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The Role of the Start-Up Aid for Young Farmers in the Adoption of Innovative Agricultural Activities: The Case of Aloe Vera

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Abstract: The poor generational renewal has been identified as a key issue for the EU policy that undermines the restructuring of the agricultural sector and the revitalisation of rural areas. The start-up aid for young farmers is one of the main EU-driven policy measures that try to mitigate this trend, by facilitating the initial investment of young newcomers in agriculture. At the same time, innovative crops with appealing characteristics are proposed as promising alternatives with high socioeconomic and low environmental impacts. Recently, a draft new call of the start-up aid for young farmers measure has been set under public consultation in Greece, which significantly alters the requirements and the level of support of the beneficiaries, compared to the previous one. The aim of this study is to explore the consequences of this change to the desirability to invest in the organic aloe vera crop, one of the leading innovating crops in Greece. In this study, taking into consideration the embedded risk and uncertainty, we utilise a stochastic version of the Net Present Value (NPV) analysis, a common discount cash flows method to detect the desirability of an investment. Results indicate that the potential alteration of the start-up aid for young farmers deteriorates the desirability of this investment and thus prevents farmers from its adoption. The analysis provides useful insights by highlighting risk factors and the possible impacts of policy measures on the desirability of innovative crops; thus, it can be useful both for investors and policymakers.

Keywords: aloe vera; net present value; stochastic analysis; risk and uncertainty; start-up aid for young farmers; young farmer problem; policy measures

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1. Introduction

In recent years, an increasing trend towards the establishment of new innovative crops appeared in Greece. These crops are launched as propitious alternatives to the common, low-productive cultivations for a large number of farms [1,2]. Alternative crops are popular among the new generation of farmers that are usually more willing to diverge from the "traditional" crops which keep the lion's share of the cultivated area in Greece. Moreover, from the beginning of the financial crisis in Greece, many young people thought of or even attempted to return to their roots and take up farming as a way out of unemployment [3]. Among these highly educated young people, alternative crops appeared to be very popular.

Since the beginning of the 80s, the EU had recognized the need to support young newcomers to agriculture and implemented relevant policy measures. Indeed, the so-called "young farmer problem" is identified as an urgent issue in the EU that jeopardizes the evolution of the sector and its competitiveness in the next decades. This kind of support targets the restructuring of the agricultural sector and the revitalisation of the rural population by providing incentives to facilitate initial investments for the establishment of the farm [4].

In the current programming period (2014–2020), the Regulation (EU) 1305/2013 and specifically the sub-measure 6.1 of the Rural Development Programme 2020 (RDP 2014–2020), which concerns newcomer young farmers, is among the most popular measures. Following this regulation, young farmers should submit a business plan with specific goals at the beginning of the investment [3]. Recently, a draft version of a new call of this measure was under public consultation. According to this draft, the level of support is going to significantly increase but at the same time, the minimum farm size requirements (in terms of gross value added) will also increase. This change is expected to substantially alter the number and the profile of the beneficiaries as well as the structural characteristics of the new subsidised investments.

Given the above discussion, the aim of this study is to examine the effect of the different calls of the start-up aid for young farmers on the desirability of investment in alternative crops. For this purpose, we examine the case of organic aloe vera crop, one of the most promising alternative crops that have been established rapidly in Greece in the last decade [2].

Despite its increasing popularity, aloe vera organic farmers in Greece face significant yield and price risks, which combined with the high establishment costs, provoke difficult investment decisions. According to Hardaker [5], two main sources of risk in agriculture can be identified, the production risk and the market risk. The former stems from the exposition of the crop in an uncertain and non-fully manageable environment. The second source of risk stems from the market side and relies on producers' prices and quantities that are distributed through the value chain. In the case of organic aloe vera leaves, the market is not yet well-established in Greece [2], and therefore, there is a high vulnerability of price levels as well as a major uncertainty regarding markets capacity, i.e., the volumes that can be distributed through each of the alternative markets.

The most common way to evaluate an investment opportunity is to use traditional discounted cash flow methods, such as the Net Present Value (NPV). However, the underlined risk and uncertainty in the organic aloe vera crop question the adequacy of a deterministic estimation of the net present value (NPV) and call for its stochastic counterpart. Recognising this need, this study relies on the stochastic NPV analysis, which allows the incorporation of the embedded risk and uncertainty of the investment. In our case, this is very important because apart from the common risks and uncertainties that agricultural activities face, there is yet limited evidence of the behaviour of aloe vera crops in Greece due to the lack of historical data. In addition, there is still a lack of technical know-how, despite the remarkably growing relevant literature (see Section 1.3).

The structure of this study is as follows; the next two sub-sections provide an overview of the "young farmer problem" in EU and in Greece as well as the policy measures initiated to tackle it. Then, Section 1.3 presents some key facts on the potential of alternative crops and the factors that affect their adoption, with emphasis on aloe vera. Section 2 describes the methodology used, and Section 3 provides the results and the discussion of the analysis. Finally, Section 4 summarises the study and presents concluding remarks.

1.1. Young Farmer Problem

The declining number of young farmers is considered as one of the major drawbacks of the EU agriculture. It is closely related to what the European Commission characterised as "distressing shortage of new farmers" [6], to highlight that older farmers do not pass their farms to the new generation at a sufficient rate [7]. In their study, Zagata and Sutherland [7] introduce the term "young farmer problem" to describe the fact that about one third of farms have a land-holder who is above 65 years of age while young farmers (<35 years) can be found only on 7.5% of farms in Europe.

The above facts questioned the competitiveness of the European agricultural sector and the food security in the long-run [8]. This poor generational renewal has been acknowledged by the European Commission, as a factor that has to be urgently resolved. To emphasize its significance, European Commission has expressed it as one of the nine specific objectives in the legislative proposal for the post-2020 Common Agricultural Policy (CAP) [9].

According to Eistrup et al. [10], even though the innovative character of young farmers may be considered as a shared characteristic of all newcomers regardless of their age, there is evidence of a positive relationship between young farmers and farm efficiency and innovation [7,11,12]. Young farmers have been described as having a more entrepreneurial approach to agriculture [13–15] and more willingness to diversify and to engage in agri-environmental schemes and eco-friendly agricultural practices [16–18]. For the above reasons, young farmers are considered as more capable of accommodating the post-productivist multifunctional agricultural systems that the CAP supports [19] in order to meet the environmental and climate objectives set at EU level [20].

Despite their importance, young farmers have to tackle several impediments to establish their activity. Among them, maybe the most important is the access to land, in cases where it is not inherited. According to McKee et al. [21], the rising capital value of agricultural land blended with the considerable emotional and time investment in the farm makes farmers reluctant to pass their land onto the next generation [22,23]. This is related both to small holdings and large-scale farms. In the latter case, land represents a significant capital asset, while in the former case, the economic rewards of farmland liquidation are limited in comparison to the loss of a valued family resource, which is instead retained for recreational use [24]. However, even when land becomes available, newcomers find themselves competing for land with existing farmers, who are attempting to achieve economies of scale [7,21]. Other commonly identified barriers include the high start-up costs, the limited access to credit [7,10] and the absence of adequate extension services which could provide the necessary training for new entrants [25].

According to Eurostat [26], in the year 2016, only 5.1% of all European farms were run by farmers younger than 35 while about 33% of all farmers are older than 65 years of age. In other words, the ratio of farmers younger than 35 to farmers older than 65 is about 0.16. It is also important to note that these figures are not horizontally applied in the EU countries. Austria is the only MS where this value is far greater than one (1.67), while Poland and Germany have values that are close to one (0.91 and 0.88, respectively). On the other hand, there are countries like Cyprus, Portugal and Romania, where this ratio is extremely small (0.03, 0.04 and 0.07, respectively) [26].

In the case of Greece, the age structure of the farm managers is described in Table 1. The ratio of farmers younger than 35 to farmers older than 65 equals to 0.11, which is below the EU average. However, there are interregional disparities, with some NUTS-II regions placed far above the average (the regions of East and Central Makedonia as well as the region of East Makedonia and Thrace) while others are far below the average (like Epirus and Central Greece). These differences may stem from the different age structures of the general population among NUTS-II regions as well as the specific structural characteristics of the agricultural sectors in each NUTS-II region.

Table 1. Farmers' age structure of EU-27, Greece and Greek NUTS-II (year 2016).

