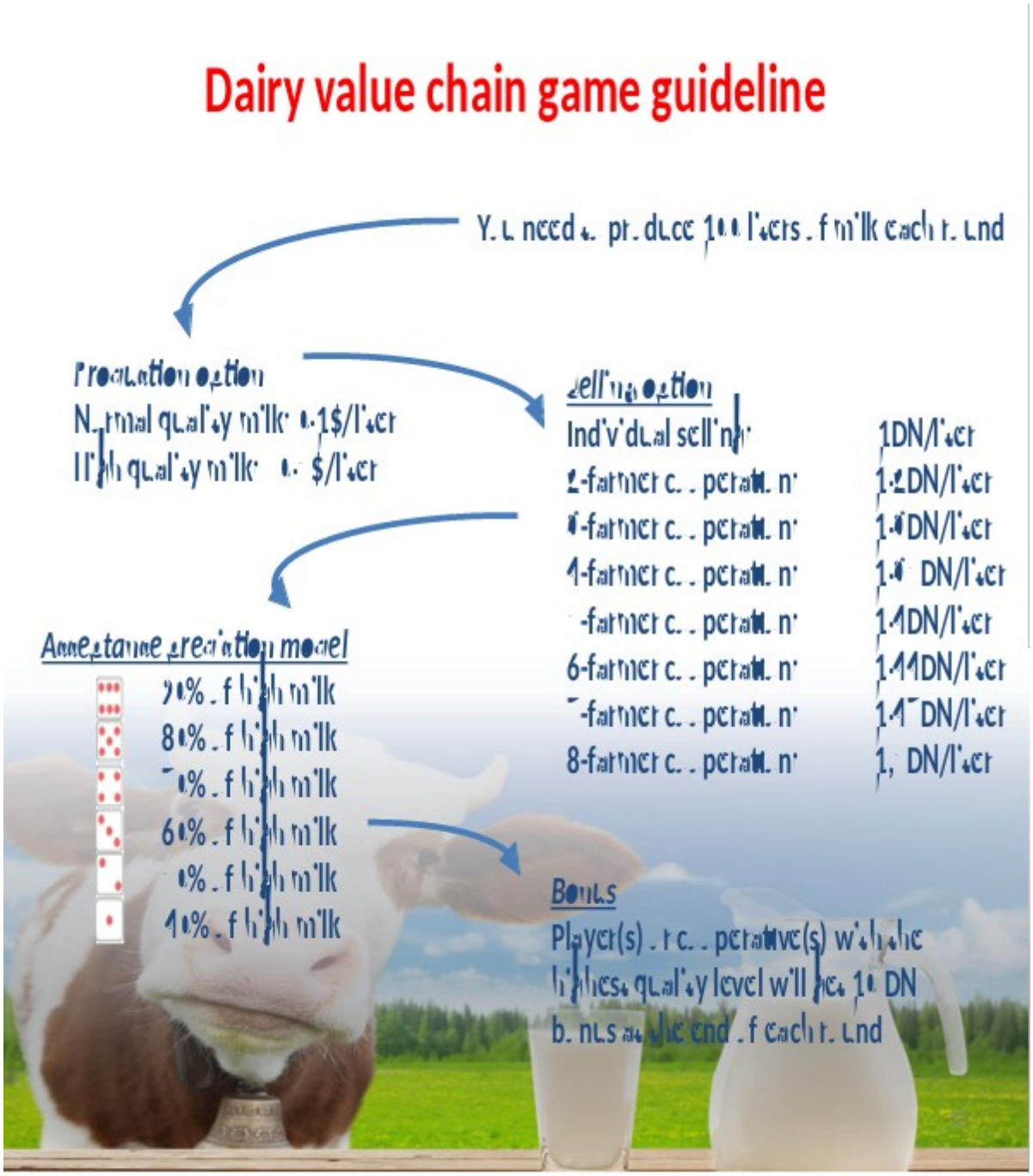
Appendices:

Appendix A: Dairy value chain game guideline



Appendix B: Basic Data of the game

Learning objectives: By playing the dairy value chain game, players should experience the dilemma of choosing cheating or no cheating/ cooperating or no cooperating.
Research objectives: The dairy value chain game should gain insight of the influence of Trust and cooperation on farmers passing goods with invisible quality attributes.
Game objectives: For players: make as much profit as possible
Target audience: Breeders in the region of Bizerte (Tunisia)
Preparation time for participants: None.
Pre-questionnaire: 10 minutes
Briefing and setup time: 15 minutes.
Playing time: 30 to 75 minutes.
Debriefing time and post-questionnaire: one hour.
Number of players: 8 to 10
Materials required for players: Instruction for players, identification labels for players, game currency for everybody
Materials required for game leader: Briefing instruction, debriefing instructions.
Equipment required: none.