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Too Complex to Choose? The Role of Heuristics in Shaping Farmers' Willingness to Pay for Income Stabilization Tool in Italy

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ABSTRACT

European agriculture is increasingly exposed to economic instability driven by extreme weather events, market volatility, and geopolitical tensions. To manage these growing risks, farmers are encouraged to adopt innovative risk management strategies such as the Income Stabilization Tool (IST), which offers protection against severe income fluctuations. However, under uncertainty, decision-making becomes challenging, often leading farmers to rely on simplified decision rules, the so-called *heuristics*. This study explores how two shock-experience heuristics affect farmers' willingness to pay (WTP) to join a IST fund, before and after learning the actual participation cost (external treatment). Through a framed-field experiment with 150 Italian apple growers, we tested the effect of individual past (personal shock experience) and general past (shocks in their social network). Results show that, before learning the actual participation cost, farmers rely on heuristics to assess risk, with individual past yielding the highest WTP (€ 421.11/ha). Once the actual price is revealed, heuristics no longer influence decisions, and WTP converges across all groups to match the control (€ 268.08/ha).

1 | Introduction

European agriculture is increasingly exposed to economic risks, driven by extreme weather events, market volatility, and geopolitical tensions, leading to strong fluctuations in farm income (Debonne et al. 2022). Between 2007 and 2015, indeed, more than one fifth of farms in the European Union experienced annual revenue losses exceeding 30% of their average income over the previous 3 years, with particularly severe impacts observed in horticulture and permanent crop sectors (European Commission 2018; Trestini et al. 2017). These income losses arise from different sources of risk, affecting production yields, product prices, and input costs. For this reason, the long-term viability of farms largely depends on farmers' capacity to manage shocks and recover after adverse events (Meuwissen et al. 2019; Reidsma et al. 2015).

To strengthen their resilience in the face of this instability, farmers can rely on a range of risk management tools supported under the Common Agricultural Policy (CAP) (Spiegel et al. 2020). These include traditional risk transfer instruments, such as insurance for crops, livestock, and plants, as well as more innovative risk-sharing mechanisms. A notable addition to this toolkit is the Income Stabilization Tool (IST), namely a mutual fund introduced through the Rural Development Programmes, which aims to stabilize farm income over time by compensating farmers for severe income losses.

Yet, despite their potential, the adoption of the IST scheme among the European Union countries has remained limited. During the 2014–2022 programming period, only Italy, Hungary, and the Spanish region of Castilla y León planned to implement the tool (EPRS 2016). Although a larger number of Member States have further included IST in their CAP Strategic Plans for the 2023–2027 period (European Commission 2023), actual implementation remains uneven, with only Italy having officially adopted the instrument. In line with this, nine mutual funds are currently active in Italy, covering different products, including sugar beet, rice, milk, apples, and fruit and vegetables. However, farmers' uptake of this instrument is generally low and highly fragmented (Ministry of Agriculture, Food Sovereignty and Forests MASAF 2024). Several factors may explain this limited diffusion, including concerns about the financial robustness of mutual funds covering systemic risks (Meuwissen et al. 2003, 2013), issues of asymmetric information and adverse selection, and farmers' trust in the scheme (Giampietri et al. 2020).

Beyond economic and institutional explanations, a growing body of literature shows that farmers' adoption of risk management instruments is strongly influenced by behavioral factors, including risk perceptions, attitudes, and cognitive processes (Capitanio et al. 2016; Meraner and Finger 2019; Trestini and Giampietri 2018; Severini et al. 2021; Čop et al. 2020). Traditional economic models typically approach these decisions by assuming rational agents, perfect information, and optimizing behavior. However, such assumptions are increasingly questioned when decisions are made in complex, uncertain, and dynamic environments, as is often the case in agriculture, particularly under climate change (Arthur 1999; Farmer and Foley 2009; Tesfatsion 2002). Empirical evidence suggests that farmers frequently depart from the predictions of expected utility theory (EUT) (Von Neumann and Morgenstern 1947), relying instead on experiential knowledge, social cues, and simplified decision rules (Moritz et al. 2024). Moreover, when decisions involve complex trade-offs and uncertain outcomes, individuals often resort to heuristics, cognitive shortcuts that reduce decision complexity when information, time, or processing capacity are constrained (Simon and Newell 1971).

In agriculture, where uncertainty is pervasive, farmers routinely rely on such simplified decision strategies. Past experiences with adverse events play a central role in shaping risk perceptions and subsequent behavior: repeated exposure to shocks tends to increase perceived risk and affect future decisions (Duinen et al. 2015). At the same time, farmers' perceptions and choices are embedded in a social context. Informal peer networks serve as important channels through which information about shocks and responses is shared, thereby influencing individual risk perceptions and adaptive behavior (Barnes et al. 2013; Tang et al. 2013).

Despite the growing recognition of these behavioral mechanisms, empirical evidence linking heuristics to the adoption of income stabilization tools is still lacking, especially with regard to heuristics based on past personal experience and socially mediated information. Against this background, this research aims to address this gap by investigating more in depth how various heuristics may trigger farmers' intention to participate in an IST fund tailored for the apples sector in Italy, implementing a framed field experiment (Harrison and List 2004). Farmers' willingness to pay to enter the fund was elicited through an experimental Becker–DeGroot–Marschak (BDM) auction conducted on 150 farmers. Participants were randomly assigned to one of three treatments (individual past, general past, and control), designed to prompt reflection on adverse events experienced either on their own farm (individual past), within their local farming community (general past), or not at all (control). Willingness to pay for the IST was measured both before and after respondents received information on the 2024 price of the IST fund, which can be considered as an external treatment, given that the experiment was conducted in a real context and that the fund manager communicated the subscription price during the course of the experiment.

The paper is organized as follows. The next Section 2 provides details on the IST fund and on heuristics. Subsequently, in Section 3 the institutional and operational context of the apple IST fund analyzed in the experiment is described. Section 4 presents the experimental design, including the three treatments, while Section 4.2 describes the in detail how external treatment has been managed. Results are presented in Section 5 and discussed in Section 6. Finally, the main conclusions of the study are drawn in the last Section 7.

2 | Background

2.1 | Income Stabilization Tool: Institutional Framework and Operational Design

The Income Stabilization Tool is an income-based risk management instrument introduced under the CAP to enhance farmers' resilience to severe income fluctuations through collective risk sharing and public co-financing. Unlike traditional insurance schemes, which rely on risk transfer and typically compensate production losses associated with specific hazards, the IST operates as a mutual fund based on risk pooling among participating farmers. Its objective is to stabilize farm income by compensating income losses regardless of their source, including market disruptions and price volatility, which are risks that are often not covered by multi-peril insurance or other existing mutual funds (European Parliament 2016).