	<35 Years		>65 Years		$\frac{<35}{>65}$
	Number	**Share (%)**	**Number**	**Share (%)**	
EU-27	527,690	5.1	3,372,920	32.8	15.6%
Greece	25,120	3.7	229,230	33.5	11.0%
Attiki	600	3.0	7550	38.2	7.9%
Voreio Aigaio	1190	4.2	8530	30.1	14.0%
Notio Aigaio	570	2.8	7600	37.3	7.5%
Kriti	3520	4.0	28,810	32.7	12.2%
Eastern Macedonia & Thrace	2670	5	13,250	25.6	20.2%
Central Macedonia	4400	4.6	24,000	24.9	18.3%
Western Macedonia	1290	5.6	5120	22.1	25.2%
Epirus	690	2.3	12,850	43.5	5.4%
Thessaly	2610	4.3	18,490	30.6	14.1%

Table 1. *Cont.*

	<35 Years		>65 Years		$\frac{<35}{>65}$
	Number	**Share (%)**	**Number**	**Share (%)**	
Ionian Islands	570	2.0	12,990	46.4	4.4%
Western Greece	2810	3.5	28,360	35.0	9.9%
Central Greece	1490	2.2	26,510	39.4	5.6%
Peloponnese	2710	3.0	35,180	38.8	7.7%

Source: Eurostat. CAP Context Indicators—2019 Update. 2019. Available online: https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/farming/documents/cap-context-indicators-table_2019_en.pdf (accessed on 1 April 2021) [27] and own elaboration.

1.2. Young Farmer Policy Support

Since the 80s, the EU has implemented a series of measures to support the revitalisation of the rural population and the generational renewal in the agricultural sector [3]. In general, two types of policy support measures can be identified in the EU. Firstly, the "early retirement" schemes which provide financial incentives to older farmers to retire prematurely and transfer their farming activities to the next generation. The second type refers to the start-up aid provided to young newcomers in order to be established in agriculture [28].

While the early retirement schemes are generally considered as unsuccessful across EU member states (e.g., [22,29]), the new entrant schemes appear to be more effective [30,31]. However, even in this case, the first attempts for the implementation of the new entrants' policy was not very successful across EU [3,32]. The turning point was the initiation of the Regulation (EU) 1257/1999, which benefitted about 177 thousand young farmers in six years period [3]. Nevertheless, the obstacles that young farmers face to enter into agricultural activity still exist, especially the scarcity of land and credit (see Section 1.1). Therefore, it is frequent for the start-up aid to young farmers to be ineffective, mainly due to the partial participation of young farmers.

In the case of Greece, the difference prior and after the Regulation (EU) 1257/1999 was even more apparent. Within one decade (1989–1999) about 13.5 thousand young farmers were benefitted, while a total of 39.5 thousand young farmers received start-up aid during the programming period 2000–2006 [3]. However, the inclusion of a business plan and the relatively hard to achieve targets resulted in a reduction in the number of new farmers in the next programming period (2007–2013). More specifically, about 19 thousand young farmers received almost €250 million during the programming period 2007–2013. In addition, according to Chatzitheodoridis and Kontogeorgos [3], the share of young farmers (<35 years old) who benefited from CAP support measures in Greece was only 13.5%.

During the current programming period (2014–2020), support for young farmers is provided under both pillars of the Common Agricultural Policy (CAP). Under Pillar I, which is based on the Regulation (EU) 1307/2013, direct payments are granted directly to young farmers decoupled from production. Under the Pillar II, which finances the EU contribution to rural development programmes following Regulation (EU) 1305/2013, young farmers are benefited by the setting-up measure (sub-measure 6.1). This regulation defines young farmer as "an individual younger than or equal to 40 years old, that possesses adequate occupational skills and competence and is setting up for the first time in an agricultural holding as head of that holding" [33]. The total support for young farmers in the EU has been doubled in the current programming period, reaching €6.4 billion. This increase is mainly the effect of the introduction of the additional direct payments for young farmers under the first pillar. Considering that Member States co-finance the measure to support the setting up of young farmer, the total public support during the current programming period amounts to €12.7 billion.

The previous call of sub-measure 6.1 in Greece had specific requirements concerning the minimum necessary farm size for entering the activity (mainly in terms of gross value added). Until today, about 15.6 thousand young farmers were benefitted by the sub-measure 6.1, receiving almost €300 million (€19,230 per beneficiary, on average) [34]. Recently, a draft version of a new call of this measure is under public consultation in Greece. According to this draft, the level of support will increase (from a range of €17,000–22,000 to a range of €35,000 to €40,000). At the same time, the minimum farm size requirements (in terms of gross value added) will also increase (from €8000 to €14,000) as well as the expected size at the end of the business plan. More specifically, according to the last call, a 10% improvement was necessary (an increase from €8000 to €8800), while in the draft version of the forthcoming call, a minimum threshold of €18,000 is required at the end of the business plan.

1.3. Alternative Crops

In recent years, more and more farmers have searched for new investment opportunities. The recent evolution of alternative crops is one of the results of this trend. Alternative crops have the potential to yield significant economic benefits, provided that a market that can distribute their produce exists. Some of the suggested alternative crops have appealing properties, like the ability to grow on poor lands, utilise sodic soil and be remarkably tolerant to poor quality irrigated water. This is a common situation in rural Greece and especially in remote areas like the Aegean islands. Indeed, the utilisation of sodic soils is a challenging task, as the majority of crops suffers significant reduction of its yield in these situations [35,36]. At the same time, the effects of climate change are already visible around the world and natural resources are under threat. As agriculture is responsible for the consumption of 80% of the water resources, alternative crops which are less demanding for irrigation water are more desirable [37].

The benefits from the cultivation of alternative crops can be also diffused to the communities in which they are developed [38,39]. Indeed, the utilisation of low-quality land can be a crucial factor for the sustainability of rural economies. The successful development of such cultivations can contribute to job creation especially in remote areas with few occupational alternatives. Moreover, it can enhance succession and offer professional opportunities to vulnerable social groups, such as unemployed youth and women.

From a consumer perspective, the increasing demand for high-quality products could also enhance the development of such crops. Consumers are now looking for products rich in nutrients, vitamins and antioxidants. Consequently, several products of alternative crops can be used not only in the food and beverage market but also in the pharmaceutical and cosmetic industry [37].

Various factors determine the level of adoption of alternative crops, such as the existence of mature markets where the produce is distributed through a well-organized and efficiently operating supply chain. This is directly related to the so-called, market risk and uncertainty, which in turn, is based on the price that is offered to the farmers for their produce and their capacity, i.e., the amount of the production that they can distribute. Other obstacles that farmers need to overcome include the lack of experience and technical know-how, the lack of the necessary credit for the start-up costs, the time needed for the crop to reach the productive stage and finally the risk that the chosen alternative crop may not be fully compatible with the soil and climate conditions of the farm [40]. Therefore, the decision of whether to adopt an alternative crop is largely affected by the attitude of the farmers/investors towards risk.

From a policy perspective, the incorporation of the above factors in the policy-making process may offer a clearer picture of where policy measures should be targeted to promote the establishment of alternative crops. In addition, the fact that the Common Agricultural Policy (CAP) places more and more emphasis on the sustainable management of natural resources and rural development can foster the expansion of alternative crops.

In general, young farmers are more eager to innovate and to take risks [41,42]; thus, it is expected that they be more willing to confront the risk and uncertainties embedded in alternative crops. In addition, due to the fact that recently many young people consider to engage in agriculture and relocate to rural areas [3], the number of potential young farmers and specifically farmers willing to invest in alternative crops has also increased [43].

Aloe Vera Crop

It is well-known that aloe vera has been used since ancient times in medicine and cosmetics [44–46]. Several studies have attributed many healing properties to the gel of aloe vera leaves, due to the presence of various bioactive compounds such as glucomannan, anthraquinones, glycosides, amino acids, enzymes, sugars and polyphenols. These compounds are linked to wound healing properties, skin protection against UV-A and UV-B and prevention of type II diabetes and cancer, to name but a few benefits [47–53]. For the above reasons, the use of aloe vera gel in food, pharmaceutical and cosmetic industries has been expanded [54]. Moreover, there are many recently published studies regarding the potential usage of aloe vera gel in fruits and vegetables edible coatings, as a way to increase postharvest life or shelf life (e.g., [55–58]). Finally, according to Martinez-Sanchez et al. [54], the aloe vera flowers also present important bioactive compounds, which can generate additional economic and business opportunities.

The aloe vera crop can efficiently utilize sodic lands [35,59] and although its root system is rather superficial, it can cope well enough in drought conditions. However, irrigation significantly improves yields. The crop presents a remarkable tolerance to low-quality irrigation water such as diluted seawater [60] and heavy salt stress [59,61,62]. Among the many species of aloe, aloe vera is probably the most popular due to its increasing global demand and its wide adaptability [63].

Aloe plantations firstly appeared in Greece during the 90s, in the south area of Crete. In the last 10 years, the cultivation has been spread to the Aegean islands, to the Peloponnesus and to the south part of the Greek mainland [2,64]. There are no official statistics yet regarding the total area of aloe vera crop in Greece. However, it is estimated that today, there are less than 200 aloe vera farmers that cultivate no more than 80 hectares, half of which are located in Crete.

