AGRICULTURAL UNIVERSITY PLOVDIV
FACULTY - ECONOMICS

LELA SLAVE KRASTEVSKA

STRATEGIC RISK MANAGEMENT IN THE INVESTMENT PROCESS OF AGRICULTURAL HOLDINGS

ABSTRACT

of a dissertation for the award of an educational and scientific degree
"doctor" in a scientific specialty
"Organization and management of production"

Research supervisor: Assoc. Dr. Teodora Stoeva

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Reviewers:

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The dissertation work has been discussed and directed for defense at an extended meeting of the "Management and Marketing" department at the Faculty of Economics of the Agrarian University, Plovdiv

The defense of the dissertation work will take place on ..... 2023 at ..... time in hall…….. .

I. General characteristics of the dissertation work

Relevance of the topic

Agriculture is one of the branches that has an important strategic importance for the development of the economy of any country. Its role is determined by the fact that this industry produces and supplies a significant part of the population's food. This is one of the main prerequisites that determine the attractiveness of the industry in the eyes of potential investors. Although in this industry the capital invested is slower to return, the interest is huge due to the generous subsidies that the states within the framework of their national policy for economic development provide. There are cases in which these subsidies, under the influence of public attitudes, so strongly distort market principles that the effect of "bursting the bubble" is reached and causing damage to the economic aspect of the state,

All these arguments support the relevance of the chosen topic of scientific research.

***Conceptual thesis of the dissertation*:**the approach of strategic management of the investment process in agriculture is a reliable tool for minimizing risk and achieving the maximum effect from the investment made in this industry.

The purpose of the dissertation:is to analyze and evaluate the existing methods for strategic management of the investment process and to propose and validate a reliable toolkit for investment management.

Tasks:

- To determine the economic essence of the agricultural holding as a production system and its essence in managing investments in this structure;
- To clarify the methodological approaches and methodological issues in research and evaluation of the effect of the investment process;

- To study and analyze the sources of risk in the agricultural sector;
- Based on the analysis carried out, to develop a reliable toolkit for managing the investment process in agriculture.

Subject of research:is the investment process in agricultural holdings.

Object of research:are the agricultural holdings in Bulgaria.

Research Approaches: the investment process is perceived as an open system, within the framework of the present study. That is why the system approach is defined as the main methodological approach in the study and analysis of this process. When evaluating the effects of investments made in agriculture, two more main approaches are used: The first approach is based on the Neoclassical theory of the enterprise. In it, the effect of investments made in agriculture is considered as the result of the use of the main production factors - land, labor, capital and entrepreneurship, without taking into account the imperfection of the institutional environment. It is assumed that the market is in equilibrium, that the legislation is adequate and applied according to the rules, that property is protected and that there is an economic realization, etc., which means, that all transactions related to the exchange and use of production factors are carried out without transaction costs. The second approach is based on Institutional Theory. In this approach, the competitiveness of agricultural enterprises is assessed, taking into account the level of transaction costs in their organization and management. The approach is implemented in the following sequence: the main types of transactions in which farm managers are involved are determined, then the level of costs for these main types of transactions is determined. taking into account the level of transaction costs in their organization and management. The approach is implemented in the following sequence: the main types of transactions in which farm managers are involved are determined, then the level of costs for these main types of transactions is determined. taking into account the level of transaction costs in their organization and management. The approach is implemented in the

following sequence: the main types of transactions in which farm managers are involved are determined, then the level of costs for these main types of transactions is determined.

Main literary and informational sources

The dissertation was developed using: scientific publications and works of Bulgarian, Macedonian, Albanian and other foreign authors; information bulletins of international organizations; reports and bulletins of the Ministry of Agriculture and Food; FAO data, as well as a number of legal acts.

Empirical information for the study is also provided by sample surveys conducted at the farm level according to questionnaires drawn up by the author.

Volume and structure of the dissertation work

The dissertation work is set out in an introduction, three chapters and a conclusion spread over 125 pages, references and appendices. The study is illustrated with 10 figures and 5 tables and 1 appendix. 142 literary sources are cited.

Content of the dissertation

INTRODUCTION

First chapter:CONCEPT OF AGRICULTURAL DEVELOPMENT - SPECIFIC FEATURES OF THE BRANCH

INtora head:approach to risk analysis and assessment

Chapter Three:DIFFERENCE BETWEEN REAL OPTIONS THEORY AND TRADITIONAL INVESTMENT DECISION THEORY

Chapter Four:A METHODOLOGICAL FRAMEWORK FOR DECISION-MAKING UNDER CONDITIONS OF RISK AT THE FARM LEVEL

Chapter Five:INFERENCES AND CONCLUSION

II. Main content of the dissertation work

INTRODUCTION

The main reasons for choosing the topic are discussed in the introduction. The main arguments for the topicality of the topic are presented. The main hypothesis of the dissertation is defined, the purpose and tasks of research are defined.

