

A Review of Concepts, Strategies and Techniques Management of Market Risks in Agriculture and Cooperatives

¹Vilmar Rodrigues Moreira, ²Axel Freier and ^{1,3}Claudimar Pereira da Veiga
¹Pontifical Catholic University of Parana (PUCPR), Rua Imaculada Conceicao,
1155 Bloco Academico, Sala 103B, Prado Velho, Curitiba/PR, Brazil
²Justus Liebig Univesitat of Giessen, Senckenberg Str. 3, 35390 Giessen, Germany
³Federal University of Parana (UFPR), Av. Prof. Lothario Meissner, No. 632,
Zip Code 80.210-170, Curitiba/PR, Brazil

Abstract: Agribusiness entrepreneurs are exposed to different types of risk. Although, agribusiness is a dynamic sector and able to adapt to a variety of weather conditions caused by different sources of risks, it appears that many countries lack of a satisfactory level of modernization and farm management. In this sense, this study's objective is analysing market risks in a general way in agribusiness and cooperative environment. Seeing agribusiness as a major supply chain reinforces the need for evaluate inter-relationships between suppliers, producers, processors and distributors. In the current context of market globalization, it is not appropriate to apply the traditional distinction between industry, service and agriculture. The results indicate that the issues concerning agribusiness have to be addressed in a comprehensive and systemic manner. Thus, considering the complexity of agribusiness systems and the diversity of the components involved, the efficient exploitation of resources is only possible with an understanding of its interactions. Cooperatives represent an organizational alternative that provides different kinds of interactions, thus, different kinds of risks. Cooperatives themselves may create their own types of risks. Risk management must approach these new issues by identifying and evaluating them and taking appropriate countermeasures.

Key words: Management of market risks, cooperatives, agribusiness, agriculture, dynamic

INTRODUCTION

Every entrepreneur has an incentive for his or her activity a reward. This reward may be intrinsic, like the acknowledgement from family and friends or extrinsic, like profit. In most cases it is a mix of both and neither part should be underestimated but nobody can survive purely from acknowledgement. The entrepreneur will determine his expectations of a reward in compliance with the efforts he has made and the uncertainty of the occurrence of this reward. To understand the impact of institutions on the entrepreneur's activity, how he/she is challenged by the framework of institutions and which kind of risks are involved, we will start with a simple model description of the so to speak "embedded" entrepreneur.

Let us consider a farmer who is the first in his region to become aware of the possibilities of alternative organic production. He has read in publications about the increasing willingness to pay for organic food and in others about new cultivation methods including alternatives to chemical pesticides. Now he is thinking about to combine these insights and to change his regular

wheat cultivation on his farm into an organic cropping system and perhaps use direct marketing instead of the regular distribution channels. Yet he is insecure whether he should use this opportunity or not: he feels unsure about the possible income distribution of his new business options and is aware of a certain resistance in his personal social surroundings because he may be risking his (or the family's) present income. But he is eager to try something new, to tinker with the arising technical and business options and he is elated when he thinks about his colleagues and friends showing him respect for his brave deed and the money he will be earning as being "a pioneer". Starting to put his idea into practice, the farmer reflects about his options and gets aware of several problems that are about to come: will I be able to handle this pioneer task? Are the new crops, the non-pesticide treatment and the soil conditions on my land compatible? Can I risk losing money (and if yes, how much?) whether this business venture turns out to be too costly? Will I violate existing laws or rights? Would I be infringing existing contracts or jeopardizing to lose the subsidies I receive from the state?

These aspects will affect the decider personally and directly. This is the case when the farmer's skills are challenged by a new crop he has chosen and now he has to improve these skills to master the new combination of fertilizers, techniques and the specific conditions of his farmland. Another example would be whether the family members of the farmer who are concerned about a loss of income, try to convince him not to exploit the new opportunity thus reducing his motivation. On the other hand, there are aspects affecting the decider indirectly as soon as surrounding elements such as rules, rights or traditions are hurt by him (consciously or not) and the decider will face sanctions later. Another example would be climate conditions or climate change it is needless to say that the farmer's business is exposed to this aspect which can hardly be entirely foreseen or even controlled. Obviously these "framing" elements of the decision generate uncertainty about expected and effective rewards.

All of these, considered as internal and external aspects, shape a "map of opportunity" for each entrepreneur differently such as Fig. 1 shows.

In some cases, individuals are less motivated to use new opportunities because of risk aversion or satisfaction with status quo. Their awareness of opportunities and their skills and motivations to pick them up are dependent on their subjective evaluation of their options. In the case of "motivated" but "not skilled" they may be willing to learn or they may organize the opportunity by using different skills of different farmers in cooperation. The aspects will influence them not only once: if aspects change over time, the once made choice is under scrutiny

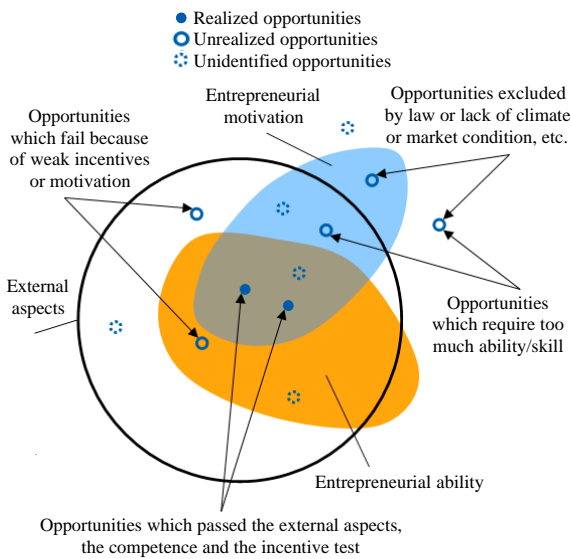


Fig. 1: Map of opportunities

again. From this perception there are two ways in which a once chosen opportunity may fail (over time or instantly):

- The opportunity is not covered by the farmer's skills or motivation (internal aspects) (anymore)
- The once used opportunity is now excluded by regulations or laws, fails to generate profits due to increasing competition or volatility or climate change, etc. (external aspects)

These two sources of failure contain different potentials to let the effective result drift off from the expected result. So, these are the first main distinction of risk types: "internal" and "external" aspects of business options are used in economic literature to differentiate "non-systematic" and "systematic" risk from an investor's point of view.