One of the major drawbacks of the aloe vera crop is that it is not very resistant to frost, even though it can withstand temperatures up to −3 °C with minor damages, as long as the frost last a short time period and is not repetitive throughout the winter [49]. This is the reason why the use of low tunnels with special film is suggested so as to prevent frost damages, especially in continental Greece. Moreover, a growing literature on the effect of on-farm practices on the quantity and quality of the aloe vera gel has been developed. The effect of irrigation has been explored in the studies of Rodriguez-Garcia et al. [59] and Murillo-Amador [61], while the utilisation of biofertilizers in the mitigation of aloe vera water stress is explored in the study of Khajeeyan [65]. A number of studies also explore the effect of the harvesting period [66–69] on the yield and in the concentration of bioactive compounds. Finally, several studies estimate the effect of various inorganic fertilizers as well as organic manures on the yield and the quality of the aloe vera gel [58,70–73].

2. Materials and Methods

The methodological framework used in this study is presented in Figure 1. The first step includes the stochastic Net Present Value Analysis (see Section 2.1). In this step, the parameters and the scenarios set for the analysis are derived from three main sources. The first source refers to the special characteristics of the policy regimes, such as the eligibility criteria and the level of young farmers' support. The second source is linked to the characteristics of the crop under investigation (in this case the organic aloe vera crop) such as the yields and the material used for the establishment (one-year or two-year old shoots). Lastly, the structure of the market(s) where the aloe vera leaves are distributed is taken under consideration. This is mainly related to the prices of the aloe vera leaves per market and the share of each market on the total quantities of aloe vera leaves that are distributed per productive period.

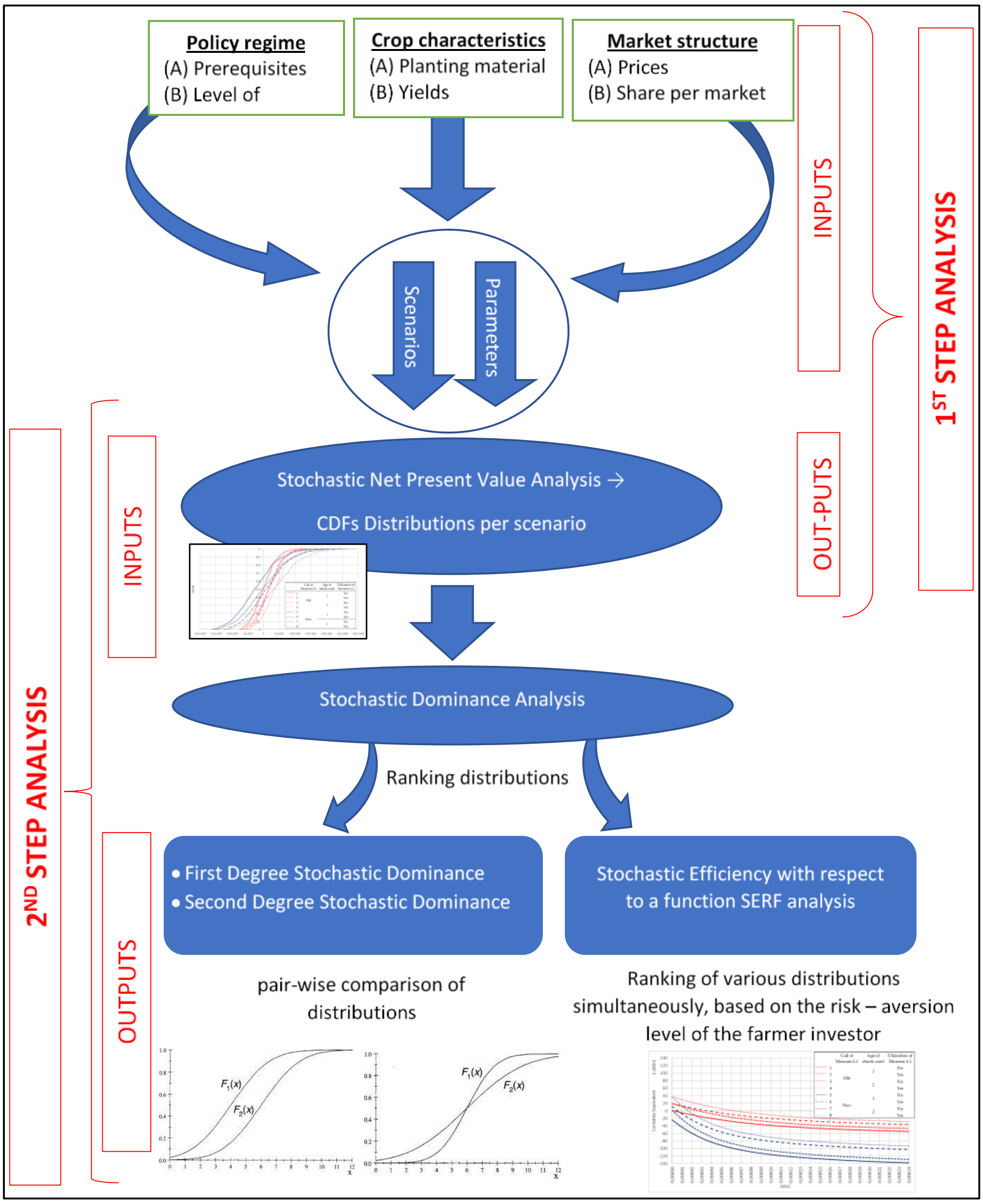


Figure 1. Methodological framework (source: own elaboration).

The outcome of the stochastic NPV analysis is a set of Cumulative Distribution Functions (CDFs) that correspond to each of the scenarios that are set. In the second step, these CDFs are ranked using the Stochastic Dominance analysis (see Section 2.2). Rather than implementing multiple pair-wise comparisons that may not have the discriminating power to distinguish a pair of distributions [5], the most efficient way to rank the distributions is by the implementation of the Stochastic Dominance with Respect to a Function (SERF) analysis. The SERF analysis can be used to rank the whole set of CDFs distributions based on the risk aversion attitude of the farmer/investor.

2.1. Simulation Model

The first step of the analysis involves the implementation of the stochastic NPV. In this way, the desirability of the investment is estimated not by producing a deterministic NPV but a whole distribution that links all feasible NPVs with specific probabilities.

The stochastic simulation model to estimate the NPV of organic aloe vera production is as follows:

$$\widetilde{NPV_s} = \sum_{i=1}^{N} \frac{\sum_j \widetilde{Y}_i(\widetilde{y}_{i,j}\widetilde{P}_{i,j}) + S_{i,s} + SV - \widetilde{VC_i}}{(1+\rho)^i} - I_s \quad (1)$$

where

$\widetilde{NPV}_s$: Net Present Value of organic aloe vera production per scenario, s (€).

I_s: Establishment (Sunk) cost of organic aloe vera farm, in each scenario, s (€).

$\widetilde{Y}_i$: Stochastic yield of organic aloe vera farm in year, i (kg/ha).

$\widetilde{y}_{i,j}$: Stochastic share (%) of yield distributed through market, j, in year, i; $\sum_j \widetilde{y}_{ij} = 1$.

$\widetilde{P}_{i,j}$: Stochastic price for organic aloe vera leaves in year, i, in market, j (€/kg). In this study, we identify three main markets available for aloe vera producers in Greece [2]. The first refers to the Greek processing units but whose capacities are still questionable. The second refers to specialised retail markets (like pharmacies, organic grocery stores and delicatessen super-markets). These markets have considerably lower capacity level but, on the other hand, offer significantly higher producer prices. Finally, few direct sales to sophisticated consumers at even higher prices, are reported.

$S_{i,s}$: Financial Support provided by the sub-measure 6.1 per year, i, and scenario, s (€).

$\widetilde{VC}_i$: Stochastic variable cost of organic aloe farming in year, i (€).

ρ: Discount rate (%).

T: Expected life of the investment (years). Taking into consideration that the productive life of an aloe vera plantation is about nine years [74], we consider the life of the investment equal to 10 years (including the growing phase of the plantation until it reaches its productive life).

SV: Salvage value of the investment.

The different scenarios, s, considered in this analysis are presented in Table 2. It should be emphasised that the alternative scenarios depict different levels of support as well as different levels of initial investment. Following several relevant studies in agriculture [2,75–81], we utilise triangular distributions to define the stochastic variables located at the right-hand side of Equation (1). This type of distribution is widely applied when the actual distribution of a random variable cannot be determined because data are too difficult or too expensive to collect [82]. This is a common case in agricultural activities when important information regarding the structure of the distributions is absent. This is also the case in this study, where no adequate and reliable information on actual yields and prices of aloe vera leaves exist.

