agriculture

Article

Information Acquisition Ability and Farmers' Herd Behavior in Rice–Crayfish Coculture System Adoption

Weihong Huang [1,*], Caiyan Yang [1], Ke Liu [2] and Rui Min [3]

[1] School of Business, Central South University of Forestry and Technology, Changsha 410004, China
[2] School of Management, Wuhan Polytechnic University, Wuhan 430023, China
[3] School of Economics, South-Central Minzu University, Wuhan 430074, China
* Correspondence: t20202531@csuft.edu.cn

Abstract: Rice–crayfish coculture systems (RCSs) have been widely promoted in China as an efficient circular agriculture model that can simultaneously improve rice quality, raise the efficiency of utilization of resources, and increase farmers' incomes. However, the herd behavior of farmers in the adoption of the rice–crayfish coculture system warrants more attention, as the rational adoption of this system by farmers is a prerequisite for achieving the above objectives. This paper analyses the formation mechanism of farmers' herd behavior based on information cascade theory. Using micro-survey data from 603 farmers in China and a bivariate probit model, we examine the existence of herding effects in the adoption of RCSs by farmers and the inhibitory effect of information acquisition capability on herd behavior. To address possible endogeneity issues, we also conducted a robustness test using the IV-probit model. Furthermore, we tested for between-group differences in agricultural income between farmers with herding adoption and non-herding adoption. The study reveals that the larger the number of prior adopters, the higher the probability of blind adoption behavior by farmers, indicating the existence of a herd effect. Information acquisition ability could significantly inhibit the herd behavior of farmers in the adoption of RCSs. We also found that farmers' herd behavior in the adoption of these systems was not economically rational. Based on the research findings, we proposed several constructive suggestions for policy perfection.

Keywords: agriculture; circular agriculture; rice–crayfish coculture system; herd behavior; information acquisition ability; farmer

Citation: Huang, W.; Yang, C.; Liu, K.; Min, R. Information Acquisition Ability and Farmers' Herd Behavior in Rice–Crayfish Coculture System Adoption. *Agriculture* **2023**, *13*, 1892. https://doi.org/10.3390/agriculture13101892

Academic Editors: Luboš Smutka and Karolina Pawlak

Received: 25 August 2023
Revised: 17 September 2023
Accepted: 26 September 2023
Published: 27 September 2023

1. Introduction

Rice–crayfish coculture systems (RCSs) refer to the simultaneous or alternate cultivation of rice and crayfish in a rice field. Since they allow two outputs from a single paddy field, they are an efficient circular agricultural model that can improve rice quality and boost farmers' incomes [1,2]. At the end of 2022, the crayfish aquaculture area in China increased from 600,000 hectares in 2016 to 1.867 million hectares, of which 1.567 million hectares, or about 84%, were under rice–crayfish coculture. In China's current market conditions, the price of crayfish is much higher than that of rice, and many farmers have witnessed the profitability of crayfish farming in paddy fields from farmers around them, and they have copied them by adopting RCSs. If an excessive number of farmers follow the trend of adopting the RCS, it will lead to an overheated investment in the crayfish industry, and the area of rice cultivation cannot be guaranteed. In this way, the RCS may not achieve ecological sustainability or increase farmers' income while ensuring food production [3]. Clarifying the logic behind the farmers' adoption of RCSs and finding reasonable methods to intervene are of great significance for ensuring food security and sustainable agricultural development.

The influencing factors of farmers' adoption of circular agricultural modes have been well documented, including farmers' knowledge [4,5], environmental values [5,6], economic values [7], policy support [8,9], risk attitudes [10], and neighborhood influences [11,12]. However, further research on the effect of social networks on farmers' adoption of circular farming models is required. Previous studies [13–16] examining the farmers' behavior imitating other farmers in their social networks have found that farmers are easily influenced by other farmers in their decisions to adopt new cultivated varieties and new agricultural technologies, their input of pesticides and fertilizers, their purchase of agricultural insurance, etc. Consequently, they show behavioral convergence, the reasons behind which can be diverse. Most studies attribute the presence of behavioral convergence among farmers to the exchange of information within their social network [17,18], difficulties in accessing information for farmers due to information asymmetry [19], and social learning mechanisms [20,21]. Firstly, their social network, which is mainly composed of relatives, friends and neighbors, promotes information exchange and increases the degree of mutual trust. The experience of other pioneers can strongly promote the imitation behaviors of farmers [17,18]. Secondly, when farmers are not experienced in agricultural production and management, they will tend to obtain more information from external sources, and if the information acquisition channels are few and the cost is high, it will directly promote farmers' imitation behaviors [19]. Thirdly, by observing the outcomes of benefits and costs of other adopters, farmers can develop an expectation of the risk of adopting a new agricultural model [20,21] and thus make a decision on whether to adopt it or not.