Introduced under Regulation (EU) No. 1305/2013, the IST initially provided compensations when income losses exceeded 30% of a farmer's historical average. Subsequent amendments under the Omnibus Regulation (EU) No. 2017/2393 allowed for sector-specific implementation and lowered the trigger threshold to 20%. In addition, activation of the IST fund requires that the area in which the farmer operates experiences an average income loss of at least 15% (area threshold). Only when both conditions are met (namely an individual income loss of at least 20% and an area-level loss of at least 15%) the fund can be activated and compensation paid. Public support under the CAP Rural Development Policy contributes both to the establishment and capitalization of mutual funds and to the co-financing of indemnities, in line with WTO Green Box requirements, with the aim of encouraging participation and ensuring the financial sustainability of the scheme (European Parliament 2026).

Similar income stabilization instruments had already been adopted in several non-EU countries, most notably in the United States and Canada, highlighting the growing policy interest in income-based risk management tools (Rippo and Cerroni 2023). For instance, in Canada, the Canadian Agricultural Income Stabilization (CAIS) program operated as a whole-farm income insurance scheme in which farmers' contributions were matched by public funds. As for the United States, the federal crop insurance system progressively shifted from yield-based to revenue-based models, notably with the introduction of the Average Crop Revenue Election (ACRE) Program under the 2008 Farm Bill (Smith and Glauber 2019). The subsequent 2014 Farm Bill further streamlined this approach by establishing a revenue-based framework for decoupled payments triggered by revenue losses relative to a 5-year Olympic average (Severini et al. 2021).

2.2 | Heuristics and Decision-Making Under Risk

When facing decisions under risk, individuals often find the integration of probabilities and potential outcomes cognitively demanding and time-consuming (Pachur et al. 2017). Consequently, when decisions involve complex trade-offs and uncertain outcomes, people frequently resort to heuristics or "rules of thumb." These represent simplified yet adaptive strategies for decision-making in contexts characterized by uncertainty and limited information (Simon and Newell 1971). Heuristics allow individuals to reach satisfactory outcomes when cognitive resources are constrained, rather than seeking optimal solutions (Simon and Newell 1971). Importantly, these heuristics are not inherently biased (Zhang and Cueto 2014) and are increasingly viewed as context-dependent strategies enabling individuals to cope with uncertainty and complexity (Bingham et al. 2019; Ott et al. 2017).

As before mentioned, the agricultural sector represents a particularly relevant context for the use of heuristics, as farmers routinely face uncertainty related to weather variability, market price fluctuations, and yield instability. In such conditions, analyzing all available information and calculating probabilities for each possible outcome can be impractical (Sanga et al. 2021). Consequently, farmers often rely on personal experience or observations of peers when making decisions. To illustrate, when faced with a price collapse, a farmer might decide how to respond based on personal past experience or by observing what neighboring farmers are doing, rather than engaging in complex forecasting or cost-benefit analysis (Duden et al. 2023). This approach allows them to replace a difficult question with a simpler one, which aligns precisely with Kahneman 2003) definition of a "heuristic."

Although heuristics can be effective in many decision-making contexts (Shah and Oppenheimer 2008; Simon 1979), their use in environments characterized by low-probability but high-impact events, such as agriculture, may lead to systematic biases (Kahneman 2011; Kunreuther et al. 2013). These biases emerge because heuristics shape how individuals subjectively evaluate both probabilities and potential losses, often diverging from objective risk assessments.

Prospect theory (Tversky and Kahneman 1973) provides a valuable framework for understanding these deviations. Unlike traditional expected utility models, research based on prospect theory emphasizes subjective probability weighting, loss aversion, and the tendency to underweight rare events unless they are personally experienced or emotionally salient. In an agricultural context, this implies that farmers may underestimate the likelihood of extreme events, such as price collapses or climatic shocks, and may therefore delay or avoid the adoption of income stabilization instruments unless a substantial loss is perceived.

Building on this framework, the literature identifies several heuristics commonly adopted by farmers when making decisions under risk (Duden et al.2023). One strategy is the "imitate-the-successful" heuristic, whereby farmers simplify decision-making by copying the behavior of peers perceived as successful (Gigerenzer and Brighton 2009; Mousavi and Gigerenzer 2014). Another strategy relates to the "threshold of concern" heuristic, whereby individuals neglect risks that fall below a subjective probability threshold, leading to inaction in the face of low-probability shocks (Kunreuther 1996). A third, and comparatively less explored, strategy concerns the role of past shock experience. This "shock experience heuristic" encompasses several interrelated cognitive shortcuts, including: (i) the availability heuristic, whereby decisions are influenced by easily retrievable memories of recent or emotionally intense events (Kliger and Kudryavtsev 2010; Nofsinger and Varma 2013), (ii) the associative heuristic, which relies on memories of similar past shocks (Mullainathan 2002), and the (iii) affect heuristic, which integrates emotional responses into risk evaluation (Slovic et al. 2007). The representativeness heuristic further implies that individuals may treat a limited number of past events as representative of broader risk patterns (Tversky and Kahneman 1973).

Empirical evidence suggests that extended periods without adverse events tend to reduce perceived risk, while recent or repeated shocks increase risk awareness and willingness to pay for formal risk management tools (Fox and Hadar 2006; Dumm et al. 2020; Duden et al. 2023). However, while most studies focus primarily on individual experience, the role of socially shared information about past shocks remains underexplored.

3 | Empirical Setting: Apple Production and Risk Management in the Province of Trento

The empirical analysis is conducted in the Autonomous Province of Trento (PAT), a region in north-eastern Italy where apple production represents the core agricultural activity and a major source of farm income. Apple cultivation accounts for about 25% of the province's gross marketable agricultural output and is characterized by a highly specialized system dominated by small-scale farms, with an average orchard size of around one hectare (ISPAT 2020). The alpine geography, marked by valleys and mountainous terrain, has historically favored farm fragmentation and the development of cooperative organizational models (Laiti et al. 2016; Fontanari and Sacchetti 2020).

A distinctive feature of the PAT is its advanced and long-standing risk management system. Farmers are widely accustomed to adopting formal risk management instruments, including multi-peril crop insurance and mutual funds, supported by high participation rates and strong institutional coordination (Rippo and Cerroni 2023). In this context, the Consortium for the Defence of Agricultural Produces (Co.Di.Pr.A.) plays a central role in organizing risk management schemes, facilitating access to public support, and disseminating information to farmers. The consortium counts 11,783 associates, corresponding to approximately 90% of farmers in the PAT.