First chapter:CONCEPT OF AGRICULTURAL DEVELOPMENT - SPECIFIC FEATURES OF THE BRANCH

The introduction presents the main specifics of agriculture as an investment sector. The main sources of risk in agriculture, which

must be taken into account in the process of investing funds, are reflected. The factors that are critical when making investment decisions in the industry are reported, such as:

- Slower turnover of invested capital and production resources;
- A long period of capital killing, especially in the creation of biological assets such as vineyards and perennials;
- Seasonal nature of the production, which reflects on the seasonal fluctuation of the income from the activity;
- The relative stability of expenses during the year and the relative instability of income;
- The difficult management of profit due to the presence of too many sources of risk in agriculture.

A review of the theoretical views on the nature of agriculture and its features has been carried out. A critical analysis of the scientific discussion on this issue is made. When justifying the nature of the farm, the system approach is used. It is considered as a whole composed of production, economic, social and legal subsystems.

In recent years, emphasis has been placed on agricultural policy research related to research, technology and rural development by strengthening the National Agricultural Research Systems (NARS) to Agricultural Innovation Systems (AIS) (Rivera et al ., 2005; Spielman and Birner, 2008; World Bank, 2006). The NARS framework is based on a linear model of research, development and dissemination aimed at investing in agricultural research institutes and higher education institutions to increase the supply of research, which has led to the creation of agricultural knowledge and information systems (AIS) whose framework stimulates demand spillovers (Rölling and Engel, 1991). It aims to integrate farmers, education, research and development, which are depicted as an agreement (a knowledge triangle). In this sense, the farmer is placed at the center of this agreement. Recently, ITI has emerged as a framework that encompasses "the totality and interaction of innovation actors" and extends "beyond the creation of knowledge to encompass the factors influencing the search for and use of knowledge in new and useful ways" (Klerkx and Leeuwis, 2008a; Hall et al., 2006). Thus, the concept of IIS encompasses the totality and interaction of actors (i.e. organizations, enterprises and individuals) engaged in the field of innovation. "

"... innovation policies are often seen as a key factor for improving the competitiveness of a given region. "In most studies the subject of analysis is the technological aspects of innovation, the development of new and new products. Despite the fact that today's innovators can only emerge from the large multinational companies that can finance this process, ongoing research reveals that innovation in rural areas is possible. Many recent studies have shown that innovation occurs without scientific knowledge (Dargan and Shuccksmith, 2008).

Various methods can be used to evaluate investments, which include costs, returns and benefits. Investments in fixed assets usually involve a large outlay (initial purchase) that is made at the beginning of the period, while the profit is spread over subsequent future periods. Investment analysis is the process of determining the performance of an investment by comparing the performance of alternative investments. Investment analysis requires information that includes an estimate of the annual net income of the investment, the initial investment costs, the residual value, the interest rate or the discount rate used. The following methods can be used to evaluate investments:

- Redemption Period (PB);
- Rate of return;
- Net Present Value (NPV);
- Internal rate of return (IRR).

Each of these methods has advantages and disadvantages and will be discussed in this section. Making an investment decision is too complicated, so a consultant should help choose the right method and make the right decision.

Redemption period.This method calculates the period for which the investment will be repaid due to the generated cash income. It calculates the time for which the income generated as a result of the investment will be equal to the initial investment costs. The method is used to determine which investments are not viable. (eg those that have no returns). It is also used to select the most suitable source of funding. For example, if we have a short payback period, we will look for short-term financing.

Rate of return. The simple rate of return recognizes the importance of investing not only the income but also the amount of capital employed in the production process. Income is calculated in terms of return on capital employed. More precisely, the rate of return

represents the net annual income as a percentage of the investment. The concept of net income is also used to calculate the difference between the average annual net income and the annual depreciation of the investment

Net present value.The net present value of an investment is the sum of the present values for each year of the net cash flows minus the initial cost of the investment. It is also known as the discounted cash flow method and is used as a discounting method for analysis. This method views the time value of money as continuous cash flows over the useful life of the investment.

Internal rate of return (IRR).The internal rate of return (IRR) is equal to the percentage of the interest rate at which the net worth of the investment equals zero. It is the maximum amount of interest at which the investor cannot afford to pay for the resources used in terms of the return on the investment and its operating costs.

Approaches to risk analysis.There are currently a number of publications related to risk management in the industry. First of all, when developing the theoretical framework, one should start by discussing the basic terms and definitions.

It is widely accepted that agricultural production is at risk. This means that due to the complexity of the production and economic system, the results of farm management are uncertain. Uncertainty is a consequence of events that have a negative impact on financial results.

