BETTER TOGETHER

THE EFFECT OF COALITION FORMING ON THE BARGAINING POWER OF GUM ARABIC HARVESTERS IN SENEGAL

MSc-Thesis
Joost Hamelink
July 18th, 2009

WAGENINGEN UR
For quality of life

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Abstract

This research studies the effect of coalition forming on the bargaining power of gum arabic harvesters in Senegal. Due to decreasing producer prices, the annual volume of gum arabic produced in Senegal has decreased of the last few years. As the world market is characterized by a demand surplus, this drop in producer prices suggests a poor bargaining situation of the gum arabic harvesters in Senegal. This research tries to analyze how coalition forming can improve the bargaining power and outcome of the gum arabic harvesters in Senegal. In order to shed light on this issue, this research uses a combination of interviews, questionnaires and simulation games. The interviews aim to gain insight into the only existing gum arabic cooperative in Senegal. The questionnaires are supposed to generate information on the current situation of the gum arabic harvesters in Senegal. The simulation games are divided into two sub-games. The first sub-game addresses the bargaining power of the players, whereas the second sub-game aims at the process of coalition forming. The data from the questionnaires suggests that the harvesters are currently being marginalized by the few traders that visit their spot market. The data from the interview suggests that a farmer's coalition can lead to a higher producer's price for the harvesters. The data from the simulation games also suggests an increase in bargaining outcome for harvesters inside a coalition. Therefore, this study suggests that gum arabic harvesters in Senegal can increase their bargaining outcome by forming coalitions. However, the generalizability of the data from the simulation games is disputable. The nature of a simulation game is artificial and it cannot be proven that the game measures the behavior that the players would show in real life. Moreover, the design of the game and the limited sample size, affect the generalizability even more.

Key words: Gum arabic, cooperatives, coalitions, coalition forming, bargaining, bargaining power, simulation games, Senegal.

Acknowledgements

Almost exactly one year ago I started working on my MSc thesis for my studies International Development at Wageningen University. It has been a long, exciting, challenging and above all educative time. I started by preparing my research in Wageningen, before going to Senegal for six months. After conducting the field work in Senegal I went back to Wageningen to analyze the data and write my report. The product this year's work is now in your hands and it would not be complete without a word of gratitude to all the people that have helped me along the way. It would be another year's work to mention all the people that helped me by name. Therefore I have to limit myself to mentioning the persons whose efforts proved essential for this research project.

First of all I owe a big thank you to Gaudiose Mujawamariya. She introduced me to the subject and she has assisted me all along the way. The many discussions we had, helped me enormously in gaining insight into this research and in creating order and structure in the chaos we started out with.

Secondly I want to express my gratitude to all the people of the *Institut Sénégalais de Recherches Agricoles* in Dakar for their warm and sympathetic help. Thanks to their hospitality I could easily find my way around. I owe special gratitude to Mme. Sene, who has supervised me during my stay in Senegal. Her advice and assistance have inspired me and her support enabled me to improve my research in many ways. The friendly help of Mr. Cheikh Mbacke Ndione has to be mentioned here too. His advice has helped me to get acquainted with the topic and the research area.

Another person who helped me out a lot is Mr. Amadou Signate. His generous assistance was indispensable in getting to know the research area. He helped me out enormously in selecting the research villages and in finding contacts in each of the villages. I am very grateful for all the help he gave me. I also owe thanks to Mr. Opa Cissokho. His information and his help were essential and his enthusiasm was contagious. I wish him the very best in his work for the Experna project.

In Wageningen University there are various persons that have helped me during the last year. First of all I want to express my gratitude to Mr. Rob Schipper. His critical reflections on my work have enabled me to improve my work a lot. I also owe a thank you to Mr. Gert Jan Hofstede, for advising me on the topic of simulation games.

I am very grateful for the inspiration I received from my friends in Wageningen: Veronica, Gabriele, Teresa, Henrique, Chen Ling, Floor and Salvador. They have all helped me with their critic remarks and thoughtful support. Moreover, they all took the effort of helping me out with testing my simulation games. Thank you all very much.

Of course I want to express my gratitude to my parents. Without their support I would not have been able to complete this project. I am very grateful for all the help they have given me during the last year.

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1. Introduction

Desertification and soil degradation cause serious problems in rural areas in the Sahel region. As droughts become more intense and occur ever more frequently, an increasing number of farmers are affected. As a consequence, a growing number of rural households are facing decreasing outputs. Therefore, these households are increasingly threatened with poverty.

The acacia tree has a positive influence on the soil quality and it can also be used for the production of gum arabic. The gum arabic can be harvested from the trees during the dry season, providing the rural households with an extra source of income. This twofold advantage of the acacia offers potential for both soil improvement, as well as a supplementary income for the rural households.

As Senegal is situated in the Sahel region, it has to deal with concerning soil degradation. The droughts put an increasing stress on the poor rural population in the arid north of the country. Despite the possible advantages of the acacia tree and the despite the favorable gum arabic prices in recent years, the Senegalese gum arabic production is gradually decreasing. This indicates the presence of market imperfections that cause low producer prices for the gum arabic harvesters in Senegal. As a result the interest in the harvest of gum arabic in the country is decreasing.

This research aims to study how gum arabic harvesters can improve their bargaining outcome, through coalition forming. This study will examine the potential of coalitions to bargain better prices than individual harvesters. If the coalitions are able to bargain better prices for gum arabic, then this should have a positive influence on the incomes of rural households in Senegal. As a consequence, the interest in gum arabic could increase, facilitating reforestation efforts.

The second chapter of this research will provide some basic background information on the gum arabic market and more specifically on the situation of the gum arabic harvesters in Senegal. The third chapter will give the problem definition, the research objective and the research questions. The fourth chapter will go into the literature on the topics related to this research. It will give a brief description of the different theories on Institutional Economics, Bargaining Theory and theory on coalition forming. The fifth chapter will describe the conceptual framework that is used in this research. It will provide the models that were used to analyze the problem. The sixth chapter will explain the methodology that was used in this research. Special attention will be given to the design and application of the simulation games as one of the research methods in this research. The seventh chapter will provide the results of the research. This section will present the outcomes of the different research methods. The eighth chapter will give an evaluation of the simulation games. As this is a relatively new research method, a special chapter is dedicated to discuss the functioning of the simulation games. The ninth and final chapter will discuss the conclusions and policy recommendations that can be derived from this research.

2. Background

Gum arabic is produced from the acacia tree and more specifically from the *Acacia Senegale* variety. The acacia trees are found throughout the African continent, as well as the Indian subcontinent. However, most gum is produced in the semi arid areas in and around the Sahel region. The acacia tree produces gum as a reaction to severe drought. Therefore the gum can only be harvested during the dry season. In order to harvest the gum, a harvester has to make a cut in the bark of the tree. The gum will flow out of the tree, forming chunks of bright gum. After a couple of weeks the harvester can return to collect the gum. The chunks are usually stored in jute bulk bags, before being sold. The quality depends on the size of the chunks as well as on the clearness of the gum. These factors can be influenced by methods of harvesting and storage, as well as by natural influences, such as temperature and rainfall. The gum can be stored for many years without loosing quality, as long as it is stored in a dry place and not in a closed or plastic container.

Besides producing gum, the acacia tree is valuable in other ways too. The leaves of the tree are used as cattle fodder and the acacia is appreciated for its fire wood. More importantly, the tree also enhances soil stabilization and soil stability (Wickens, 1996). Therefore the application of the acacia tree can contribute to environmental conservation and combat soil degradation in a region which suffers from serious environmental stress.

Figure 2.1 Acacia Tree

Although gum arabic might not be as well-known as other commodities, it has a wide range of applications. The most common application for gum arabic is as an emulsifier, stabilizer and thickener in candy (e.g. the Dutch drop), ice cream, syrups and above all, soft drinks. The pharmaceutical industry also uses gum arabic, in order to keep medicines from separating into different ingredients. Traditionally, gum arabic has been used against stomach aches, diarrhea and it can also be used to soothe a soar throat. Besides its use for consumption, gum arabic also has various industrial applications. It can be used as a component for glues, paints, inks and lubricants.

On the world market there is an excess demand for gum arabic. There is more demand for gum than the gum producing countries are actually producing. Historically Sudan is by far the most important gum exporter. Its production makes up 50-80% of the world total (World Bank, 2007). Besides Sudan, Chad and Nigeria also make up for an important share of the global production. Furthermore, there are several other African countries that export smaller and less significant amounts of gum arabic. The export price of gum arabic has been highly volatile over the last decades. Natural factors, such as rainfall and temperature, have a high influence on both the quantity and quality of the gum produced each season. Therefore, differences in rainfall and temperature affect the world price. Furthermore, the ongoing political unrest in Sudan has forced some importers of gum to shift their focus away from this country, to other countries. However, the production of gum is still characterized by serious fluctuations in quality and quantity. Therefore it is not surprising that the food industry and pharmaceutical industry are investigating the opportunities of a synthetic alternative.

On a global level, Senegal is one of the smaller exporters of gum arabic. Traditionally, most of the gum is produced in the Northern region, around Linguère. More recently, the south has started to produce gum arabic too. The North of Senegal is characterized by a dry savannah landscape. During most time of the year, the area suffers from droughts. Usually, the rainy season starts in May and it lasts until early October. Consequently, the gum production usually starts in November in the North of the country and it moves gradually southwards. The first three months of the production season are the most productive. After these three months, there is another period of about two or three months, in which the production is gradually slowing down.

Source: www.state.gov/p/af/ci/sg/

Figure 2.2 Gum arabic production in Senegal

In Senegal most of the gum harvest is carried out by shepherds of the *Fulani* ethnical group (a.k.a. *Peuhl*, *Fula* or *Fulbe*). Traditionally, the *Fulani* people live from cattle breeding and they can be found throughout most of the northern part of Sub-Saharan Africa. In Senegal the *Fulani* live mostly in the Northern part of the country. Because of the droughts, the pastoralists have to lead their herds over vast areas of dry and sparsely inhabited lands.

The Northern region of Senegal has little vegetation and the trees are scarce and dispersed. This makes the large scale exploitation of the acacia tree unprofitable. Not surprisingly, the gum harvest is a secondary activity for the pastoralists in the area. They can combine their herding with the harvesting of gum arabic. There are some experiments with large scale plantations of gum, but the productivity of these projects is still disappointing. Moreover, it is unlikely that an individual harvester will invest in one or more acacia trees. It takes about five years before an acacia tree starts producing gum. Therefore few harvesters will be interested in making such an investment.

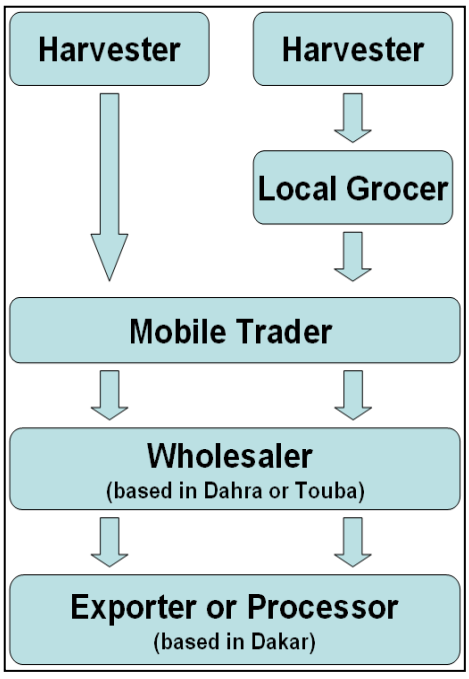

Figure 2.3 Gum arabic market chain in Senegal

There are only few gum arabic exporting companies in Senegal and they are all located in the Dakar region. Besides these exporting companies, there is one major pharmaceutical company, which procures large quantities of gum arabic. Altogether, these companies rely on few wholesalers for their supplies of gum. These wholesalers are usually established either in Touba, or in Dahra, which is not that far away from the gum production area. In turn, the wholesalers depend on a number of mobile traders, who travel around the area to buy up the gum arabic. These mobile traders usually visit the larger villages in the area during the weekly market of each village. In general the production area is difficult to access and a 4x4 pick up is necessary to visit the villages. In the rainy season some of the villages even become inaccessible. Usually the mobile traders do not primarily trade in gum arabic, but also in other products.

Typically, the harvesters can choose between two different types of clients to sell their gum to. First of all they can choose to sell their gum arabic on the weekly market to one of the mobile traders. Secondly, if the harvester cannot afford to wait for the market, he can choose to sell his gum to a local grocer in the village. Later, the local grocer sells the gum on to one of the mobile traders that visit the village. Consequently, the price a harvester receives from the grocer is lower than the price on the market.

As most weekly markets are only visited by very few mobile traders in arabic gum, the harvesters are reliant on them for selling their gum. Not many pastoralists can afford to wait various weeks for a good price, or arrange transport to a bigger city themselves. Therefore they depend on the price they can bargain on the local market. Because of a lack of competition, the mobile traders have the possibility to make price arrangements. This results in the formation of local monopsonies, which negatively affect the bargaining power of the harvesters. Obviously, this influences the harvester's price negatively.

In general, the gum arabic market chain in Senegal has a low level of organization. On the one hand, exporting companies complain about the low quality of the available gum. This is largely due to poor methods of harvesting and storage. Moreover they also complain about the decreasing quantity of gum. Apparently, the production of gum arabic in Senegal has dropped from 3400 tons in 1974, to an annual 700-1000 tons in recent years (Asyila Gum, unpublished). On the other hand, the harvesters of gum arabic complain about the low prices they receive for their gum. Reportedly, over the last three to five years, the price for raw gum has decreased drastically. So far, only little effort has been made to organize the gum arabic chain in Senegal. Three years ago a pilot was set up, forming a harvesters' cooperative in Tambacounda, in the southeast of Senegal. As this project is still in its initial phase, it requires support from governments and NGO's. Besides this project, there are no other initiatives that aim to improve the gum arabic chain in Senegal.

3. Problem definition, objective and research questions

3.1 Problem definition

Gum arabic can provide pastoralists in Senegal with an extra income during the dry season. Although there is an excess demand on the world market, the prices for the harvesters in Senegal have gone down dramatically over the last few years. This relatively low price for harvesters will affect their livelihood strategy, forcing them into other activities rather than collecting gum. Consequently, the production of gum arabic has decreased significantly. This influences the accurate exploitation and plantation of acacia trees in a negative way, causing further deforestation and soil degradation.

The low prices can partly be explained by the poor bargaining situation of the harvesters. They are dependent on only few buyers. Because the harvesters are not organized, the traders can exploit their bargaining advantage to lower the price.

3.2 Research objective

The objective of this research is twofold. The primary objective is to shed light on the possibility of improving the bargaining position of harvesters through coalition forming. This might lead to an increase in the income of the harvesters. Indirectly this could also lead to a growing interest in gum arabic production and hence, an increase in the production. Three areas need to be explored, in order to investigate the possible effects of coalition forming on the bargaining position of harvesters. First of all, the current situation of the gum arabic chain needs to be analyzed. This should help to examine the perspectives for coalition forming. Secondly, the possible benefits of coalition forming should be investigated. This should help to judge whether or not coalition forming can really improve the bargaining outcome of harvesters. Finally, it is interesting to gain insight in the process of coalition forming and the actual functioning of the coalition. This can show whether or not the benefits of the coalition reach the individual harvesters. The first objective of this research can be met by studying these three areas.

The secondary objective of this research is to pave the road for further research on the possible benefits of coalition forming. For example, reforestation programs often make use of the local communities for maintaining projects. These communities are a key factor for the continuity and feasibility of these programs. Forming a cooperative for gum arabic harvesters can help to create an economic incentive, to maintain certain reforestation projects. Furthermore, there are many other benefits that can be achieved through coalition forming. First of all it can lead to shorter supply lines. Besides, it can also lead to improved harvesting and storage methods, which will positively influence the quality of the gum. This research will only investigate the possibility of improving the bargaining position through coalition forming, but it can be used as a starting point for further research on the benefits of coalition forming.

3.3 Research questions

A set of research questions has been designed, in order to analyze the problem in a systematical way. The general research question is the main question that is supposed to be answered by this research questions. The specific research questions address different underlying problems. These questions should help to answer the general research question.

3.3.1 General research question

This research aims to answer the following general research question:

- Can coalition forming improve the bargaining power and outcome of gum arabic harvesters in Senegal?

3.3.2 Specific Research questions

The following specific research questions have been formulated to give a structured and thorough answer on the general research question:

- What are, currently, the major problems that limit the bargaining power of the gum arabic harvesters?
- Can these problems be neutralized by forming coalitions?
    - Is there actually an increase in the bargaining outcome when negotiating with a coalition, instead of bargaining individually?
- Can harvesters benefit from the advantages of coalition forming?
    - Which harvesters join the coalitions and which do not?
    - How is the coalition represented during negotiations?
    - How is the bargaining outcome divided within the coalition?
    - Is there any opportunistic behavior that threatens the stability of the coalitions?