Within this institutional setting, an apple-specific Income Stabilization Tool was introduced in 2019 and represents the first fully operational apple-specific IST scheme in the European Union. The scheme, administered by Co.Di.Pr.A., aims to cover income risks not addressed by traditional insurance instruments, particularly those related to market and price volatility. Participation is restricted to consortium members and is voluntary, with annual renewal. In its first year of implementation, 1995 apple producers, corresponding to 55% of all apple growers in the PAT, enrolled in the scheme, covering 5382.38 hectares and reaching a total fund value of €8730863.62 (Rippo and Cerroni 2023). At least 30% of the fund's resources derive from farmers' contributions, with the remaining share publicly subsidized, mainly through EU funds. Enrolled farmers are eligible for compensation when apple-related income declines by 20% or more relative to a predefined reference income, with indemnities covering up to 70% of the documented loss.

Information on participation conditions and costs is typically communicated during annual meetings organized by the defense consortium, ensuring a shared and transparent informational environment. At the time the survey was launched, the participation fee for the 2024 IST coverage had not yet been announced, allowing us to elicit farmers' willingness to pay without anchoring responses to a known price. However, midway through data collection, the official participation fee was disclosed, introducing an external informational shock and a potential source of bias in stated preferences. This issue, and the measures adopted to address it, are discussed in detail in Section 4.2.

4 | Methodology

4.1 | Experimental Procedure

To elicit farmers' monetary preferences for enrolling in an IST mutual fund specifically designed for the apple sector, we employ a framed field experiment (Harrison and List 2004). Specifically, this study applied the Becker–DeGroot–Marschak (BDM) lottery method (Becker 1965), which is one of the most widely used incentive compatible mechanisms for value elicitation in experimental economics (Noussair et al. 2004). An incentive compatible value elicitation mechanism employs an incentive scheme that induces subjects to truthfully reveal their real values (e.g., Cummings et al. 1997; Cerroni et al. 2019). In the BDM mechanism, participants simultaneously submit their willingness to pay for acquiring a specific good or service. Then, a random sale price is drawn from a predefined distribution of possible prices for that item. Participants who submitted a bid higher than the randomly drawn price receive the good and pay a price equal to the one drawn. In our case, the "good" is represented by an income stabilization tool, which cannot be actually purchased during the experiment. Therefore, to adhere to experimental protocol and simulate a realistic purchasing scenario for IST coverage, three elements were considered in this phase: (i) the participant's WTP; (ii) an estimated market price for IST coverage in 2024; (iii) a hypothetical income variation forecast for 2024, based on a simulation of a potential income shock, as better discussed in Section 4.1.7 (Figure 1). To estimate this hypothetical income variation, sector experts were consulted, including insurance professionals, agricultural technicians, and researchers. Based on their input, a probability distribution of potential income variation for 2024 was developed. This distribution was revealed to farmers only after they submitted their WTP, to avoid influencing their valuation (see Section 4.1.3).

After receiving formal ethical approval from the University Research Ethics Committee of the University of X, the experiment was conducted between February and April 2024 through online face-to-face interviews with participants recruited with the support of the defense consortium. The sample consisted of 150 apple producers from the PAT, divided into three randomized treatment groups according to the heuristic nudge applied: (i) Individual past; (ii) general past; (iii) control group, as better described in next paragraphs (Section 4.1.5). Participants were divided into 45 different sessions, conducted on separate working days, with a maximum of five farmers per session. Communication between participants was minimized to prevent potential peer influence on individual decisions. The full experimental procedure, structured in seven phases (see Figure 1), is described below.

4.1.1 | *Participants' Welcoming and Initial Endowment*

Participants were welcomed, and the objectives, structure, and timeline of the research were clearly explained. Each participant then gave their informed consent to take part in the study.

Participants were informed that they would receive a €25 monetary compensation as a reimbursement for their time. They were also told of their right to withdraw from the study at any point without forfeiting their compensation.

4.1.2 | *Explanation About the IST Mutual Fund and Rules for the Experiment*

Before completing the questionnaire, detailed instructions were provided regarding the experiment's rules. Communication between participants was minimized to avoid potential peer influence on individual decisions.

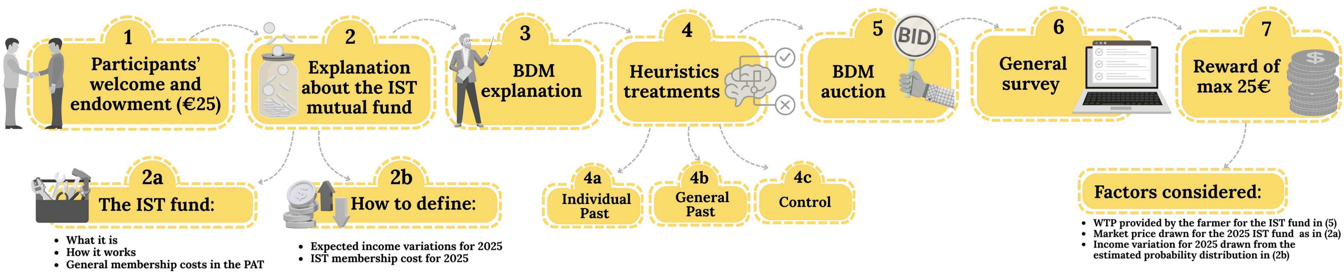

FIGURE 1 | Overview of the experiment. *Source:* our elaboration.

Participants received a clear explanation of what an IST fund for apples is, including the types of risks it covers and how it works. It was also explained how the cost of participation in such a fund is generally calculated in the PAT region (2a in Figure 1). Importantly, participants were informed that the actual 2024 participation price was still being developed and, for the purpose of the experiment, would be randomly drawn from a probability distribution of potential market prices established by the fund's managing body. At this point, as previously mentioned, participants were told that they would be asked to state their willingness to pay to join the fund in 2024. Once submitted, their WTP would be compared to the randomly drawn market price for the IST fund coverage cost (as better explained in Section 4.3). As in a real market setting, farmers would "purchase" the coverage only if their WTP was equal to or higher than the drawn price. To support this explanation, visual slides were used to demonstrate how their income might change under different scenarios: joining versus not joining the IST fund, and in the presence or absence of a market shock. Participants were also informed that to fully immerse them in the decision-making process and simulate the real impact of their choices, they could earn up to an additional €25 at the end of the experiment. This depended on their choices (whether they joined the fund or not) and the simulated market outcome. As previously noted, a probability distribution of potential income shocks for 2024, developed by industry experts, was used. At the end of the experiment, an income variation was randomly drawn from this distribution to simulate a realistic income shock scenario (2b).