LITERATURE REVIEW

Linked opportunities (internal aspects in value chains):

The effectiveness and long-term viability of a supply chain (and the division of labour in the whole agribusiness) is determined by the circumstances as well as the sharing of the risks and rewards of the supply chain are coordinated among participants (Chen, 2012; Da Veiga *et al.*, 2014).

Seeing agribusiness as a major supply chain reinforces the need for inter-relationships between suppliers, producers, processors and distributors. In the current context of market globalization, it is not appropriate apply the traditional distinction between industry, service and agriculture. The issues concerning agribusiness have to be addressed in a comprehensive and systemic manner (Lomott and Lyskawa, 2014). Thus, considering the complexity of agribusiness systems and the diversity of the components involved, the efficient exploitation of resources is only possible with an understanding of its interactions (Dethier and Effenberger, 2012). The following considerations regarding agribusiness help to understand some of its aspects concerning the economic, administrative and risk management perspectives as shown adapt by Just *et al.* (2003), Dethier and Effenberger (2012), Chen (2012) and Lomott and Lyskawa (2014):

- Agricultural production is heavily influenced by international markets and the demand for commodities is far greater than the demand for food products to the end-consumer. This asymmetry is inherent in market forces and creates a perception of injustice in most producers

- Agricultural production is heavily constrained by biological processes and normally presents considerable delays considering the timing of decisions and its consequences
- Government policies influence agribusiness market worldwide. In developed countries, policies are typically aimed at increasing farmer’s profitability which directly influences the increase in the price to end-consumers. In developing countries, the policies are aimed at reducing prices to end-consumers
- Most of the demand by the production factors (inputs) is not uniformly distributed in time. This stimulates to find activities that do not compete for resources in certain periods of time (crop rotation)
- The owner’s organizational form, production factors and producers vary considerably around the world
- Some evidence shows that yields generally increase over time and any deviation from this trend is random (not clustered). However, prices are highly correlated in adjacent time periods

The evaluation of the above suggests that an analysis of agribusiness perspectives in terms of economics, administrative and risk management must consider a wide range of concepts, methods and interrelations (Lomott and Lyskawa, 2014).

Cooperation, cooperatives and its risks: Up to now agribusiness entrepreneurs, like farmers, seize an opportunity solely as independent entrepreneur or as manager of their own firm incorporating further business opportunities and using the division of labour (Lendel *et al.*, 2015). These two forms include or exclude totally a second option of business. Between these two extremes of organizing between pure market transaction and pure incorporation “hybrid” forms of organization arise. From a transaction costs’ viewpoint they are formed because both extremes are more costly to achieve ex ante or to control ex post. For instance, two farmers can insist on their independence with respect to their cultivation decision but can act conjointly when selling their yield or purchasing seeds together. This form of conjoint transactions is an agreement beyond contracting but not necessarily integration (Bergmuller *et al.*, 2007; Lendel *et al.*, 2015).

Horizontal contractual agreement between entrepreneurs can be institutionalized in cooperatives. A cooperative as an intermediary organization among markets and members’ activities can increase the bargaining power of small-scale farmer by pooling their purchase or sales to larger quantities. Cooperatives are able to organize the access to markets for their members

to ensure a greater profit or at least, more stability of prices, demand and supply. The producing entrepreneurs expect a certain “trade-off” when they organize their business ventures in cooperative organizations instead of simple market transactions. The “design principles” to rule cooperative organizations which account for their success contain risks as it is the case like in any organization. The cooperative’s management can be considered as an agent representing the producers (principals) what may lead to the already described misbehaviours. Figure 2 shows the principles for institutional arrangements in cooperatives.

Cooperatives can include horizontal contractual agreements among members. However, these contracts are mostly incomplete and may give rise to the problem of imperfect commitment which is the inability of contractual partners to bind themselves to once given promises that they later would like to renounce: the effective engagement of cooperative entrepreneurs in their cooperative may become lower than the promised. This may lead to “shirking” within teams which is a form of hidden action especially in a conjoint production.

Members who form cooperatives are at the same time, customers, suppliers and managers of these organizations. The farmers’ behavior and the cooperative principles can affect the administration and production decisions. This issue becomes, therefore, relevant to be addressed, especially in countries with a distinct cultural diversity affecting the cooperative system (Thompson, 2015).

Agribusiness cooperatives try to invest their resources considering their cooperative principles and seeking to a balance in the economic and social goals. Thus, one of the main challenges faced by cooperatives is to balance economic, social and political interests of their members. Economic interest involves enterprise growth of cooperative and their members. Social interest is regarding to services and benefits that are expected from cooperatives by their members. And political interest

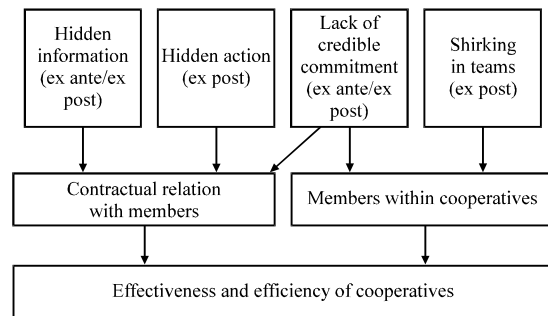


Fig. 2: Efficiency and design principles for institutional arrangements in which farmers co-operate

usually creates internal disputes for power and representation of cooperatives before a community. The inability of cooperatives for balancing those interests may increase the lack of competitiveness and create complex managerial situations. This issue raises relevant questions regarding the ability of a cooperative to survive in such globalized and competitive environment and at the same time, balancing political rationality (cooperative principles) and economic rationality (economic efficiency).