4. Theoretical Framework

This chapter will summarize the literature relevant to this research. This summary can broadly be divided into three different parts. The first part will describe the literature that can help to analyze the current situation of the gum arabic harvesters in Senegal. The second part will go deeper into the literature on bargaining and bargaining power. The third part will summarize the literature on the process of coalition forming. Each part will give a brief summary of the literature, followed by a framework that will be used in the following stages of this research.

4.1 Current situation

This part will go deeper into the theory that can help to explain the current situation of the gum arabic market in Senegal. It will try to explain the structure of the market using New Institutional Economics. Firstly, this section will describe some of the market failures that might be occurring in Senegal and the transaction costs that are related to these failures. After having summarized the literature on this topic, a model will be constructed that can help to analyze the current situation of the gum arabic harvesters in Senegal. This model should help to answer the question whether there are perspectives for coalition forming in Senegal.

4.1.1 Market failures

Market failures are usually defined as deviations from the neoclassical economic, perfect market. As in real life these perfect markets are inexistent, most markets have at least some market failures. A market failure occurs when the transaction costs for a certain operation, are higher than the utility gained from it (Ellis, 1988. Saenz, 2006). A transaction cost can be defined as a cost incurred for using the market. They can usually be divided into three groups (Williamson, 1981):

- Contact: Finding a suitable trade partner and information concerning the transaction.
- Contract: Setting up a legitimate and complete contract.
- Control: Enforcing the contract and monitoring the partner.

As described in the background, the northern region of Senegal has a rather underdeveloped infrastructure and is difficult to access. Moreover, the Fulani people inhabiting the region live very dispersedly. Therefore, it is relatively difficult and expensive to travel between the few bigger villages. Consequently, the harvesters face relatively high transaction costs for finding a trade partner. Because of these high transaction costs, harvesters are almost entirely dependent on the nearest spot market. Consequently, their bargaining position depends on the number of traders that visit the local spot market. If only one or few traders visit the market, the harvesters face a local monopsony[1]. If this market failure occurs, the traders have the opportunity to utilize their bargaining advantage, in order to lower the prices (Varian, 2005 / Chern & Just, 1978). Obviously, this has a negative effect on the income of the gum arabic harvesters. Although these local monopsonies might be disadvantageous for the harvesters, they may be socially efficient. Because most gum producing villages produce relatively small quantities and these villages are quite remote, there will be few traders willing to incur the transaction costs and risks of traveling to these villages for only small quantities of gum. The formation of a coalition can change the structure of the market, and hence, the structure of the bargaining situation. For example, the local monopsony situation described before would cease to exist and be converted into a bilateral monopoly (Chern & Just, 1987 and Sivramkrishna & Jyotishi, 2008). This could improve the situation of the gum arabic harvesters.

[1] When many sellers face only one buyer, a monopsony occurs. On the other hand, an oligopsony occurs when many sellers face only very few buyers (Chern & Just, 1987 and Sivramkrishna & Jyotishi, 2008). Both concepts have relatively similar effects on the sellers. Therefore, they will be treated as one.

4.1.2 Model on current situation

After having discussed the literature that is relevant to the current situation of gum arabic harvesters, a model can be constructed that allows studying the current situation of the gum arabic trade in Senegal. Literature suggests that coalition forming can be an effective tool against the negative effects of a monopsony, turning it into a bilateral monopoly. This suggests that a monopsonistic situation provides good perspective for coalition forming. Therefore, it should be investigated whether or not local monopsonies exist, in order to answer this question.

As explained above, there are various causes for the existence of local monopsonies. The most obvious cause is a local lack of competition on the buyers' side of the market. If there are only few traders in a village with many harvesters, these harvesters will be more likely to face monopsonistic conditions. Besides this, the mobility of the harvesters is also an important factor. If the harvesters do not have the opportunity to go to other villages and visit different markets, they become more dependent on their local market. If this local market is characterized by little competition on the buyers' side, the harvesters face a local monopsony. Therefore, it can be assumed that a monopsony exists if there is little competition on the buyers' side, while there are many harvesters and the harvesters have a low mobility.

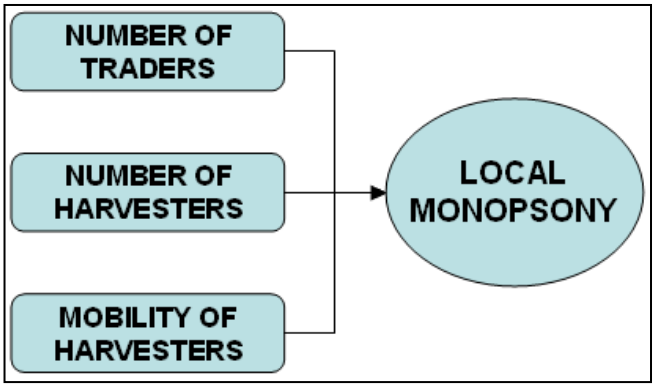

Figure 4.1 Determinants of local monopsonies

4.2 Bargaining power

This part will go deeper into the theory on bargaining power. It aims to facilitate the analysis of the bargaining situation of the gum arabic harvesters in Senegal. First of all, this part will mention some of the basic, relevant notions concerning game theory. Secondly, this part will go more specifically into bargaining theory, in order to define some of the most relevant determinants of bargaining power. These determinants are used to construct a model that will help to analyze the bargaining power of the gum arabic harvesters in Senegal.

4.2.1 Game theory

Game theory offers a wide array of different games that can be used to analyze certain problems. Bargaining problems form an important part of game theory. Although there are many different forms of bargaining games, most of them do not apply to the situation studied in this research. Most typical cases studied in game theory concern highly abstract and structured games (e.g. Dictator Games, Ultimatum Games, etc). Most research carried out on these games was carried out in a laboratory setting, controlling all circumstances (Kagel & Roth, 1995, Stähler, 1998 and Smith 2000). In general research on game theory tries to predict equilibrium outcomes of these games. Many experiments show that the classical Nash equilibria are often not reached. Apparently players prefer 'fair' strategies, which approach a 50/50 division, over the 'unfair' Nash strategies. The number of observed Nash equilibria decreases even further when players are negotiating face to face instead of anonymously. (Kagel & Roth, 1995 and Stähler 1998). This shows that there are social factors that play an important role in the bargaining process. The social factors seem to play an even more important role in repeated games (Stähler, 1998). In this case, the games are repeated many times and the players are unaware of the number of games. The social factors are an important

issue, because the bargaining situation studied in this research has a very open structure. It concerns two parties bargaining over a transaction, without a fixed pattern. Instead of being abstract, the situation of the gum arabic market is very concrete. Moreover, in this real life situation the players will obviously negotiate face-to-face and the transactions can be repeated many times. Consequently, social factors will play an important role in the bargaining process.

4.2.2 Bargaining theory

In general, each bargaining problem consists of at least two players. These players are supposed to bargain over a feasibility set *F*, which contains all the possible outcomes of the bargaining process. If the players reach an agreement, they receive their bargained payoff. If the players do not reach an agreement, they only receive their breakdown payoff, which is v_1 for player 1 and v_2 for player 2. Obviously, the feasibility set contains all outcomes better than the breakdown payoff. (Binmore et al. 1986) According to Muthoo (2001) a bargaining situation occurs when two players have an incentive to trade, because they can become better off from trading. If such a situation occurs, both players will try to negotiate a deal that makes them better off than their breakdown payoff.

In most bargaining situations, one of the players has more bargaining power than the other. He can exert this power in order to allocate a large share of the outcome to himself, typically bargaining a price as close as possible to his marginal costs. Bargaining power can be defined as the ratio of a player's ability to influence the other party, to the cost of not agreeing of the player (Stähler 1998 and Nagarajan, 2006). In other words, the bargaining power of a player is determined by his own breakdown option, as well as the power he can exert on the other party. Usually it is possible to define the breakdown payment of each player to a certain extent. The power each player has on the decision of the other player is generally more difficult to define. This often depends on a number of structural elements, as well as on the agent specific characteristics of each player (Nagarajan, 2006). In the following part, a summary will be given of the most relevant structure elements and agent specific characteristics that influence bargaining power.

When analyzing a bargaining process, it is important to recognize a number of elements that determine the structure of a bargaining game. First of all, it is important to distinguish between cooperative and non-cooperative games (Kagel & Roth and 1995. Stähler, 1998). In cooperative games players are willing and able to cooperate in order to reach a Pareto-efficient outcome. In this case it is important that both players can trust each other. Therefore it is necessary that they can make sure the other party keeps it promise. This requires information and the possibility to enforce an agreement. It is evident that repeated games are more likely to be cooperative than one shot games. In non-cooperative games players do not have the certainty that their opponent will keep his promise. Therefore it is unlikely that in these games the players will cooperate, which often leads to a Pareto inefficient outcome. Experimental research (Kagel & Roth, 1995) shows that both types of games can lead to very different equilibria.

Besides the difference between cooperative and non-cooperative games, there is also a distinction between asymmetric and symmetric games. In a symmetric game, both players have equal payoffs and strategies. In asymmetric games players have different payoffs. In asymmetric games the players do not necessarily have different strategies. Furthermore, there is also a difference between perfect and imperfect information. In a game with perfect information, both players know all the previous moves that were made by their opponents. Perfect information is often confused with complete information. In complete information, both

players also have information about the payoffs of their opponents, whereas in perfect information they only have information on the actions. It is obvious that the above mentioned factors can have an important influence on the bargaining outcome for both parties.

Another important element that can influence bargaining power in a game is the number of agents on each side of the market. Taylor (1995) argues that if, in a trading situation, one side of the market has fewer agents (the short side of the market) then the agents on this side will have more bargaining power than the agents on the long side of the market. This idea corresponds to the neoclassical situations of monopoly and monopsony. In his experiments, Taylor (1995) shows that the short side of the market tends to attract most of the surplus.

Besides these structural elements, there are also some agent specific characteristics that influence the bargaining power of players. Taylor (1995) mentions another important determinant of bargaining power. In a bargaining process with multiple agents, i.e. multiple sellers and buyers, the agents that trade large quantities tend to have more bargaining power than the agents that only trade small amounts. This should result in a higher price (per unit) for sellers of large quantities.

Another important issue is the risk attitude of the traders and harvesters of gum arabic. The attitude to risk can be defined, analyzing the marginal utility to income and the level of income (Varian, 2005). For a risk averse person the utility function is concave. If a risk averse person is poor, he finds himself on the left side of the curve. On this side, small changes in income lead to large changes in utility. Loosing a small amount money will lead to a large loss in utility.

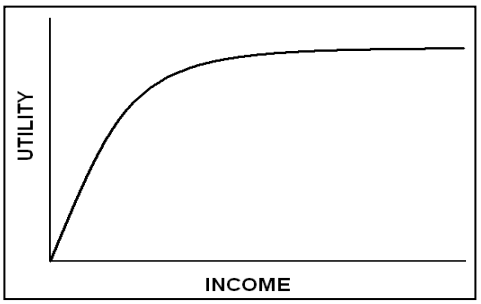

Figure 4.2 - Risk aversion

According to Ray (1998), a poor person with low income and low assets, is likely to be risk averse. Poor people have a high marginal utility for income. Therefore, poor people will prefer a smaller, certain amount of money, over a larger uncertain amount. In the case of the gum arabic chain in Senegal, the issue of risk attitude is especially important in relation to the breakdown options of both players. When both players reach an agreement, they will have a relatively certain outcome. On the other hand, when both players do not reach an agreement, they opt for finding another trade partner. This option brings along an uncertain aspect. In the case of breakdown, it is not certain whether or not the player will find a better trade partner. It is likely that the harvesters will have greater difficulty in finding another trade partner. They are dependent on the few available traders on their spot market. On the other hand, the traders can find numerous harvesters on the same spot market and moreover, they can also travel to other markets.

Another important determinant of bargaining power is the patience of the agents. Generally, the agent that is the most patient will have more bargaining power (Davila & Eeckhout, 2004). However, patience itself is determined by various factors. Stähler (1998) argues that the player with the best bail-out position, or breakdown payment, will suffer less time pressure and therefore gain bargaining power. Charness (2005) mentions the *melting ice pie* phenomenon. This means that if both players fail to reach agreement on the division of a pie in one round then, in the following round of negotiations, the size of the pie will decrease. This *melting ice pie* has a negative influence on the patience of both players, but generally it aggravates the situation of the agent that is already the most impatient. Finally Muthoo (2001) and Stähler (1998) mention the influence of risk attitude on bargaining power. He states that the agent that

is most risk-averse will also be the agent that is most willing to reach an agreement. Therefore this agent will be more impatient and lose bargaining power.

Bargaining power is also determined by the ability of one player to punish the other (Smith, 2000). The threat of a punishment should be viable in order to be effective. Depending on the structure of the bargaining situation, a punishment can have different forms. In the case of the gum arabic trade in Senegal, the most obvious punishment would be a non-agreement. Both players, traders and harvesters, can use this threat, but it will mostly affect the player with the worst breakdown alternative.

Finally, if the bargaining occurs in a real life setting, as it is the case in this research, it can be expected that personal factors will also play a role. Henrich et al. (2004) argue that in developing countries, the age, experience and education of the players can influence their bargaining outcome.

4.2.3 The effect of coalitions on the bargaining process

Folkes & Weiner (1976) give a useful and general description of coalitions. They state that "the formation of coalitions permits combination or the adding of resources of the participants, thus facilitating goal attainment". Komorita et al. (1989) investigate coalitions with an approach that is funded in bargaining theory. They define a coalition more specifically as "two or more parties who agree to pool their resources to achieve some mutually desired outcome". Since this research is focusing on the effect of coalitions on the bargaining process, the latter definition is preferred.

Many theories suggest that coalition forming can improve the bargaining power of the coalition members. First of all, the formation of a coalition changes the structure of the market, and hence, the structure of the bargaining situation. For example, the local monopsony situation described before would cease to exist. When the harvesters manage to create a coalition, they can convert this local monopsony into a local bilateral monopoly. In this bilateral monopoly, the traders would face only one client; namely the coalition. This would severely deteriorate the breakdown payoff for the buyers. In case of breakdown they will have more difficulty in finding new trade partners. This deterioration of the breakdown payoff will also have a negative influence on the patience and risk aversion of the traders. Moreover, the threat of punishment from the coalition is more viable than that of the individual harvesters. Clearly the bargaining power of the players inside the coalition would drastically improve. This is also shown in Taylor (1995), where the short side of the market, the side with fewer players, is able to attract more of the available surplus. This suggests that creating a coalition would shorten one side of the market. Moreover, a party that is trading a large quantity will also have more bargaining power. This would increase the expected outcome of the negotiations. Therefore, the forming of a sellers' coalition, in a monopsony, can improve the bargaining outcome of the sellers.

Whereas most literature suggests that coalition forming will lead to an increased bargaining outcome, some scholars point out the possible disadvantages of coalitions. In the case of strong monopsonies, coalition forming does not necessarily lead to an improvement (Sivramkrishna & Jyotishi, 2008). In this case, the negotiations between the buyer and the coalitions can result in a breakdown. If a monopsonist is powerful enough, he can refuse to trade with the coalition. In this case, the members of the coalition would be worse off. This would remove the incentive for the harvesters to join the coalition and eventually, the coalition would fall apart.

4.2.4 Model on bargaining power

This part will construct a model that allows examining the bargaining power of the gum arabic harvesters in Senegal. This model will include various market structure elements, as well as agent specific characteristics that have an influence on the bargaining power of the harvesters. This will allow for an effective analysis of the effect of coalitions on the bargaining power of the harvesters.

The most important chain structure element is the number of players on each side of the market. As mentioned before, a monopsonistic situation has a negative effect on the bargaining power of the harvesters. So if there are only few buyers and many harvesters who depend on these buyers, the harvesters will face a decreased bargaining power. The monopsonistic situation that the harvesters face can be aggravated if the harvesters are isolated from other markets due to low mobility. On the other hand, if the harvesters form a coalition, they reduce the number of players on their side of the market. This would convert the existing monopsony into a bilateral monopoly. In this case, the bargaining power of the harvesters should increase. Therefore, it is expected that joining a coalition has a positive effect on the bargaining power of a harvester.

Figure 4.3 shows the determinants of bargaining power that will be used in this research. Some of these determinants can be influenced by the formation of coalitions. This structure can be used to analyze the bargaining power of harvesters in situations with, or without coalitions.