Table 2. Description of the scenarios examined in this analysis.

	Call of Measure 6.1	Age of Shoots Used	Utilisation of Measure 6.1	Land Size in Year 1 (ha)	Level of Support ($S_{i,s}$) (€)	Level of Initial Investment (€)	Land Size in Year 10 (ha)
1	Old	1	No	0.9	0	69,475	1
2			Yes		19,500 ($S_{1,2} + S_{4,2}$)		
3		2	No		0	59,307	
4			Yes		19,500 ($S_{1,4} + S_{4,4}$)		
5	New	1	No	1.4	0	108,072	1.9
6			Yes		37,500 ($S_{1,6} + S_{4,6}$)		
7		2	No		0	92,256	
8			Yes		37,500 ($S_{1,8+} S_{4,8}$)		

Source: own elaboration.

The triangular distribution has also the advantage of being intuitively plausible to non-statistically minded decision makers [83]. Therefore, it can be used as a means of involving experts by factoring in their subjective estimates of the minimum, most likely (mode value) and maximum values of the triangularly distributed stochastic variables [82].

Typically, a triangularly distributed random variable X is denoted by X~Triangular (a, m, b), where, a, denotes the minimum, m, denotes the maximum and b, denotes the mode value.

As already mentioned, during the last call of the sub-measure 6.1, farmers got a support that ranged from €17,000 to €22,000. The actual level of support depended on the type of activity (agriculture, livestock, bee farming) and the location of the farm (the farms that are located at remote and/or mountainous areas receive a premium). Moreover, the minimum requirements in terms of the farm's Gross Value Added (GVA) were €8000 at the beginning of the investment and €8800 (10% increase) at the end of the investment. This corresponds to 0.85 ha and 0.94 ha at the beginning and at the end of the business plan, respectively, given the GVA index of the crop (9500 €/ha), provided by the Hellenic Ministry of Rural Development and Food.

The draft version of the forthcoming call of sub-measure 6.1 alters the above farm size requirements as well as the level of support. As far as the aloe vera farm size is concerned, it suggests a minimum of 1.4 ha at the beginning of the investment which should be expanded to about 1.9 ha after four years. Total support increases up to €40,000 depending on the same factors as the previous call.

To examine the effect of the last call of the start-up aid for young farmers on the desirability of the investment in aloe vera crop, we assume a young farmer that begins his activity with 0.9 ha of aloe vera crop. Given the minimum requirements of this call, we assume that this expands to 1 ha of aloe vera crop after 4 years. The farmer receives a total support of €19,500 (70% at the beginning and the rest 30% after the fourth year), as we assumed that his farm is located in a remote area (realistic assumption for aloe vera farms). We also consider two different versions based on the age of the shoots that the farmer uses to establish the aloe vera crop. Finally, we also consider a business-as-usual scenario, where the farmer does not participate in the call, to directly compare the desirability of the investment, with and without the support provided by the last call of measure 6.1.

To compare the last call, with the draft version of the forthcoming call, we proceed in a similar way but with different scenarios adjusted in the prerequisites of this draft call. We assume a young farmer that invests in 1.4 ha of aloe vera crop. Based on the draft version of the forthcoming call, he receives €37,500 (70% at the beginning and the rest 30% after the fourth year). However, in this case, the young farmer should expand the aloe vera crop by 0.5 ha, i.e., at the end of the business plan, the aloe vera crop should cover 1.9 ha (see Table 2).

The stochastic NPV analysis is implemented using the Simetar© 2021 software [84]. One thousand iterations are performed based on Latin Hypercube Simulation. This a version of the well-known Monte Carlo simulation, that uses stratified random sampling to ensure that all areas of the probability distribution are considered [85]. In each simulation, the values of the stochastic variables of the right-hand side of Equation (1) are chosen randomly, based on the predefined triangular distributions. Based on the resulting 1000 NPVs, a Cumulative Distribution Function (CDF) is formed.

2.2. Stochastic Dominance Analysis

To rank the NPV distributions based on each of the eight scenarios (see Table 2), we run the Stochastic Dominance analysis. This analysis is suitable for the categorization of several risky alternatives based on particular assumptions about the investors' attitudes towards risk. First-order stochastic dominance (FSD) only assumes that investors have positive marginal utility, i.e., their utility function has a positive slope (thus, more is preferred to less). If X_1 and X_2 are two sets of random outcomes and F_1 and F_2 the corresponding cumulative distributions, F_1 first-degree dominates F_2 if and only if $F_1 \leq F_2$. Graphically, FSD criterion requires that F_1 always lies to the right of F_2. If FSD criterion fails to discriminate a pair of distributions, the second-degree stochastic dominance criterion (SSD) may be applied. This criterion additionally implies that the investor is risk-averse;

thus, his utility function has a positive but decreasing slope. According to SSD, F_1 s-degree dominates F_2 if [86]

$$\int_{-\infty}^{x^*} [F_2(x) \geq F_1(x)] dx 0, for\ all\ values\ of\ x^* \quad (2)$$

with at least one strict inequality for some x's. In graphical terms, it requires that the area enclosed between F_1 and F_2 should be non-negative up to any point x. In empirical studies, it is often found that the SSD is not discriminating enough to yield useful results [87], in the sense that there are too many choices throughout the efficient set [88]. To deal with this issue, Hardaker et al. [87] introduced the Stochastic Efficiency with Respect to a Function (SERF) analysis to compare a set of risky alternatives based on the risk attitude of the investor. This approach has found wide usage in agriculture (e.g., [2,75,79,89–92]).

The SERF approach requires additional assumptions to be made regarding the form of the risk-averse utility function as well as the risk aversion attitude of the investors. Based on these additional assumptions, SERF analysis ranks a set of risky alternatives in terms of Certainty Equivalents (CEs), that is, the amount of payoff a farmer would require to be indifferent between that payoff and the risky activity [87]. For a risk-averse investor, the estimated CE is typically less than the expected money value [1]. Intuitively, a positive CE reveals that the potential investor is willing to undertake the investment, given his risk aversion level [85].

For each risky alternative and for a chosen form of the utility function, utility is estimated based on the degree of risk aversion r and stochastic outcome of x as [86]

$$U(x,r) = \int U(x,r) f(x) dx \quad (3)$$

The CEs for each of these values of U are found by

$$CE(x,r) = U^{-1}(x,r) \quad (4)$$

where U^{-1} is the inverse form of the utility function. The most commonly used form of utility function in agricultural studies is the negative exponential function. It assumes constant absolute risk aversion, through the inclusion of a constant Absolute Risk Aversion Coefficient (ARAC). This implies that preferences are unchanged if a constant amount is added at all income levels [85]. In other words, the farmers' risk aversion level remains constant, regardless of their wealth [93,94].

In general, there are no standard ranges for ARACs. A common way to proceed is to normalise the range of ARAC against wealth. The relation between absolute and relative risk aversion is $r_a(w) = r_r(w)/w$, where $r_r(w)$ is the relative risk aversion coefficient with respect to wealth (w) [86]. Values greater than zero indicate risk aversion. Following Anderson and Dillon [95], we assume that the upper limit of $r_r(w)$ is equal to 4 (extremely risk-averse behaviour), and we use family income to define wealth [2,96]. Therefore, following Liontakis and Tzouramani [2], the upper limit of ARAC is equal to 0.00024. For the lower limit, we apply the value of 0 (indicating a risk-neutral investor).

2.3. Data Description

The data used in this analysis were obtained through personal in-depth interviews with 33 aloe vera producers located in the Southern and Central part of Greece (see Figure 2), which were members of the Hellenic Association of Aloe Vera Producers. Provided that there are no more than 200 aloe vera farmers around Greece, the sample corresponds to 15% or more of the total population. The farmers provided detailed technoeconomic data regarding establishment and cultivating techniques. It has to be noted that the average farm size of the sample is very low (less than 0.2 ha) while only one farm has size larger than one hectare (see Figure 3). This fact questions the scale efficiency of the sample farms and may cause an upward bias in the cost of production. However, the sample reflects the actual population. In general, farmers are still reluctant to adopt aloe vera cultivation and are waiting for the first positive signs of the market. Therefore, the first innovative aloe vera farmers begin their activity by the establishment of aloe vera crop in a small portion of their land. Then, provided that market signs are positive, they are willing to significantly expand their plantations either by utilising their own land or by renting available land.