Yet independently of cooperative principles, it is important to verify that normally co-ops prioritize needs of their members and members prioritize their revenue maintenance and expansion rather than social development. These considerations reinforce the path dependence among cooperatives and members, especially related to economic rather than social aspects.

Risks in agribusiness cooperatives: Farmers who are members of cooperatives are doubly exposed to the risk of economic losses: the risk of loss in production due to environmental factors, pests, diseases, etc., causing losses in sales and lower profitability and risk of loss in the cooperative participation caused by the first situation, since, it decreases the members' supply portion to the cooperative and its participation in the financial surplus. However, members of cooperatives often are unaware of the risks that cooperatives are subject and consequently the risk of financial loss due to patronage (Zeuli, 1999). Because of this, a better risk management by farmers and by cooperatives is an important issue for all involved in agribusiness.

As other agribusiness enterprises, agribusiness cooperatives in addition to operating in an environment that is inherently risky are also exposed to high levels of financial and market risks. According to Manfredo and Richards (2007), many types of situations create risks for cooperatives. Usually cooperative activities focus on a few commodities and/or operate in geographic limited regions and/or using small sales channels. Most small cooperatives have a low level of diversification and generally for commodity trading (such as fruits, vegetables and horticultural species) there are no available options of futures market and insurance. These cooperatives do not have the opportunity to manage their risks using the tools provided by the market. Many cooperatives also work in pool type operation (with sharing of losses) where the production of its members should be sold in a pre-determined time limit. Although, this type of arrangement is interesting to members realizing them from the worries about the "time to market", it limits cooperative to maintain inventory and to sell them when the price is more attractive. All this

implies high levels of market risks. Also, general cooperatives operate with small profit margins without having access to financing by using financial market (stock exchange) and they have to distribute residue (surplus) to its members. These characteristics oblige cooperatives to provide high degrees of leverage and therefore also to present high levels of financial risks.

Given the variety of activities performed by cooperatives, the risks that affect its operations come from different types and sources. Furthermore, especially in developing countries, cooperatives are considered organizations that have social functions and despite being a prerequisite for the social performance, economic performance is not always the priority, thus increasing the incidence of financial risks.

Zeuli (1999) assess the risks that cooperatives are subject with special emphasis to natural disasters and catastrophes which affects agricultural production. In this case, the cooperative members are doubly exposed to risk, since these natural events, besides affecting the production on their properties, also destabilizes the cooperative production and income. That is, the occurrence of these risks implies losses in the cooperative and this is directly reflected in the distribution of surpluses to members (furthermore, destabilizing the producer's income). Researcher presents a number of managerial responses to these risk classes and the role cooperative should play in order to assist its members and to mitigate the consequences of risks. The options presented are related to the use of available instruments in financial markets (forward contracts and insurance) and offer insurance directly to members of the cooperative.

Risk management in agribusiness cooperatives: Unlike the farms, agribusiness cooperatives are united with clear boundaries and well defined actors. Studies on risk management on farms, especially on large ones may have results that are biased. This situation might happen mainly if a farm has several properties where their activities are diversified by investing in different cultures in each of them, thus creating a specialty situation in each of these properties. For small farms, the studies on risk management can also produce biased results. The apparent diversification activities may be related to other factors and not necessarily represent a concern for a better management of risks such as subsistence farming, the turnover of land use, the use of climate in seasonal plantations, etc. In contrast, an agribusiness cooperative is formed from members representing different farms and sizes with different behaviours on risk management. As cooperatives have several suppliers and their mix of production can be well diversified, the risk management in

cooperatives aimed at economic efficiency is feasible and justifiable because of its economic, social and competitive advantages that can be offered to its members.

According to Manfredo and Richards (2007), "it is surprising that many cooperative managers tend to accommodate rather than actively manage various sources of risks in which cooperatives are subject to as businesses". Reasercher argue that the provision of risk management instruments by cooperatives to its members can generate value and increase the retention rate. For market risks, for instance, this is justifiable because the financial instruments to manage this type of risk as futures markets is not easily accessible to all members, mainly due to cash flow constraints, transaction costs (such as commissions), the lack of knowledge about the tools available and the general reluctance to hire hedge instruments (safeguards) (Shapiro and Brorsen, 1988). Moreover, some members may be in a situation in which they can better manage their risks than transfer this responsibility to cooperatives in the case of large producers and those who have access to private or government insurance and this may contribute to this lack of concern from cooperative managers in not providing the support for risk management for its members.

Risk management in cooperatives affects the variability of members' income who receive their share in the distribution of surplus. Risk aversion from farmers has a fundamental role in risk analysis in cooperatives, especially because farmers themselves control the cooperative and its ultimate goals. Assuming that farmers are risk averse and usually do not have a diversified mixes of production, the cooperative's ability to insure stable income and diversify production is an important issue to members. However, as noted by Ferreira, the choice between diversification and specialization is not just simply a competitive strategy but involves the cooperative identity with its members and it is situated at the corporate strategy level. In this context, it appears that the challenge of administration, especially in planning and controlling is often increased due to the inherent cultural and political characteristics to each producer with common interests and at the same time conflicting.