Due to the difficulty in distinguishing herd behaviors from peer effects, many studies about farmers' behavioral convergence did not make a clear distinction between these two concepts. The peer effect denotes the influence of peers who share similar basic characteristics and face similar decision-making problems, and it usually happens in the same social network or industry group [22]. Herd behavior refers to individuals extracting information from the observed behaviors of their predecessors in an incomplete information environment and giving up their own private information to follow the majority of people's choices [23]. Although both show conformity characteristics, there are differences between these two concepts. The peer effect refers to the interactive communication and learning between decision makers and peers, which reduces decision-making uncertainty through the imitation of peers' decision making. However, herd behavior emphasizes the behavior of subsequent decision makers ignoring their own knowledge to follow the previous decisions of the majority [24]. We want to explore whether there is a herd effect in the promotion of RCSs, where farmers ignore their own situation and blindly follow others' decisions.

Drawing upon the discussions above, this study aims to explore the presence of herd behavior and its mechanism in farmers' adoption of RCSs, as well as its related economic consequences. Previous literature provides theoretical and methodological references for this study. However, studies on farmers' herd behavior based on empirical data have not considered farmers' neglect of their own knowledge, and most of them directly test the impact of other farmers' adoption on the adoption behavior of the study subjects. Therefore, this paper rigorously identifies herd behavior in the adoption of RCSs and measures the herd effect based on the theory of herd behavior. Second, studies on farmers' herd behavior in decision making usually focus on testing the existence of the herd effect, and factors influencing farmers' herd behavior have not been investigated in the literature from the perspective of information acquisition ability. Thus, in this paper, we contribute to the literature by examining the effect of information acquisition ability on farmers' herd behavior. Third, research on the outcome of farmers' herd behavior remains inconclusive, although there have been many contributing studies in the financial field on the impact of herd behavior on investors' benefit. Therefore, our study aims to quantify the economic outcomes of farmers' herding behavior by comparing the income of farmers who adopted the RCS due to herding reasons with the income of farmers who adopted it due to other reasons.

The remainder of the paper is structured as follows. Section 2 presents the theoretical analysis. Section 3 details the data sources, the econometric model, and descriptive statistics. Section 4 reports the estimation results. Section 5 discusses research outcomes and implications. Section 6 features the results, policy implications and suggestions for further research.

2. Theoretical Analysis

2.1. The Herding Behavior in Farmers' Adoption of RCSs

Informational cascades are theorized as an underlying mechanism of herding [25]. Bikhchandani, Hirshleifer and Welch (BHW) proposed the concept of information cascades for the first time in 1992 [26]. They argued that, in the case of incomplete information, rational decision makers will combine private information and others' decisions to infer the best decision. Furthermore, if the decision preference of others reaches a high level, later decision makers will give up their own information and follow the decisions of others, in which case an informational cascade occurs. These, of course, require that individuals decide in a sequence and that the actions of others are observable. Anderson and Holt (1997) carried out an experimental test of the theory, concluding that herding is indeed observed and interpreting their data as showing that subjects decided rationally [27]. Conversely, Huck and Oechssler (2000) found little support for rational cascade theory [28].

Since the above conclusions are mainly based on mathematical derivation or experiments, their applicability in analyzing farmers' production decision making requires further analysis.

