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Scope of Behavioral Economics in Agricultural Decision-Making

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Abstract: ***This paper provides a general overview of behavioral economics in agricultural decision-making. In the first part, we discussed how behavioral economics complemented and provided new insights, a different perspective of the understanding of modeling agricultural decisions in ongoing argument of deviation of profit maximization behavior among farmers. Next, farmers' behavioral responses to risk and uncertainty inan inherent risky environment in agricultural activities, in which an alternative approach provides better insightsfor understanding risky decisions. We have also discussed the important behavioral finding of bounded rationality, i. e., cognitive limitation and biases-a significant characteristic that affect the farmers' decisions; finally, we discussed the role of experimental methods in agricultural economics that significantly helps in better policy analysis through behavioral economics.***

Keywords: Behavioral Economics**,** Decision-Making, Agricultural Economics, Risk behavior, Experimental Method

1. Introduction

Changing consumption patterns and increasing food demand puts more pressure on available resources. It causes an intensive use of resources and gives rise to the over-exploitation of our planet, which is already on the verge of a critical stage. In addition, the consequence of growing climate concerns and pets and disease worsens things and culminates in a fragile and risky decision-making environment. These challenges make policymakers' and farmers' decisions more critical in designing agricultural practices, fulfilling the current generations' desires without compromising future opportunities. It becomes even more complex while including the priorities for establishing sustainable agricultural practices established by the Sustainable Development Goals of the 2030 Agenda of the United Nations. All these challenges intervene with each other and make it too complex to model and understand the agricultural decision.

Various studies raised concerns about understanding and modeling the process and consequences of farming decisions. Willock (1999) highlighted the importance of personality, attitude, and the role of cognition in setting objectives in farm decision-making and found significant differences in goal settings. Schwarze et al. (2014) also concluded in an experimental setting that farmers are not utility maximizers. Further, Appel &Balmann (2019) revealed important behavioral characteristics of farmers who were more resilient in difficult situations and mostly followed a path-dependent strategy. This study also found that cognition was an important determinant of success. In some recent studies, scholars have made an attempt, an alternative views, a behavioral and psychological method to explain various agricultural phenomena by designing effective food and production policies with set goals (Edwards-Jones, 2006; Just, 2006; Lusk &McCluskey, 2018: Liu et al., 2014;).

This study explores the scope of behavioral economics, economic psychology, and decision theory in agricultural making. Recent developments in behavioral economics, i. e., anchoring, biases, intuition, cognition, loss aversion, and nudging, are common practices in decision-making. All these terms have been found to be more prevalent in decision-making. This study aims to analyze how different behavioral approaches explain complex agricultural decisions under different conditions. Therefore, in section two, we have discussed the significance of behavioral factors in agricultural decision modeling. In section three, we have discussed the insights of risky behavior through the lens of behavioral economics in agricultural decisions. In section four, we have discussed how cognitive biases significantly influence farmers' decision-making. In section five, we have discussed the role of experimental methods in behavioral and agricultural decision-making. Finally, in section six, we summarize our arguments in the light of the above discussion.

2. Modeling Agricultural decisions

The fundamental assumption of strong rationality behavior is that profit is the sole driver of decision-making. With this underlying assumption that farmers can perfectly account for each criterion, i. e identifying all alternatives, the best possible crops that ensure the optimal production of the best use of soil, existing government policy and market support, and other costs, etc. But behavioral economists emphasized individual capabilities' limitations and observed that this assumption could not hold in all cases. Willock (1999) explained behavioral factors, i. e., intuition, cognition, and biases, are relevant in modeling farmers' decisions, and they intervene as mediating variables between dependent and independent variables.

A study examining the optimal decisions among Dutch farmers found that farmers were unable to reach their optimum choices to account for the implication of animal health; cost-benefit analysis on animal health expenditure and its returns (Huijps et al., 2010). They were not adopting compliance with the given expert advice. This implies that farmers do not always implement best management practices. They prefer to choose the option which considers to be most important, given the constraint of available savings. This is the most common practice in developing countries where farmers carry out small business or agricultural practices. So, in a family-oriented farm business or farm activities, individual emotions, cognitions, and intuition may play an important role in decision-making. In another study among Kenyan farmers on input choices (fertilizer), Duflo et al. (2011) found that farmers' responses to optimum fertilizer utilization cannot be achieved through a free market or heavy subsidies. They identified significant biased behavior in optimal investment on fertilizer use, as suggested nudging could be an effective tool for the farmers to make use of fertilizer effectively.