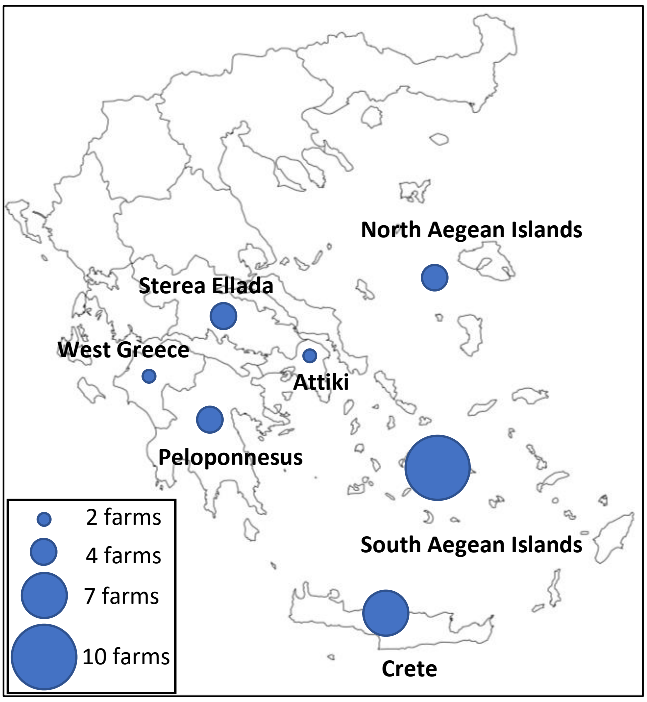


Figure 2. Location and distribution of the aloe vera farms in the sample (source: own elaboration).

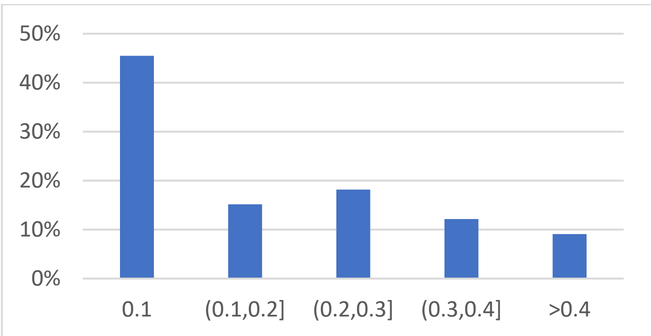
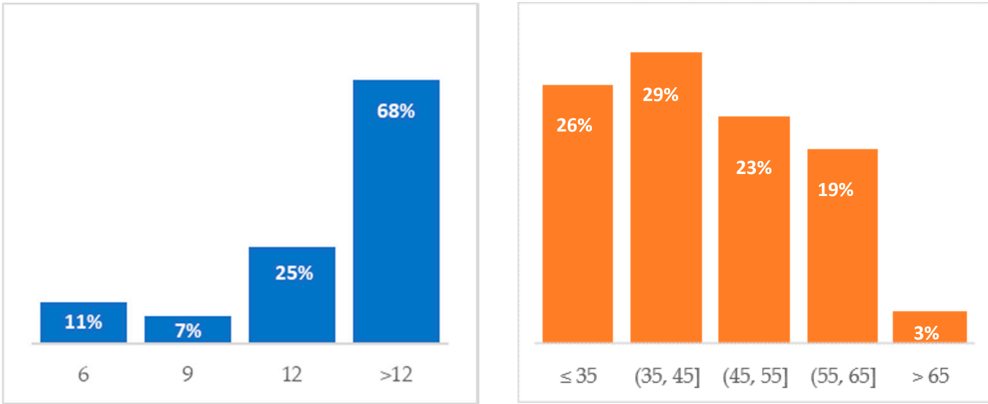


Figure 3. Distribution of the size of aloe vera crops in the sample (source: own elaboration).

Figure 4 presents some demographic characteristics of the aloe vera farmers in the sample. The farmers have a high level of education and are much younger than the average Greek farmers (it is noteworthy that there is only one farmer older than 65 years representing the 3% of the sample). This fact confirms that young farmers are more willing to invest in alternative crops. It is of course expected that, if aloe vera crop is successfully developed in the next years, an increasing number of people of various educational levels and age groups will invest in this crop, altering the age and education distributions accordingly. However, it is rather unlikely that these distributions will ever converge to the agricultural sector distributions.



(**a**) (**b**)

Figure 4. (**a**) Age and (**b**) level of education (in terms of number of years in education) distribution for the aloe vera farmers in the sample (source: own elaboration).

2.3.1. Establishment Costs

The elements of the establishment costs of the aloe vera crop are presented in Table 3. The cost differs according to the age of shoots that are used for the plantation. Younger shoots (one-year old) are cheaper, but there is a two-years gap between establishment and the beginning of productive life. On the other hand, the older shoots (two-years old) are more expensive, but their productive life begins much faster after their installation (one year gap). In both cases, the establishment cost incorporates the aggregate operating costs until the plantation reaches its productive life. Thus, in the young (old) shoots, two years (one year) operating costs are incorporated in the establishment costs.

Table 3. Establishment cost of an organic aloe vera farm in Greece (€/ha).

Cost Elements	Age of the Shoots Used for the Aloe Vera Crop Establishment		
	One-Year Old	**Two-Years Old**	**Own-Produced Two Years Old**
Soil preparation	696	696	696
Purchase of aloe vera shoots	15,000	20,000	4000 *
Irrigation system	6872	6872	6872
Mechanical equipment	1560	1560	1560
Non-mechanical permanent capital (mainly fetch and anti-frozen tunnels **)	20,984	20,984	20,984
Labour	11,589	5515	5515
Land	3262	1631	1631
Variable cost	8378	4213	4213
Annual Capital cost	8853	4426	4426
Total cost	77,194	65,897	49,897

(Source: own elaboration). * The value of shoots equals to the cost for the removal of the shoots from their maternal plant, planting in a pot and nursery costs for one year. ** The establishment of the aloe vera plantation in Greece reveals that in many cases, aloe plants were damaged during the winter, especially in continental Greece due to low temperatures. Therefore, we consider as necessary the use of low tunnels with special film in order to protect the plantation from frost.

Table 3 also presents the establishment cost when own-produced shoots (two years old) are utilised. In this case, the reported value of the shoots corresponds to the cost of removal from the maternal plant and planting in a pot as well as nursery costs for one year.

2.3.2. Revenues

As it has been already mentioned in the previous chapter, the cultivation of aloe vera is still in its infancy stage. For this reason, there is still limited evidence regarding actual yields and market prices. For the purpose of this study, the triangular distribution parameters of yield and price have been approximated by "filtering" farmers' experience and expectations based on market agents' knowledge and literature review. An alternative approach would be the derivation of empirical distributions based on the actual responses of the farmers in the sample. However, these empirical distributions are characterised by significant "noise" which appears as a long right-tail. This is the outcome of the extremely high expectations of many farmers, considering yields and prices [2]. These expectations do not seem rational at least at this stage of aloe vera crop development. For this reason, the facts derived from the literature (mainly regarding yields) but also from market experts (mainly regarding prices) have been used to reduce the skewness of these distributions.

Using the terminology followed in Equation (1), the revenues are estimated as: $\sum_j \widetilde{Y}_i(\widetilde{y}_{i,j}\widetilde{P}_{i,j})$. In this study, the triangular distributions that have been used for the estimation of revenues are as follows:

$$\widetilde{P}_{\text{i},1} \sim \textit{Triangular}\ (0.15; 0.25; 0.20)\ (€/\text{kg})$$

$$\widetilde{P}_{\text{i},2} \sim \textit{Triangular}\ (2; 4; 3)\ (€/\text{kg})$$

$$\widetilde{P}_{\text{i},3} \sim \textit{Triangular}\ (5; 7; 6)\ (€/\text{kg})$$

$$\widetilde{Y}_i \sim \textit{Triangular}\ (35; 75; 50)\ (\text{tn}/\text{ha})$$

$$\widetilde{y}_{\text{i},\,1} \sim \textit{Triangular}\ (0.8; 1; 0.9)\ (\%)$$

$$\widetilde{y}_{\text{i},2} \sim 0.9 * (1 - \widetilde{y}_{\text{i},1})\ (\%)$$

$$\widetilde{y}_{\text{i},3} \sim 1 - \widetilde{y}_{\text{i},2} - \widetilde{y}_{\text{i},1}\ (\%)$$

Table 4 and Figure 5a present the expected annual revenues from the organic aloe vera crop, based on the expected values of the stochastic yields, prices and market shares. These values indicate that all the three market channels are important for the determination of the revenues, even though the shares of these markets are much different.