According to Zeuli (1999), agribusiness cooperative strategies to reduce risks in the availability of raw materials supply to its production and variability of income would be, respectively, the geographic expansion of its members and diversification in the product line offered to the market. The first option has the advantage of contributing to the diversification of cooperative production by increasing the number of suppliers but entails higher logistics costs. The second has the

advantage of reducing risks but entails higher investment and production costs. Yet according to the researcher, one of the biggest obstacles to adopt these measures, aiming at a better risk management and the economic efficiency is the possible conflict with the cooperative principles. Increasing the number of members (to ensure the cooperative supply and improve diversification) may lead to increase the problems of cooperative governance. Diversify the portfolio of production can lead a loss of the cooperative strategy focus and generate conflict with the members' resistance for changes.

Some researchers have been devoted to studying the cooperative capacity in managing the different types of risks they are exposed (Shapiro and Brorsen, 1988; Zeuli, 1999; Manfredo and Richards, 2007). Regarding market risks, diversification of production and/or activities is one of the most used strategies for its management. However, in the cooperative context, this strategy is not always easily applicable. Cooperatives do not have the same flexibility compared to Investor Owned Firms (IOF) for making changes in its portfolio.

Furthermore, agribusiness cooperatives do not always have access or even opportunity to use some instruments to cope with risks. In the Brazilian context, for instance, not all cooperatives (especially the smaller ones) have access to hedge options such as forward contracts or options, mainly due to the lack of offer of such instruments in the Brazilian financial market or constraints such as guarantees. Moreover, the production diversification normally depends on the availability of inputs (normally from members who have production portfolios more specialized rather than diversified) and investments in new technologies which usually it is not easily achievable due to difficulties in financing and the resistance of members (inertia for changes) who are the main stakeholders of a cooperative. These risks are caused mainly by a path dependency among members and cooperatives.

Analysis, measurement and monitoring of market risks in agribusiness: There are several reasons for production level variability such as climatic variation including rain lack or excess, technological level variation, credit availability and producer debt level, demand and price variation, among others. Frequently, when agribusiness production is going through crisis concerning some cultures there is a great migration to other more profitable cultures. However, agricultural product prices reflect the balance between supply and demand, so a product showing good profitability in a certain moment may usually be sub-supplied considering its potential demand.

In this case, increased supply caused by production migration may decrease prices and hence be unfavorable to new producers. In this context, one of the consequences of variation in production levels is the gross margin variability, especially because market supply variations influence directly the prices paid to producers. Variations of supply and demand (in some cases), caused by seasonal or stationary factors are of very important to the analysis of agricultural price behavior.

There are many methods and tools for analyzing and monitoring the market risks. In this study, we will discuss some of them regarding agribusiness. Among the strategies for market risk management, risk analysis associated with the diversification strategy will be explored in a greater detail. It will be presented methods for risk incorporation in models through the construction of efficiency frontiers which are useful tools in determining the optimal mix of production considering the risk-return relation. Another important tool to assess financial and market risks, the Value-At-Risk technique (VAR) will be explored as well.

General assessment of risks in agribusiness:

Entrepreneurs may decide between different “risky” opportunities. Moreover, they can also choose between different amounts of risk and so far influence the quantity and quality of risks they are willing to take. On the other side, they are exposed to external aspects they have to face as risk-takers.

Companies are increasingly subject to the negative consequences, resulting from various types of risks, mainly due to the increasingly competitive and global environment with continuous technological and behavioural changes. An integrated management of financial, legal, operational and strategic risks, under a systemic approach is a trend in modern studies regarding risk management in business.

However, despite being an activity supported by many economists, not all companies are effectively engaged in the practice of risk management (Taffarel *et al.*, 2015). Often, risk management is mainly focused on credit and market risks and hence the main concern is about price fluctuations and analysis of credit agreements. Further, sources of risks are not always analyzed in greater detail. But it is not surprising the lack of concern towards an effective risk management on the part of companies as demonstrated by the theory published on this subject. Frequently, risk management through hedge instruments such as future market contracts may create no value for a company, since the transaction cost paid to the financial market can be

equivalent to the cost to bear risks themselves. However, risk management can generate value through other forms. The active management of risk can reduce non-marketable risks, mitigate financial difficulties, reduce taxes, increase debt capacity and thereby avoid the financing costs through stock release.

In agribusiness, all companies are subject to some level of risks. For these companies risks are characterized by several factors including variability and uncertainty regarding prices and production. However, eliminating these risks is neither feasible nor desirable, since it could also limit the possibility of higher returns. Companies should have a better management between risk and return and therefore have no restrictions to the possibility of growth caused by risk aversion.

Some studies around the world have highlighted the importance of considering risks in agribusiness through different perspectives. Studies by the United States Department of Agriculture (USDA), for instance, shows that the production risks (fluctuation in productivity) and market risks (price fluctuation) are the types of risks that most concern grain producers in the United States. For the case of livestock producers, institutional risks which are related mainly to laws that could prevent the participation in a particular market are also important sources of concern. These concerns are also present in several developing countries with a degree of relevance and prominence to several tariff barriers that are imposed on domestic products in the foreign markets. In addition, uncertainties about possible funding sources and the constant rule changes in agricultural contracts are additional sources of risks for producers.

Economic efficiency analysis: One of the very first considerations of risks in economic efficiency analysis was made with the seminal work by Markowitz (1952) in “Portfolio Selection”. Researcher with his modern portfolio theory applied to investment decisions, introduces the stochastic programming to economic problems, thus representing a considerable advance in the decision making process towards risk. The analysis is based on the principle that an entrepreneur tends to the utility maximization rather than profit. In a simplified way, the efficient portfolios are those which offer the lowest risk (variance) for a given expected return and the highest expected return for a given level of risk.