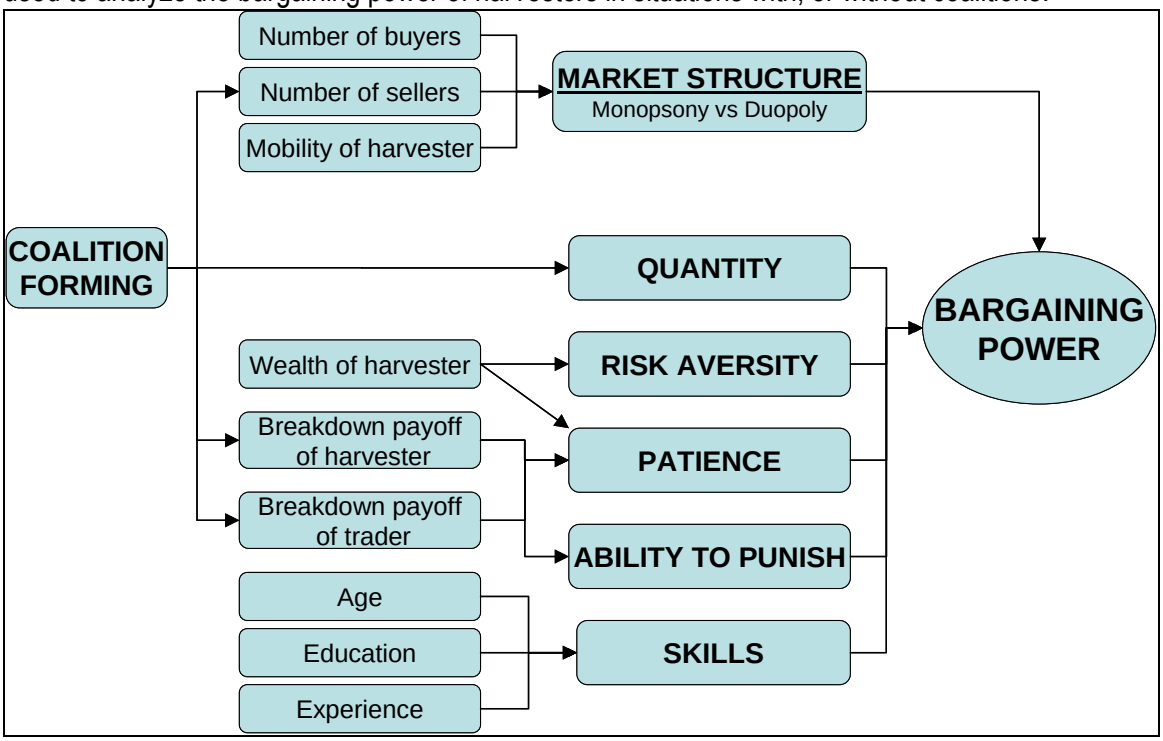

Figure 4.3 Determinants of bargaining power

Besides the chain structure elements, agent specific characteristics also influence the bargaining power of the harvesters. One of the most important characteristics is the quantity of gum the harvester is trading. The quantity is supposed to have a positive effect on bargaining power. Furthermore, the risk attitude of the harvester will also influence his bargaining power. A risk averse harvester will have lower bargaining power. Risk attitude is mainly determined by the initial wealth of the harvester. Therefore it can be assumed that wealthy harvesters will have higher bargaining power. Besides risk attitude, patience does also play an important role in determining the bargaining power of harvesters. Patience is determined by the wealth of the

harvester and on the breakdown payoff of both parties in the bargaining process. The harvester's ability to punish the trader also influences his bargaining power. This ability to punish is mainly determined by the breakdown payoffs of both parties. Coalition forming will improve the breakdown payoff of the harvesters and deteriorate that of the traders. This will improve the ability to punish, as well as the patience of the harvesters and hence their bargaining power. The skills of an agent are another important determinant of bargaining power. In the case of the gum arabic harvesters in Senegal, skills can be defined as a combination of experience in the profession, education (literacy) and age. These factors will all influence the negotiating skills of the harvester in a positive way.

A final important issue is the relation between the bargaining power and the bargaining outcome. As bargaining power is a rather abstract notion, it might be difficult to observe it empirically. Therefore, it might be more practical to study the effects of the determinants of bargaining power, on the bargaining outcome. As a consequence, the model above needs to be augmented, including the relation between bargaining power and bargaining outcome. For this model it can be assumed that bargaining outcome is determined by bargaining power and exogenous factors. These exogenous factors include the world market price and other world market conditions that influence the bargaining outcome for the gum arabic harvesters. As these factors are exogenous to the bargaining process, they will have a fixed effect on the bargaining outcome. Therefore, it can be assumed that any change in bargaining power will result in a change in bargaining outcome. This means that an observed change in bargaining outcome suggests a change in bargaining power.

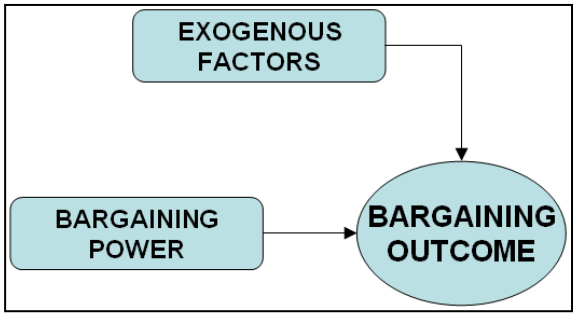

Figure 4.4 Determinants of bargaining outcome

When it comes to the operationalization of this model, it is important to bear in mind that there are various abstract notions in this model. The notions of risk aversion, patience and ability to punish are rather abstract and difficult to measure concretely. The determinants of these notions (wealth and breakdown payoff) are easier to quantify. Therefore the determinants of the abstract notions will be used in the operational part of the research. It can be assumed that any observed changes in the determinants have a corresponding effect on the notions that they are supposed to influence.

4.3 Coalition forming

The topic of producers' cooperatives (or coalitions) has been a popular issue in recent years. Many theories suggest that producers that join in cooperatives can profit from economies of scale, synergies and other benefits. Besides, these cooperatives are believed to play a key role in modernizing market chains in developing countries. Instead of going into the numerous possible benefits of coalition forming, this research will focus on the role that it plays in the bargaining process. First of all, this chapter will go into the process of coalition forming itself. It will mention the most relevant factors that influence the decision of players to either join a coalition, or not. The second part will discuss the equality of income inside the coalitions. It will mention the most important factors that influence the outcome of the members of the coalition. Both issues will be represented in a model. These models should help to analyze the possibilities for the harvesters to benefit from participating in a coalition.

4.3.1 The process of coalition forming

This part will go into the factors that shape a coalition. As the objective of this research is to improve the situation of the harvesters, special attention will be paid to the determinants of the participation of harvesters in coalitions. Obviously, the possible benefit of a coalition in the bargaining process will provide the harvesters with an incentive to join. Still, some harvesters might be more likely to join a coalition than others. Theory provides many factors that play a role in the decision of participating in a coalition. The most relevant factors are mentioned in the following part.

Folkes & Weiner (1976) investigate various factors that play a role in the formation of coalitions. They find that two factors play an important role in this process, namely skills and endowments. When it comes to skills, Folkes & Weiner show that agents with high skills tend to collaborate with each other. The highly skilled players also tend to keep out lower skilled players, because they cannot make a valuable contribution to the coalition. This would mean that highly skilled harvesters are more likely to join a coalition than lower skilled harvesters. Caplow (1968) goes further into the role of endowments. He finds that in a multiple agent bargaining process, agents with small endowments, i.e. small quantities, tend to join coalitions, whereas agents with large endowments tend to non-cooperate. In practice, this would mean that harvesters with large quantities of gum are less likely to join a coalition than farmers with small quantities.

Most of the factors above have only been tested in highly sterilized experiments. These theories have not been tested outside of these synthetic environments. Many researchers that have tried to explain coalition forming in real life situations (e.g. Henrich 2004 and Hofstede 2002) find that social factors play a very important role in coalition forming. It appears that in real life situations, agents base their decisions largely on social relationships and not only on economic incentives. Coalitions in these real life situations are likely to be shaped by kinship, friendship, religious and other social relations. Henrich et al. (2004) add to this by listing some factors that also play a role in coalition forming in developing countries. They argue that the education of players has a positive influence on their probability of joining a coalition.

4.3.2 Model on the decision to join a coalition

The most obvious incentive a harvester can have to join a coalition is the financial benefit of an increased bargaining outcome. It might seem superfluous to mention this benefit, but if this incentive is not present, there would be few harvesters interested in forming a coalition. When this prerequisite is met, there are various determinants that influence the decision of a harvester to join or not.

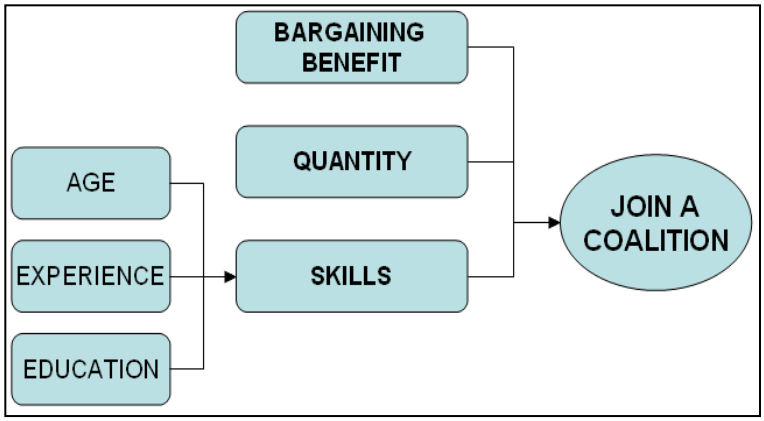

Figure 4.5 Determinants of the decision to join a coalition

First of all, the endowments have a negative influence on the probability of a harvester to join a coalition. If a harvester is endowed with a large quantity of gum, he already has some bargaining advantage of his large quantity. He might therefore refuse to cooperate. Skills also play an important role in the

process of coalition forming. Apparently, highly skilled players are more likely to join a coalition and they tend to keep out lower skilled players. Henrich et al. (2004) argue that in developing regions, education plays an important role in coalition forming. Therefore, a higher educated harvester would be more likely to join a coalition than a lower educated harvester. The above mentioned determinants are summarized in Figure 4.5. Obviously, social and cultural factors do also play a role in the process of coalition forming. However, a full social analysis of this process goes beyond the scope of this research.

4.3.3 Income equality inside the coalition

A coalition can only be formed when the players have greater (expected) utility from joining the coalition, than they would have from leaving the coalition. Once a coalition is formed, there are various factors that can influence the degree to which the members can benefit from the coalition. This part will go into the possible factors that explain how members can benefit from the coalition. First of all, a description will be given of the process of bargaining within the coalition, as well as the representation. Furthermore, this part will also go into the effect of opportunistic behavior on the coalition. Studying these issues should help to gain insight into how the harvesters can all benefit from a coalition.

As mentioned before, this research aims to improve the income that harvesters receive from gum arabic. Therefore it is useful to investigate the bargaining within the coalition. If coalition can indeed lead to a better bargaining outcome, it is interesting to study how this advantage is divided within the coalition. Komorita (1989) goes deeper into the process of *reward allocation*. One of the most obvious norms of allocations is the *distributive justice,* or *equity theory* (Homans, 1961 and Adams, 1963 in Komorita 1989). This norm specifies that the reward for each player should be directly proportional to his input. This would mean that each harvester would be equally rewarded for every kilo of gum arabic he contributes to the coalition. Although this allocation seems the most apparent and fair, it does not necessarily lead to the highest stability. For many reasons, some of the participants in the coalition can have more influence than others. They could use this influence, in order to allocate a larger share of the outcome to themselves. This influence can be defined as *bargaining strength* (Komorita 1989). Bargaining strength is similar to bargaining power, but it only deals with bargaining within a coalition. A player with a high bargaining strength can allocate a share of the outcome which is disproportionate to his input. There are many factors that can influence the bargaining strength of players. First of all, the input of each player plays an important role (Komorita 1989). It is evident that players with a relatively high input have a higher bargaining strength. Besides the input, the skills of the players can also influence the bargaining strength (Folkes & Weiner, 1976). As mentioned before, players with high skills are more likely to join a coalition and they tend to keep out lower skilled players. This means that in a coalition, players with high skills will have more bargaining strength. It can be assumed that, as in any bargaining situation, social factors will also play an important role. It is evident that preexisting social connections, as well as social hierarchy, have a major impact on the outcome allocation. This can also have an effect on the representation of the coalition. Some highly skilled or socially influential participants can strive to represent the coalition in some way. They can later use this influential position, in order to allocate more of the bargaining outcome to themselves.

The representation of the members in the coalition is an important factor in determining the income equality within the coalition. The better each member is represented; the better will be his outcome. It is obvious that an egalitarian representation would improve the equality of income, as all members are equally represented.

Every coalition faces the threat of opportunistic behavior. Opportunistic behavior can be described as “a condition of self-interest seeking with guile” (Williamson, 1987). It includes providing false information and breaking promises. Opportunistic behavior usually occurs in case of imperfect information and it can harm a coalition in various ways. For example, a player can give false information about his input. If we look at the specific situation of the gum harvesters in Senegal, it is not unthinkable that opportunistic behavior occurs. A harvester can break his promise to trade his entire harvest through the coalition.

The risk of opportunistic behavior largely depends on the reactions of the traders on the coalition. Most likely, only one of the traders will reach an agreement with the coalition on the procurement of the gum arabic from the coalition. This trader will be better off than in a situation without coalitions. He will face reduced transaction costs and, for the duration of the agreement, he will have no competition. Consequently, this trader will be willing to pay more for the gum arabic he procures from the coalition. On the other hand, there will be other traders that are left out of the negotiations with the coalition. These traders face decreased bargaining power and they have more trouble in finding other trade partners. As a reaction to their deteriorated position, these traders might try to break the coalition. They can do so, by offering higher prices to members that leave the coalition. This can seriously undermine the effectiveness of a coalition. As mentioned before, opportunistic behavior occurs in a situation of incomplete information. Therefore, it can be assumed that, in case of (nearly) perfect information, opportunistic behavior is less likely to occur.

4.3.4 Model on income equality inside the coalition

Once a coalition is established, there are various factors that influence the income equality of its members. One of the most important factors is the reward allocation. There can be bargaining inside a coalition to divide the collective bargaining outcome. The most obvious norm for allocation would be distributive justice. This norm would reward all harvesters proportionate to their input. This would mean that all members would receive the same price per quantity of gum arabic. If the coalition manages to reach a bargaining advantage and it applies distributive justice, than all members would be better off. The representation of the coalition is also an important determinant of its stability. If the representation is more or less egalitarian, all harvesters have equal influence on the decision making process. This would improve the income equality inside the coalition.

Opportunistic behavior is an important threat to the stability of the coalition. As mentioned before, disappointed traders can try to break the coalition in order to regain their bargaining power. This could give an incentive to some harvesters to leave the coalition. This opportunistic behavior would result into a loss of bargaining power for the coalition. This would seriously endanger the continuity of the coalition and the income for the remaining members. The determinants of income equality inside the coalition are depicted in Figure 4.6

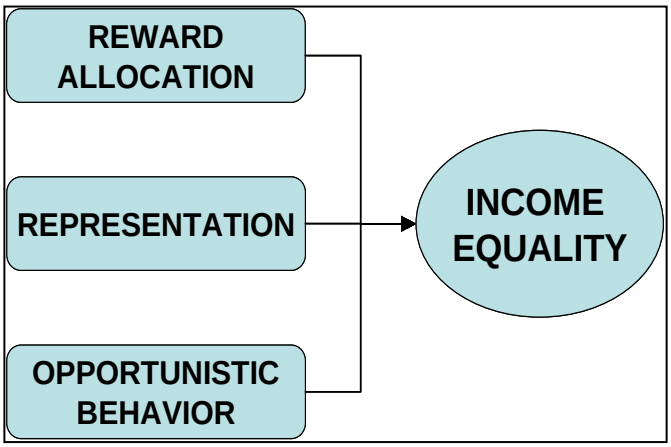

Figure 4.6 Determinants of coalition stability

5. Methodology

This section will explain the methodology that was used in this research. It will describe the methods that were used to analyze the model that was mentioned in the previous section. This research will apply a triangulation of methods, in order to gain credible and viable data. Using a combination of methods should lead to more reliable answers to the research questions (de Vaus, 2001). This research will make use of three different methods. First of all, this research will use questionnaires to gain data on the current situation of the gum arabic trade in Senegal. Secondly, a series of simulation games will be applied. These simulation games will help to shed light on the processes of bargaining and coalition forming. Finally, this research will use interviews in order to gain relevant information about the only existing gum arabic cooperative in Senegal. The data of these three methods can be compared in order to confirm or dispute the hypotheses.