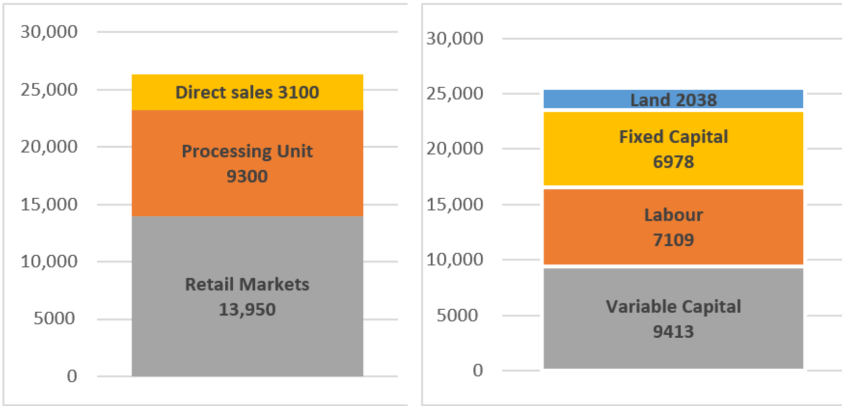
2.3.3. Costs of Production

Figure 5b, provides the main elements of the annual costs, on average, for the aloe vera crop. The share of the variable capital is about 35%, followed by labour costs and fixed capital. In the variable capital costs, the shipping costs of aloe vera leaves are the main cost element. Shipping costs considerably vary between different Greek rural areas and can play an important role in the future spatial distribution of the crop [2]. It should also be noted that the stochasticity of yields also affects annual costs, as the labour cost for harvesting and the shipping costs are directly related to yield.

Table 4. Expected revenues from organic aloe vera leaves' sales (per ha), based on the expected values of yields, market share and price.

Market Channel	Quantity (Tones)	% of Total	Price (€/kg)	Revenues
Processing Unit	46.5	90%	0.2	9300
Retail Markets	4.7	9%	3.0	13,950
Direct sales	0.5	1%	6.0	3100
TOTAL	51.7			26,350

Source: Own elaboration.

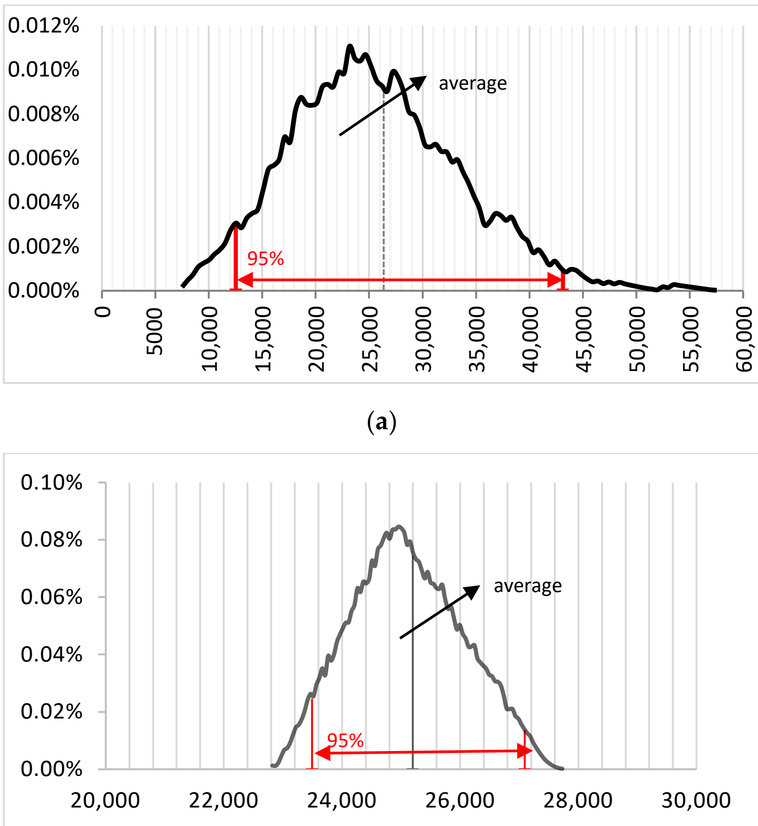


(**a**) (**b**)

Figure 5. Average annual revenues (**a**) and costs of production (**b**) per hectare (source: own elaboration).

3. Result and Discussion

Figure 6a,b presents the distributions of annual revenues and costs per hectare. In the case of revenues, an increased dispersion as well as a big right tail characterise the distribution. In 95% of the cases, the revenues vary between €12,000 and €43,000, while the average value is equal to €26,000. This considerably high variation stems from the combination of the stochastic variables for yields, prices and market shares.



(**a**)

(**b**)

Figure 6. Distribution of revenues (**a**) and costs (**b**) of organic aloe vera crops per year (source: own elaboration).

On the contrary, annual costs have much lower variation. This is due to the fact that the stochastic part of annual costs only regards harvesting and shipping of the aloe vera leaves. The stochasticity of these variables is based on the stochastic nature of the yield. In 95% of the cases, the annual costs vary between €23,500 and €27,000, while the average value is about €25,000. Therefore, the annual costs are somewhat lower than the revenues, on average terms. However, the large variability of revenues evokes the possibility of losses and thus justifies the usage of risk analysis.

Given the importance of each market in our analysis, these results indicate that the farmer should ensure the distribution of a significant part of the yields either to retail markets or through direct sales, so as to reach a decent level of revenues that is located in the centre or even in the right-hand side of the distribution of revenues. This is a very important outcome as it reveals the necessity for market differentiation.

On the other hand, if the distribution of aloe vera leaves through either retail markets or direct sales is not possible, the farmer should seek a processing unit that offers a price higher than the expected value of 0.2 €/kg (see Table 4). It should be mentioned that an additional source of income could also be created by supplying shoots to other farmers that want to invest in aloe vera. However, this is not a straightforward procedure as a special permission and specific requirements are necessary. In addition, any prediction on the quantities of shoots that a farmer can supply per year is risky and questionable. In any case, we did not consider that the supply of shoots can significantly contribute to the economic outcome of the farm, in the long run. That is the reason why we did not consider this parameter in the estimation of total revenues.

Stochastic Investment Analysis

The stochastic model in Equation (1) provides a distribution of NPVs for each of the alternative scenarios. Each distribution links a feasible range of NPVs with a specific probability of occurrence [97]. Figure 7 depicts the Cumulative Distribution Functions (CDFs) of the NPV distributions for each of the alternative scenarios, while Table 5 provides the corresponding summary statistics.

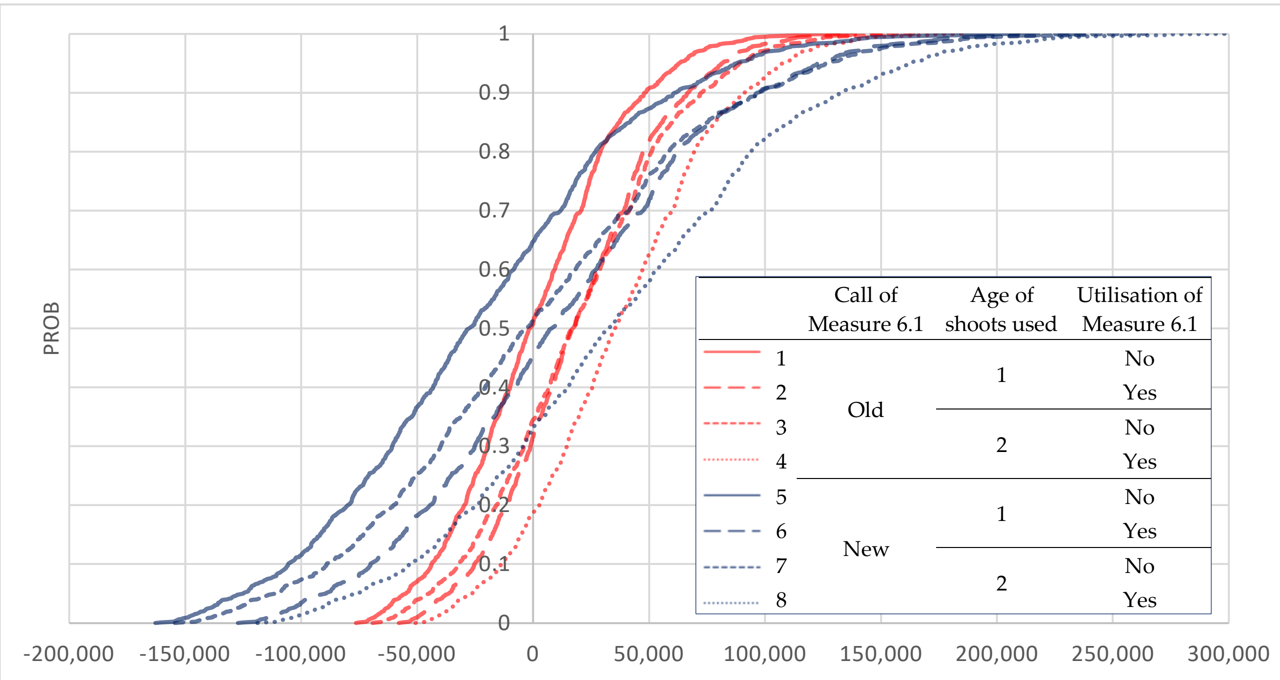


Figure 7. NPV distribution under the alternative scenarios (source: own elaboration).