4.1.3 | BDM Mechanism Explanation

After clarifying all aspects of the IST fund and the method of calculating participation costs, a comprehensive explanation of the BDM mechanism was provided.

4.1.4 | Informational Treatment: The Heuristics

Participants were exposed to an informational treatment based on heuristics. The first group (i.e., the individual past) was asked to reflect on the years in which they had personally experienced significant income losses, sufficient to trigger IST activation (defined as at least a 20% drop compared to the individual average income of the previous 3 years). Each farmer was presented with a list of years (2013–2022) and asked to select those in which they believed they had suffered such a loss. The second group (i.e., general past) was informed about the average income losses that apple growers in the PAT suffered over the past 10 years, highlighting the years that would have triggered IST activation. Each farmer was shown in how many of those years (2013–2022) the IST fund would have been activated based on average income data, and therefore authorized to distribute compensation to farmers who experienced severe income drop.

The third group (i.e., the control group) received no specific information about income shocks. However, to maintain consistency and avoid bias an unbalanced experimental design, they were asked to indicate in which of the past 10 years (2013–2022) they had participated in outreach events organized by local agricultural risk management consortium. These events aim to promote the consortium's work to the local farming community.

4.1.5 | BDM Auction for WTP Elicitation

After resolving any remaining questions, the experimental auction took place. Farmers were asked to state their WTP for IST participation in 2024.

4.1.6 | General Survey

Participants then completed a short general questionnaire, including socio-demographic questions and items designed to profile their risk attitudes. Farmers risk profiles, including risk preferences, was measured via the BRET task (Crosetto and Filippin 2013). In this task, participants choose how many boxes to collect out of 100. One box contains a bomb. Earnings increase linearly with the number of boxes collected (0.15€ per box), but if the bomb is collected, the payoff is zero. This setup allows participants to freely choose any number between 0 and 100 without data truncation.

Besides, perceptions of income variability associated with fluctuations in apple market prices were elicited for both the retrospective (past 3 years) and prospective (next 3 years) periods. These perceptions were based on self-reported responses concerning the main factors that affected farm income variability in recent years and those expected to influence it in the near future.

4.1.7 | Final Reward

The final reward is determined by the following payoff function and it is contingent on two randomly drawn variables: (i) a market price for IST coverage in 2024 and (ii) a simulated income variation derived from an expert-developed probability distribution. The final payoff function is defined as:

$$payoff = INC + \Delta INC - I * C + I * R * (0.7 * \Delta INC)$$

Where:

- INC is the baseline annual farm income per ha (25.000€);
- ΔINC is the simulated income variation experienced by the farmer in 2024 with respect to the average annual income in the period 2021–2023;
- I is an indicator variable = 1 if the farmer decides to enroll in the IST scheme, = 0 otherwise;
- C is the cost (per ha) of participating in the IST scheme and depends on the farmer's valuation elicited through the BDM procedure. If the farmer's WTP is lower than the randomly drawn market price for IST coverage in 2024, the farmer does not enroll into the scheme and $C = 0$. Conversely, if the farmer's WTP is higher than the randomly drawn market price for IST coverage in 2024, the farmer enrolls in the scheme and C is equal to that market price;
- R is another indicator variable =1 if ΔINC= -20%, =0 otherwise;

TABLE 1 | Examples of payoff calculation under income loss scenarios with (scenario 2) and without (scenario 1) IST coverage.

Item	Scenario 1: Income loss without IST coverage Values	Scenario 2: Income loss with IST coverage (The "Safety Net") Values
Baseline income	25.000€ per hectare	25.000€ per hectare
IST coverage cost	0€ per hectare	150€ per hectare
Income variation	−25%	−25%
IST compensation	0€ per hectare	4375€ per hectare
Final income	18,750€ per hectare	22,975€ per hectare
Payoff	7.5€	9.19€

Source: Our elaboration.

- The term ($0.7 * \Delta INC$) represents the indemnification payment, which covers 70% of the income loss for participants with active IST coverage.

The final monetary compensation paid at the end of the study is calculated based on a fixed conversion rate applied to the final accumulated income (1€ for every 2500€ of final income).

To facilitate the understanding of this mechanism, Table 1 provides two illustrative examples of payoff calculation under income loss scenarios, with and without IST coverage.

In Scenario 1, the participant's WTP is lower than the market price of IST coverage; therefore, no coverage is purchased and no compensation is received. In Scenario 2, the participant enrolls in the IST scheme at a cost of 150€ per hectare. When a 25% income loss occurs, the scheme provides an indemnification equal to 70% of the loss, resulting in a higher final income and payoff.

4.2 | Exogenous Variables Influencing the Experimental Outcomes

As detailed in Section 4.1, to avoid distortions in the estimation process, all participants received the same level of information regarding the functioning of the apple-specific IST fund in the PAT and the standard participation costs. Specifically, the cost of joining the IST fund is determined annually by the Consortium for the Defence of Agricultural Produces (Co.Di.Pr.A.) and, for the 2023, consists of a fixed fee (€150 per hectare of apple orchard) plus 0.5% of the insured value per hectare. For example, for a farm with one hectare of apples insured at a value of €20,000, the total cost of participation would amount to €250 (€150 fixed + €100 variable component).

This explanation allowed even those farmers who had never participated in the fund to understand the typical cost range of the IST, thus levelling the participants' baseline knowledge. Likewise, participants were informed that the exact participation price for 2024 had not yet been set by Co.Di.Pr.A. For experimental purposes, they were told the price would be randomly drawn from a distribution of historical participation costs used in previous years (see Section 4.1.2). This approach helped participants formulate their WTP without being anchored to a specific figure, reducing the risk of biased valuation.