This section will explain each of the three research methods. It will describe the objective of each method, as well as the data it is intended to provide. Furthermore, the sampling method that was used for each method will also be discussed. After the description of the three methods, this section will go into the data analysis. That part will explain the quantitative methods and equations that have been used to analyze the data.

5.1 Questionnaires

This part will explain the application of the questionnaires that were used in this research. Firstly, the objective of the questionnaires will be discussed. After this, the content of the questionnaire will be discussed, as well as the data it is intended to provide. Finally the sampling method that will be explained.

The objective of the questionnaires is twofold. The principal objective of the questionnaire is to gain information on the current situation of the gum arabic trade in Senegal. It is supposed to examine the current bargaining situation of the gum arabic harvesters and determine to what extent they are facing a monopsonistic situation. The secondary objective of the questionnaires is to gain information about the respondents that can later be used to analyze the results of the simulation game. Some general information on the respondents is needed to compare to the outcomes of the simulation game. The section on simulation games will go further into this. Furthermore, the questionnaires also help to gain some general information on the respondents, which can be used to explain their decisions.

The questionnaires intend to gather information about the current bargaining situation of the gum arabic harvesters in Senegal, as well as some personal information. The information on the current bargaining situation is covered by a section of questions on the bargaining position of the respondent. This section includes questions on the choice of client, as well as on the bargaining process and perceived bargaining power of the respondents. Besides, the questionnaires also provide information on the age, experience and education of the respondents. Moreover, the questionnaire also generates data on the primary and secondary livelihood activities of the respondents. As most harvesters are pastoralists, the size of their herd can be used as a measure for their wealth. Finally the questionnaires also shed light on the intensiveness of the gum related activities of each respondent. A complete version of the questionnaire can be found in Appendix B. A complete list of variables that are derived from the questionnaire is given in Appendix C.

The sampling method that was used in this research is *convenience sampling* (de Vaus, 2001). The questionnaires were presented to respondents that, later during the same session, also participated in the simulation game. Therefore, the sampling method for the questionnaires largely depended on the sampling method of the simulation game. The sampling method of the simulation games will go further into the rationale behind this choice of method.

In the research area, the questionnaire was presented to harvesters, as well as mobile traders and grocers. This mix allowed examining the problem from both angles. In total a number of 58 respondents have completed the questionnaire. Although most of the respondents participated in the simulation game, some of them only filled out the questionnaire without further participation in the game. Their data can only be used to analyze the current situation and not to compare to the results of the simulation game.

5.2 Simulation games

The second method applied in this research is simulation gaming. Although this is a relatively new and unexplored research method, it can be effectively applied in this research. This section will explain how this method was used in this research. The first part will explain the objective of the simulation games and why they can be a useful method in this research. The second part will go into the design of the game. It will explain the underlying rationale of the final design of the game. The third part will describe the data that the game is supposed to generate and the fourth part will go into the sampling method. An outline of the actual procedure of the game can be found in appendix D.

5.2.1 Rationale of using simulation games as a research method

The objective of the simulation games is to shed light on the bargaining process, as well as the process of coalition forming. As both of these processes are versatile and interrelated, they are difficult to investigate with other, more static methods. The simulation games are intended to shed light on bargaining and coalition forming, as well as on the factors that have an influence on these processes.

Although simulation games have been used as a training tool for many years, their application as a research method is relatively new. Duke & Geurts (2004) argue that simulation games can give an insight in what they call “macro problems”. These macro problems are characterized by complicated interrelated processes. Studies by Meijer et al. (2006) as well as Zuñiga (2007) have effectively used simulation games to shed light on multi-agent situations. Since bargaining and coalition forming are versatile and complicated processes, with many visible and invisible interrelations, they can be defined as macro-problems. The holistic and dynamic nature of simulation gaming allows to capture the entire picture at once, integrating all aspects and interrelations. Moreover, this research aims to study a situation that is still practically inexistent in the research area. In this case, simulation gaming provides the possibility of creating this situation artificially.

Anyhow, it is important to be aware of the limitations of this method. The main limitation of simulation games is their artificiality. Participants act in an artificial reality that is created by the researcher. This affects the generalizability of the research results. On the other hand, if the games are designed close to the real life situation, participants will behave more according to their normal behavior. This would reduce the degree of artificiality and hence, improve the generalizability (Duke & Geurts, 2004).

5.2.2 Design of the game

As the application of simulation games as a research tool is rather new, the literature on this topic is scarce. It goes without saying that there is no pre-made game that can directly be applied to the situation that this research addresses. Therefore, a new game that is specific to this research was designed. The following part will discuss the design of the game.

With their *21-step guide to a successful gaming simulation*, Duke & Geurts (2004) provide an excellent framework to designing a simulation game. They emphasize on the importance of defining the problem and its key components before turning to the game design.
Before starting to design the simulation game, it is useful to recall its objective. The simulation game should provide an insight in the bargaining process, as well as the process of coalition forming. The previous chapter explained the conceptual models that will be used to analyze these processes. These models were used to create the simulation game.

After the initial design of the simulation game, it was put to the test in various test runs. These test runs have been executed with fellow students in the Netherlands, as well as with the research target in Senegal. These tests have led to a better insight in the functioning of the game. The experiences from the test runs were used to reshape and improve the simulation game.

Since the game is intended to study two different processes, the game is divided into two sub-games. The first sub-game should provide information on the bargaining process and the effect of coalitions on this process. The second sub-game is supposed to study the process of coalition forming. Both these sub-games are included in the same simulation game. The following will give a more detailed description of both sub-games.

5.2.3 Bargaining sub-game
The first sub-game studies the bargaining process and the effect of coalitions on this process. Obviously, this game takes the form of a bargaining game. This means that harvesters and traders have to bargain over a fictitious transaction of gum arabic. The bargaining game requires two rounds in order to examine the effect of coalitions on the bargaining power of the harvesters. The first round resembles the existing situation of the gum arabic market in Senegal. There are various farmers that bargain individually over a certain amount of gum with one single trader. This corresponds to the monopsonistic situation which is assumed to be present in most villages. The second round of bargaining allows for coalitions to form. These coalitions, as well as the harvesters that stay outside the coalition, will bargain with the trader again. The results of these two rounds can be compared, in order to examine the effect of coalitions on the bargaining power of the harvesters. As the harvesters are free to decide whether they join, don't join, or leave the coalition, there are three possible scenarios for the bargaining game. These situations are depicted in Figure 5.1 (page 22). In the first round the harvesters are only allowed to bargain individually. In this case, only situation 1 will be observed. In this situation the harvesters are supposed to have little bargaining power, as they face a monopsony. This low bargaining power should result in a low bargaining outcome. In the first situation there can be differences in outcomes between harvesters. These differences are caused by different endowments, skills, wealth, etc. In the second round of the game the harvesters are allowed (but not obliged) to form coalitions. Consequently, in the second round, all three situations can be observed. First of all, the harvesters can decide not to form any coalitions. In this case, situation 1 will be observed. The second possibility is that some harvesters choose to form a coalition. In this case, situation 2 will be observed. The harvesters

within the coalition will supposedly bargain a better outcome than the individual harvesters in situation 1. Besides, the harvesters that stay outside the coalition will face an even further reduced bargaining power. This loss in bargaining power is caused by their loss of importance. Their quantity of gum is considerately lower than that of the coalition. Therefore the trader has less incentive to reach an agreement with these individual harvesters.

The third possible scenario is depicted in situation 3. In this case a coalition is created, but one of the members defects on the coalition. The harvester that defects on the coalition expects he can reach a better bargaining outcome on his own. This expectation can be caused by a poorly functioning coalition, or by an attempt of the trader to break the coalition. In this case the trader would offer a higher price to the defecting harvester. It is evident that the defecting farmer should have a higher outcome than the coalition. The coalition in situation 3 will have lost a member and hence, it will face reduced bargaining power. Consequently the coalition in situation 3 will have a lower bargaining outcome than the coalition in situation 2. The three situations that are mentioned above can all occur in the bargaining game, as well as in real life. Given the set of incentives they face, the harvesters are free to decide on their own actions. Therefore, their behavior in the bargaining game can be expected to correspond to their behavior in real life.

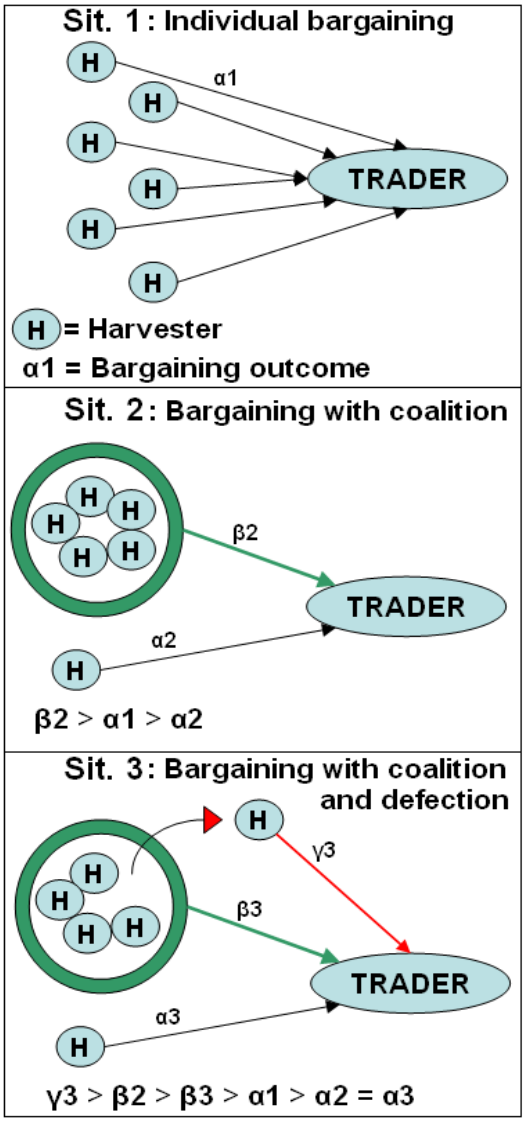

Figure 5.1 Possible bargaining scenarios for the simulation game

Besides the basic structure of the game, there are various important issues that come into play when studying the effects of certain factors on the bargaining process. As all players of the game also complete a questionnaire, these questionnaires can be used to derive some personal variables for each participant (e.g. age, education, experience, wealth, etc.). These personal variables can be used to analyze the bargaining outcomes in both rounds of the bargaining game. Besides these personal variables, the endowments of the players are supposed to play an important role in the bargaining process. This effect can be studied by endowing the harvesters with different quantities of gum, before each round of the bargaining game. Before each round of the game, the harvesters have to throw a dice. The outcome will determine the quantity of gum (10kg-60kg) they get to sell in the bargaining game. This allows for an analysis of the effect of endowments on the bargaining power of the harvesters.

The harvesters are not obliged to sell their gum during each round. They can refuse to sell to the trader. In this case they have no transaction and their outcome will be zero. Although in real life the harvesters might wait and store their gum for the next market, this is not taken into consideration in the bargaining game. It is assumed that the harvesters are dependent on the

weekly market and therefore they will be willing to sell. However, as a punishment, the harvesters can still decide not to sell. In this case, both the harvester and the trader would have a low breakdown payoff. A harvester can use this punishment, in order to increase the outcome of the next round of negotiations.

Another important issue in the design of the bargaining game is the setting of the game. Broadly speaking, there are two options. The first option is to play the game in an open setting. In this situation all players are gathered in the same room. When they are not bargaining themselves, they can still observe the other players. Although this option seems the most practical, it can influence the results. The players that play later in the game can observe and learn, from the players that play earlier. They have information on the previous outcomes, which would positively influence their bargaining power and outcome. The other option is to play in a closed setting. In this case the bargaining would take place in a closed room and the players would not be able to observe the actions of others. For this research, the most appropriate option is the open setting. This setting corresponds best to the open market situation on the spot markets in Senegal. As a result, this situation should allow for behavior that is closer to the real life behavior of the participants. However, when analyzing the data, the possibility of a learning effect should be taken into consideration. As a result, the observations on the behavior of the individual players will not be independent.

Besides the setting of the game, there is another important consideration for the design of the game. In a bargaining game the researcher can choose to fix a price band, or he can leave the bargaining completely open. For statistical analysis it can be useful to fix a price band for the bargaining process. In this case, the researcher fixes a bottom and a ceiling price for the bargaining. This can be done by offering both players a certain breakdown option. This makes sure that the negotiation will take place within these two prices. The advantage of this price band is that all outcomes will be within the same band and therefore, easier to compare. The alternative is bargaining without any price bands. In this case, the players are free to negotiate any possible price.

The initial design of this game intended to use a price band. A breakdown option was given to both the harvesters and the trader. The objective of this price band was to keep bargaining within a reasonable price range. When the initial game was put to the test, the price band did not provide the desired effect. In practice, the game reached an equilibrium price, equal to either the ceiling, or bottom price. Since the bargaining takes place in an open setting, the players can observe the previous transactions. In the test runs it turned out that after two or three transactions, the bargained price reached either the fixed ceiling or the fixed bottom. Once the prices reached this extreme, they did not change in the following transactions. As a result, the results of the game would become useless and it would be impossible to detect certain influences on the bargaining process. Therefore, the final version of the game does not use any price bands. Another advantage of not using a price band is that the villages in the research area have different characteristics and different markets. Consequently, a certain price band might be very suitable for one village, but it can be misappropriate for another village.

Because this bargaining game does not use any price band, the players are free to bargain over any possible price. In the best case they stick to the prices they are used to deal with. But they can also bargain over prices that are less realistic. Consequently, there can be large differences in prices between different games. This should be taken into account when analyzing the results.

5.2.4 Coalition forming sub-game

Besides the bargaining game, this simulation game includes another sub-game. The second sub-game addresses the process of coalition forming. This sub-game takes place in between the first and the second round of the bargaining game. After the first round, the harvesters have to determine their endowment again, by throwing a dice. Once all harvesters have received their quantities of gum arabic, they can discuss the possibility of forming a coalition. The harvesters are not obliged to form a coalition, or to stay loyal to it after having joined.

In this second sub-game the effect of various factors on the process of coalition forming can be observed. First of all, the effect of endowments can be observed, as the harvesters are endowed with different amounts of gum. Secondly, the information of the questionnaires can be used to analyze the effect of skills and education on the coalition forming process.
Besides, if the harvesters decide to form a coalition, they should agree upon a representational structure, as well as on the reward allocation. This allows for an analysis of the influence these factors have on the stability of the coalition. Moreover, the second round of the bargaining sub-game is also interesting. In this round there can still be changes in the shape of the coalition, as the harvesters could defect on the coalition.

5.2.5 Data

After having described the design of the games, this section will briefly explain the data that the simulation game is supposed to generate. The bargaining sub-game will provide various interesting variables. First of all, each harvester has a certain endowment (quantity) in each of the two rounds. Secondly, this endowment is used to bargain a price (per kg). During the second round of the bargaining sub-game the harvesters can organize themselves. Therefore it is interesting to compare the results of this round to the results of the first round.

The second sub-game will lead to a set of variables that can help to explain the process of coalition forming. The most obvious variable is the one describing the participation in a coalition of each harvester. It simply mentions whether or not a harvesters participated in a coalition. Besides this variable, the second sub-game will also generate data on the shape of the coalitions that were formed during the game. The second coalition forming sub-game provides information on the representation and reward allocation of the coalition. Besides, it can also record whether or not there are harvesters defecting on the coalition. A full list of variables that are generated by the game can be found in appendix C.

5.2.6 Sampling method

The sampling method that was used for the simulation games is convenience sampling (de Vaus, 2001). For the successful completion of one game, it is necessary to gather 5-9 people at the same time, at the same place. As most gum arabic in Senegal is produced in the northern region, this region has been chosen as the research area. Due to the highly dispersed farmer population, the number of possible sample villages in the research area was very limited. In the end, seven villages were selected[2]. These seven villages are home to the major weekly markets in the region. Because these weekly markets attract many harvesters and traders, also from surrounding villages, the villages were visited on their market day. This was necessary, in order to find the required amount of participants in the villages.

The above shows that a more random sampling method would pose huge practical difficulties. Because of the limited budget and time frame of this research, convenience sampling was the

[2] These villages are: Dodji, Barkédji, Louggéré Tiolly, Ndiayène Fouta, Ranerou, Vélingara and Thièl. A more detailed map of the research area can be found in appendix A.

preferred method. Other methods would be practically impossible to use, given the circumstances. In the end, the game was played in seven villages. In two of the villages it was possible to find enough players to execute two separate runs of the game. This leads to a total of nine games, with a total of 50 players (41 farmers and 9 traders).