Uncertainty can significantly impact the agricultural production decisions of farmers [29], such as diversified planting [30], adoption of crop innovation [31], farmland allocation decisions [32], etc. In environments with high event uncertainty, people's choices are likely influenced by others' decisions and personal previous experiences [33]. When farmers lack experience with new varieties or technological innovations, they will somewhat reduce their trust in their own information. As a result, they tend to believe that other independent individuals made decisions after obtaining sufficient information and then follow the behaviors of most people to reduce information asymmetry and decision-making uncertainty [34]. The RCS is a new type of circular farming model. Compared to the typical rice monoculture, the operation of RCS poses higher risks and more technical difficulties [35]. And it is not easy for newcomers to obtain technical and market information about RCS [36]. This kind of information asymmetry makes it difficult for farmers to confirm the accuracy of their own information, which may lead to the farmers' behavior of imitating those who have made adoption decisions in the group [37]. Farmers naturally trust information sources within their social networks, and the adoption behaviors of neighbors, relatives, or friends have a strong driving effect on farmers' adoption of new varieties or technologies [38–40]. As a consequence, the herd effect may occur in the adoption of the RCS. Our first goal is to examine the relationship between the prior adopters and the likelihood that farmers will follow the adoption behavior of their predecessors and ignore their private information.

2.2. The Impact of Information Acquisition Ability on Farmers' Herd Behavior

As decision-making subjects, farmers' decisions are non-independent and are individual behavioral judgments based on available information [41,42]. The existing literature shows that the prohibitive cost of acquiring information will promote an individual's imitation of other people's behaviors [37], while the transparency of public information can reduce individuals' herding behavior [43]. At the same time, the acquisition of effective information has a significant impact on farmers' adoption of circular agriculture technologies [44,45]. Therefore, we should consider the impact of information access on farmers' RCS adoption behavior. Individual farmers make their decision to choose one or more information sources depending on a variety of reasons, such as source accessibility and quality [46,47]. This provides them with different information and knowledge to feed their requirements [48–50]. Studies have shown that both quantity (number of information sources) and quality of information influence the adoption of new technologies and sustainable agricultural practices [51–53].

As mentioned in the informational cascades theory, the higher the accuracy of the farmers' own information, the lower the likelihood of herd behavior arising [23]. Therefore, the breadth and depth of the acquisition of private information can effectively inhibit farmers' herd behavior. A stronger ability to acquire information can make farmers more confident in making correct predictions in agricultural model adoption decisions [52], allowing them to rely more on themselves to make choices rather than blindly following others' behavior. Conversely, when farmers are unable to accurately grasp the information related to the RCS, they are more likely to be influenced by the other farmers' behavior and give up their initial decision-making information. Thus, the second objective of this paper is to explore the impact of information acquisition ability on farmers' herding behavior.

2.3. The Economic Rationality of Farmers' Herd Behavior

In the information cascade model, individuals modify their subjective judgment—by observing previous actors—and choose appropriate actions, which is a learning process following Bayes' rule [27]. In this context, individuals' herd behavior is rational, but individual rationality may lead to collective irrationality [28]. Indeed, the herding behavior of investors in the financial sector has been shown to cause undesirable market outcomes, such as excessive market volatility and market destabilization [54,55]. The rationality or irrationality of the herd behavior of farmers in RCS adoption has not been explored in previous literature. Farmers imitate others' adoption of RCS while ignoring their personal information, which may lead to there being too many RCS adopters in the same area, resulting in a rapid increase in crayfish production and a decrease in crayfish selling prices. In addition, if farmers cultivate crayfish in rice fields without understanding the RCS, their lack of cultivating knowledge and experience may lead to low production or high cost of crayfish. Farmers' herd behaviors in the adoption of RCS may not bring them the expected high returns. In our opinion, if the herd behavior of farmers is irrational, it means that they only mechanically imitate others in adopting RCS and do not master the technical specifications and production factors allocation of the RCS. If this is the case, there should be a significant difference in their farming revenue compared to that of farmers who independently made the decision to adopt the RCS. Conversely, if the herd behavior of farmers is economically rational, then the difference between the two groups of farmers should not be significant. Therefore, the third objective of this paper is to test the economic rationality of farmers' herd behavior in RCS adoption.