New York University authors (Knight, 1921) distinguish between risk calculated on the basis of statistics and objective probabilities. According to this author, uncertainty is a consequence of unknown statistical circumstances for which the probabilities are also unknown. This distinction is not very functional because probabilities are rarely known, and taking probabilities as subjective beliefs is widespread (Moschini and Hennessy, 2001). Most authors believe it is more useful to distinguish between uncertainty as a result of imperfect knowledge and risk as a result of exposure to uncertain adverse economic consequences.

(Hardaker et al., 2004). In practice, the two concepts are very closely related and are interchangeable. Risk emphasizes "probabilities" resulting from environmental influences, and uncertainty relates to "possible negative impacts" on well-being. There

is no risk without some uncertainty, and in most cases uncertainty implies some risk.

Much of the risk management literature is concerned with social protection against poverty, particularly in developing countries (Dercon, 2005; World Bank, 2000). In this context, the term "vulnerability" is often used to define the probability that a given risk will lead to a significant reduction in well-being, i.e. resilience or lack of resilience to disaster. In this regard, vulnerability depends not only on the characteristics of the risk, but also on the assets available in the household to secure its income and on the availability of insurance mechanisms.

A growing body of research examines risk issues from a managerial perspective. They mainly focus on risks with significant consequences for society or the economy, which go far beyond the consequences for a specific economic entity. These "systemic" risks can also be important for agriculture. In the literature, risk management is part of a broader framework that includes at least three stages: risk assessment, risk management, and information about possible risks. These three stages can be defined in different ways - for example the International Council on Risk Management (2008). The first stage usually involves the systematic processing of available information in order to determine the frequency and extent of specific events.

This risk analysis approach involves three linear steps. First of all, for the mdish companion, it is measured whether it is at risk, and whether the changes that need to be managed. The next step involves using this information to determine the best option and risk management tools for a farmer based on their available assets and risk preferences. finally, appropriate policies are defined through legislation to improve the risk management strategy.

The relationship between these three groups of elements is not linear in nature. Further analysis of the samples shows that it is not possible to understand the sources of risk next to the tools available to address each risk, nor the availability of tools and markets next to optimal government policies. The interaction between these three groups of elements is multidirectional. This type of connection in the system is better represented by the three dimensions or axes of a cube (the second part of Fig. 1). Continuous feedback between elements on all axes leads to the simultaneous identification of risks, risk

management strategies and policies. The availability, development, and use of any tool or strategy is largely system-wide. It includes the nature of the risks, the extent to which they are interrelated,

Production diversification can in some cases be a good risk reduction strategy and in some cases can replace the need for insurance. Measures related to the stabilization of prices in the domestic market can stimulate the development of futures markets. In practice, it is usually impossible to isolate and identify individual risks, agricultural strategies and government policies, so a holistic approach to systems analysis is needed.

Some elements of government policy have been specifically designed to address the risks faced by farmers. Others may have a direct impact on agricultural risk, even if they are not specifically designed to do so.

Sources of risk.The sources of risk in agriculture are many and varied. The market, through the increase in the price of economic raw materials and production, has a direct impact on risk. Various hazards related to climate, pests and diseases or personal circumstances affect production in ways that are beyond the farmer's control. Unexpected changes may occur in terms of access to credit and other sources of income that affect the financial stability of the farm. The legal framework or changes to it may introduce additional obstacles and political risks. Some risks are systematic and some are unsystematic. Their occurrence and associated damage are largely unknown. These circumstances make them very difficult to manage for both farmers and markets. Some climate risks (drought and floods) are systemic as they affect most agricultural producers in the country. Others, such as hailstones, are more characteristic and easier to systematize in analyses. Many of the risks are interrelated. Some entry and exit prices may be positively correlated. Accounting for these dependencies is critical to developing effective risk management strategies. Some risks are catastrophic because they are very rare but cause great damage. They are often both systematic and unsystematic. Some entry and exit prices may be positively correlated. Accounting for these dependencies is critical to developing effective risk management strategies. Some risks are catastrophic because they are very rare but cause great damage. They are often both systematic and unsystematic. Some entry and exit prices may be positively correlated. Accounting

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Risks and sources associated with agriculture have different characteristics and can be classified in many different ways. Newbery and Stiglitz (1981) distinguish between systemic and non-systemic risks. Systemic risks are related to events that repeat over time. These can be analyzed with a probabilistic model to obtain a good estimate of the actuarial ratios. Conversely, non-systemic risks are characterized by very short or incomplete information about their occurrence. Therefore, there are difficulties in estimating them with a probabilistic model. This distinction is similar to the comparison between risk and uncertainty, and it is difficult to make a clear distinction between these two types of risk. The concept of cognitive impairment follows the same line of demarcation - it arises, when people do not know the probability or potential extent of an event (Skees and Barnett, 1999). Decision makers often forget the bad events that caused losses and do not use this information in their decision making.