However, midway through data collection (after 71 out of 150 responses had been gathered), the managing body of the IST apple fund in the PAT (Co.Di.Pr.A.) publicly announced the actual participation price for 2024. This introduced an external source of bias (external treatment), as the remaining 79 responses were potentially influenced by this new and uncontrolled informational treatment. To address this issue, we slightly adjusted the protocol described in Figure 1. During the sessions conducted after the announcement (i.e., after the external treatment), we explicitly informed participants that the experimental setting differed from the communication released Co.Di.Pr.A. Farmers were clearly instructed not to consider the newly announced 2024 participation price in the first part of the experiment, as this price substantially differs from historical pricing due to managerial and administrative reasons. Specifically, the 2024 participation fee distinguishes between "regular fund members" and "new members." For farms that had participated in the fund in previous years, the fee amounts to €20.00 per hectare of apple-growing area. In contrast, farms that had not previously enrolled are required to pay an additional private membership contribution covering also the years prior to 2024 in which they had not participated. Given this substantial change in fund management, participants in the experiment were clearly informed that this pricing structure was exceptional and applicable only for 2024, and that participation fees in subsequent years would also depend on farmers' willingness to pay. Accordingly, it was emphasized that the experiment was designed to provide the fund manager with evidence on farmers' actual willingness to pay, with the aim of informing and supporting the definition of future pricing policies. The research protocol was thoroughly explained again, as outlined in Figure 1, emphasizing the importance of using the historical pricing benchmark of €150 per hectare plus 0.5% of the insured value[1] as reference price. Once participants had declared their WTP based on this reference scenario (Figure 1, step 5), they were then asked whether they would be willing to join the IST apple fund in 2024, considering the new market price imposed by the fund manager. Despite the control measures introduced, we expected that this external factor might introduce a bias in farmers' WTP. Therefore, this effect has been verified according to the statistical analysis described in the dedicated paragraph.

4.3 | Sample Description and Statistical Analysis

The experiment follows a between-subjects design, involving three distinct groups, as described in paragraph 4.1.4: individual past ($N = 46$), general past ($N = 44$), and control group ($N = 60$). Farmers ($N = 150$) were randomly assigned to the different treatments. The groups are statistically comparable in terms of socio-demographic characteristics (e.g., *education level*), farm structure (e.g., *number of years the farm has been producing apples*), prior knowledge of the IST fund, or attitudes toward adopting such coverage (e.g., *objective knowledge of the IST scheme*, participation in the IST fund in 2023). Furthermore, farmers risk profiles, including risk preferences—measured via the BRET task (Crosetto and Filippin 2013)—and perceptions of income variability due to apple market price fluctuations over the past 3 years and expectations for the next three, are statistically comparable across groups (Table 2). The same holds true for their approach to agricultural insurance, as measured by average insurance premiums paid and the value of insured assets.

Additionally, we conducted a more in-depth analysis of the two informational treatments (general past and individual past) to assess whether the heuristics were effectively activated and perceived as distinct. Specifically, we controlled whether the average number of years in which participants reported a severe income drop differed significantly from the number of years in which the IST fund was officially activated (general past). To this end, we analyzed the frequency of responses by year, comparing perceived versus actual activation patterns.

To assess whether there were statistically significant differences in average willingness to pay (WTP) across the three experimental treatments (Individual Past, General Past, and Control), and to examine the potential impact of the IST fund's revised participation price announcement on WTP, a one-way ANOVA was conducted, followed by Bonferroni-adjusted pairwise comparisons.

Prior to conducting the ANOVA, the data were tested to ensure that its underlying assumptions were met. Specifically, the Shapiro-Wilk test was used to assess the normality of the residuals, while Levene's test was applied to evaluate the homogeneity of variances across groups. Additionally, the one-way ANOVA was employed to confirm the success of randomization and to check for any systematic differences between groups.

The Shapiro-Wilk test indicated a violation of the normality assumption ($W = 0.96$, $p < 0.001$). However, given the balanced group sizes, ANOVA was deemed robust to this deviation (McDonagh 2008). Levene's test confirmed homogeneity of variances across the treatment groups ($W_0 = 1.96$, $p = 0.144$), supporting the validity of the ANOVA model.

5 | Results

ANOVA and Bonferroni-adjusted pairwise comparisons were used to test differences in apple farmers' willingness to pay to join the IST scheme for the year 2024 across different heuristic treatments (i.e., Control, Individual past, and General past), both for the full sample and separately for farmers who were or were not exposed to the 2024 IST price announcement (external treatment). Specifically, the average WTP values for each treatment, ranging from €255.98 ± 149.97 per hectare in the general past group to €311.09 ± 203.70 in the individual past group (Table 4), were further disaggregated into "WTP before IST price communication" and "WTP after IST price communication" in order to clearly assess whether the disclosure had a measurable impact on farmers' decisions (see Figure 2).

To verify whether the heuristics were effectively activated and perceived differently by participants, we first examined how those in the individual past treatment recalled episodes of severe income loss and compared their responses to the actual IST activation years presented to participants in the General Past treatment (Table 3). Specifically, we analyzed the average number of years in which individual past participants reported experiencing income drops of at least 20% and compared these responses to the historical record of fund activations.

The IST fund was officially triggered in 3 years over the past decade (2014, 2015, and 2019); in contrast, farmers in the Individual Past group reported, on average, only 1.66 ± 1.24 years of substantial income losses, representing a statistically significant underestimation of adverse events compared to the actual record (one-sample *t*-test: $t = -7.17$, $p < 0.001$). Moreover, farmers' recollection of the specific years in which losses occurred diverged markedly from historical data. The most frequently mentioned years of major losses were 2017 (36%), 2022 (28%), and 2013 (28%), none of which correspond to actual IST activation years. Conversely, the official activation years were largely underreported: only 13% identified 2014, 6% mentioned 2015, and 11% recognized 2019 as years of severe losses.

Once the presence of distinct heuristic responses across treatments was established, we proceeded to analyze the effect of the external informational treatment, focusing on the impact of disclosing the official IST participation price for 2024 (external treatment). As illustrated by the WTP distributions in Figure 2, this informational treatment had a notable influence on farmers' stated willingness to pay. In particular, panel (b) shows substantial differences in the WTP density across the three treatment groups before the announcement, while panel (c) reveals a marked convergence in responses after the price disclosure.

This pattern is confirmed by the statistics reported in Table 4. Prior to the price announcement (namely before the external treatment effect), farmers in the individual past group reported the highest mean WTP (€421.11 ± 178.45), significantly higher than both the control (€268.08 ± 201.81) and general past (€263.81 ± 130.62) groups ($p = 0.006$). However, after the price announcement (i.e., after the external treatment effect), the average WTP in all groups dropped and converged, with no statistically significant differences remaining between treatments (control: €272.79; individual past: €240.36; general past: €243.53; all n.s.).

The results (Table 4) also indicate that the general past heuristic does not significantly influence farmers' decision-making. Recalling the years in which other farmers (within their peer group) received compensation due to the official activation of the IST fund did not trigger evaluative shortcuts among participants. Farmers behaved as though they had not received this information at all, with no observable differences compared to the control group. This limited behavioral response can be at least partially attributed to the specific context in which the experiment took place. The defense consortium that manages the IST fund is a well-established and highly active institution (see Section 3). It maintains regular communication with farmers through targeted updates and local assemblies,

TABLE 2 | Descriptive statistics and group comparisons across treatments.