Table 5. Results of the stochastic estimation of the net present value (NPV) per scenario.

Assumptions				Outcomes				
Scenario	**Call of Meas. 6.1**	**Age of Shoots**	**Utilisation of Meas. 6.1**	**Mean**	**CV**	**Min**	**Max**	**Prob < 0**
1	Old	1	No	1016	3510	−76,304	131,699	51%
2			Yes	19,509	183	−57,811	150,192	32%
3		2	No	19,110	212	−69,152	166,512	35%
4			Yes	37,603	108	−50,659	185,005	19%
5	New	1	No	−23,834	−270	−162,810	209,175	65%
6			Yes	11,729	549	−127,247	244,738	46%
7		2	No	1611	4468	−154,461	264,152	51%
8			Yes	37,174	194	−118,898	299,715	33%

Source: own elaboration.

According to Figure 7, the CDFs of the NPV distributions can be divided into two groups. The first group (depicted with the red colour) includes all the scenarios that correspond to the last call of the start-up aid for young farmers. Scenarios 1 and 3 that do not utilise the start-up aid for young farmers are clearly dominated by the other two scenarios (2 and 4). Therefore, as expected, the start-up aid measure adds net present value to the investment.

In addition, the age of the shoots used for the establishment appears to be an important factor for the NPV of the investment. The use of one-year old shoots for the establishment of the aloe vera crop, ceteris paribus, deteriorates the desirability of the investment. This is clear from the comparison of the pairs (1, 3); (2, 4); (5, 7); and (6, 8). In all these pairwise comparisons, the scenario in which two-years old shoots are utilized dominates the other. The establishment of aloe vera crop with two-year old shoots results in a shorter growing period until the crop reaches its productive phase. This fact counterbalances the higher purchase cost of the older aloe vera shoots. This is a very important outcome that has to be taken under consideration by the farmers that are willing to invest in aloe vera.

In addition, the probability of negative NPV is much lower when the farmer benefits from the start-up aid as well as when two-year old shoots are used. The probability for negative NPV is the lowest (19%) when both of the above assumptions hold. However, it has to be noted that even though this scenario has the lowest probability for negative NPV, a 19% probability is still considered high, especially for a risk-averse investor.

The comparison of the NPV distributions that belong to the second group (which corresponds to the forthcoming call of the "young support" regime) yields similar results. The utilisation of start-up aid for young farmers and the use of two-year old shoots are two important factors that affect the position of the NPV distribution and its specific characteristics. However, in the case of the second group, the probability of negative NPVs is even greater.

Another useful and compact way to illustrate the findings of the analysis is the StopLight charts (Figure 8), which show the probability of achieving a minimum and a maximum goal for each scenario. StopLight charts are more user-friendly, especially for decision makers not familiar with risk ranking tools [87]. For this reason, they have been used in extension services [98]. The red colour represents the probability of a not favourable outcome to occur, while green represents the probability of a favourable outcome to occur. Finally, the yellow area represents the probability of an in-between outcome to occur. In our study, we set the minimum target to zero NPV, while the maximum is estimated as the maximum mean value among the eight scenarios, following Andrew et al. [99].

The results of the stoplight chart highlight the fact that scenarios 4 and 8 have the lowest probability to yield negative NPV, while scenarios 1 and 5 have the highest probability for a negative value of the NPV. Scenarios 4 and 8 have almost the same probability for a favourable outcome, but scenario 8 has a much higher probability for a negative NPV relative to scenario 4. Another interesting outcome that is highlighted by this analysis is the high variability of NPVs. Even scenarios 1 and 5 which are clearly dominated by the rest of the scenarios have a significant probability (about 15%) to yield a favourable outcome. On the other hand, scenarios 4 and 8 that dominate the rest of the scenarios have a significant probability to yield an unfavourable (negative) outcome (19% and 33%, respectively).

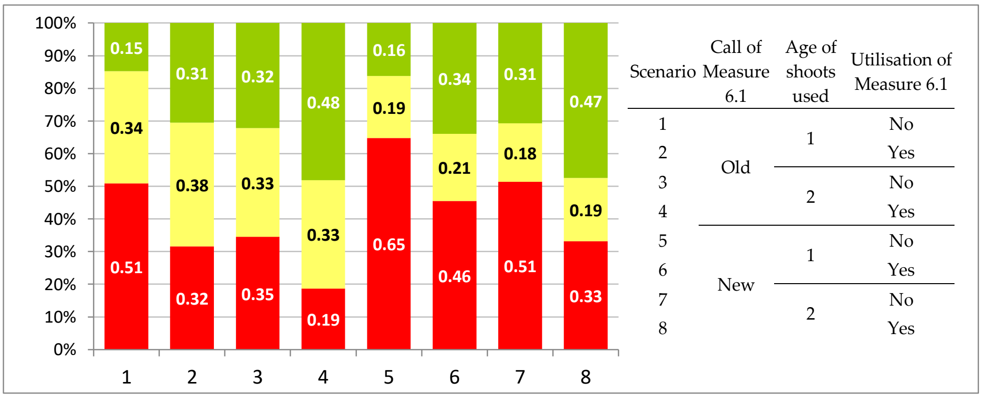


Figure 8. StopLight Chart for probabilities less than 0 (red light) and greater than 37,602 (green light) per scenario (source: own elaboration).

Turning back to Figure 7, it also demonstrates that there are some CDFs that cross each other. In that case, there is no uniform ranking across alternatives for all the levels of risk aversion [100]. To determine the preferred alternative based on the level of risk aversion, the SERF analysis is applied, and the results are provided in Figure 9. As expected, the Certainty Equivalents for each scenario decrease as the level of risk aversion increases. There are three scenarios (1, 5, 7) where the values of the CEs are negative or equal to zero even for a risk-neutral investor (ARAC = 0). This outcome indicates that the start-up aid for young farmers can significantly affect the newcomer's decision to engage in aloe vera farming. Among the scenarios that do not include the young farmers support, only scenario 3 yields a positive but still very low level of NPV for a risk-neutral investor.

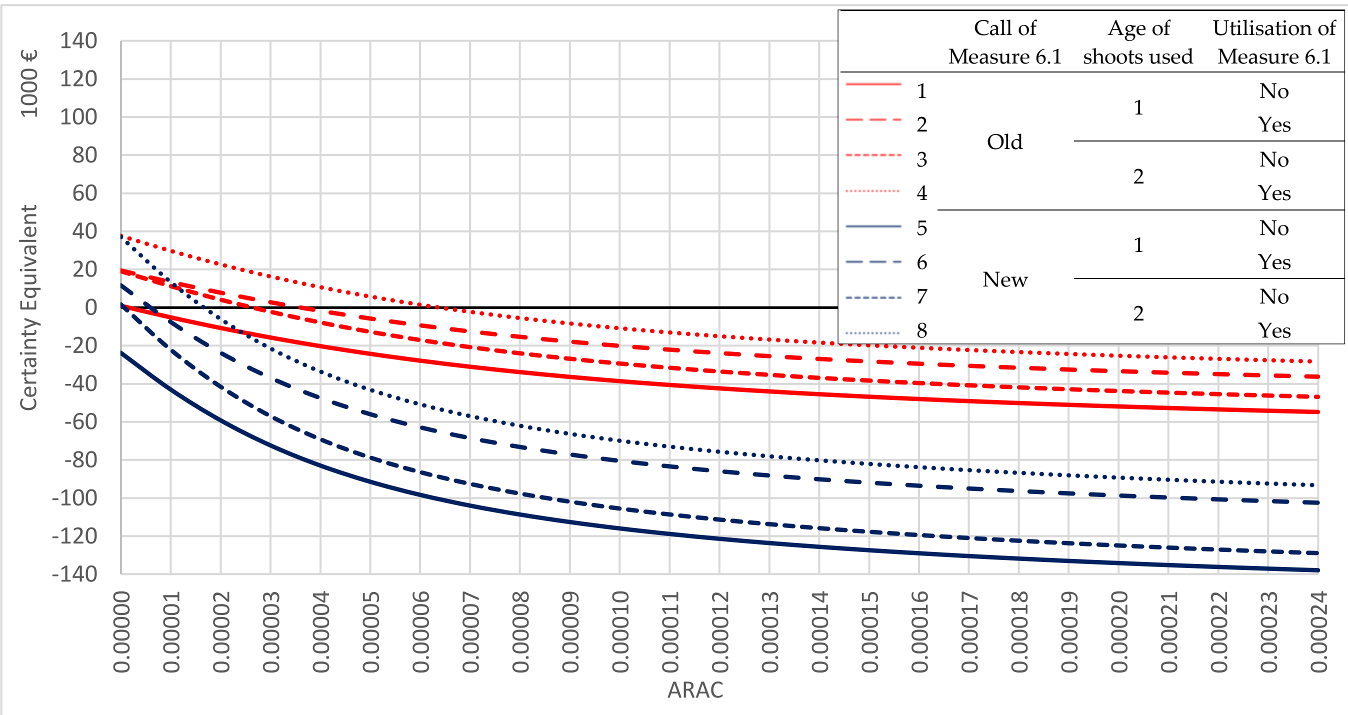


Figure 9. Stochastic Dominance with Respect to a Function (SERF) analysis results (source: own collaboration).