In Markowitz’s theory, the expected utility is a function of income (or gross margin) and its level of risk. If the utility function of a decision maker is quadratic or if the frequency distribution of returns is normal then only the expected return and its variance will be

considered in the decision this is known as E-V analysis (“expected income-variance”). The E-V analysis assumes that a decision maker chooses the lower variance option for a same expected return or the higher expected return option for a similar level of variance. In this case, efficient portfolios are those that offer the lowest risk (measured by variance) for a given expected return and the highest expected return for a given level of risk.

Expected-value analysis: For a risk-averse entrepreneur, the greater the variance of the expected income (due to greater variability in product prices for example), the lower the level of utility will be. Risk aversion implies that an entrepreneur requires higher income at an increasing rate for each additional unit of risk. However, more parameters must be considered if the utility function's order is higher (not quadratic).

If the utility function of a decision maker for income ($U(y)$) is quadratic, an E-V analysis is appropriate. Nevertheless, many theorists have criticized its use due to the fact that a quadratic utility function is characterized by the increasing absolute risk aversion while the marginal utility value decreases. Anyway, quadratic utility functions bring good approximation for most desirable functions (Hazell, 1971).

The computational advantages of E-V Model outweigh any theoretical limitations. This is because the E-V analysis can be performed using quadratic programming or by linear approximation. Other higher-order functions can lead to non-convex programming problems with a greater degree of difficulty to find a solution (Hazell and Norton, 1986).

Given an expected utility function modelled after an E-V analysis to a risk-averse decision maker, the iso-utility curves are convex in E-V plan (Fig. 3). Along each iso-utility curve, a decision maker must choose a production plan with greater variance (risk) only if the expected return is also increasing by ($\partial E/\partial V > 0$) and this compensation must increase at an increasing rate of risk variation ($\partial^2 E/\partial V^2 > 0$).

The aim at an E-V analysis is to develop a set of feasible plans with a minimum variance (risk) for a given level of income expected. Such plans are known as E-V efficient points and they define the efficient frontier for all feasible plans. With the whole set of efficient plans, a decision maker will choose the one that best represents his preference among the various expected incomes and its related variances which are defined by E-V function. When this utility function can be defined, a single plan may be considered as of maximum utility (point P in Fig. 3).

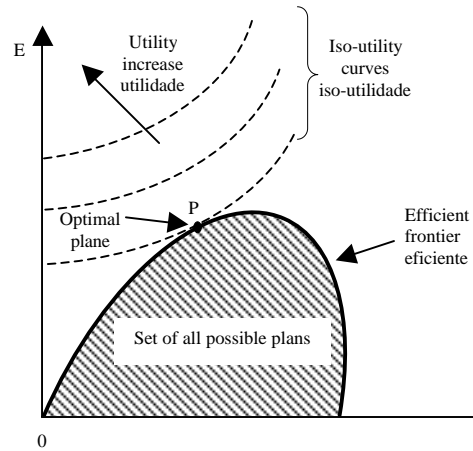


Fig. 3: Efficient frontier in E-V analysis (Hazell, 1971; Hazell and Norton, 1986)

Yet, when the utility function parameters cannot be estimated, an alternative is getting the set of efficient plans and thus allow the decision maker can elect the final choice. This makes the specification of a utility function less rigid and can compensate the situations in which the variance cannot be fully accepted as a risk measure. Furthermore, if we consider other socioeconomic factors to determine the utility function, the decision maker has the freedom to choose the plan that best represents the multiplicity of his objectives.

Value-at-Risk (VaR): A method of risks assessment that has become quite popular in recent years is the Value-at-Risk (VaR). This method has been improved and adopted as a standard for the assessment of market risks in financial institutions during the 1990s. The main incentive for its use was a demand for tools to assess and control risks after the financial crisis of the early 1990s. Currently, the VaR is being used for a risk assessment even wider which was conceived and it also helps in controlling and managing operational and credit risks.

VaR measures the worst possible scenario of expected losses in a given period and under normal market conditions, considering a certain confidence level. For example, if a bank believes that the daily VaR of its product portfolio is \$35 million with a confidence level of 99%, then there is only one in 100 chances of a loss $>$ \$35 million (considering normal market conditions). This number summarizes the bank's exposure to market risks with the likelihood of this risk. In this case, the shareholders can decide how comfortable they are towards this level of risk. If it is not the desired situation, VaR calculation process can be used to assess where

corrective actions should be taken to reduce risks. According to researcher in contrast to other risk assessment tools, the VaR provides an aggregated view of the portfolio risks considering leverage, correlation and other situations (Jorion, 2001).

Although, it was widely reported and developed for the financial market, particularly for risk assessment of derivatives, VaR can also be applied to assess other types of risks. The VaR summarizes in a single number the total risk exposure of assets, companies or financial institution. One of the VaR advantages is that its results are easily interpretable. Unlike other risk assessment criteria such as stochastic dominance and certainty equivalents which consider the distribution of gains and losses in full, the VaR includes only a portion of the distribution (left tail portion) which means translate risks as a bad effect. The calculation of VaR allows the joint consideration of multiple risk sources in the analysis such as price variation, futures prices, interest rates, etc. Moreover, temporal measures of volatility and scenarios analysis are possible to be implemented with this approach.

The formal definition of VaR is the percentile description of the expected distribution of profits and losses over a given period of time as shown in Fig. 4. Considering c as a confidence level, the VaR corresponds to the percentile $1-c$ of the distribution of gains and losses. For example, with a confidence level of 95% VaR would be what exceeds 5% of the total number of observations. Figure 4 illustrates the VaR. All values to the left of V^* (corresponding to the p area) would be the most highly undesirable values (Jorion, 2001).

The methods used to calculate VaR are the use of variance-covariance parameters, the Monte Carlo simulation and the historical simulation. A more detailed view of these methods can be found by Jorion (2001).