	Categorical variables – Frequencies and Fisher's Exact Test						
	Individual past ($N = 46$)		General past ($N = 44$)		Control ($N = 60$)		
Variables	**Num**	**In %**	**Num**	**In %**	**Num**	**In %**	**sign**
Subscription to the IST Fund in 2023	30	68.18	26	56.52	34	56.67	n.s.
Self-declared knowledge of the IST fund	42	91.30	38	86.36	56	93.33	n.s.
Objective knowledge of the IST fund	40	86.96	40	90.91	50	83.33	n.s.
Gender (Female ratio)	3	6.52	2	4.55	3	3.33	n.s.
Main risks affecting apple income: apple price fluctuations over past 3 years	32	69.57	29	65.91	43	71.67	n.s.
Main risks affecting apple income: apple price fluctuations over next 3 years	38	82.61	41	93.18	51	85.0	n.s.
	Continuous variables – Means, Std.Dev, ANOVA and Bonferroni Tests						
	Individual past		**General past**		**Control**		
	Mean	**Std. Dev**	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**	**sign**
Age	51.21	11.26	49.61	12.03	49.8	13.30	n.s.
Education level (years)	12.63	2.80	12.20	2.40	13.25	3.07	n.s.
Farm structure (number of years the farm has been producing apples)	2.52	0.84	2.45	0.79	2.31	0.96	n.s.
Risk preferences (BRET: number of boxes collected)[a]	33.87	20.17	38.61	20.34	36.32	18.73	n.s.
Insurance premium paied for weather-related risk coverage in 2024 (€/farm)[b]	22,333.51	18,769.94	25,127.28	21,350.58	22,983.32	18,160.43	n.s.
Value of insured assets for weather-related risk coverage in 2024 (€/farm)[b]	114,050.40	86,291.23	128,083.7	96,184.81	122,612.90	102,721.60	n.s.

Note: This table reports summary statistics and tests for differences across the three treatment groups (Individual Past, General Past, Control) for key categorical and continuous variables. Fisher's Exact Test was used for categorical variables, and ANOVA for continuous variables.

[a] In The BRET, the minimum number of collectable boxes is 0 and 100, respectively. Risk neutrality is reached at 50 collected boxes. Our sample is, on average, mildly risk-averse ($0.551 < CRAA < 0.574$).

[b] This information is provided by Co.Di.Pr.A. and refers to aggregated data for farmers who participated in the experiment.

Source: Our elaboration.

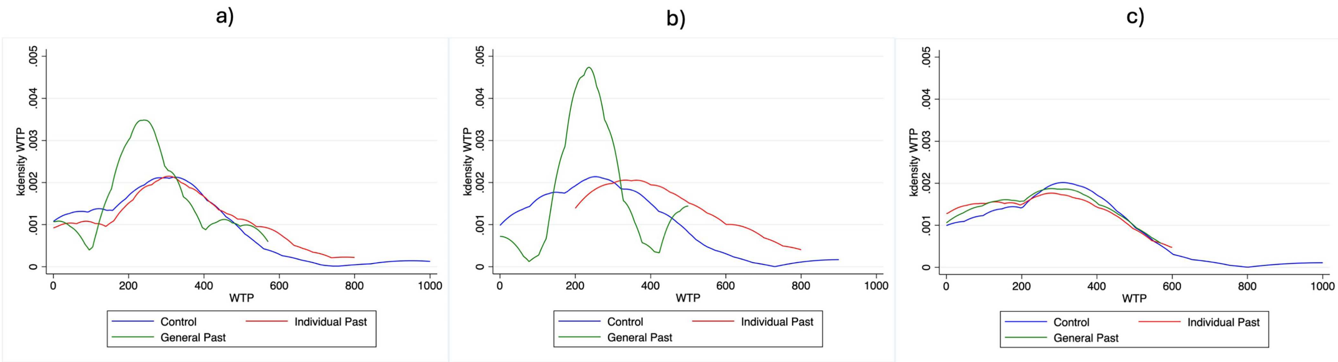

FIGURE 2 | WTP distribution for joining the IST mutual fund in 2024 for the total sample (a) and the reduced sample: before the 2024 IST price communication (b) and after the 2024 IST price communication (c). *Source:* our elaboration.

TABLE 3 | Comparison between official IST fund activation years and self-reported episodes of income losses ≥ 20% (individual past treatment).

Year	IST fund activated (official record)[a]	Respondents reporting income losses ≥ 20%	
		In number	*In %*
2013	No	13	28%
2014	Yes	6	13%
2015	Yes	3	6%
2016	No	3	6%
2017	No	17	36%
2018	No	9	19%
2019	Yes	5	11%
2020	No	4	9%
2021	No	5	11%
2022	No	13	28%

Note: Percentages refer to the share of respondents in the individual past treatment who reported income losses of at least 20% in a given year, which corresponds to the threshold required for fund activation.
[a]Official IST fund activation year, according to Co.Di.Pr.A. data.
Source: Our elaboration.

fostering a strong network and a well-informed agricultural community. As a result, farmers in this area tend to be well-acquainted with the risk management tools available and understand how they function in practice.

Indeed, as presented in Table A1 in the Appendix, the vast majority of respondents (90.67%; $N = 136$) reported being familiar with the IST apple fund, and 60% ($N = 90$) stated they had participated in it the previous year (2023). Moreover, 86.67% ($N = 130$) demonstrated objective knowledge of the fund by correctly identifying the risks it covers. While a small share of non-participating farmers cited high participation costs (16%, $N = 24$) and low indemnity levels (12.6%, $N = 19$) as barriers to enrollment, the overall picture is more positive. Notably, 23.4% ($N = 22$) of adhering farmers considered the cost of joining the fund to be low, and 14.89% ($N = 14$) believed the indemnities were high. Most significantly, 53.19% ($N = 50$) of those enrolled in the IST fund in 2023 reported doing so out of habit, and 35.11% ($N = 33$) stated that the fund's functioning was simple, clear, and easy to understand.

6 | Discussions

The results indicate that farmers in the Individual Past group significantly underestimated the frequency of income loss events and failed to accurately identify their timing relative to the official IST activation records. This pattern suggests that farmers may rely primarily on personal experience when assessing income risk. However, alternative interpretations cannot be ruled out and warrant further consideration. While the IST fund is activated when a given area experiences a sufficiently large average income loss (-15%), compensation is paid only to farmers whose individual income losses exceed the eligibility threshold (- 20%). As a result, farmers in the Individual Past group may have personally experienced fewer or less severe losses than those implied by area-level activation criteria, even in years when the fund was triggered. Consequently, discrepancies between farmers' perceptions and institutional data may reflect the distinction between area-based activation and farm-level compensation, rather than genuine misperceptions of risk.