3. Materials and Methods

3.1. Data and Sources

The data for this study were obtained from a field survey on the development of the RCS conducted by a group from Huazhong Agricultural University in July 2019. In China, the RCS is currently being vigorously promoted and developed mainly in the plains of the middle and lower reaches of the Yangtze River [56]. Therefore, Hubei and Jiangsu provinces were selected as the survey areas for this study. The area of RCS in the Hubei province ranks first in China, which is above 300,000 ha. In the Jiangsu province, the area of rice–crayfish coculture has reached more than 100,000 ha, and the crayfish industry chain is more developed. Thus, it is relatively easy for farmers in these areas to understand and accept the RCS. This study selected four counties (cities) in the Hubei province and two counties (cities) in the Jiangsu province for the research. Huangmei County, Jianli County, Zhongxiang City and Qianjiang City (in the Hubei province) and Xuyi County and Xinghua City (in the Jiangsu province) were selected as the research areas. Stratified sampling was conducted in these 6 counties based on the following sampling procedure. Firstly, according to the proportion of area under RCS to total cultivated area, three townships, with a proportion of over 60%, from 30% to 60%, and less than 30%, respectively, were selected in every county. Secondly, among the selected 18 townships, 3 sample villages were selected according to the aforementioned selection criteria, totaling 54 sample villages. Thirdly, 12 farmers were randomly selected in each village and interviewed one-on-one, with the farmers answering the questions and the investigators recording their answers. Ultimately, A total of 631 pieces of sample data were obtained for this study. In this study, 603 valid questionnaires were retained by excluding questionnaires with inconsistent and incomplete answers.

3.2. Econometric Model and Variables

3.2.1. Econometric Model

Given that implicit herding behavior is difficult to observe and identify in the real world, this paper focuses on farmers' explicit herding behavior, i.e., farmers ignore their own information and follow other farmers to adopt the RCS. The identification of herd behavior in farmers' adoption of the RCS is shown in Figure 1.

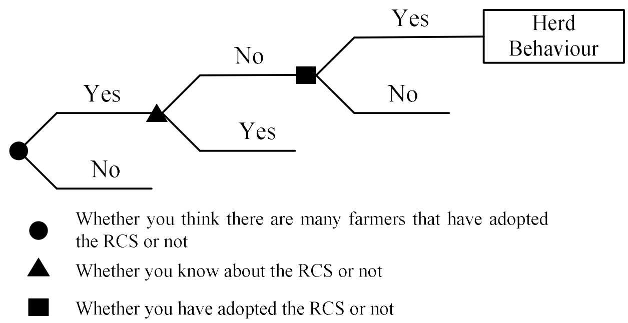

Figure 1. Method for identifying the herd behavior of farmers.

First, we asked the interviewed farmers, "Do you find that there are many farmers around you that have adopted the RCS?" If the answer is "yes", it means that they have been psychologically influenced by the adoption decisions of others (due to the fact that this item on the questionnaire had been designed to fit a 5-point scale, this paper further processed the data. Specifically, if the answer from farmers is "relatively many" or "numerous", the value assigned here is yes; otherwise, the value assigned is no.). Next, we asked farmers, "Do you know about the RCS?"; if the answer was "No", it meant that the farmers' own information indicated that they should not or were not suitable to adopt the RCS. Finally, farmers were asked whether they had adopted the RCS, and if they had done so, we gauged that they had shown dominant herd behavior.

This study constructed an econometric model to examine the impact of prior adopters on farmers' understanding and adoption of RCS. The explanatory variables were two dichotomous variables (1 if yes, 0 if no): "whether farmers know about the RCS" and "whether farmers adopt the RCS". The bivariate probit model was chosen as the estimation model in this paper. The dummy variable for farmers' understanding of RCS is y_a, and y_a = 1 indicates that farmers understand the RCS, while y_a = 0 indicates that farmers do not understand the RCS. The dummy variable for farmers' adoption behavior is y_b, with the same assignment rule as y_a. The latent variables of the understanding and adoption behavior are $y_a{}^*$ and $y_b{}^*$, respectively. Their functions are as follows:

$$\begin{aligned} y_a{}^* &= \alpha_1 x_1 + \alpha_2 x_2 + \alpha_3 x_1 x_2 + \sum_{j=4}^{n} \alpha_j control + \varepsilon_a \\ y_b{}^* &= \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_1 x_2 + \sum_{j=4}^{n} \beta_j control + \varepsilon_b \end{aligned} \quad (1)$$

In Equation (1), x_1 denotes the number of prior adopters. x_2 denotes the information acquisition ability of farmers. $x_1 x_2$ denotes the interaction term between information acquisition ability and the number of prior adopters, and its coefficient reveals the moderating effect of information acquisition ability on the decision making of others in influencing the adoption behavior of farmers. *Control* denotes the control variables affecting the degree of understanding and adoption behavior. α and β are the estimated coefficients corresponding to the two sets of variables. ε_a and ε_b are the random perturbation terms in the two equations, assuming that (ε_a,ε_b) conforms to a two-dimensional joint normal distribution, and ρ denotes the correlation coefficient of the two random perturbation terms.