Another approach to perform a VaR analysis is the Extreme Value Theory Method which helps reducing the problems regarding time series and also allows the calculation of VAR for long periods. In this case, the VaR could be applicable to the rural setting considering

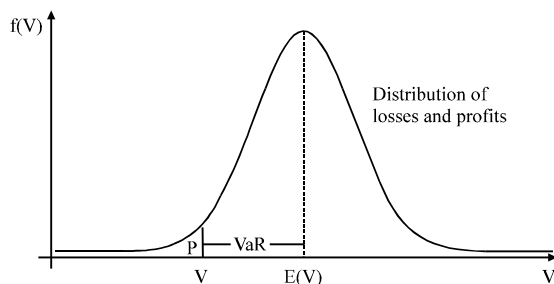


Fig. 4: Value-at-Risk; adapted by Jorion (2001)

periods near or longer than six months, for example (periods that typically define transitions between seasons).

Risk management in agribusiness: The diversification of production is the most common strategy for agribusiness entrepreneurs to reduce risks. It assumes that two or more activities (preferably being negatively correlated) will not go through difficult problems at the same time. On the other hand, diversification when unsuccessful can be worse than the monoculture. It may sometimes entail a decline in profitability and as a result, a negative multiplier effect on employment and income in rural areas. Moreover, the supply of products considered at risk (which have great variability of investment returns) is threatened by the behaviour of producers who prefer safer production plans. This whole scenario of advantages and disadvantages in diversification is increasingly concerning administrators and agricultural economists who have been working on risk reduction policies.

Dillon and Anderson (1971) presented an argument about consideration of risks by farmers and indications of possible inconsistencies between objectives to maximize profit and/or utility:

- Typically the traditional agriculture is efficient in maximizing profit
- However, to generate growth is necessary to develop new techniques and consider new inputs
- Yet, new techniques and inputs are risky from producers' standpoint
- Producers are risk averse
- The risk is therefore an obstacle for growth

According to researchers, this line of argument tends to emphasize risk aversion. However, they argue that risks are not necessarily a negative influence for producers. Diversification as a way to reduce risks in rural production, is an important factor for the following reasons: to reduce the seasonality of input; for an alternative use of machinery; to stabilize income due to changes in different product prices; among other. Diversification is a trend present in empirical research conducted at various locations around the world.

Strategies to cope with market risks: For farmers, the risk management at most part of the time essentially is aimed at determining the combination of actions that represent different levels of risk and return. Some strategies are aimed at reducing risk such as diversification of activities. Other strategies are aimed at transferring risks such as futures and production contracts.

Regarding market risks, sales price variation on produced products, input prices from supply and the demand levels are the main sources of these type of risk. Normally such changes are not easily predictable and occur after the producer's commitment to the desired production level that is after they have invested in planting or livestock. Fluctuations in supply and demand levels as well as both national and international economic situation, affect the profitability of producers when it influences a decrease in selling prices or an increase in input prices. Some management actions for coping with these types of risks include use of market information as an aid for planning, diversification of production and sales market and use of hedge through futures and options contracts (Yeh and Chen, 2014).

Production contracts are also an alternative for the management of production and market risks. In this type of contract a buyer (usually an industry or a distributor) purchases in advance the production and makes decisions on the varieties and cultural practices adopted. This option can be quite interesting for small producers who lack financial resources to invest in production and/or in diversification.

Because of the variety of types and sources of risks in agribusiness and the peculiarities inherent to each type of producer, there is no single managerial strategy common to all of them. Producers face different types of risks and require different tools for their management. In addition, producers' perceptions regarding the importance and influence of each type of risk in their operations can vary widely depending on the type of project and region in which they are. The management strategies adopted to prevent and mitigate the consequences of risks also vary widely.

Hedging to reduce market risks: Interaction between entrepreneurs exposes the success of their business options to a kind of risk cascade "from fork to farm". On the one hand, trust in entrepreneurial relationships may reduce principal-agency-problems but direct and personal negotiations expose a linked entrepreneur to the bargaining power of contracting partners. Coordination mechanisms in the agribusiness value chain leading to the detriment of the majority because of the heterogeneity and bargaining power of the participants could prevail. This is one reason why producers cooperate. Another aspect of agricultural production is the fact that cash flows between entrepreneurs are unequally distributed over time. Relevant inflows result from yields during a certain time period when all information of the whole cultivation period is priced. During the harvest period

prices may fluctuate and the producer who reaches the market first may receive the best price and the last the lowest. Therefore, commodity exchange and valuation systems have evolved trying to overcome these information and price asymmetries (Wu *et al.*, 2014).

The first who has used some sort of futures market was the Greek philosopher Thales of Miletus (624-546 BC). With his capabilities to calculate forthcoming weather phenomena he predicted a good summer and a great harvest of olives and spent money to secure the use of local oil mills "which he hired at a low price because no one bid against him". In this way, he obtained milling permissions of the olive yield beforehand which he later (during the harvest-time) sold with profit to other producers. Insofar Thales became the first "philosophic speculator" on the first futures market. Two considerations are important: there must have been a negotiation between Thales and the millers about the rents and a contract was made before the commodity was physically transferred. It is remarkable that there is an option which develops from an entrepreneurial skill to predict a future development and a market for rights and obligations of an agricultural commodity and a pricing system has evolved.

Why trade on anonymous markets: Participating in new (and today anonymous) markets is another business opportunity that must be seized by (agribusiness) entrepreneurs. They must be skilled and motivated to be a market participant. The following decision situation may clarify the need for an anonymous market.