5.3 Interview

The third methodology of this research is interview. This extensive interview should provide information on the experiences of the only existing cooperative in Senegal. The information from this interview can be compared with the findings from the questionnaires and simulation games.

The objective of the interview is to gain in-depth and qualitative information on the experiences of the only existing gum cooperative. Above all, the interview focuses on the bargaining process and the effect the cooperative has had on this process. It is important to know whether or not the members have an advantage from joining the coalition or not. Furthermore, the shape of the cooperative is also an important factor. It is interesting to find out which form of representation and reward allocation are used and how this functions in practice. The information from this interview can help to interpret the findings from the other two research methods.

The interview was carried out in Tambacounda and the respondent was the president of the Experna cooperative, Mr. Opa Cissokho. The outcome of the interview resulted in a brief case study on the Experna cooperative. This case study can be found in appendix E.

5.4 Data analysis

This section will go into the methods and techniques that have been used for the analysis of the data from this research. The variables from the questionnaires and the simulation games will be combined, in order to answer the research questions. As mentioned before, a full list of variables from both the simulation games and the questionnaires can be found in appendix C. The data can be analyzed using descriptive statistics, as well as regression analysis. The outcomes of these quantitative analyses will be compared to the qualitative outcomes of the interview. The following section will explain the quantitative methods used in this research. Firstly, the following part will explain what techniques are used to examine the current situation of the gum arabic trade in Senegal. Secondly, the analyses on bargaining power will be discussed and finally, this part will give an explanation of the methods used to analyze the process of coalition forming.

5.4.1 Current situation

This part will give a brief description of the quantitative methods used to analyze the current situation. As the questionnaire provides many nominal variables, the current situation of the gum arabic harvesters will mostly be studied using descriptive statistics. The variables from the questionnaire will be used to characterize and typify the harvesters. This typification will help to gain an insight in the decisions the harvesters make, as well as the bargaining situation they face. Besides this harvester specific typification, the researched villages will also be analyzed. This analysis will be more qualitative of nature. It will help to gain insight into the situation in the village and hence, it will give an indication on the market structure.

5.4.2 Bargaining power

This part will discuss the quantitative methods used to analyze the bargaining power of the harvesters. First of all, the initial bargaining power of the harvesters, in a situation without coalitions, will be investigated. After this, the effect of coalitions on the bargaining process will be discussed. The information from the questionnaires and the simulation games can be combined and compared, in order to investigate the bargaining power of the harvesters of gum arabic.

When it comes to the quality of the data, the nature of the simulation game provides one major limitation. The bargaining outcome that the players negotiate each round is specifically problematic. Because the players in each game are free to bargain over any possible price and also because the players can observe each others behavior, it is difficult to compare between the different bargaining outcomes of each game. The outline of the simulation game provides the risk of considerable differences in average bargaining outcome between the different sessions. This means that the bargaining outcome of each player depends partly on the particular game session in which he played. Therefore the bargaining outcome of the entire sample is not characterized by a normal distribution. As a consequence, the bargaining outcomes can only be compared within the groups. One solution to this problem could be to analyze the deviation from the group mean of each player (Park, 2008). Taking the deviation from the group mean, instead of the actual bargaining outcome would enable comparisons between players from different sessions. However, this method would require an even larger sample size, in order to generalize the results. Due to the already limited sample size of this research, the assumption of a normal distribution of the bargaining outcome cannot be proven. As a result, the possibilities for statistical analysis are limited. It is not possible to execute efficient regression analysis, Pearson's Chi-square, or other methods that are based upon the assumption of normal distribution.

On the other hand, the limited number of game sessions does allow for an in depth analysis of the results of each session. Since only nine games were executed, it is possible to study each outcome specifically. The scenarios of each game session can provide useful information on the bargaining outcomes and the variables that play a role in determining it. Some descriptive statistics can be applied to the outcomes and the observations themselves can already give suggestions about the behavior of the players.

Despite the fact that it is not possible to use regression analysis or Pearson's Chi-square, the bargaining outcome and its determinants can still be analyzed. In order to analyze the bargaining outcome over the whole sample, this variable needs to be transformed. The observed bargaining power shows large differences between the different game sessions. These differences make it difficult to observe trends between the different games. This problem can be solved by calculating the relative deviation of the group mean for each player. This can be done in various steps. First of all, the mean bargaining outcome of each game session needs to be calculated. Secondly this mean is subtracted from the individual bargaining outcome of each player. This results in a variable that shows the deviation from the group mean. Finally, this variable is divided by the group mean in order to calculate the relative deviation from the group mean. This final variable can be used to spot trends between the various game sessions. The relative deviation from the group mean can be ranked on several variables (*quantity, age, wealth,* etc.) to check for certain trends.

The first round of the simulation game can give useful information on the current bargaining situation of the harvesters. In this first round, the harvesters bargain individually with the trader. This situation is supposed to correspond to the current, real life situation. The results of this round can be used to analyze the bargaining power of the harvesters in a situation without coalitions. Figure 4.3 (page 14) suggests that there are various factors that influence the bargaining power of the harvesters. The factors that influence the bargaining power of gum arabic harvesters include the age, experience, education and the endowed quantity of gum arabic of each harvester. The wealth can also play an important role in determining the bargaining power. The variable wealth that is used in this research combines the size of each harvester's herd, with the type of animals in the herd. As most harvesters are pastoralists, this variable can be used as estimation for their wealth.

Besides, as the bargaining outcomes are derived from the simulation games, it makes sense to take into account that the players might learn from the others, while waiting for their turn. As a result, there might be a learning effect. Therefore, another factor should be included. This variable specifies the order of play of each game. The later the player plays, the more experience he will have gained before actually playing himself. All these factors can be compared individually to the bargaining outcome. The relative deviation from the group mean of the bargaining outcome can be ranked according to the various determinants to check for certain trends. This can give suggestions to whether or not there are relations between these variables. The analysis of the data from the simulation games can be found in appendix G.

In the second round of the bargaining sub-game, the harvesters can form coalitions. The bargaining outcomes of these coalitions can be compared to the outcomes of the individual farmers. This way, the effect of coalitions on the bargaining process can be analyzed. Since the bargaining outcome is not normally distributed, a paired sample t-test is not possible for this comparison. Therefore a non-parametric Wilcoxon matched pairs signed rank test is preferred. This method can help to analyze the difference between the bargaining outcomes of the individual harvesters and the coalitions. This procedure can be repeated to check for the difference between the outcomes of coalition members and harvesters that defect on the coalition. It is important to notice that in case of a low number of observations it is preferable to execute an exact test, rather than an approximate test (Siegel 1956).

After having compared the means, it is interesting to analyze how bargaining power is determined in the second round. The variables used to analyze this are comparable to those in round 1. However, in the second round, the harvesters have the opportunity to join a coalition. This can have an influence on their bargaining power. If they join a coalition, the harvesters do not have to bargain with their small individual quantity of gum arabic. Instead, they can bargain with the collective amount of gum, from the coalition. Therefore, the coalition members should have larger quantities for bargaining. Furthermore, the number of members of the coalition, as well as the number of coalitions present in the second round can both have an effect on the outcome. These factors should therefore be taken into account. Moreover, farmers that defected on the coalition are supposed to have an even higher outcome.

5.4.3 Coalition forming

After investigating the bargaining power, this part will go into the process of coalition forming. In this part there are two interesting situations to investigate. The first situation studies the relation between the decision of a harvester to join a coalition or not and the factors that influence this decision. The second situation concerns the income equality inside the coalitions and the variables that can influence this.

If coalitions actually provide a bargaining advantage, then harvesters should have an incentive to join a coalition. Figure 4.5 (page 16) shows that there are several factors that influence the decision of a harvester to join a coalition or not. These factors include endowed quantity, age, experience and education. This equation can be estimated using regression analysis. All independent variables are derived from the questionnaire, except for the quantity. As this quantity is randomly determined (by the roll of a dice) this variable is assumed to have a normal distribution. This allows for the application of regression analysis to study this causal relation. As the outcome of the dependent variable (the decision to join a coalition) only takes the value 1 (does join) or 0 (does not join), this model can be defined as a binomial choice model.

Therefore, a Probit estimation will be used to estimate the following equation:

Equation 1.

$$Join\ coalition = \beta_0 + \beta_1 quantity\ endowed2 + \beta_2 age + \beta_3 gum\ experience + \beta_4 education + \varepsilon$$

The second situation of interest to the process of coalition forming concerns the income equality inside the coalition. Figure 4.6 (page 18) shows that this income equality is determined by reward allocation, representation and opportunistic behavior. Since these determinants are defined as nominal variables, the analysis of this process will have a more qualitative approach. The relatively low number of cases from the game and interview allow for a qualitative analysis. This should give sufficient insight into the stability of coalitions and the determinants of this stability.

6. Research results

This section will explain the findings from the different research methods that were used during this research. These results should help to provide an answer to the research questions. This section is divided into three parts. The first part will describe the research findings on the current situation of the gum arabic harvesters in Senegal. This part will analyze their bargaining situation. The second part will go further into the determinants of bargaining power. This part is supposed to provide insight into the factors that can influence bargaining power. This part will also analyze the effect of coalition forming on the bargaining outcome. The third and final part will go deeper into the process of coalition forming. It will discuss the factors that influence the decision of a farmer to join a coalition or not. Furthermore, this part will also pay attention to the reward allocation and stability of the coalitions.

6.1 Current situation

This part will describe the results of the research on the current situation of gum arabic harvesters in Senegal. First of all, this part will give a description of the characteristics of the harvesters in the research. Secondly, a description of the researched villages will be given. Finally, the current bargaining situation of the harvesters will be discussed. These analyses should provide an answer to the question if there are perspectives for coalition forming in Senegal.

The data from the questionnaires can help to analyze the characteristics of the gum arabic harvesters in northern Senegal. The following part will characterize the farmers on a number of variables. These variables include gum profession, age, gum experience, ethnicity, education, livelihood activities, wealth, the period of activity in gum arabic and the quantity they harvest.
The full list of descriptive statistics applied on these variables can be found in appendix F.

From the statistical analyses it can be derived that the typical gum arabic harvester is likely to be a relatively poor, Peuhl pastoralist, with little or no formal education. On average, the harvesters spend between 6 and 7 months on the harvest each year. The period of intensive exploitation lasts about 3-4 months and, depending on the location, usually starts in November. The other months of activity depend on the location of the harvester. The quantity a harvester can collect per week depends on the effort he puts into harvesting. The data show that some harvesters are very interested and collect over 100kg of gum, during the period of intensive production. Other harvesters are less interested or dependent and collect less than 10kg. The average collected quantity of gum per week lies between 40-65kg, for the intensive period.

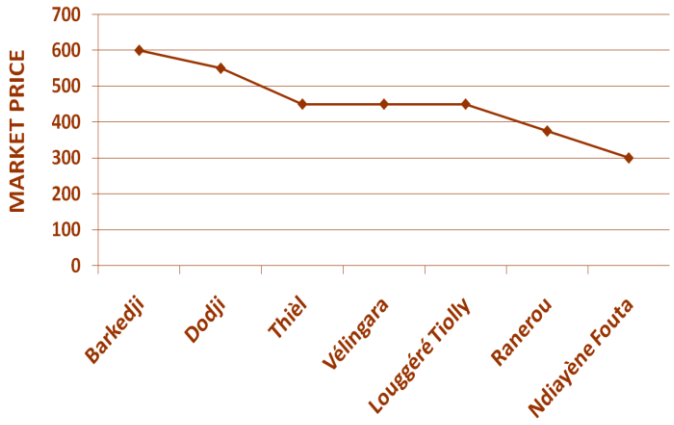

Figure 6.1 Spot market price vs. Distance to major city

Besides the farmer specific characteristic, the characteristics of the village can also have an influence on the situation of gum harvesters. Figure 6.1 (page 29) suggests that the location of the village has an effect on the spot market price of gum arabic. When the villages are ranked according to traveling time to the nearest major city, it seems that this distance has a negative effect on the spot market price. The villages that are further away from a city have lower reported spot market prices. The spot market price in the most remote village is only 50% of the reported spot market price in the village that is closest to a major city.

The data from the questionnaire also suggest that the majority of the harvesters depend on the local spot market. Most of the harvesters sell their gum either on the spot market, or to the local grocer. Some of the harvesters cannot afford to wait for the spot market and sell their gum to a local grocer. In turn, the local grocer also depends on the spot market for selling on his gum. This means that both grocers and harvesters depend on the traders that visit the local spot market. Apparently, the majority of the harvesters are not able to travel to other markets, or to wait for other traders and better offers.

Most harvesters report that the traders determine the price in the negotiations. The data suggest that the traders fix their price, based on the wholesale price they face. Apparently, factors, such as quality and quantity, do not influence the price per kg. Accordingly, both harvesters and traders suggest that the traders fix prices and have a higher bargaining power.

As described above, the gum arabic harvesters have low human capital and assets. As a consequence, they cannot afford to wait for the next market, or travel to another, if prices are not satisfactory. In some cases, the harvesters cannot even afford to wait for the weekly spot market and they have to sell to the local grocer. Therefore, the harvesters are dependent on the few traders that visit their local spot market. Considering this situation, it is not surprising that the traders are reported to have a high bargaining power and they are able to fix the prices. Moreover, the more remote villages report a lower spot market price for gum arabic. This suggests that local monopsonies exist and traders effectively exploit this situation, in order to get the best price, given the wholesale price they face.

6.2 Bargaining power

Besides describing the current situation of gum arabic harvesters in Senegal, this research also aims to analyze their bargaining power. This section will go further into the results that can help to explain the determinants of the bargaining power of harvesters and the effect of coalition forming on their bargaining power. The first part of this section will go into the determinants of bargaining power of individual harvesters. The second part will analyze the difference in bargaining power between individual harvesters and coalitions.

As only nine simulation games have been played, it is possible to summarize the observations that were made during the game play. As this section explains the bargaining power, it will discuss the observations that were made during the bargaining sub-game. In the first round of the bargaining sub-game, the harvester had to negotiate individually with the trader. During the various sessions of the simulation game, there were three different scenarios observed in this round. The first scenario was observed in four games. In this first scenario the trader would mention a wholesale price that he receives from his client, the wholesaler. This price served as an argument for the trader, to negotiate a price below this wholesale price. Consequently, the bargaining outcomes of the harvesters in this round did not exceed the fictitious wholesale price. In three of the four games with this wholesale price scenario, the outcomes were equal for all harvesters. In this case, all players bargained the same price with the trader. This equal

outcome scenario does not allow for analyzing the determinants of bargaining power. However, this equal outcome scenario occurs often in real life bargaining in the research area.

The second scenario was observed in only two games. In this scenario the harvesters argued that they had an alternative client, which would offer them a certain price. Therefore, the harvesters were able to bargain a price above this fictitious breakdown option. The third scenario was observed in the remaining three simulation games. In this scenario none of the players invented a breakdown option. This led to a more open bargaining process, with more variety in the outcomes. The observations of the simulation games were used to analyze the determinants of bargaining power and outcome. The results form the different simulation game sessions can be found in appendix G.

When studying the determinants of bargaining power in the first round of the game, it makes sense to check for the effects of certain variables on the bargaining outcome. When studying the games in more detail it is possible to observe a relation between some variables and the bargaining outcome. Considering that three of the total of nine games have an equal outcome scenario, there are six games remaining to study the effect of certain variables on the bargaining outcome. Apparently only *quantity* and *game sequence* seem to be related to the bargaining outcome. They both seem to have an effect in four of the game sessions. The other variables (*age, education, experience, wealth*) do not seem to have an effect on the bargaining power. Besides, in some cases it might be possible that the effects of the quantity and the game sequence cancel each other out. This can happen when the randomly determined quantity is decreasing during the game, while the game play experience is increasing. Therefore it is useful to construct another variable, which combines these two variables. This variable can be used to check for any combined effect of *play sequence* and *quantity*. This can be done by dividing the game sequence through the total number of players in the game session and then multiply this by the quantity of each player. This produces a variable which can be used as a proxy for bargaining power. This variable seems to have an effect on the bargaining outcome in four of the games.