The observable variables y_a and y_b are determined by using the following equations:

$$y_a = \begin{cases} 1 & if y_a{}^* > 0 \\ 0 & if y_a{}^* \leq 0 \end{cases}$$
$$y_b = \begin{cases} 1 & if y_b{}^* > 0 \\ 0 & if y_b{}^* \leq 0 \end{cases} \quad (2)$$

When $\rho \neq 0$, maximum likelihood estimation can be used to estimate the probability of the value of (y_a, y_b). Our study focuses on the behavior of farmers not understanding the RCS but adopting it, and the following equation is used to estimate the probability of the occurrence of such behavior so that we can further analyze its influencing factors.

$$\begin{aligned} P_{01} =& (y_a = 0, y_b = 1) = P(y_a{}^* \leq 0, y_b{}^* > 0) \\ &= P(\varepsilon_a \leq -X_a\alpha, \varepsilon_b > -X_b\beta) \\ &= \int_{-\infty}^{-X_a\alpha} \int_{-\infty}^{X_b\beta} \varphi(z_1, z_2, \rho) dz_1 dz_2 \\ &= \Phi(-X_a\alpha, X_b\beta, \rho) \end{aligned} \quad (3)$$

In the above equation, X_a and X_b represent two sets of influencing factor variables of farmers' understanding of RCS and RCS adoption behavior that have been mentioned in Equation (1). α and β are the parameters to be estimated for the two sets of variables. $\varphi(\cdot)$ and $\Phi(\cdot)$ are the probability density function and the cumulative distribution function, respectively. The consistent estimation results of the two sets of parameters can be obtained by using a maximum likelihood estimation method for the above equation.

3.2.2. Endogeneity Discussion and Instrumental Variable Selection

Due to farmers' adoption of the RCS, they usually pay selective attention to characteristics similar to their own and are particularly concerned about people who have also adopted the RCS, thus leading to a reverse causal relationship. Furthermore, certain factors that simultaneously affect the number of other farmers who have adopted the RCS and the surveyed farmers' adoption behavior may be omitted from the model. Therefore, if the model of this study suffers from endogeneity problems due to bidirectional causality and omitted variables, it will largely lead to the the causal effect in Equation (1) being overestimated, leading to a serious estimation bias. For this reason, this paper seeks an instrumental variable to address the potential endogeneity problem.

In this study, "whether there is an agricultural regional brand for crayfish in the district where the farmer is located" was selected as the instrumental variable for "the number of prior adopters". The option "farmers who do not know about the RCS but have adopted the RCS", hereafter referred to as "blind adoption", was the dependent variable (if $y_a = 0$ and $y_b = 1$, the dependent variable of the model was assigned to be 1, otherwise, it was assigned to be 0). Then, the IV-probit model was used to test the causality.

The Ministry of Agriculture and Rural Affairs of China guided relevant industry associations to release China's Agricultural Brand Catalogue in 2019, which included a total of 300 representative regional public brands of characteristic agricultural products across the country. Being chosen as a regional public brand of crayfish demonstrates that the region has a large-scale crayfish industry, a mature industrial chain, and a good market response. Therefore, the number of RCS adopters in such regions is likely to be even larger. This also means that the instrumental variables in this paper can positively affect the endogenous explanatory variable (the number of prior adopters). In addition, the regional public brand list was published after this survey was carried out. So, there is no evidence that the regional public brand directly affects the decisions of farmers to adopt the RCS, suggesting that the exogenous requirement of the instrumental variable is also fulfilled.

3.2.3. Variables and Descriptive Statistics

Prior adopters. One of the core explanatory variables in this paper is the number of prior adopters of the RCS. Since the herd effect arises from the individual's perception of the outcome of others' decisions, this study measures this variable from the perspective of the subjective perception of the interviewed farmers.