Classification of agricultural risks. According to the OECD (2000), risks in agriculture are divided into two main groups. The first includes the general risks for all economic activities (marital status, health, personal accidents, macroeconomic risks), and the second - the risks that directly affect agricultural production. The latter can be decomposed as follows: production risks (weather conditions, pests, diseases and technological changes), environmental risks (production, climate change, management of natural resources such as water), market risks (changes in the prices of raw materials and the products, the link with the food chain in terms of quality and safety, new products) and finally institutional risks (agricultural policy, safe handling of food, regulation and environmental protection).

Some authors such as Huirne et al. (2000) and (Hardaker et al., 2004) distinguish two main types of risk in agriculture - business and financial risk. First is business risk, which includes production, market, institutional and personal risk. Production risk is due to unpredictable climatic conditions and technological advances in crop and animal husbandry. Market risk is related to uncertainty about the prices of

final products, and sometimes of raw materials, at the time of decision-making. Institutional risk is a consequence of government actions and regulations. These can be, for example, laws regulating the disposal of animal manure or the use of pesticides, tax regulations and payments, and others. Personal risks are due to random life events such as death or illness. Secondly, financial risks arise from the different methods of financing agribusiness. Using debt means that before the equity is offset, interest must be paid, which can create a risk of bankruptcy. In addition, there is financial risk when interest rates rise or farmers do not have access to loanable funds.

Musser and Patrick (2001), Baquet et al. (1997) identified five main same student risks in agriculture - production, market, financial, legal and human. Production risk is a consequence of changes in average yields in crop production and average productivity in livestock production due to adverse weather conditions, diseases and pests. Market risk is related to changes in purchase prices and quantities that can be sold in the market. Financial risk is related to the ability to pay bills, the availability of financial resources to continue farming and avoid bankruptcy. Legal risk and environmental risk are related to legal disputes initiated by other companies or individuals and to changes in regulations related to the environment and agricultural practices.

Relationship between agricultural risks.Risks are very rarely completely independent of each other, especially when measured in terms of their impact on the calculation of profit or income. In these equations, all risks are expressed in terms of change in price "p", production "q", costs "C" and other sources of income "O" and there are some typical correlations between these variables.

For example, output prices may be positively correlated with input prices. There are several examples of illustrations suitable in this situation. Changes in energy and agricultural commodity prices show a positive relationship between them. Another classic example is the case of specialized livestock farms, for which feed input prices are often tied to higher end product prices. We can improve the equality of profits by assuming that only two sources of risk affect the farm. These are product prices and the price of a specific production resource, and the other elements in the equation are assumed to be certain.

If prices and costs are independent (or unrelated), then the profit variable will be the sum of the weighted average production cost variance "P" and the uncertain cost variable "C". In general, the profit variance will also depend on the ratio or covariance between prices and costs. A positive covariance will mean that there are situations where low production prices are offset to some extent by low production input prices. These situations will be more common than the reverse - low output prices at high input prices. Therefore, the total variance will be less than the sum of the variables.

Some authors find a negative correlation between the other components of household land income in Delhi. Example Freshwater and Jetté-Nantel (2008) find that net profit, government payments and off-farm income are negatively correlated in the Canadian farm household. Negative relationships between prices and production of the same or different goods, as well as between agricultural and non-agricultural incomes, can be a very important mechanism for stabilizing farmers' incomes. Attempts to change the variance of one of the components of the income equation may prevent farmers from benefiting from these correlations.

Climate change and risk management. Climate change is a reality that has some impact on risk in agriculture. According to the Intergovernmental Panel on Climate Change (IPCC, 2007a), there is evidence that the earth's surface temperature has increased globally with some regional differences. During the last century, the level of precipitation has changed in most places: "significantly wetter - in the eastern part of North and South America, northern Europe and northern and central Me ilia, about drier - in the Sahel, southern Africa, the Mediterranean and South Asia. Widespread increases in heavy rains have been observed even in places where total rainfall has decreased. "The extent of regions affected by drought, tropical storms and hurricanes varies greatly from year to year, but the data show a significant increase in intensity and duration compared to 1970." "Under a warmer climate in the future, there will be an increased risk of more intense, more frequent and longer heat waves. Models predict an increase in summer droughts and winter wetness in most parts of the northern, mid- and high latitudes. Summer shows a higher risk of drought, there will be an increase in extreme rainfall.

These trends are consistent with data on the observed frequency of catastrophic events around the world. Data from the United Nations International Strategy for Disaster Reduction show a significant increase in the number of natural disasters, particularly hydrometeorological events, over the last century. Hoyois et al. (2007) report a significant increase in the number of hydrometeorological disasters since the late 1990s compared to the previous decade. However, the total amount of damage did not increase significantly.