Table 6.1 Observations in First Bargaining Sub-Game

Game	Scenario	Outcome	Observed Effects		
			Play Sequence	Quantity	Proxy for B.P.
1	Open	Different	✓	✓	✓
2	Wholesale price	**Equal**	X	X	X
3	Harvester alternative	Different	X	✓	X
4	Harvester alternative	Different	X	X	X
5	Wholesale price	**Equal**	X	X	X
6	Open	Different	✓	✓	✓
7	Wholesale price	Different	✓	X	✓
8	Wholesale price	**Equal**	X	X	X
9	Open	Different	✓	✓	✓

Table 6.1 shows that there are five games which, show an effect on at least one of the three variables. As mentioned before, three of the games had an equal outcome scenario, which does not allow for detecting effects of certain determinants. This leaves only one game (Game 4) unexplained. This game has different bargaining outcomes, but none of the variables seems to have any effect. When taking a look at the observations in this game, it seems that there are outliers in this game. There are players with high game experience and high quantity that have bargained a lower outcome than other players. As a result, this game does not show any positive influence from the quantity or the play sequence.

The in-depth analysis of the games has shown that there are three variables which seem to have an effect on the bargaining outcome: *quantity, play sequence* and the *proxy for bargaining power*. It is interesting to make further analysis on the effect of these variables on the bargaining outcome. Figure 6.2 shows the relation between *quantity* and the *bargaining outcome*. This graph was constructed by ranking the relative deviation from the group mean of the bargaining outcome according to quantity. Then the average was calculated for each quantity (10kg, 20kg, 30kg, etc.). Furthermore the correlation coefficient that corresponds to the graph was calculated. In Figure 6.3 and 6.4 the same procedure was followed to check for the effect of *sequence* and the *proxy for bargaining power.*

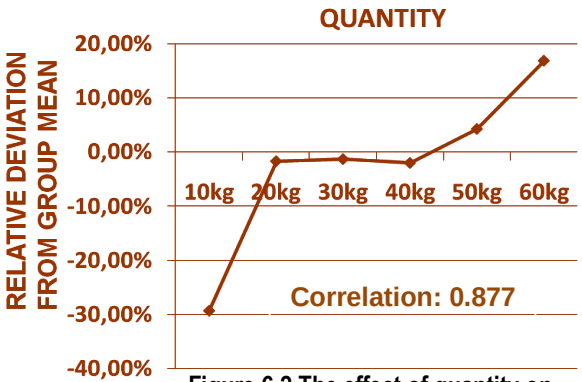

Figure 6.2 The effect of quantity on bargaining outcome

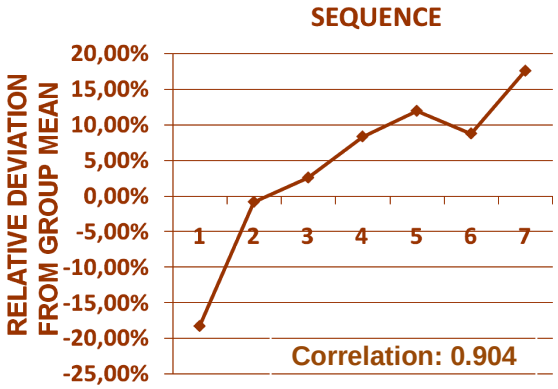

Figure 6.3 The effect of play sequence on bargaining outcome

As shown in figures 6.2-4 there seems to be a positive trend in all three variables. Although there are some minor decreases, all three graphs show a general positive trend. Moreover, all three variables result in relatively high correlation coefficients. Although it is not possible to calculate the significance of these correlations, this still suggests that these variables are positively related to the bargaining outcome. The remaining variables (*age, education, experience, wealth*) do not show a clear trend. These variables cannot be assumed to influence the bargaining outcome.

The above shows that only quantity and play sequence seem to have an influence on the bargaining outcome. The other variables that were tested (*age, education, experience, wealth*) do not appear to be related to the bargaining outcome. For education and wealth this might be caused

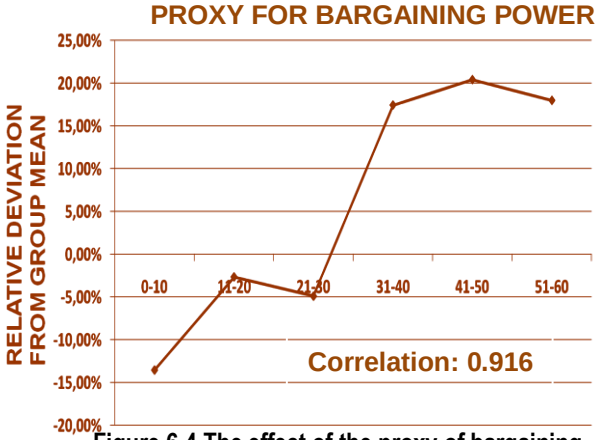

Figure 6.4 The effect of the proxy of bargaining power on bargaining outcome

by the fact that there are many similar observations on these variables. As most gum arabic harvesters are relatively poor and have received little or no formal education, there are many low outcomes on these variables. The tiny differences between the harvesters might not be significant enough to cause any difference in bargaining power. Therefore, these variables cannot be discarded completely. In general, the observation from the first bargaining sub-game suggest that in the games, bargaining power is mainly determined by quantity and play sequence. Other factors do not seem to play a role in this phase.

Between the first and the second round of the bargaining sub-game, the coalition forming sub-game was held. All of the game sessions had a similar outcome in this coalition forming sub-game. In all the game sessions a coalition was formed that included all harvesters in the game. The next section on the coalition forming process will go deeper into this sub-game. However, it is important to note that all games resulted in a coalition that included all harvesters. This is important for the analysis of the observations that were made in the second round of the bargaining sub-game. During the second round of the bargaining sub-game the harvesters could negotiate collectively with the trader. In all nine games, the coalition was able to negotiate a higher price than any of the individual harvesters in the previous round. In general, the negotiations between the trader and the coalition were more intense and static than the individual negotiations. The harvesters were able to put more pressure on the trader, threatening him with breakdown. This resulted in more aggressive bargaining and eventually, an improved bargaining outcome for the harvesters. Although the traders faced a decrease in bargaining power, they did not manage to break either of the coalitions. As a result, no defection was observed.

After having investigated the factors that influence bargaining power in a setting without coalitions, it is interesting to compare these results to those of the second round. In the second round of each session, the harvesters could form coalitions. As mentioned before, in each session, the harvesters formed coalitions that included all players. Because all harvesters join the coalition, each simulation game has only one bargaining outcome in the second round, namely the outcome of the coalition. It is interesting to compare the bargaining outcome of both rounds of the game. Firstly it is important to notice that, because each game had only one coalition, there are only nine paired observations to compare. Due to this low number of observations it is preferable to execute an exact test, rather than an approximate test. The outcome of the Exact Wilcoxon Signed Rank Test shows that the outcome of the second bargaining sub-game is 30% higher than the average outcome of the first bargaining sub-game in the each session[3]. Furthermore, the outcome of the second bargaining sub-game is 10% higher than the highest individual outcome of the first bargaining sub-game in each session[4].The results of the simulation game are confirmed by the information from the interview. The only Experna cooperative in Senegal reported an increase of producer prices of almost 100%. Besides, The section on methodology suggested that it would also be interesting to compare the differences between farmers inside and outside coalitions. However, the simulation game did only provide cases of coalitions that included all harvesters. None of the simulation games has shown a scenario of defection. As a consequence, it is not possible to compare the results of these possible scenarios.

The results that were mentioned in this session can give some suggestions about the bargaining power of gum harvesters in Senegal. First of all, it seems that skills do not play an important role in determining the bargaining power of harvesters in the simulation game.

[3] One tailed $\alpha = 0.05$
[4] One tailed $\alpha = 0.05$

Furthermore, the wealth and education of the harvesters do not appear to be significant factors in determining bargaining power. This might be caused by a lack of variation in these variables. The most important factors to determine the bargaining power seem to be the quantity of gum and the play sequence. In the second round, coalitions are formed in all games. These coalitions include all harvesters present in the session. These coalitions perform significantly better than the individual harvesters. All coalitions reach a higher bargaining outcome than any individual farmer in the first round of the same game. This increase in bargaining power is confirmed by the information from the interview. As all coalitions include all harvesters, it is not possible to analyze the determinants of bargaining power in the second round. Moreover, neither defection, nor exclusion is observed.

6.3 Coalition forming

This part will go further into the results that were found on the process of coalition forming. These results are derived from the simulation games, as well as the interview. As discussed before, the limited number of simulation games does not allow for a quantitative analysis. Therefore, this part will give a more qualitative description of the observations that were made. First of all this part will go into the factors that influence the decision of a harvester to join a coalition. After this, the stability of the coalitions will be discussed.

The observations made during the simulation game are supposed to shed light on the determinants of the decision to join a coalition. Between the first and the second round of the bargaining sub-game, the coalition forming sub-game was held. All of the game sessions had a similar outcome in this coalition forming sub-game. In all the game sessions a coalition was formed that included all harvesters in the game. During the process of coalition forming there were always two or three harvesters who understood the possible benefit of a coalition. In all sessions, these few harvesters were able to convince the other harvesters in the game to join the coalition. As a result all the game sessions had one large coalition that included all harvesters. Unfortunately, this result means that it is impossible to estimate Equation 1.

Equation 1.

$$Join\ coalition = \beta_0 + \beta_1 quantity\ endowed2 + \beta_2 age + \beta_3 gum\ experience + \beta_4 education + \varepsilon$$

Because in each game all the harvesters joined a coalition, there is only one observed outcome in the dependent variable *join coalition*. Therefore this binomial choice model cannot be estimated.

Apparently, the harvesters decide to join, regardless of their individual characteristics. Besides, the results suggest that the harvesters do not tend to exclude each other. Considering the model of Figure 4.5 (page 16), this would mean that the economic incentive for the harvesters to join, is so strong that all harvesters join the coalition, irrespective of their individual skills, education and quantity of gum. The results of the simulation game are confirmed by the information from the interview. Apparently, the only existing gum arabic cooperative in Senegal includes all harvesters in its region.

After having discussed the decision of harvesters to join a coalition, this part will go into the income equality within the coalition. The first issue that will be treated is the reward allocation. The observations from the simulation games indicate that all observed coalitions apply distributive justice. When it comes to the reward allocation, all coalitions use the same price per kg for each member. This means that the reward of each member is directly proportionate to

his input. The interview shows that the Experna cooperative also applies distributive justice. The Experna cooperative applies a fixed price per kg (after overhead costs) for all harvesters.

Besides the reward allocation, the representation of the coalitions does also affect the income equality inside the coalition. During the simulation game the harvesters always applied an egalitarian representation scheme. In all of the observed games, either one or two harvesters represented the coalition in the negotiations with the trader. After having negotiated a price the representatives turned back to the rest of the members to discuss whether or not they would agree with the price. Using this way of representation, each member has a voice in the price negotiations. The information from the interview shows that the Experna cooperative also applies an egalitarian way of representation. In the Experna cooperative the director negotiates a price with the trader. The harvesters need to agree on the price. Moreover, the harvesters have the power to fire the director and choose a new one. All major decisions need to be agreed on by the harvesters. This egalitarian representation should have a positive influence on the income equality inside the coalition.

The third issue that can affect the income equality inside the coalition is opportunistic behavior and more specifically, defection. During the simulation games not a single case of defection was observed. The coalitions remained stable in all nine sessions of the game. Although the traders faced decreased bargaining power, they were not able to break the coalitions. The information from the interview shows that the Experna cooperative did not have any reported cases of defection so far. Although some traders without contract tried to go into the villages to buy the gum of the coalition members, they did not succeed. These actions were reported to the direction of the cooperative. The local government does also support the stability of the cooperative. Officially, traders require licenses to buy gum arabic from harvesters. These licenses are issued by local government officials. In the area of the Experna cooperative, these licenses are only issued to traders that have a contract with the cooperative.

The absence of defection in the game suggests that the coalitions are difficult to break. One of the factors that might cause this absence of defection is the observability of the actions of the members. In the games all players were negotiating in the same room. This means that a defector could easily be detected. This defector could face some kind of punishment for his defection. In real life, the harvesters live in small villages. Social ties are very short and therefore, the actions of the harvesters are easily observable to the other harvesters. This might explain the absence of cases of defection.

The information from the simulation games and the interview suggests that the harvesters have high incentives to join a coalition. This research has only observed positive cases of harvesters that did join a coalition. This suggests that the incentive to join is high, but it does not allow for an analysis of other possibly influential factors. The observed coalitions seem to be stable as no defection occurs. Both the interview and the simulation games show that distributive justice and egalitarian representation are preferred. This is supposed to have a positive effect on the income equality inside the coalition, meaning that all members can benefit equally from the coalition.

7. Review on simulation games

Before heading to the discussion on the outcomes of this research in the next chapter, this chapter will give a review on the use of simulation games as a research method. Since this is a relatively new research method, it might be relevant to discuss its functioning. This section will go into the advantages and disadvantages of this method. Firstly an explanation of the practicalities that were required to execute the simulation games will be provided. And after this, the quality and reliability of the data that were generated with the simulation games will be discussed. This should lead to a number of conclusions about the effectiveness of this research method.

7.1 Practicalities

Using simulation games as a research method poses various practical problems. The main practical problem in this research was to gather a sufficient number of participants at the same time and the same place. The simulation game requires 4-7 gum harvesters and 1 trader to play together for a session of about three hours. Due to the highly dispersed farmer population in the research area, it proved difficult to arrange these sessions. First of all, the research area had to be narrowed down to only seven villages. This already limited the number of game sessions and hence, the number of observations. Besides, these villages needed to be visited on their market day, in order to find enough people available. In some of the villages it was difficult to find enough harvesters and/or traders for a successful run. Because the villages were visited on market days, most (potential) participants only had come to the village for commercial activities. As these activities can easily take all day, it was difficult to draw these people away from the market, to have them participate in the research for three hours. That is why, a modest monetary compensation was offered to the participants, in order to convince them to participate. This incentive proved useful, but it was still difficult to find enough participants. Most potential participants had only come to the market for a commercial reason. The potential benefit of this commercial activity could not be topped by the research compensation. Although it was difficult to gather enough people, it was still possible to run at least one session in each of the villages. Nevertheless, the organization of these sessions and the efforts of finding participants proved very costly and time consuming. It is obvious that these practicalities had a negative effect on the randomness of the sample. As a consequence, the generalizability of the results is affected in a negative way.

Besides the troubles with finding participants, there were also some linguistic difficulties. As most of the participants had received little or no formal education, they did not speak French. Therefore, interpreters were used to facilitate the research. However, in some of the villages, the variety of dialects and accents required a chain of two or even three translators. This provided some difficulties when it came to explaining the procedure of the simulation and the interpretation of the responses. Although very close attention was paid to the common understanding of the game rules, these lingual differences could have had a negative effect on the quality of the data.

7.2 Reliability of the data

One of the most important issues concerning the reliability of the data from simulation games is the artificiality of the game. Like any simulation game, the game used in this research consists of a set of incentives that were invented by the researcher and imposed on the participants. As explained in the game design, a lot of attention was spent on designing a game that would correspond as closely to reality as possible. As a result, the game that was used in this research consisted of a set of incentives that corresponded rather well to the incentives of a

real life gum arabic bargaining situation. However, it is still not proven that the participants of the game behaved in the same way in which they would behave in reality. This is also shown in the significant effect that the play sequence has on the bargaining outcome. It is theoretically impossible to prove that the harvesters would show exactly the same behavior on their spot market, as in the simulation game. As a consequence it is always disputable whether or not the results of a simulation game can tell something about a real life situation. Anyhow, the data from the simulation can at least help to give a suggestion on the behavior of participants in reality.

When looking more specifically to the simulation game that was applied in this research, more drawbacks can be identified. As explained above, in a simulation game the researcher specifies a set of incentives. This means that some of the factors in the simulation game are fixed by the researcher, whereas other factors are left open. In the simulation game that was used in this research, the players were free to negotiate any price. The test runs of the game had shown that negotiating with fixed price bands would lead to the same result in each game. Because this would lead to useless information, it was preferred to use open bargaining, without price bands. This meant that the harvesters were free to negotiate any price. As a result, there were large differences in negotiated prices between villages. As the sample size was already limited due to practical reasons, it could not be assumed that the bargaining outcome was characterized by a normal distribution. Consequently, it was not possible to apply regression analysis on the bargaining outcome. This limits the generalizability of the results from this research.

The setting of the simulation game did also have an influence on the outcomes. Because in reality the harvesters bargain in an open setting on the market, this open setting was preferred for the simulation game. Because the harvesters were able to observe the actions of the other players, the order of play affected the outcome. The open bargaining setting caused a learning effect. The players that played later in the game had an advantage over the players that had played earlier.

Another drawback of simulation games occurred in the coalition forming sub-game. As this research aimed to analyze the determinants of the decision to join a coalition or not, this sub-game should have provided useful information on this process. However, during the sessions of the game it turned out that all harvesters joined a coalition. As a consequence, analyzing the determinants of this decision was not possible. Moreover, the same problem was observed when it came to analyzing the effects of defection. This shows that, when using simulation games, the variety of the data depends on the actions of the players. Other methods can provide the possibility of selecting a sample with specific outcomes on certain variables. On the contrary, using simulation games, the researcher is dependent on the outcomes that are provided by the game.