We will presume that a wheat producer must bear costs (c_{Prod}) of 120€/t for his production. The producer will deliver the wheat to his purchaser (trader) who will be able to bundle different offers and distribute the commodity and finally get a sales bonus of 10% of the market price (p_{market}). Furthermore, producer and trader will agree on a contract with the fixed price (p_{fix}) of 150€/t and a delivery due on July 1st. On the day of delivery the market price (p_{market}) has risen to 160€/t; the margin for the producer will be $P_{margin} = p_{fix} - c_{Prod} = 150 - 120 = 30$ as he has agreed on price fixing. The trader will have $T_{margin} = (p_{market} \times 1.1) - p_{fix} = 176 - 150 = 26$. Each of them will now consider what one would have earned without a contract agreement (Table 1):

Table 1: Earnings with raised price

	Trader's revenue with contracting	Trader's revenue without contracting
Producer's revenue with contracting	30 (26)	30 (16)
Producer's revenue without contracting	40 (26)	40 (16)

Table 2: Earnings with fallen price

Producer's	Trader's revenue with contracting	Trader's revenue without contracting
Producer's revenue with contracting	30 (4)	30 (14)
Producer's revenue without contracting	20 (4)	20 (14)

In the case with a market price higher than the fixed price the producer has fewer incentives for further price fixing contracts in contrast to the trader. Let us further assume that producer and seller keep $p_{fix} = 150\text{€}/t$ before the next harvest period and agree on price fixing again. This time the market price drops to $p_{market} = 140\text{€}/t$ on July 1st with the results of Table 2 (the trader again receives a bundling and distributing bonus of 10% on the market price).

Different incentives will occur and influence both entrepreneurs' willingness to fulfill their contract's obligations. We can conclude that both contractors will falter between their options to fix prices beforehand or not. With an increase of the market price's volatility the inherent risk of this contract type will increase as well.

International stock markets provide market platforms for the trade of commodities including corn, wheat, soybeans, soybean meal, soybean oil, rough rice and many more which can be traded electronically day and night. The traded entity is a futures or forward contract giving the holder the obligation to buy or sell at a certain price. One important advantage for market participants is a daily pricing of a commodity that has to be delivered in the future and a standardization of this trade. Producers receive a present value for their delivery obligation.

How to hedge: Producers may use the opportunity to sell their yield in advance, before harvesting. They can decide to "use" a present price for a future transaction or wait until they harvest the "physical" commodity and sell it. It will be a matter of the entrepreneur's attitude towards risk if he or she accepts a sale beforehand and to what price. Obviously, this decision situation seems to be similar to the price fixing between producer and trader. The difference is the price formation, either between two (heterogeneous) partners or on an international market. In both cases there must be contractual partners, the producer with the obligation to deliver and the unknown contract partner with the obligation to accept delivery. Both agree on a current price for the wheat to be delivered.

The purpose of "hedging" is to protect the existing or planned value positions by entering into an opposite position in the derivatives market. Again, we will look at the decision terms of a wheat producer, now in Northern America with regard to one of the most frequented commodity markets in Chicago. Here, at the Chicago

Mercantile Exchange (CME) 10 million contracts are traded every day of which about 1 million refer to the deliverance of agricultural commodities. In our case, the producer may bear costs (c_{Prod}) of 400 US-Cent/bushel for his production. He now wants to choose a futures contract with the obligation to deliver. The futures price (p_{f1}) is 600,00 US-Cent/bushel on May 5th for a delivery on December 15th, at the same time the price for 1 bushel of wheat and immediate delivery (on the spot market: spot price (p_{s1}) is 551.00 US-Cent/bushel. The producer's delivery obligation is equal to a "short"-position on the market. On August 20th, he decides to harvest his wheat, the futures price (p_{f2}) has declined to 497.25 US-Cent/bushel what equals the price for immediate delivery (p_{s2}).

The exchange-rules offer two possibilities for the producer to fulfill his contractual obligations: either he can transfer the commodity physically to the contract partner or both may only invoke provisions concerning delivery. Because of the participant's anonymity it is unimportant who will finally fulfil the delivery and who will finally accept it. Difficult to exercise (and costly) would be a wheat transfer between contracting parties on different continents (who may interact anonymously on an international market). Therefore, any "wheat delivery obligation" can be compensated or "cleared" with the help of another "wheat acceptance obligation". Clearing institutions are responsible for this task and they guarantee to combine obligations of the same characteristics. In our case the producer "clears" his delivery obligation (short) with the purchase of another acceptance obligation (long) of the same characteristics.

The margin the producer receives can be divided into the margin resulting from the futures business and the margin resulting from the physical transfer of wheat.

$P_{fmargin} = p_{f1} - p_{f2} = 600.00 - 497.25 = 102.25$ which is 102.25 US-Cent/bushel and $P_{smargin} = p_{s1} - p_{s2} = 551.00 - 400.00 = 151.00$ which is 151.00 US-Cent/bushel.

Therefore, the total margin for the producer is $P_{smargin} + P_{fmargin} = 151.00 + 102.25 = 253.25$ which is 253.25 US-Cent/bushel.

Figure 5 displays the purpose of "hedging" which is to protect the existing or planned value position: receive 600 cent/bushel and a total profit of 600 cent/bushel - 400 cent/bushel = 200 cent/bushel by entering into an opposite position in the derivatives market. The latter is to be seen in the opposed profit/loss flows from physical transfer and futures transfer.

We can conclude that using a futures hedge will lead to a producer's position similar to the fixed pricing contract. Producers have to choose between two payment flows: a fixed flow a "flat-rate" so to speak of 200

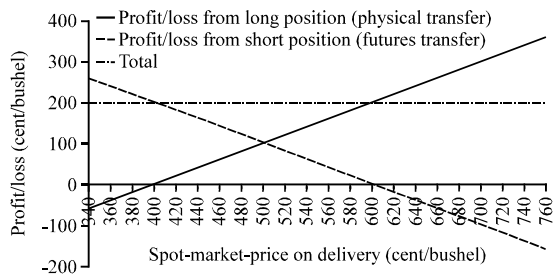


Fig. 5: payments from different positions

cent/bushel in every spot-market price situation during the time of delivery. The other opportunity is to keep the payment flows directly attached to the spot-market price (the long position, Fig. 5). Again the individual skills and the motivation including the attitude towards risk will influence the decision.