These trends in global warming and catastrophic events are likely to affect agricultural and livestock production or yields and their diversity. The IPCC (2007b) numbers that "...in mid- to high-latitude regions, moderate warming has a positive effect on crop and pasture yields, but even mild warming reduces yields in seasonally dry low-latitude regions." According to the same report, most studies model the impact of changes in mean values of climate variables. So far, very few models have included the impact of increased frequency of extreme events and changes in weather on production. However, "... recent studies show that climate change scenarios that include increased heat stress,

Risk management strategies.Risk management strategies begin with farm decisions regarding the choice of the type of output to be produced, the allocation of land and the use of other materials and techniques, including irrigation and the diversification of on- and off-farm activities. Farmers can manage market risk through tools that include insurance and futures markets, but not all risks can be insured. The main reasons for this are the systemic nature of the risk, the lack of information about the probabilities and the information asymmetry regarding these probabilities. It is therefore useful to segment all risks into three different layers depending on the most appropriate or available tools.

The basic principles of common risk reduction strategies (risk sharing, consolidation and diversification) are well known to economists. In addition, they were also widely used by farmers in the past.

Risk management strategies can be grouped into three categories (Holzmann and Jogersen, 2001):

- Prevention strategies - to reduce the probability of unfavorable conditions when a given event occurs;

- Strategies for mitigating the potential adverse consequences of the event;

- Strategies for coping with and mitigating the impact of the event once it has occurred.

Strategies can be based on agreements reached at different institutional levels: agriculture or Community arrangements, market mechanisms and government policy. The farmer has the opportunity to choose between the available tools, the combination of tools and strategies that best suits his level of risk exposure and risk aversion.

Range and approaches of real options. Lander and Pinches (1998) summarize the application of real options in 16 areas: natural resources, competition and business strategy, manufacturing, real estate, research and development, public goods, mergers and acquisitions, corporate governance, interest rates, stocks, labor, venture capital, advertising, law, hysteresis effect and corporate behavior, development and environmental protection. We will focus on the most important areas of application of real options in the scientific literature.

Investments in natural resources. The product price in the field of natural resources in investment projects has a high degree of random fluctuations, which also requires that all management options be used. Brennan and Sehwaaz (1985) investigated the problem of how to estimate the value of copper production in a high risk cash flow project. In their research, they use portfolio financing including short-term assets from futures contracts as well as long-term assets from mineral ancillaries, then derive a partial differential equation for copper products.

Trigeorgis (1990) analyzed the evaluations of a multinational project related to the exploitation of a natural resource. Initially, the NRS of the project is negative. Managers identify several options: delay options, failure options, and rescaling options during the course of the project.

A methodological framework for decision-making under farm-level risk conditions. Continuous changes related to crises in agriculture and food production in terms of food security, as well as changes in government policy, are constantly creating new risks. Strategic risks are usually unpredictable and their management requires a set of assessment and decision-making tools. This part will

outline a methodological framework set of tools such as scenario analysis, rating system and risk mapping, payoff matrix, decision tree, portfolio of real options. It is an analytical framework for agricultural holdings through which quick decisions can be made in situations where there is uncertainty and the farm has access to a limited amount of information. In the literature, a number of authors have published research on depending on the art for the yacht that you are not speed. Raynor (2007) suggests using the scenario approach for planning and real options for making strategic flexible decisions. He uses examples from companies such as Johnson & Johnson, Microsoft, Sony and Vivendi to show how they are successfully using flexibleArt strategically. Before him, a theoretical model was developed for assessing strategic uncertainty based on the existing potential and development perspective. Assessment and mapping are used to operationalize the theoretical model. Boehlje (2005) developed rating, mapping, decision tree and real options (International Food and Agribusiness Management Review, 8 (2): 1-20). Raynor (2007) suggests using the scenario approach for planning and real options for making strategic flexible decisions. He uses examples from companies such as Johnson & Johnson, Microsoft, Sony and Vivendi to show how they are successfully using flexibleArt strategically. Before him, a theoretical model was developed for assessing strategic uncertainty based on the existing potential and development perspective. Assessment and mapping are used to operationalize the theoretical model. Boehlje (2005) developed rating, mapping, decision tree and real options (International Food and Agribusiness Management Review, 8 (2): 1-20). Raynor (2007) suggests using the scenario approach for planning and real options for making strategic flexible decisions. He uses examples from companies such as Johnson & Johnson, Microsoft, Sony and Vivendi to show how they are successfully using flexibleArt strategically. Before him, a theoretical model was developed for assessing strategic uncertainty based on the existing potential and development perspective. Assessment and mapping are used to operationalize the theoretical model. Boehlje (2005) developed rating, mapping, decision tree and real options (International Food and Agribusiness Management Review, 8 (2): 1-20). to show how they use it successfully strategically flexibleArt. Before him, a theoretical model was developed for assessing strategic