An important advantage of the simulation games is that they enable researchers to study complicated processes with many interrelations. The advantage of the simulation games is their holistic character. Simulation games allow for a snapshot of the entire situation, grasping all its elements and interrelations at once. Although there were practical difficulties in finding players and explaining the games to them, it provided a good opportunity to observe the bargaining process. This would have been more difficult in a real life setting. Moreover, the simulation games also provided the opportunity to study a situation which did not yet exist. With other methods it would have been very difficult to study the effect of coalitions on the bargaining process.

7.3 Conclusion

This research has shown that the use of simulation games brings about considerable practical difficulties. Once taken out of the laboratory into the field, this method proves time consuming and hence, expensive. This limits the opportunities for simulation games to gather large numbers of observations. Besides, the reliability of the data from simulation games is always disputable, since the games are artificial. The observations from simulation games can give at most a suggestion about the behavior in reality. Moreover, the quality of the data is largely dependent on the outcome of the game. There is always an aspect of uncertainty in the application of simulation games. The proceeding of the games influences the quality and usefulness of the data. This underlines the importance of good preparation and executing various test runs of the simulation game. But even after a good preparation, the actual proceeding of the game in the field is uncertain.

However, although this method has some major disadvantages, it can still be a useful method. In some complicated processes with many interrelations, other methods would only allow for studying separate fragments of the process. Moreover, in this research the games were used to study a situation which is not yet present. In this case the simulation games provide an interesting opportunity to find information about the possible behavior in this new situation.
In general it can be said that, this method brings about many practicalities and the reliability of the data is disputable. However, if this method is used in combination with other methods, it can still make a valuable contribution to research on complicated processes and inexistent situations.

8. Discussion and policy recommendations

This section will provide a discussion of the results of this research. This discussion should give conclusive answers to the research questions. This should lead to a set of policy recommendations, as well as points for further research. Firstly, this section will discuss the current situation of the gum arabic harvesters in Senegal. After this, the second part will go further into the bargaining power and the effect of coalition forming on this bargaining power. The third part will discuss the process of coalition forming. The answers from these three parts should provide an answer to the general research question of this research.

8.1 Current situation

This section is supposed to provide an answer to the first specific research question[5]. The results of this research show that most gum arabic harvesters in Senegal are relatively poor. They have received little or no formal education. Therefore the harvesters have limited possibilities when it comes to selling their gum. Due to the poor infrastructure and large distances the harvesters are largely dependent on the gum price on the spot market in their specific village. The few traders that visit each market are reported to fix the prices. Moreover, the more isolated a village is, the lower the reported spot market price. This suggests that the harvesters face local monopsonies or oligopsonies, which are successfully exploited by the traders. Such a situation is supposed to give perspectives for coalition forming. Theoretically, coalition forming should provide the harvesters with a better bargaining position.

8.2 Bargaining power

This section will provide an answer to the second specific research question[6]. The results of the simulation games suggest that the most important determinants of bargaining power are the endowed quantity and the play sequence. Personal factors do not seem to play a significant role in determining bargaining power. This indicates that the quantity of gum available is an important determinant of the price per kg. The insignificance of the factors *wealth* and *education* may be caused by a lack of variety in the data. Both these variables show many similar outcomes. The remaining factors *age* and *gum experience* do not play a significant role in determining the bargaining power. This outcome contradicts the literature on this topic. It might be that the simulation games were too synthetic and players did not play according to their personal characteristics. However, it might also be that these factors do not play a role in the bargaining process in Senegal. The reason why these four personal factors were not significant provides ground for further research. The outcomes of the simulation games show that coalition forming has a significant positive effect on the bargaining outcome of harvesters. This increase in bargaining outcome suggests that the coalitions have higher bargaining power than the individual harvesters. These results are confirmed by the experiences of the Experna cooperative. The findings strongly indicate that the coalitions can provide harvesters with an increase in bargaining power and outcome. This should provide the harvesters with a strong incentive to join up and form coalitions.

8.3 Coalition forming

This section will answer the third specific research question[7]. The results of the simulation games and interview show that the coalitions tend to include all available harvesters. The coalitions in the simulation game, as well as the Experna cooperative, include all the harvesters

[5] What are, currently, the major problems that limit the bargaining power of the gum arabic harvesters?
[6] Can these problems be neutralized by forming coalitions?
[7] Can harvesters benefit from the advantages of coalition forming?

present. This suggests that the harvesters have a very strong incentive to join a coalition. Although this might be a convenient outcome, it does not allow for studying other determinants of the decision of a harvester to join the coalition, or not. Although this research suggests that the harvesters have a high incentive and cooperative spirit, further research could help to map the influence of other factors in this decision process.

The coalitions in the simulation games and the experiences of the Experna cooperative show a preference for egalitarian representation. This has a positive effect on the continuity and stability of the coalitions. Since all members are represented equally, this will influence the income equality inside the coalition in a positive way. Moreover, all the studied cases showed a preference for distributive justice as reward allocation. This reward allocation contributes to the stability of the coalition. More importantly, distributive justice allows all the participants of the coalition to benefit from the increased bargaining power of the coalition, proportionate to their input. This means that all members can profit from the improved price per kg, bargained by the coalition. Finally, the results of this research suggest that there is little incentive for defection on the coalition. None of the studied cases showed any form of defection on any of the coalitions. This might suggest that there is high observability of actions of the members. Future research could help to shed more light on this outcome.

8.4 Conclusion

After having answered the three specific research question, it is possible to answer the general research question[8]. The results of this research have shown that the current, monopsonistic situation of the gum arabic trade provides good perspectives for coalition forming. It seems that the coalitions provide their members with an increase in bargaining power and bargaining outcome. Since the coalitions tend to include all harvesters and since the coalitions tend to apply distributive justice and egalitarian representation, it seems that many gum arabic harvesters in Senegal can profit directly from coalition forming. The possible benefit, as well as the organization of the coalitions provides the members with little incentive to defect. This has a positive influence on the stability and continuity of the coalition. In general, this research suggests that coalition forming can improve the bargaining power and outcome of gum arabic harvesters in Senegal.

8.5 Policy recommendations

The first policy recommendation that is suggested by this research is the formation of gum arabic coalitions in Senegal. This research indicates that the gum harvesters in Senegal can benefit from coalition forming. Therefore it can be advised to facilitate the creation and formation of coalitions.

Evidently, more research is required on the formation of coalitions. The current research has only focused on the bargaining aspects of coalition forming. There are many other possible advantages and disadvantages from coalition forming, which need to be studied, in order to create successful coalitions. Other studies might help to design an effective implementation of these coalitions.

Furthermore, the approach that was used in this research can be relevant for studies on similar forestry products (e.g. monkey bread, aboghar, etc.). As gum arabic might not be the only secondary product that is produced by poor pastoralists, it is interesting to study the opportunities of other products too.

[8] Can coalition forming improve the bargaining power and outcome, of gum arabic harvesters in Senegal?

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Appendix A: Research villages

SOURCE: http://www.iss.co.za/Af/profiles/Senegal/senegal_rel89.jpg

A: Dahra
B: Tambacounda
1: Barkedji
2: Dodji
3: Thièl
4: Vélingara
5: Louggéré Tiolly
6: Ranerou
7: Ndiayène Fouta

Appendix B: Questionnaire
(Translated from French)
Name:…….

Game tracking number

Age:…… **Ethnicity :**…….

What education have you received ?

☐ Formal ⟶ Number of years :……..
☐ Informal ⟶ Which ?.....

What is your primary livelihood activity ?:……

What are your secondary activities ? :

- ……
- ……
- ……

Herd size

☐ Large (>100)
☐ Average (50-100)
☐ Small (26-50)
☐ Very small (<25)

Herd type

☐ Large
☐ Mixed
☐ Small

How many years of experience do you have with gum arabic?……

What is your profession related to gum arabic ?

☐ Harvester
☐ Grocer
☐ Mobile trader
☐ Wholesaler
☐ Other :…….
☐ Other :……..

Is there currently a gum arabic cooperative in your village?

☐ Yes ⟶ What type of cooperative :……
☐ No

Are you part of this cooperative ?

☐ Yes
☐ No ⟶ Why ?.....

What is your period of activity in gum arabic each year ?

High intensity : from …… to ……
Low intensity : from …… to ……

Frequency of harvest exploitation

	Weekly	Monthly
High intensity		
Low intensity		

Frequency of commercialization

	Weekly	Monthly
High intensity		
Low intensity		

Average quantity of gum harvested at each occasion

High intensity :…….....

Low intensity : ……..

Who are your principal clients ?

- ……
- ……
- ……

What reasons do you have for this choice of client ?

……

……

Who determines the price in the negotiations?

☐ The trader / grocer
☐ The harvester
☐ The wholesaler / processor
☐ The price is determined through bargaining
☐ Other…….

What are the most important factors that determine the price (per kg) in the negotations?

☐ The quality of the gum
☐ The quantity of the gum
☐ The season
☐ The relation with the client
☐ Other……

Who has the best bargaining position?

☐ The trader ⟶ Why ?.....
☐ The harvester ⟶ Why ?.....
☐ Both parties are balanced
☐ Other……

Appendix C: Variables derived from questionnaire and simulation game

VARIABLES FROM QUESTIONNAIRE		
VARIABLE NAME	**TYPE**	**DESCRIPTION**
Tracking Number	Nominal	Personal tracking number of the player
Game Role	Nominal	Role of the player in the game (Trader = T / Harvester = 1,2,3, etc.)
Date	Nominal	Date of the questionnaire and game
Place	Nominal	Place of the game
Name	Nominal	Name of the respondent
Age	Ratio	Age of the respondent
Ethnicity	Nominal	Ethnical group to which the respondent belongs
Education	Nominal	Type of education received (Formal / Quran School / Alphabetization)
Formal Education	Ratio	Number of years of formal education received
Primary Activity	Nominal	Primary livelihood activity
Secondary Activity	Nominal	Secondary livelihood activities
Herd Size	Ordinal	Number of livestock animals the respondent owns. Divided into four groups (1: <25 2: 25-50 3:51-100 4: >100)
Herd Type	Ordinal	Type of animals in the livestock of the respondent. Divided into three groups (1: Large = cows, camels, horses, etc. 2: Mixed =mix of large and small 3: Small = sheep, goats, etc.)
Wealth	Ordinal	Combination of Herd Size and Herd Type, divided into 5 groups
Gum Profession	Nominal	The respondent's profession in gum arabic
Gum experience	Ratio	Number of years the respondent is working in gum arabic
Existing Coalition	Nominal	Is there a coalition of gum arabic harvesters in the village?
Type of Coalition	Nominal	Type of coalition, in case there is one present
Participation	Nominal	Does the respondent participate in the coalition, in case there is one present
Participation Reason	Nominal	Reason of the respondent to participate, or not, in case there is a coalition
High Intensity Period	Nominal	Period of highly intensive activity in gum arabic
Low Intensity Period	Nominal	Period of low intensive activity in gum arabic
HI Harvest Frequency	Ratio	Number of days per week spent on harvesting gum arabic, during high intensity period
LI Harvest Frequency	Ratio	Number of days per week spent on harvesting gum arabic, during low intensity period
HI Quantity	Ratio	Average quantity harvested per week, during the high intensity period
HI Commercial Frequency	Ratio	Number of times per week the gum is sold, during high intensity period
LI Commercial Frequency	Ratio	Number of times per week the gum is sold, during low intensity period
Client	Nominal	Clients that buy the gum arabic of the respondent
Client Reason	Nominal	Reason for the choice of client
Price Determination	Nominal	Which party determines the price during the negotiations?
Price Factors	Nominal	Factors that determine the price of the gum, during the negotiations.

Bargaining Position 1	Nominal	Which party has the best bargaining position according to the respondent?
Bargaining Position 2	Nominal	Why does the above mentioned party have a better bargaining position?
Market Price	Ratio	Current producer price of gum arabic at the local spot market
Distance to Major City	Ordinal	This variable ranks the villages on their proximity to the nearest major city, considering distance and road quality (Linguère) (1 = Closest, 7 = Furthest away)

VARIABLES FROM SIMULATION GAME		
VARIABLE NAME	**TYPE**	**DESCRIPTION**
Play sequence	Ratio	Order number of the player, indicating which turn he had in the simulation game
Game Tracking Number	Nominal	Tracking number of each game.
Local Market Price	Ratio	Local market price (only in case this is used by players as an argument or alternative)
Wholesale Price	Ratio	Wholesale price (only in case this is used by players as an argument or alternative)
Farmers	Ratio	Number of farmers in this specific game
Quantity Endowed 1	Ratio	Quantity of gum arabic endowed to the harvester in Round 1 (determined by roll of dice)
Quantity Sold 1	Ratio	Quantity of gum arabic sold in Round 1
Outcome 1	Ratio	Price per kg agreed with trader in Round 1
Quantity Endowed 2	Ratio	Quantity of gum arabic endowed to the harvester in Round 2 (determined by roll of dice)
Bargaining Quantity 2	Ratio	Quantity of gum arabic the harvester bargains with in this round. In case he joins a coalition, this variable equals the total amount of the coalition.
Join Coalition	Nominal	Did the farmer join a coalition in this round (1 = yes, 0 = no)
Number Coalitions	Ratio	Number of coalitions created in this specific game
Coalition Members	Ratio	Number of members in the coalition to which the respondent belongs
Quantity Coalition	Ratio	Total quantity of gum of the coalition to which the respondent belongs
Reward Allocation	Nominal	Reward allocation within the coalition
Coalition Representation	Nominal	Type of representation within the coalition
Coalition Position	Nominal	Does the respondent have an influential position within the coalition? (1 = yes, 2 = no)
Quantity Sold 2	Ratio	Quantity of gum arabic sold in Round 2
Outcome 2	Ratio	Price per kg agreed with trader in Round 2
Defection	Nominal	Did the respondent defect on the coalition? (1 = yes, 2 = no)

Appendix D: Game procedure

1. The game is played with one trader and 4-8 harvesters. Before the game all players are supposed to complete a questionnaire. All players are handed out a tracking number, which links them to their questionnaire.

2. Before the first round, each player has to throw a dice. The outcome determines their endowment for this round. The possible outcomes are 10, 20, 30, 40, 50 and 60 kilos of gum.

3. In the first round the harvesters have to negotiate a sales price (per kg) for their gum, with the trader. In this round all harvesters have to negotiate individually. In order to pick up learning effects, the harvesters should go up and negotiate with the trader in a fixed order, according to their tracking number. The outcome of the negotiations is reported to the researcher.

4. After the first round the harvesters have to throw the dice again, to determine their quantities for the second round. The possible outcomes are the same as in the first round.

5. Before the second round of negotiations, the harvesters have some time to try to form a coalition. If a coalition is formed, this should be reported to the researcher. The members of the coalition have to agree on a reward allocation and a representational structure. This should also be recorded by the game leader.

6. In the second round of negotiations the harvesters have to negotiate again with the trader. If there is a coalition, it should negotiate collectively. The coalition should bargain one price for the total quantity they have. If a member defects on the coalition, this should be indicated to the researcher. The outcomes of the negotiations are, once again, recorded by the researcher.

Appendix E: Case study on the Experna cooperative

(Source: Interview with Mr. O. Cissokho)

Being the only gum arabic cooperative in Senegal, Experna comprises of 80 villages and 1200 members. The cooperative was founded in 2005, as an initiative of local populations and it includes all gum producers in the region. The mission of Experna is to improve the revenues from forestry production, most notably, gum arabic and monkey bread, as well as to preserve the forestry resources in the long run. The objective of Experna is to create dynamic rural communities that can exploit natural resources in a sustainable way. Besides, the cooperative also aims to improve harvesting methods and commodity prices for farmers. Moreover, the cooperative also focuses on active protection and preservation of forestry resources. Because the cooperative is still in its initial stages, it operates with help from the government, as well as from NGO's. However, this young cooperative has already established some notable achievements. The cooperative has successfully installed a forest-fire-department. Besides, the cooperative employs a team of forest guards, which supervise the extraction of natural resources from the forest and protect the forest from illegal exploitation. Moreover, the cooperative has facilitated a reforestation program of 400ha and they have recently installed machinery that will allow the local community to process raw monkey bread into powder.