These results highlight the importance of the start-up aid for the establishment of young farmers for their decision to invest in agriculture. This is also the finding in the study of May et al. [101] which used a behavioural approach to determine how the support paid to young farmers significantly influenced the incentives of young farmers to stay in agriculture.

The remaining scenarios, i.e., scenarios 2, 4, 6, 8, result in a positive CE value, for some range of risk aversion. SERF analysis indicates that the most desirable investment is the one represented in scenario 4. In this scenario, positive CE values are present for a large range of ARAC values (0, 0.00006). Therefore, the analysis suggests that the start-up aid for young farmers given by the last call is more effective at least in the case of organic aloe vera farm relative to the forthcoming call.

Interestingly, scenarios 4 and 8 cross the vertical axis at the same point. This is an indication that for a risk-neutral investor, the desirability of the investments represented by scenarios 4 and 8 is equal. However, as the level of risk aversion increases, the CEs of scenario 8 are rapidly decreasing and cross with scenarios 3, 2 and 1 at different levels of risk aversion. Therefore, investors with different levels of risk-aversion rank differently the scenarios examined in this study. For example, when the risk aversion attitude of an investor corresponds to an ARAC value between 0 and 0.00001, scenario 8 is ranked as the second-best scenario, but when the investor's risk attitude corresponds to a higher than 0.0003 ARAC value, scenario 8 is only ranked in the 5th place.

This is also the case in other studies that utilise the stochastic NPV analysis to rank different investment options. For example, Asci et al. [102] analyse the viability of greenhouse tomato investment decisions, under different production technologies. The authors end up with different rankings, at different levels of risk aversion, while the high-technology ranking was only desirable at a lower level of risk aversion producers. This was also the case in the study of Boyer et al. [103] regarding different productive systems of Tennessee cotton crop as well as in the study of Andrew et al. [99] regarding the economic viability in different chicken farming systems in Tanzania.

Finally, it is also important to notice that after a certain level of risk aversion, the rankings remain steady.

These finding suggest that under the forthcoming start-up aid for young farmers, an investor should have an extremely low-risk aversion level (almost risk-neutral) to positively evaluate the option to invest in aloe vera farming. This was not the case, under the last call of the measure 6.1, according to which aloe vera crop remained a desirable investment up to a certain level of risk-aversion. It should be noted, however, that the increased requirements which the draft version of the forthcoming call proposes have already raised negative reactions by the Greek agricultural sector agents. No decisions have been taken yet, but the possibility of a compromise solution seems to be the most possible outcome of the consultation procedure.

In any case, the results of the analysis suggest that the aloe vera crop has a high level of risk. Therefore, under the assumptions made in this study regarding potential yields and prices, aloe vera crop does not seem to be a viable option, at least for an investor that is conservative and has high level of risk aversion.

These results also demonstrate the benefits of the stochastic version of the Net Present Value analysis. Given the average values, in all cases (except scenario 5), the NPV is positive. Therefore, the traditional NPV analysis would suggest that this investment is desirable. Thus, the inclusion of risk and uncertainty in the NPV analysis can be very beneficial and informative for potential investors, especially in the agricultural sector, where risk and uncertainties are usually high.

Moreover, despite the fact that the vast majority of the aloe vera leaves (90%) are distributed to processing units, an important source of income lies in retail markets and direct sales. This is a very important outcome that reveals the necessity of market differentiation. In other words, a processing unit alone cannot support the economic sustainability of an aloe vera farm, except if it offers a much higher price. This, in turn, highlights the necessity of a market research prior to the establishment of the aloe vera crop. The on-going research on new, innovative uses of aloe vera gel, other than those of traditional medicines and cosmetics (such as in edible food coating), can help to maintain the interest of innovative investors in aloe vera.

Other possible ways to overcome the risk linked with this cultivation is vertical integration as well as farm income diversification. Aloe vera is a crop suitable for vertical integration through the development of small-scale processing units, either at the individual farm level or at a producer organisation level. According to our knowledge, two cases of vertical integration exist so far in Greece, one formed by a cooperative form in Naxos island and the other by an individual farmer in Chios island. Moreover, aloe vera plantation offers the opportunity for the development of alternative forms of tourism, like eco-tourism, utilizing the multifunctional farm model. This can enhance income diversification, a strategy which in turn can lower income risk and uncertainties [104,105].

4. Concluding Remarks

This analysis examines the role of policy measures in the adoption of innovative crops. The study uses the cultivation of aloe vera in Greece as an example to demonstrate the effect of the new farmers' policy measure and the start-up aid it provides to the desirability of the investment on alternative and less common but propitious crops. One main characteristic of these innovative activities is the increased level of risk and uncertainty that accompanies their adoption. To account for these significant elements, we implement a stochastic NPV analysis, where some key factors like prices and yields are not deterministic but are incorporated in the model as stochastic variables. The analysis is implemented in light of the forthcoming call for the start-up aid measure that is significantly modified compared to the previous one.

The results of our analysis indicate that the forthcoming call of the young farmers measure deteriorates the desirability of investment in organic aloe vera crop and possibly of other innovative crops, compared to the last call of the measure. This is mainly due to the increased demand for land and capital initial investments it requires which already pose restrictions for newcomers in agriculture. These requirements may discourage the development of alternative crops that are popular among young potential farmers and hold back generational renewal in the sector.

Furthermore, it is our belief that the true added value of this analysis lies in the fact that it can present a good example of what should be considered in decision-making both at the farm level (investor) and the administration level (policy-making). For the former level, the analysis demonstrates risk factors that the simple investment analysis overlooks and may prove to be useful for the sustainability of any investment on (more or less) innovative crops. For the latter level, this analysis can provide valuable insights regarding the possible impact of policy measures on the adoption possibilities of innovative crops.

Specifically, the need to account for risk and uncertainty in decision making is crucial as indicated by our results, since the common deterministic NPV methodology would in most cases suggest that the investment in aloe vera is desirable and that farmers should proceed to the establishment of the activity. However, the stochastic NPV highlights the significant possibility for a negative economic outcome as well as the factors that may result in it.

The analysis also suggests ways to overcome the market risk associated with the activity, by market differentiation, since the results highlight the significant amount of income that can derive from direct sales and retail markets. Another way to cope with risk is vertical integration which can be appealing to young investors, given the increasing research on alternative aloe uses in pharmaceuticals, cosmetics as well as the food and beverages industry.

It should be emphasized that though this analysis sheds light in many methodological and practical aspects regarding the evaluation of the investment in aloe vera and perhaps other alternative crops, it is limited by the lack of data regarding this novel activity. Thus, the analysis can significantly improve in the future to incorporate historical data regarding yields and prices as well as data from a larger number of fully productive farms.

Moreover, it is important to notice that, for a certain group of people, aloe vera crop is more than an investment. It is a way to innovate and to discover new potentials, a challenge to accomplish and, all in all, a "way of life". In this sense, the aloe vera "legend" can add to the desirability of the investment and compensate for increased risk and uncertainty. This is the case for many of the existing aloe vera farmers, who do not act as *homo economicus* and thus may not exclusively target profit maximization [106]. In this sense, the utility function of this group of farmers may be more complex and multi-attribute [107,108]. This discussion goes beyond the scope of this study but still presents an interesting topic for future research.

Finally, emphasis should be given to the positive effects that a wide successful adoption of this cultivation can provide to the local communities. Aloe vera belongs to a group of crops that can efficiently utilize poor lands and so they can substantially add to the sustainability of rural economies. Supporting policy regimes are important tools in this effort as without support these investments would be undesirable by farmers/investors. The start-up aid for young farmers can not only contribute to this effort but also accommodate the current trend of rural repopulation. For this new generation of potential farmers, alternative crops are more popular and attractive. Overall, the main idea of the start-up aid for young farmers support is the restructuring of the agricultural sector and the revitalisation of rural areas. The adoption of innovative crops can facilitate these structural changes, provided that both market and production risk are mitigated through the investigation of potential markets and the implementation of well-designed extension services that can assist farmers to be successfully involved in the cultivation of alternative crops.

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