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Raynor's (2007) theoretical model is useful for strategic claims decisions in unsafe environments. In the books The Strategic Paradox: Why Dedication to Success Leads to Failure (and What to Do About It), the author shows that in order for companies to succeed in the unpredictable future, they must develop practical strategies. These strategies must be based on multiple choices that meet the requirements of various possible future events, rather than a single strategic commitment. Rayner suggests that to do this, the key to such decisions is strategic flexibility. In the decision making process, it includes the steps of anticipation, formulation, accumulation and execution.

The forecastinvolves identifying the forces of change or forces that shape the future, identifying the range of possible future events, and deciding which future events are plausible or have the highest chance of actually occurring. Formulation as a step involves developing an optimal strategy for each scenario and identifying the "core" (or common elements) and "conditionals" (or unique elements) of those strategies. Accumulation as a step involves the decision to commit to the core elements of the strategy and to determine options for the "conditional" elements. Finally, implementation is a step related to the implementation and monitoring of strategic choices, including the implementation of appropriate options.

The analysis of the scenariocan help identify alternatives fucherry, coitabout Yes sis izpolie. System assessment is related to risk assessment and uncertainty mapping. On this basis, the farm must decide which projects can be pursued and

implemented. The payoff matrix and the decision tree (based on real options) are tools for analysis and help in deciding which projects to implement. Creating a portfolio of projects is necessary to ensure that the farmer is diversifying his risk.

The economic analysis of investmentdecisions so far in practice has been made using net present value (NRC) based on discounted cash flows (CTR). In theory, however, there is an alternative approach (RO) based on modern financial techniques that overcomes the limitations associated with the NSS approach (Dixit and Pindyck, 1994). Traditional NSS analysis boils down to a clear pattern of several variables, including earnings. Indeed, the use of NSS allows risk to be addressed either by changing the after-tax cash flow or by changing the discount rate (Hine and Pritchett, 2003). In contrast, RO analysis clearly reproduces the changing nature of investments and the risk environment in which investment decisions are made, investment decisions are eliminated, or all potential alternatives are designed.

A series can be used to apply Rayner's model on instruments. Traditional methods used to justify investment decisions are based on the GMP method. It is based on the relationship between the current and future value of the project. In this regard, the value of the project is calculated by discounting the expected future values to the present value using the discount factor. Mathematically, this relationship is expressed as follows:

T is time, with the numerator expressing the expected cash flows and the denominator the risk. The rule is that if the NSS is positive, the investment is acceptable; otherwise it is rejected. The NSS analysis applies the now-or-never rule (Trejo, 2000), which is applicable to projects included in a pre-developed plan. Unfortunately, this is not feasible for most real business projects.

Farmers must constantly react and change investments in the corresponding change of the dish in the market of sr.Yes. You know that it is possible to postpone investment decisions, ie. to wait for better information. The NSS model does not include this possibility, although the business strategy is a series of alternative options, not just project cash flow. The NSS model does not take into account this business uncertainty and the inclusion of the weighted cost of capital (WACC) is done in a

very subjective way. Of course, NSS can be used in a more complex method through the decision tree, where different investment scenarios are developed.

To illustrate the imperfection of the NSS method, we will use the following example. A farm wants to invest in fixed assets worth BGN 100,000 and will generate revenue of about BGN 110,000 as it is the lowest year, etc., and a discount rate of 15%. The NSS receives a negative value (-4348 BGN), which means that the project is rejected. With a reduction in interest rates and the discount rate is 9%; then the NSS is positive (BGN 917) and the project should be accepted. What should be done if the project's internal rate of return is 10%? Is the project even worth it? The problem here is that the project is more than a one-time investment. In this case, the interest rate affects the investment decision. This project is equivalent to the financial option of one share for one year. The task of the project is to be completed not tomorrow or the day after tomorrow, but at some other future time. Any project may be delayed until the NSS considers this possibility.

Analysis of strategic investments through a decision tree.Suppose a farm wants to introduce a new technology with the production of a certain product. The invete station can be divided into three stages as follows. At t = 0 (near future) the farm will spend BGN 200 on market product potential research. If the market potential is sufficient, the farm will invest BGN 800 in feasibility studies, permits, etc. in t = 1. During the period t = 2, the farm will invest BGN 8,000 in the production of the new product. At the final stage, three income levels will be reached - high, medium and low cash flow over the next four years of the project.