Behavioral economics is perhaps more helpful in understanding and designing sustainable agricultural practices. Farmers' decisions to adopt organic farming, efficient use of water and soil conservation, and pesticide use have been less explored. Analysis of various policy measures to achieve certain goals has found frequently failed; for example, the EU introduced the agri-environmental scheme to encourage environmentally positive agricultural practices, providing an annual cash payment to compensate the cost of adoption of sustainable practices under the Common Agricultural Policy; in this scheme, farmers have to enroll the farming area to avail the benefit, many studies reported poor response by farmers in most of the countries (Yang et al., 2005; and Espinosa-Goded et al. (2010).

It has been observed that frequent deviation from the appropriate use of resources and policy response, ex-ante policy analysis. It is caused by information gaps or intended attitudinal responses in the decision-making process. It observed that decision-makers, sometimes objectives, i. e., short-term or long personal and economic objectives, a multitude of values, and goals differ. It shows a significant deviation in the economic modeling of the economic rationale of the neo-classical approach. On the contrary, it is in line with the behavioral interpretation of bounded rationality, a farmers' managerial skill, decision strategy, and varied objectives.

Behavioral economics suggests that other factors, such as altruism, self-control, and social norms about fairness, are common behavioral patterns across different populations (e. g., Fehr and Schmidt 2006). A study on social preferences and their impact on farm technology adoption behavior, Chouinard et al. (2008) find that some farmers were willing to give up profits to engage in land stewardship practices, supporting the altruistic behavior in their multi-utility hypothesis based on self and social interests.

3. Risk Tolerance/ Risk Response

Risk and risk perception have been critical factors in agricultural decision-making. With given socio-economic background, their perception varies, resulting in farm behavior. It is said that a farmers' response to the risk is very much subjective in nature, as suggested by various behavioral and experimental results. It can be said that the revelation of individual risky behavior is a significant contribution to behavioral economics. It has found frequent use of prospect theory in explaining farmers' decisions in various contexts (De Brauw and Eozenou, 2014; Liu & Huang, 2013; Liu, 2013) and suggested a better model for explaining risk behavior (De Brauw and Eozenou, 2014. Bocqueho et al., 2014). Prospect theory defines the notion of capturing subjective features in decision-making; it derives value function from relative changes in the outcome compared to a reference point, unlike the absolute level of outcomes as expected utility suggested. It also suggests that similar outcomes can be perceived as either gains or losses at a reference point. Moreover, prospect theory also posits varied risk attitude behavior in the gain and loss domain; a potential loss is weighted higher than an equivalent gain. Therefore, the utility function derived concave in the domain of gains and convex in the domain of losses (Tversky and Kahneman, 1992). Another important human tendency is observed in individuals mostly overweight small probabilities and underweight larger probabilities.

Considering all these characteristics in the domain of risk, farmers' elicitation of risk behavior can provide a potential explanation for various policy responses. Hardaker et al. (2015) argued that agricultural activities' inherently high-risk tendency causes farmers to consider often the safety-first principle to achieve the target outcomes rather than maximize the profit (Moscardi&Janvry, 1977). In the use of prospect theory in the risk analysis, Liu & Huang (2013) found that loss aversion is an important factor in explaining village income, and Liu (2012) also concluded that loss aversion is an important factor in understanding the adoption of new technology among Chinese farmers. Zhao & Yue (2020) elicited risk preference among USA farmers to analyze variability among farm choices. Similarly, Villacis et al. (2021) analyzed farmers' agro-climatic risk perception and risk attitude in agricultural decision-making. Recently, some studies have also examined uncertainty behavior (Barham et al., 2014; Ward & Singh, 2015; Crentsil et al., 2020) and found that farmers use technological innovation as a tool for reducing risks (Barham et al., 2014), whereas, some ambiguity averse farmers hesitate to adopt new technologies (Ward & Singh, 2015).

Further analysis of risk behavior in agriculture and perception of risk behavior, i. e., market, institutional, production, and financial risks, is critical in management strategies. Behavioral response to risk is typically the result of the interaction of the perceived risk and risk preference of decision-makers. Risk perception is defined as a perception of the economic environment of the decision-maker, which significantly influences the decision-making process (Slovic et al., 1982). It is determined by the exogenous factor where decision-makers are exposed to the risk. Consequently, risk perception is subjective and assesses decision-makers' occurrence of uncertain events and potential impacts. Behavioral and experimental economics significantly contributed to recent literature on understanding risk and uncertainty behavior. Dohmen et al. (2011) concluded the strong relationship between willingness to take risks and socioeconomic background. Therefore, gaining a subjective notion of understanding in farmers' decision-making under different contexts of risk exposure, i. e., extreme weather events, sudden price decline, drought, and flood, are leading to exceptional risk and uncertainty. They affect farmers' risk perception and decision-making through the direct effect of farmers' behavioral responses and strategic decisions regarding market volatility and productivity. Farmers' responses to the risk and uncertainty are increasingly important in this context.