Digging deeper into farmers' responses, we observe that 28% of respondents identified 2022, the most recent year evaluated, as a year of severe income loss, even though the IST fund was not officially activated that year. This suggests that recency may increase the salience of adverse events, potentially inflating perceived risk for 2024 and, in turn, affecting WTP. This pattern aligns with findings from cognitive psychology, where individuals tend to base their decisions on easily retrievable memories, which are often recent or emotionally salient (Kliger and Kudryavtsev 2010; Nofsinger and Varma 2013). Conversely, other farmers appear to underestimate the risk of income loss in years when the IST fund was actually activated, indicating a potential disregard for historical evidence. This behavior may reflect the use of the threshold of concern heuristic, whereby individuals discount low-probability events they perceive as falling below a subjective threshold of relevance. As found in previous studies on flood insurance (Botzen et al. 2015; Robinson and Botzen 2019), applying such a threshold reduces the perceived need for risk management. When probabilities are deemed too low, they receive insufficient cognitive weight, ultimately reducing WTP for protective measures (Duden et al. 2023; Robinson and Botzen 2019).

This flattening of differences strongly suggests that, in the absence of objective pricing information, farmers relied on heuristics to estimate their exposure to risk and formulate their

TABLE 4 | Effect of heuristic treatments and communication of IST price for 2024 on farmers' WTP to join the IST Fund (Mean ± Std. Dev).

	Control	Individual past	General past	Sign.
Total	270.75 ± 207.55	311.09 ± 203.70	255.98 ± 149.97	n.s.
Num. of respondents	*60*	*46*	*44*	
Before IST price communication	268.08[a] ± 201.81	421.11[b] ± 178.45	263.81[a] ± 130.62	**
Num. of respondents	*26*	*18*	*27*	
After IST price communication	272.79 ± 214.83	240.36 ± 189.36	243.53 ± 180.14	n.s.
Num. of respondents	*34*	*28*	*17*	

Note: Table reports the results of ANOVA and Bonferroni Post Hoc Test comparing average WTP per hectare among three treatments: *Control group* (no heuristic information); *Individual Past* (participants recalled their own past income losses); and *General Past* (participants were informed about years when peer farmers received compensation through the IST fund). *Total* refers to the full sample, including both observations collected before and after the official announcement of the IST participation price for 2024. Before IST change in price and After IST change in price show instead disaggregated results for each respective period. Means not sharing a letter within a row are significantly different (p-value < 0.05). Significance level (Sign.): n.s. not significant, $^{**}p < 0.05$.
Source: Our elaboration.

WTP. Once an authoritative price signal was introduced, the influence of subjective judgment diminished, and group-level differences narrowed substantially.

Taken together, these patterns point to a systematic reliance on experience-based heuristics in the absence of objective reference points. The strong response observed in the Individual Past group before price disclosure is consistent with the availability heuristic, whereby individuals evaluate probabilities based on recent (Mullainathan 2002) or memorable events (Slovic et al. 2007). Scholars define this behavior as a shock experience heuristic, which is a decision-making shortcut where personal recollections of adverse events substitute for an objective understanding of risk (Kliger and Kudryavtsev 2010; Nofsinger and Varma 2013). This behavior may also be reinforced by the representativeness heuristic (Tversky and Kahneman 1973), as farmers treat their own limited experience as broadly indicative of future outcomes. Once an authoritative external price signal was introduced (i.e., the external treatment), however, reliance on subjective judgment diminished, and treatment effects were neutralized. At the same time, this interpretation should be considered with some caution, as the sample size may have limited the possibility of detecting more nuanced between-group differences, particularly after price disclosure. In contrast, the General Past heuristic did not produce a measurable behavioral effect. Recalling years in which peer farmers received compensation did not alter WTP relative to the Control group. Here again, caution is warranted, since the lack of significance may also reflect the difficulty of detecting relatively small effects. This limited response may be explained by the specific institutional context of the study area, where farmers are part of a well-informed agricultural community. Indeed, most respondents were familiar with the fund, many had participated in it previously, and demonstrated a high level of objective knowledge regarding its functioning. These findings suggest that farmers in the PAT operate within a well-informed and functionally integrated institutional environment, in which participation in the IST fund is widespread, habitual, and perceived as straightforward, an uncommon scenario in the agricultural sector. In contrast to the coherent literature, which identifies lack of awareness, knowledge, affordability, and trust as key barriers to adoption of mutual or insurance-based risk management tools (Giampietri et al. 2020; Madaki et al. 2023), this context appears to enable even less informed or attentive farmers to benefit from prevailing behavioral norms. Here, enrollment in the IST fund is perceived as "normal," and peer influence may operate subtly through social norms rather than through explicit evaluative cues.

Numerous studies have shown that individuals tend to imitate the behavior of others (Andersson et al. 2014; Berg 2014; Delfino et al. 2016), particularly those perceived as similar or successful (Nikolaeva 2014). This is especially relevant in high-risk settings, where imitation is recognized as a significant behavioral mechanism in disaster risk management (Kunreuther 2021). Prior research has shown that extreme shocks often prompt farmers to replicate the risk management strategies of more successful peers (Sutherland et al. 2012; Zilberman et al. 2012). In our case, however, trust extends beyond peer networks. Farmers reported relatively high trust levels not only in the local cooperative system (mean = 3.87 ± 0.93), but also in the defense consortium that manages the fund—namely Co.Di.Pr.A.—(mean = 3.59 ± 1.20), in technical experts frequently consulted by the consortium (mean = 3.23 ± 1.10), and in the broader insurance system (mean = 3.44 ± 1.03), based on a 1-to-5 scale (1 = not at all; 5 = completely). In such a well-informed and high-trust environment, the conditions for imitation are arguably already fulfilled. As a result, the provision of historical peer-based information may add little to farmers' decision-making processes, potentially explaining the absence of a measurable treatment effect in the general past group relative to the control group.