For Yes, the project is realistic, we predict that in period t = 3 the revenues from the project will be BGN 8,000, BGN 3,000 and - BGN 2,000 respectively, and these flows are the same during the project's estimated periods. The column for total probability P shows the probability that each of the variants will occur as the product of the probabilities for each of the three stages. For example, for the variant with revenues of BGN 8,000, the probability of this happening is 0.144 = 0.8 * 0.6 * 0.3. We use a discount rate of 11.5%, which expresses the risk of the project, and obtain an expected NPV of -307 BGN (Table 1).

From the point of view of NSC analysis, NSC is a negative value, i.e. the project is unacceptable. If we use the probabilities that the project will have a negative NPV, it will be equal to 0.664 = 0.144 + 0.32 + 0.20, i.e. overall the project is unacceptable. What happens if we delay the start of the project by a year if sales are low?

Table 1. Calculation of NSS for the project

Indicators/ period	t = 0	t = 1	t = 2	t = 3	t = 4	t = 5	t = 6	NSS	R	NSS * R
Expenses/ BGN revenue:										
Option D	-200	-800	-8000	8000	8000	8000	8000			
Option D				3000	3000	3000	3000			
Option B				-2000	-2000	-2000	-2000			
Discount	1	0.8969	0.8043	0.7214	0.647	0.5802	0.5204			
The present value in BGN:										
Option D	-200	-717.52	-6434.4	5771.2	5176	4641.6	4163.2	12,400	0.144th in frequency	1786
Option D	-200	-717.52	-6434.4	2164.2	1941	1740.6	1561.2	55	0.192 most common	11
Option B	-200	-717.52	-6434.4	-1442.8	-1294	-1160.4	-1040.8	-12,290	0.144th in frequency	- 1770 year
Option B	-200	-717.52						-918	0.32	-294
Option A	-200							-200	0.2	-40
NSS of project, BGN										-307

The new scenario increases the NSS from a negative to a positive flow by BGN 196 (table 2).

Table 2. Calculation of the NPV for the project with a deferral option

Indicators/ Period	t = 0	t = 1	t = 2	t = 3	t = 4	t = 5	t = 6	NSS	R	NSS * R
Expenses/ BGN revenue:										

Option D	-200	-800	-8000	8000	8000	8000	8000			
Option D				3000	3000	3000	3000			
Option B				-2000	0	0	0			
Discount	1	0.8969	0.8043	0.7214	0.647	0.5802	0.5204			
The present value in BGN:										
Option D	-200	-717.52	-6434.4	5771.2	5176	4641.6	4163.2	12,400	0.144th in frequency	1786
Option D	-200	-717.52	-6434.4	2164.2	1941	1740.6	1561.2	55	0.192 most common	11
Option B	-200	-717.52	-6434.4	-1442.8	0	0	0	-8795	0.144th in frequency	-1266
Option B	-200	-717.52						-918	0.32	-294
Option A	-200							-200	0.2	-40
NSS of the project, BGN										196

Based on modern financial valuation techniques, the real options approach overcomes the shortcomings of the GMP technique.

The real options approach. Similar to the GMP approach and the RO cash flow approach, time and risk enjoy goal analysis, but they are incorporated in two different ways. It is considered that the cash flow was invisible, then it is a business and the money is needed and Yes, entered this business. Time is taken into account to estimate cash flows and how long the decision can be delayed. The risk is returned as a consequence of the business itself and the consequences that occur before the investment decision is made. Even the most basic option pricing models should include at least five to six variables that reflect cash flow, timing, and risk information.

A key point in evaluating investment opportunities as an option lies in the ability to make a connection between the characteristics of the project and those of the financial options. The fixed assets of the holding should be closely related to the state of the financial markets after researching the stock market. The waiting time to make an investment decision is related to financial market options. Uncertainty about the future

value of fixed assets is expressed by variation in their income - this is analogous to the variation in earnings per share for financial options. Finally, the time value of money will be applied through the discount rate used in the GMP approach (Table 3).

The annual net revenues estimated for the NSS analyzes are estimated values. From the point of view of strategic investment decisions, these revenues can decrease or increase depending on the risk. The valuation of these reductions is estimated using the RO method. These strategic decisions can be considered as managerial alternatives. Each option can affect future cash flows. The following options can be distinguished:

- Postponement of the invet station;
- Temporarily to interrupt and restart;
- Convert names and information to capture active;
- Refusal to make the investment;
- Switch to new materials or finishing products

Table 3. Comparison between investment and real options

An investment alternatives	times variables	Real options
NS of acquired assets	S	The share price
Potential investment	x	Purchase price
Delayed the investment	T	Delay period
Quality-price ratio	Rf	Discount
Uncertainty of a project	□	A return variation of one action

The question here is whether real options can reflect the essence of our business project? The INseki investment project is unique. Therefore, there are different types of real options. For example, these can be the options for geographical expansion of the market, introduction of a new product or technology, postponement of the investment decision, refusal of investment and others. Once the actual option is defined, any source of risk that would affect it can be identified. There are different approaches to implementing RO. The Black-Scholes equation is suitable for simple real options with one source of uncertainty and one decision date. Sporlerder and Kimberly (2000) use this model to estimate ROs for investments in “new generation cooperatives”. For more complex investment decisions, the use of RO requires more sophisticated applications of quantitative methods. A more crude and not very complicated method is that of the

binomial estimation model. This model is suitable for a wide range of PO applications (Amran and Kulatilaka, 1999).