When it comes to gum arabic, the cooperative treats about 40-50 metric tons of gum arabic a year. The cooperative assists in the transport the storage and the sale of the gum. In some cases, harvesters can make use of advanced payments. In practice, the coalition has only one client each season. Before the start of the season, the cooperative negotiates with various potential clients. The client that offers the best condition gets a permit to buy the gum from the region covered by the cooperative. The price per kg is fixed for the entire season. This means that the client goes into the villages on a weekly basis to buy the gum directly from the harvesters. The harvesters receive a fixed price per kg of gum arabic.
The cooperative deducts about 20% of the negotiated price, in order to cover the operational and overhead costs. In recent years, the price per kg (after costs) received by the harvesters varied between 500XOF and 700XOF[9]. These prices are roughly the double of the prices the harvesters received before the start of the coalition.

The increase in price has led to an increased interest in the production of gum arabic. The production has grown every year since the installation of the coalition. This increase is stimulated by the annual Day of the Gum, which is organized by the cooperative. On this day, the three harvesters that have produced the highest quantity during the past year receive an award and a monetary reward. The cooperative also encourages the participation of women in the exploitation of forestry resources. Traditionally, the gum harvest is a strictly male activity, but in last years' Day of the Gum, the second prize was won by a woman.

The representation of the cooperative resembles an egalitarian structure. Each member is supposed to acquire a member card. This member card has the symbolic value of 100XOF[10]. Each of the 80 villages has a periodic assembly, where problems can be discussed. These assemblies are also used to elect a village head. In their turn these village heads gather in a large assembly. This assembly of village heads can choose the president of the cooperative. Besides, this assembly has to agree upon the contract with the client of the cooperative.

[9] 500XOF – 700XOF equals 0,76€ - 1,07€
[10] 100XOF equals 0,15€

Once the cooperative has a contract with a client, the members are obliged to sell their gum to this client, for the fixed price. As this price is roughly the double of the price the harvesters used to receive, they have hardly any incentive to defect on the cooperative and sell individually. However, the traders that did not manage to get a contract with the cooperative face a sudden loss of business. Some of these traders go into the villages anyway. They try to persuade the members to sell their gum outside of the cooperative. So far, these attempts have failed. The members refuse to trade outside the cooperative and they report the attempts of the traders. The local government structure assists the cooperative in this sense. Traders need to purchase a permit, in order to buy gum legally from a certain village. The local government officials only issue permits to the trader that has a contract with the cooperative. This makes the attempts, of traders to break the coalition, officially illegal.

In general, the experiences of Experna are hopeful. They have achieved an increase in the price of gum arabic for harvesters. This has lead to an increase in production. All members can benefit equally from this increase, as the cooperative applies distributive justice. The representation of the cooperative follows an egalitarian pattern and there are no reported defections on the cooperative. However, the cooperative can still not do without external support from governments and NGO's.

Appendix F: Analysis of data from questionnaire

Part 1: Farmer characteristics

HARVESTERS (43 obs)	HIGHEST	LOWEST	MEAN	STD. DEV.	95 % CONFIDENCE INTERVAL	
AGE (in years)	23	72	46	12.78	41.58	49.45
GUM EXPERIENCE (in years)	3	50	19	12.29	15.15	22.71
QUANTITY HARVESTED PER WEEK (in kg)	125	9	54	31.81	40.98	67.85
PERIOD OF INTENSE ACTIVITY (in months)	7	2	3.79	1.79	3.24	4.34
PERIOD OF NORMAL ACTIVITY (in months)	9	3	6.44	1.75	5.9	6.98

TRADERS/GROCERS (15obs)	HIGHEST	LOWEST	MEAN	STD. DEV.	95 % CONFIDENCE INTERVAL	
AGE (in years)	25	76	40	13.93	31.95	47.38
GUM EXPERIENCE (in years)	4	35	14	9.32	8.7	19.03

	HARVESTERS (43obs)		TRADERS/GROCERS (15obs)	
ETHNICITY	Number	Percentage	Number	Percentage
Peuhl	41	95%	5	33%
Wolof	2	5%	9	60%
Serer	0	0%	1	7%
Total	**43**	**100%**	**15**	**100%**

	HARVESTERS (43obs)			TRADERS/GROCERS (15obs)		
EDUCATION	Number	Percentage	Avg. Duration (years)	Number	Percentage	Avg. Duration (years)
Formal Education	1	2%	2	4	27%	8
Quran School	6	14%	5.17	9	60%	11
Alphabetization	4	9%	2.25	0	0%	0
None	32	74%	0	2	13%	0
Total	43	100%		15	100%	

PRIMARY LIVELIHOOD ACTIVITY (before gum activities)	HARVESTERS (43obs)		TRADERS/GROCERS (15obs)	
	Number	Percentage	Number	Percentage
Agro pastoralist	36	84%	2	13%
Arable farmer	5	11%	1	7%
Local Grocer	0	0%	9	60%
Mobile Trader	0	0%	3	20%
Other	2	5%	0	0%
Total	43	100%	15	100%

SECONDARY LIVELIHOOD ACTIVITY (besides gum activities)	HARVESTERS (43obs)		TRADERS/GROCERS (15obs)	
	Number	Percentage	Number	Percentage
Agro pastoralist	0	0%	3	20%
Arable farmer	14	32%	6	40%
Local Grocer	0	0%	1	7%
Trader	0	0%	2	13%
Other	3	7%	1	7%
None	26	61%	2	13%
Total	43	100%	15	100%

WEALTH OF HARVESTERS

HERD SIZE \ HERD TYPE	Large	Mix	Small	Total
Large >100	1	3	0	4
Medium 51-100	0	4	4	8
Small <50	0	4	19	25
Total	1	11	23	35

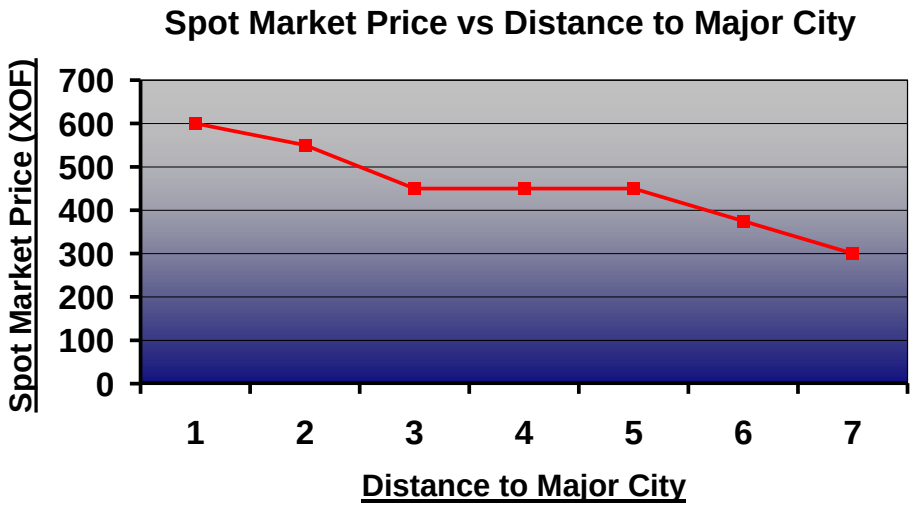
NO PRIVATE HERD	1
Harvesters that are not pastoralists	7
TOTAL	43

PERIOD OF ACTIVITY	MONTH								
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June
Harvester (43 obs)	21	41	43	43	42	39	19	14	11
Traders (15 obs)	2	5	15	15	15	15	3	2	2
Total	23	46	58	58	57	54	22	16	13

PERIOD OF INTENSE ACTIVITY	MONTH							
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Harvester (43 obs)	21	31	43	20	19	16	2	1
Traders (15 obs)	2	5	13	10	9	9	1	0
Total	23	36	56	30	28	25	3	1

Part 2: Village characteristics

Remoteness of village and local market price		
Village	**Distance to major City**	**Reported Market Price**
Barkedji	1	600
Dodji	2	550
Thièl	3	450
Vélingara	4	450
Louggéré Tiolly	5	450
Ranerou	6	375
Ndiayène Fouta	7	300



Part 3: Current bargaining situation

HARVESTERS' CLIENTS (43obs)

Client	Number	Percentage	Reason	Number	Within Percentage
Only local grocer	9	21%	Long existing relation	6	67%
			Grocer gives advances	2	22%
			Grocer buys anytime	1	11%
Both local grocer as spot market	23	53%	If they can afford to wait, they prefer to sell on spot market	2	9%
			Looks for best price	21	91%
Only spot market	9	21%	Looks for best price	7	78%
			Looks for best and sometimes waits until next spot market	2	22%
One specific trader	2	5%	Long existing relation	2	100%
Total	43	100%		43	

LOCAL GROCERS CLIENTS (11 obs)

Client	Number	Percentage	Reason	Number	Within Percentage
Only mobile trader	6	55%	Looks for best price	2	33%
			Only available client	3	50%
			Trader gives advances	1	17%
Both mobile trader and wholesaler	5	45%	Looks for best price	5	100.00%
Total	11	100%		11	

PERCEIVED PRICE DETERMINATION	HARVESTERS (43obs)		TRADERS (15obs)	
	Number	Percentage	Number	Percentage
Harvester determines price	2	5%	0	0%
Trader determines price	36	84%	7	47%
Price is determined by wholesalers/processors/exporters	2	5%	6	40%
Trader determines price, but harvester has some influence on price	3	7%	2	13%
Total	43	100%	15	100%

FACTORS THAT DETERMINE THE PRICE IN NEGOTATIONS	HARVESTERS (43obs)		TRADERS (15obs)	
	Number	Percentage	Number	Percentage
Quantity	2	5%	2	13%
Quality	1	2%	0	0%
Wholesale price	21	49%	10	67%
Trader fixes the price	14	33%	3	20%
Total	43	100%	15	100%

PERCEIVED BARGAINING POWER	HARVESTERS (43obs)				
	Number	Percentage	Reason	Number	Within Percentage
Harvester has highest bargaining power	1	2%	Harvester can fix price	1	100%
Trader has highest bargaining power	39	91%	Traders use a fixed price	36	92%
			Trader faces wholesale price	3	8%
Bargaining power is equal	3	7%	both parties have equal bargaining power	1	33%
			Trader faces wholesale price	2	67%
Total	43	100%		43	

PERCEIVED BARGAINING POWER	TRADERS (15obs)				
	Number	Percentage	Reason	Number	Within Percentage
Harvester has highest bargaining power	2	13%	Harvesters can choose between different clients	2	100%
Trader has highest bargaining power	11	73%	Because there are few traders, they can fix the price	3	27%
			Traders have better transport and therefore better breakdown option	6	55%
			Trader faces wholesale price	2	18%
Bargaining power is equal	2	13%	both parties have equal bargaining power	2	100.00%
Total	15	100%		15	

Appendix G: Analysis of data from simulation game

Wilcoxon test: Price2=Average Price1*1.30			
Sign	**Obs**	**Mean Rank**	**Sum of Ranks**
Positive	6	6.17	37
Negative	3	2.67	8
Zero	0		
All	9		
z		1.718	
Prob>z (one tailed)		0.049	

Wilcoxon test: Price2=Maximum Price1*1.10			
Sign	**Obs**	**Mean Rank**	**Sum of Ranks**
Positive	6	5.17	31
Negative	2	2.50	5
Zero	1		
All	9		
z		2.136	
Prob>z (one tailed)		0.039	

Game I					
Village	Barkedji				
Distance	1				
Market Price	600		Players		
General	Player Number	1	2	3	4
	Age	40	52	41	46
	Education	10	0	0	0
	Wealth		1		2
Round 1	Scenario	Open			
	Quantity 1	10	30	20	60
	Play sequence	1	2	3	4
	Bargaining Outcome 1	1250	1550	1550	2250
	Average Outcome 1	1650			
	Deviation from Average	-400	-100	-100	600
Round 2	Quantity 2	30	10	10	20
	Quantity Coalition	70			
	Bargaining Outcome 2	2500			

Game II					
Village	Barkedji				
Distance	1				
Market Price	600		Players		
General	Player Number	5	6	7	8
	Age	27	32	34	36
	Education	2	16	0.08	0
	Wealth	1	4	1	2
Round 1	Scenario	Wholesale price 1000			
	Quantity 1	60	20	60	60
	Play sequence	1	2	3	4
	Bargaining Outcome 1	1000	1000	1000	1000
	Average Outcome 1	1000			
	Deviation from Average	0	0	0	0
Round 2	Quantity 2	20	30	30	20
	Quantity Coalition	100			
	Bargaining Outcome 2	1500			

Game III						
Village	Dodji					
Distance	2					
Market Price	550		Players			
General		Player Number	9	10	11	12
		Age	56	42	28	48
		Education	0	0	0	0
		Wealth	1	1	1	1
Round 1		Scenario	Harvester's alternative 500			
		Quantity 1	40	50	20	30
		Play sequence	1	2	3	4
		Bargaining Outcome 1	700	700	650	650
		Average Outcome 1	675			
		Deviation from Average	25	25	-25	-25
Round 2		Quantity 2	30	10	25	20
		Quantity Coalition	85			
		Bargaining Outcome 2	950			

Game IV							
Village	Dodji						
Distance	2						
Market Price	550		Players				
General		Player Number	13	14	15	16	17
		Age	35	60	67	50	54
		Education	4	0	0	0	0
		Wealth	1	1	1	1	3
Round 1		Scenario	Harvester's alternative 500				
		Quantity 1	40	30	50	30	50
		Play sequence	1	2	3	4	5
		Bargaining Outcome 1	750	750	550	700	750
		Average Outcome 1	700				
		Deviation from Average	50	50	-150	0	50
Round 2		Quantity 2	20	10	10	30	30
		Quantity Coalition	100				
		Bargaining Outcome 2	2000				

Game V								
Village	Thièl							
Distance	3							
Market Price	450		Players					
General	Player Number		18	19	20	21	22	23
	Age		45	44	41	32	55	70
	Education		16	23	15	14	0	0
	Wealth						1	1
Round 1	Scenario		Wholesale price 500					
	Quantity 1		30	50	60	60	30	40
	Play sequence		1	2	3	4	5	6
	Bargaining Outcome 1		400	400	Break down	400	400	400
	Average Outcome 1		400					
	Deviation from Average		0	0	-400	0	0	0
Round 2	Quantity 2		20	30	50	60	20	20
	Quantity Coalition		200					
	Bargaining Outcome 2		450					

Game VI					
Village	Vélingara				
Distance	4				
Market Price	450	Players			
General	Player Number	24	25	26	27
	Age	38	37	29	37
	Education	0	3	0	5
	Wealth	4	3	3	2
Round 1	Scenario	open			
	Quantity 1	60	20	50	30
	Play sequence	1	2	3	4
	Bargaining Outcome 1	1750	1900	2025	1700
	Average Outcome 1	1843.75			
	Deviation from Average	-93.75	56.25	181.25	-143.75
Round 2	Quantity 2	50	20	50	60
	Quantity Coalition	180			
	Bargaining Outcome 2	2125			

Game VII								
Village	Louggéré Tiolly							
Distance	5							
Market Price	450	Players						
General	Player Number	28	29	30	31	32	33	34
	Age	56	46	38	58	72	60	43
	Education	1	0	0	0	2	3	0
	Wealth	4	2	1			5	1
Round 1	Scenario	Wholesale price 1000						
	Quantity 1	40	60	10	10	10	60	10
	Play sequence	1	2	3	4	5	6	7
	Bargaining Outcome 1	800	850	700	700	900	1000	1000
	Average Outcome 1	850						
	Deviation from Average	-50	0	-150	-150	50	150	150
Round 2	Quantity 2	20	50	50	40	30	10	60
	Quantity Coalition	200						
	Bargaining Outcome 2	1100						

Game VIII				
Village	Ranerou			
Distance	6			
Market Price	375	Players		
General	Player Number	35	36	37
	Age	36	35	34
	Education	0	2	0
	Wealth			0
Round 1	Scenario	Wholesale price 400		
	Quantity 1	50	30	50
	Play sequence	1	2	3
	Bargaining Outcome 1	400	400	400
	Average Outcome 1	400		
	Deviation from Average	0	0	0
Round 2	Quantity 2	60	40	50
	Quantity Coalition	150		
	Bargaining Outcome 2	2000		

Game IX	
Village	Ndiayène Fouta
Distance	7
Market Price	300

		Players				
General	Player Number	38	39	40	41	42
	Age	38	42	30	52	38
	Education	0	0	0	0	0
	Wealth	2	1	1	1	1
Round 1	Scenario	open				
	Quantity 1	10	40	60	60	50
	Play sequence	1	2	3	4	5
	Bargaining Outcome 1	1000	1500	1800	1800	1700
	Average Outcome 1	1560				
	Deviation from Average	-560	-60	240	240	140
Round 2	Quantity 2	10	60	50	20	60
	Quantity Coalition	200				
	Bargaining Outcome 2	2500				