4. Cognitive Limitations and Learning in Decision-Making

Recently, cognition got significant attention in the literature on decision theory. Cognition includes learning ability, analytical capability, and perseverance (patience) that significantly influence the quality of decision-making. Datta and Mullainathan (2014) argued that the effectiveness of decisions' outcomes is critical at the right time with the right strategy. Therefore, the adoption of technological innovation and input utilization at the appropriate time is essential for its effectiveness. In profit maximization, Appel and Balmann (2019) and Weersink and Fulton (2020) highlighted the role of cognitive capacity in the process of agricultural decisions; both studies fund a unique role in resolving the complexity of agricultural decisions.

In the context of developing countries, Gaurav and Singh (2012) highlighted the farmers' difficulties with financial decision-making in India; poor and vulnerable farmers were suffering hardship in accounting for common financial matters, and their success and financial aptitude were directly linked to their cognitive ability, i. e., education and financial literacy. Similarly, Waldman et al. (2019) found that Zambian farmers were cognitively biased in predicting the rainy season and making wrong agricultural decisions.

Behavioral economists are also interested in the role of learning in decision-making. A traditional learning method consists of intuitively three common paths in the decision, learning by doing, learning by using and obtaining more and more information from various sources. Behavioral economics enriches our understanding with new information about the experience-weighted attraction of learning models (Camerer and Ho, 1999), including belief-based and reinforcement learning; they find empirical validity in favor of this model. Maertens and Barrett (2013) suggested that learning networks vary even in similar communities; therefore, non-traditional learning processes through social interaction might be important in understanding agricultural decisions. If it is considered that learning behavior is linked with cognition, a differential learning process affects decision-making. For example, Weersink and Fulton (2020) found the differential impact of profit maximization and social and cognitive factors at different stages of adopting new technology.

Cognitive capacity has also been analyzed linking with sustainable agricultural practices. Wittstock et al (2022) tried to understand the adoption of sustainable practices among German farmers. They found poor responses to this agri-environmental scheme due to complex administrative processes. It found that farmers were not ready to change their behavior even after compensation for the losses of adopting sustainable practices and suggested that learning, heuristics, and reducing administrative hurdles may increase the adoption of the scheme. Similarly, examining the climate concern and adaptability strategy among small farmers in Zambia found that they had no knowledge about climate change, and most farmers attributed climate change to supernatural forces. In this view, implementing climate policy remains ineffective without knowledge and awareness about climate concerns among farmers (Nyanga et al., 2011). In another study, a cross-country analysis of knowledge and awareness about climate concerns found that higher awareness and knowledge about climate change is a prerequisite for shaping the concerns and responses of individual behavior (Shi et al.2016).

The above examples suggest that farmers lagged in complex information processes; they lacked behind in knowledge and response to amounts of information. Farmers generally worked to achieve their set goals, and they considered it to be an efficient outcome. But it is often not easy to accomplish; even sometimes, farmers unintentionally deviate from the efficient outcomes due to their cognitive limitations and biases. Behavioral economics interpretation of bounded rationality proposes that individuals' cognitive capacity to analyze and process information. Cognitive capacity varies individually and is depleted by the use of other activities.

In general, it can be said that there has been a significant gap in information and knowledge in agricultural practices, farmers' knowledge, and policy design. It is a prerequisite condition to have access to relevant and reliable information for the targeted population to achieve any policy objective (Llewellyn, (2007). It another study, Higgins et al. (2017) analyzed various policy initiatives and their effectiveness through behavioral; experimental methods among USA farmers and concluded a significant lack of knowledge and awareness about government policies and it plays a significant role in policy effectiveness. Pavlis et al. (2016) also found a similar result in the context of the adoption of sustainable practices among European farmers

5. Role of Experimental Methods

One of the characterizations of behavioral economics is that it strongly depends on experimental laboratory setups with a broad spectrum of experimental methods (Weber &Camerer, 2006). The experimental method and behavioral economics have grown together (Weber &Camerer, 2006), and agricultural economics has also benefited in evaluating the impact of policies, as Colen et al. (2016) highlighted its role in comprehensive assessment in significant policy evaluation and suggestions. Higgins et al. (2017) argued the role of experimental methods in agricultural decision-making is:

"Economic experiments can be used effectively to improve the design and implementation of government policy and programs. Experiments are especially useful when evaluating new and innovative policies that are entirely prospective, since traditional economic techniques (such as statistical analysis of data and simulation modeling) may be unavailable or inapplicable for policies that have never before been implemented" Higgins et al. (2017)

Moreover, experimental economics also increases its relevance in identifying and understanding the role of behavioral factors in the agricultural decision-making process. For example, simplified simulation models have provided significant insights into the maximization assumption of the expected utility hypothesis (Appel &Balmann, 2019). In the context of technology adoption for sustainable practices in agricultural decision-making, Czap et al. (2019) highlighted the potential role of behavioral factors in the adoption of sustainable agricultural technologies; it suggested an important behavioral tool "nudge" as an effective policy outcome. Further, in the risk and uncertainty analysis, behavioral and experimental economics significantly contributed to accounting for risk sensitivity in different domains (risk, loss, and uncertainty scenarios) and its implication in decision-making (Zhao & Yue, 2020; Villacis et al., 2021; Ward & Singh 2015; Barham et al., 2014).

It implies that behavioral economics enriches our understanding through more information on farmers' behavioral responses in evaluating new and innovative policy perspectives. It is known that traditional economic methodology does not provide scope for the analysis of unavailable or inapplicable policies that have not yet been implemented, but experimental and behavioral economics provides scope in simulation to tailor the questions being asked, controlling the parameters. Therefore, experimental research complements simultaneously to fill the policy-related research gaps that traditional economics cannot reach and to identify the shortcomings of existing theories. In this view, experimental economics complemented behavioral economics in expanding its scope and explaining it with the help of a new approach to address these shortcomings. Experimental economics has been frequently used to evaluate ex-ante choice in the context of farmers' preferences. Broch &Vedel (2012) examined agri-environmental contracts among European farmers to protect biodiversity and groundwater conservation. Similarly, another study by Christensen et al. (2019) examined how to increase the demand for the agri-environmental subsidy scheme among Danish farmers.

6. Conclusion and Further Consideration

The extensive literature on farmers' behavior in agricultural decision-making is based on the underlying assumption of the profit maximization hypothesis. This is the fundamental of the neo-classical economic theory of decision-making, which includes only economic factors in the decision modeling. But sociologists, psychologists, and, behavioral economists identified vital behavioral factors that advance new insights into decision-making. This article discusses an overview of the farmers' decision-making processes in view of behavioral and psychological factors. Behavioral and experimental methods are seen as complementary tools for policy evaluation and suggestions. Economists and policymakers agreed that behavioral economists advance new insights in the agricultural decision-making literature in the prolonged debate on the profit maximization hypothesis. Alternative studies that included behavioral factors concluded that they are equally important as economic factors in modeling agricultural decisions, i. e., adoption of innovation, diversification, and applying conservation practices.

The behavioral economic literature is gaining ground in understanding how risk and uncertainty behavior affects decision-making; prospect theory and extreme events are useful to provide valuable insights in explaining agricultural decision-making. Leading climate concern is another source of risk and uncertainty for agricultural decision-makers. It affects production decisions in management practices, and climatic responses through the direct influence of the perception of risks, losses, and uncertainty. This ultimately leads to influences on investment decisions.

Other insights from behavioral economics are cognition and learning. A cognitive limitation is associated with the analytical ability that leads to the diversion in motivation and goal setting; for example, innovation and technology adoptions are driven by a dynamic learning process through multiple stages, unlike what we empirically model as a binary decision. Information dissemination process and learning behavior through social networks of informal settings and formal settings have received attention in behavioral economics. This can help understand agricultural decision-making processes, especially in the developing world, where information dissemination and learning processes happen in an informal setting.

Further, the economic experiment is another leap in methodological development that widens the scope of behavioral economics. The feature of experimental processes provides scope for generating data in a controlled setting. A randomized control trial (RCT) is a comprehensive method in which participants are divided into treatment and control groups to analyze the effects of a particular event on ex-ante proposed policies and its effectiveness. Similarly, Holt Laury and another systematic method are frequently used in eliciting risk preference.

Finally, the interaction of behavioral and experimental methods in agricultural research can complement providing valuable insights into farmers' decision-making. The intersection of behavioral economics and agricultural adoption research can provide valuable insights into farmer behavior, may validate underlying behavioral models, or call for improvements in the existing frameworks. The above discussion in this paper is not to be seen as exhaustive. It is merely some of the examples in myriad potential subject areas of behavioral economics in agricultural decision-process. Therefore, described linkages and indicative opportunities detailed in this study are meant to provide insight that needs further research that will advance research in both behavioral economics and agricultural decisions.

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