Use of RO in agriculture. The theoretical advantages of the RO method have been formulated and evaluated in a number of publications (Bjerksund and Ekern, 1990; Demers, 1991); Moon, 2006). However, only a few studies have applied RO analysis in agriculture.

Purvis et al. (1996) examine the adaptation of free-range cow technology under conditions of uncertainty and irreversibility in environmental policy development.

Ekboir (1997) analyzed the investment decisions of individual farmers under conditions of risk and technological change using a dynamic stochastic model.

Winter-Nelson and Amegbeto (1998) develop a model for investment decisions under uncertainty to analyze the effect of price changes on investment decisions for soil conservation in your area.

Price and Wetzstein (1999) develop a model to determine the optimal threshold for introducing and abandoning investments in irrigation systems, where irreversibility and income uncertainty with prices and average yield are set as stochastic variables.

Tegene, Wiebe, and Kuhn (1999) develop a model for investment decisions to change agricultural land into construction boundaries as an irreversible investment under conditions of uncertainty when this land is included in the government's environmental policy.

Khanna, Isik, and Winter-Nelson (2000) analyzed the impact of price uncertainty and expectations of lower fixed costs on crop rotation optimization.

Carey and Zilberman (2002) developed a stochastic dynamic model for adaptation to irrigation.

Tsuramani et al. (2002) assessed farmers' sensitivity to organic farming using RO analysis.

Ehmke et al. (2004) apply RO theory to measure the value of institutions in biological land use using precision land use technology.

The review of new opinions in investment analysis and applications of RO analysis in agriculture aims to further develop the evaluation of investments in agriculture. While investment decisions are strategic in nature, they can be made during the investment period. The evaluation of these strategic decisions should influence the evaluation of investment projects, they can be modeled as options and evaluated using some techniques applied in financial options. The application of RO analysis complements static NSS analysis and contributes to incorporating risk and uncertainty into investment analysis. This makes RO analysis very suitable for evaluating investment projects in agriculture.

The dissertation presents a modern methodology that can be used to manage uncertainty in making strategic investment decisions in agriculture with an emphasis on small farms. Modern innovation and knowledge systems are analyzed based on the concept of agriculture. The need to implement innovations in rural areas, mainly through small farms, is emphasized. The relationship between innovations and decision-making options from the point of view of their application in agricultural holdings is emphasized. An analysis of the traditional methods of investment evaluation, their advantages and disadvantages has been made. The relationship between uncertainty in farm management and investments in the direction of different approaches with risk analysis is revealed. The theoretical consideration of risk management strategies prepares the basis for the application of the real options method in the evaluation of strategic investments. Therefore, the main emphasis is placed on market risk management strategies based on futures and insurance contracts. On the basis of the new institutional economy and transaction costs, the logic for concluding effective insurance contracts in agriculture is considered methodologically. Information asymmetry is analyzed for the counterpart of market inefficiency. The role of government is seen in terms of uncertainty in agriculture depending on whether the country's economy provides the most appropriate "set" of markets. The role of the government in this process is defined.

A comparative analysis of traditional analysis methods and that of real options is made. Traditional methods of investment evaluation consider the future with a certain degree of certainty, which implies a passive approach to investment analysis. Traditional models, such as net present value, assume that managers have no flexibility to change investment choices and that the decision is all or nothing. Real options analysis as a tool for investment decisions outperforms other similar tools in quantifying uncertainty and correctly models management flexibility, which can be the following: "to give up", "to exercise" or "to wait". From a theoretical point of view, an analysis of the application of real options has been made.

Based on the typical dualistic structure of agricultural holdings in the country, the typology of these holdings was developed, which is based on the standard indicator of production volume. Special attention is paid to small farms and the indicators that can be used to define them.

III. Publications

IV. Contributions

The following contributions of a scientific and applied nature can be highlighted in the dissertation:

1. The nature of the investment risk in agriculture has been clarified;
2. A conceptual framework for risk analysis and assessment in the investment process in agriculture has been developed;
3. The main risk management methods in the investment process in agriculture have been analyzed and evaluated;
4. A strategy for managing investment risk in agriculture based on the real options method is proposed.