7 | Summary and Conclusions

This study examines how farmers assess risk and determine their willingness to pay (WTP) to join an Income Stabilization Tool (IST) mutual fund tailored to the apple sector in Italy, focusing on the role of heuristics in risk perception. A field experiment was conducted with 150 apple producers in the Province of Trento, where participants were randomly assigned to one of three groups: a control group, a treatment group prompted to recall adverse income events personally experienced by farmers (individual past), and another prompted to recall similar events generally affecting producers in their network (general past). The effect of these heuristics was analyzed both in the absence and presence of an external information treatment, namely the communication of the 2024 official IST enrollment price by the fund manager. The findings reveal that, in the absence of official price information, farmers tend to rely on experience-based heuristics to inform their decisions. In particular, recalling personally experienced negative events (individual past) significantly affects WTP, whereas recalling adverse events experienced by peers (general past) has no significant impact. The negative effect of the individual past treatment aligns with the fact that farmers recalled significantly fewer relevant income losses compared to the broader income crises communicated by the fund manager. However, once the actual price of the fund was disclosed, these differences across groups flattened out, override the influence of individual experience heuristic-based reasoning.

The experiment reveals a complex interplay among the various sources of information farmers rely on. Notably, these sources, whether provided by public institutions or acquired individually, appear to follow a hierarchy in influencing farmers' preferences. Within this hierarchy, the fund manager, and more broadly public communication bodies, play a pivotal role in shaping decision-making. In the context of this study, information from the fund manager carries the greatest weight, largely due to the institution's strong regional reputation. However, this influence may differ across regions. A second important aspect concerns the consistency between farmers' individual risk perception and the risk assessments made by the fund manager. To promote broader participation in the fund, the fund manager should aim to bridge the gap between perceived and actual risk. As this study has shown, farmers often underestimate or inaccurately recall past risk events, which can lead to suboptimal decisions regarding risk management. Enhancing transparency and enabling the verification of discrepancies between farmers' subjective risk perceptions and the risks objectively assessed by the fund manager could therefore play a crucial role in encouraging farmers participation in the fund. This, in turn, would support the broader objectives of the CAP, which aims to foster farmer engagement in risk management. A limitation of this study is the relatively small sample size: the initial sample of 150 farmers, divided across three treatment groups, was further split by the external information treatment, which reduces statistical power and may limit the robustness of the results.

Author Contributions

Alice Stiletto: methodology, software, data curation, investigation, formal analysis, visualization, writing – original draft, writing – review and editing, conceptualization, validation. **Ruggiero Rippo:** methodology, software, data curation, investigation, writing – review and editing, conceptualization, validation. **Samuele Trestini:** validation, supervision, funding acquisition, project administration, resources, writing – review and editing, conceptualization, methodology. **Elisa Giampietri:** writing – review and editing, conceptualization. **Roberta Raffaelli:** funding acquisition, project administration, writing – review and editing, resources, conceptualization, supervision, methodology. **Simone Cerroni:** conceptualization, methodology, software, validation, supervision, writing – review and editing, project administration, resources.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Endnotes

[1] The insured value is the maximum amount, agreed upon in the contract, that the insurance company will pay in the event of a production loss.

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Appendix A

TABLE A1 | Descriptive statistics of the sample.

Variables	Frequency Num. of respondents	In %
Subscription to the IST Fund in 2023	90	60.00
Self-declared knowledge of the IST fund	136	90.67
Objective knowledge of the IST fund	130	86.67
Gender (Female ratio)	7	4.67
Main risks affecting apple income: apple price fluctuations over past 3 years	104	69.33
Main risks affecting apple income: apple price fluctuations for next 3 years	130	86.67
	Mean	**Std. Dev**
Age	50.18	12.27
Education level (years)	12.75	2.83
Farm structure (number of years the farm has been producing apples)	2.42	0.88
Risk preferences (BRET: number of boxes collected)	36.24	19.61
Insurance premium paied for weather-related risk coverage in 2024 (€/ha)*	23412.94	19231.49
Value of insured assets for weather-related risk coverage in 2024 (€/ha)*	121591.8	1720.80
Reasons why farmers choose not to join the fund ***"I did not join the IST fund in 2023 because…"***	**Num. of respondents**	**In %**
I believe the indemnities I could receive are too low	19	12.67
I believe the participation costs are too high	24	16.00
I do not understand how the instrument works	10	6.67
It does not provide greater coverage for risks already covered by other passive protection tools (e.g., insurance)	8	5.33
It does not provide greater coverage for risks already covered by other active protection tools (e.g., nets, anti-frost systems, irrigation)	7	4.67
It was not recommended to me by the fund manager/insurer/intermediary/insurance company/my cooperative	4	2.67
Lack of transparency in how the trigger event is defined	13	8.67
I produce few apples/apples are not my main source of income	11	7.33
Reasons why farmers choose to join the fund*"I joined the IST fund in 2023 because…"*	**Num. of respondents**	**In %**
The cost of joining the mutual coverage scheme are low	22	23.40
The indemnities I could receive are high	14	14.89
I do it every year	50	53.19
I understand how the instrument works	33	35.11
It provides greater coverage for risks already covered by other passive protection tools (e.g., insurance)	29	30.85
It provides greater coverage for risks not covered by other passive protection tools (e.g., insurance)	38	40.43
It provides greater coverage for risks already covered by other active protection tools (e.g., nets, anti-frost systems, irrigation)	13	13.83
It was recommended to me by the fund manager	17	18.09
It was recommended to me by an insurer/intermediary/insurance company/my cooperative	13	13.83
My income from apple production varies from year to year	16	17.02
It is my main source of income	8	8.51
Cooperation (Scale: 0 = Never, 5 = Always) **"In general, …"**	**Mean**	**Std. Dev**
I have cooperated with other farmers in the past	3.27	1.43
I have exchanged relevant agricultural information with other farmers	3.71	0.97

(Continues)

TABLE A1 | (Continued)

Cooperation (Scale: 0 = Never, 5 = Always) **"In general, …"**	**Mean**	**Std. Dev**
I prefer cooperative risk management tools (e.g., mutual funds) over insurance	2.89	1.22
I attend shareholder meetings	3.86	1.15
I attend training events organized by the fund manager.	2.73	1.24
I belong to a producer organization (OP)	4.45	1.26
I deliver apples to a cooperative or consortium	4.71	0.97
Trust (Scale: 0 = Never, 5 = Always)*"In general, …"*	**Mean**	**Std. Dev**
I trust the PAT cooperative system	3.87	0.93
I rely on active risk management tools (nets, irrigation, etc.)	3.19	1.57
I trust the intermediary/insurer for risk management decisions	3.44	1.04
I rely on fund manager for risk management decisions	3.59	1.20
I trust the opinions of technical experts (agronomists, etc.)	3.23	1.10
I trust other farmers	2.62	0.99
I rely on the Chamber of Commerce for agricultural information	1.86	1.04

Note: *This information is provided by Co.Di.Pr.A. and refers to aggregated data for farmers who participated in the experiment.
Source: Our elaboration.