CONCLUSION

Agribusiness entrepreneurs are exposed to different types of risk. They are linked to the fields of psychology (e.g., the attitude towards risky options and a bounded rationality), technology (e.g., pest control, crop rotation etc.) and economy (like prices or market access). Although, agribusiness is a dynamic sector and able to adapt to a variety of weather conditions caused by different sources of risks, it appears that many countries lack of a satisfactory level of modernization and farm management. It is common to evidence situations in which larger producers have to compete for some scarce resources such as rural credit. In the case of small producers, the high dependence of government action and the lack of professionalism in management are important factors that should be considered. For these producers, one of the best alternatives and opportunity for development is to participate in any organization which promotes common progress such as a cooperative. Cooperatives can open up an organizational solution for these risks although cooperatives itself may create its own types of risks. Risk management in cooperatives must approach these fields by identifying and evaluating them and taking appropriate countermeasures.

Cooperatives play an active role in the development of agribusiness. They are across the whole supply chain which define the agribusiness and provide to its members real conditions for improvement in technical, market and management levels. A cooperative may permit the increased bargaining power, production scale, diversification and stabilization of crops, adding value to

agricultural products, expanding markets and capitalizing producers. Moreover, in some countries a cooperative can still operate in areas where the state has failed to satisfactorily perform its social function.

In some countries such as Brazil, cooperatives play an important social role as an effective promoter of development in rural areas. However, it is possible to notice that the social role played by cooperatives has no direct influence in its economic decisions. The organizations' image concerned with social issues affecting its members and organizations considered "almost philanthropic" does not suit the reality of national and international competitive economic scenario. Nowadays cooperatives, in order to exercise some effective role in agribusiness and be considered players with significant market impact are increasingly looking to professionalize and redirect their decision making process to a more rational and economical focus. That is the idea that the political rationality in the cooperatives is something prevalent and can influence its attitudes on making decisions as it is normally defended by the published theory on the subject is becoming increasingly in doubt.

In this study, we discussed concepts, strategies and techniques concerning management of market risks in agriculture and cooperatives.

REFERENCES

Bergmuller, R., A.F. Russell, R.A. Johnstone and R. Bshary, 2007. On the further integration of cooperative breeding and cooperation theory. *Behav. Processes*, 76: 170-181.

Chen, K., 2012. Procurement strategies and coordination mechanism of the supply chain with one manufacturer and multiple suppliers. *Int. J. Prod. Econ.*, 138: 125-135.

Da Veiga, C.R.P., C.V. da Veiga, A. Catapan, U. Tortato, W.V. da Silva and A.K.G. Leinig, 2014. Institutional theory and resource dependency in the alteration of distribution channels. *Int. Bus. Manage.*, 8: 240-250.

Dethier, J.J. and A. Effenberger, 2012. Agriculture and development: A brief review of the literature. *Econ. Syst.*, 36: 175-205.

Dillon, J.L. and J.R. Anderson, 1971. Allocative efficiency, traditional agriculture and risk. *Am. J. Agric. Econ.*, 53: 26-32.

Hazell, P.B.R., 1971. A linear alternative to quadratic and semivariance programming for farm planning under uncertainty. *Am. J. Agric. Econ.*, 53: 53-62.

Hazell, P.B.R. and R.D. Norton, 1986. *Mathematical Programming for Economic Analysis in Agriculture*. 1st Edn., Machillan Publishing Co., London, New York, ISBN: 0-02-947930-4, pp: 400.

- Jorion, P., 2001. Value at Risk: The New Benchmark for Managing Financial Risk. McGraw Hill, New York.
- Just, D.R., S. Wolf and D. Zilberman, 2003. Principles of risk management service relations in agriculture. *Agric. Syst.*, 75: 199-213.
- Lendel, V., J. Soviar and J. Vodak, 2015. Creation of corporate cooperation strategy. *Procedia Econ. Finance*, 23: 434-438.
- Lomott M.J. and K. Lyskawa, 2014. The new instruments of risk management in agriculture in the European Union. *Procedia Econ. Finance*, 9: 321-330.
- Manfredo, M.R. and T.J. Richards, 2007. Cooperative risk management, rationale and effectiveness: The case of dairy cooperatives. *Agric. Finance Rev.*, 67: 311-340.
- Markowitz, H., 1952. Portfolio selection. *J. Finance*, 7: 77-91.
- Shapiro, B. I. and B.W. Brorsen, 1988. Factors affecting farmer's hedging decisions. *North Central J. Agric. Econ.*, 10: 145-153.
- Taffarel, M., A. Clemente, W.V. Silva, C.P. Veiga and J.M.D. Corso, 2015. The Brazilian electricity energy market: The role of regulatory content intensity and its impact on capital shares risk. *Int. J. Energy Econ. Policy.*, 5: 288-304.
- Thompson, S., 2015. Towards a social theory of the firm: Worke cooperatives reconsidered. *J. Co-operative Organiz. Manage.*, 3: 3-13.
- Wu, W.S., Y.J. Liu, Y.T. Lee and R.C.W. Fok, 2014. Hedging costs, liquidity and inventory management: The evidence from option market makers. *J. Financial Markets.*, 18: 25-48.
- Yeh, J.H and L.C. Chen, 2014. Stabilizing the market with short sale constraint? New evidence from price jump activities. *Finance Res. Lett.*, 11: 238-246.
- Zeuli, K.A., 1999. New risk-management strategies for agricultural cooperatives. *Am. J. Agric. Econ.*, 81: 1234-1239.