Information acquisition ability. Referring to the study of Abdul [57], we measured the information acquisition ability of farmers according to their utilization of multiple information channels, used the Item Response Theory (IRT) model to estimate the value of information acquisition capacity, and constructed a two-parameter IRT model in Logstic form.

$$\omega_{ij} = \frac{exp[c_j(Access_i - d_j)]}{1 + exp[c_j(Access_i - d_j)]} \tag{4}$$

ω_{ij} represents the probability that farmer i can obtain information from the jth channel. $Access_i$ is the parameter for the ability of farmers to obtain information, and the larger its value, the stronger the information acquisition ability. c_j is the discrimination parameter of the jth channel, and the larger its value, the greater the discrimination of the jth channel in the differentiated ability to access information. d_j is the difficulty parameter of the jth channel, and the larger its value, the more difficult it is for farmers to obtain information from the jth channel.

According to the actual situation in the research area, the main channels for farmers to obtain information on agricultural technology include technicians from agricultural enterprises, agricultural extension departments, agricultural demonstration bases, cooperatives, social networks (relatives, friends, and neighbors), online platforms (mobile phones and computers), and paper-based information (books and newspapers), a total of seven channels.

Control variables. We selected control variables from the characteristics of the head of the household (including age, years of education, village cadre) and family characteristics (including agricultural acreage, distance between the farthest two plots, participation in cooperatives, and the proportion of household agricultural income). A total of seven control variables were introduced into the model. The descriptive statistical results of all variables are shown in Table 1.

Table 1. Descriptive statistics results for all variables.

Classification of Variables	Variable	Description	N	Mean	Std. Dev.
Explained Variables	Adoption of the RCS	1 if an adopter, 0 otherwise	603	0.632	0.483
	Understanding of the RCS	1 if farmer understands the RCS, 0 otherwise	603	0.491	0.500
explanatory variables	Prior adopters	Number of other farmers who have adopted the RCS: 1 if almost none, 2 if relatively few, 3 if average, 4 if relatively many, 5 if numerous	603	3.708	1.186
	Information acquisition ability	Parameters estimated by the IRT model	603	0.000	0.413
Instrumental variable	Regional public brand areas	1 if yes, 0 otherwise	603	0.348	0.477

Table 1. *Cont.*

Classification of Variables	Variable	Description	N	Mean	Std. Dev.
Control variables	Age	Years of age	603	52.657	7.906
	Years of Education	Years of Education	603	8.172	3.059
	Village cadre	1 if yes, 0 otherwise	603	0.123	0.328
	Agriculture acreage	In hectares	603	5.462	12.486
	Land fragmentation	The distance between the two farthest plots (in kilometers)	603	0.840	2.935
	Participation in cooperatives	1 if yes, 0 otherwise	603	0.323	0.468
	Proportion of household agricultural income	Household agricultural income/total household income	603	0.673	0.340

4. Estimation Results

4.1. Estimated Results of Information Acquisition Ability

We estimated information accessibility by using the two-parameter IRT model. The discrimination and difficulty parameters of the seven information channels (shown in Table 2) and the potential information accessibility parameters (shown in Table 3) were obtained.

Table 2. Estimation results of the IRT model for information acquisition ability.

	Discrimination Parameter	S.E.	Difficulty Parameter	S.E.
Technicians from agricultural enterprises	0.488 ***	0.14	1.374 ***	0.401
Agricultural extension departments	2.803 ***	0.67	0.091	0.062
Agricultural demonstration bases	0.664 ***	0.212	3.357 ***	0.946
Cooperatives	0.675 ***	0.195	2.891 ***	0.734
Social networks	0.167	0.138	−6.937	5.686
Online platforms	0.145	0.134	7.226	6.64
Paper-based information	0.027	0.218	90.945	723.105

Note: The asterisks *** denote significance at the 1% level.

Table 3. Interval distribution of the parameter of information acquisition ability.

Parameter Range	Frequency	Percentage
$(-\infty, -0.5)$	263	43.62%
$(-0.5, 0)$	55	9.12%
$(0, 0.5)$	27	4.48%
$(0.5, 1)$	216	35.82%
$(1, +\infty)$	42	6.97%

In terms of discrimination, agricultural technology extension departments, agricultural enterprise technicians, agricultural demonstration bases and cooperatives have a stronger discriminatory effect on farmers' ability to obtain information. This indicates that there is a great difference in the utilization of these four information channels by farmers and that the above four channels play an important role in helping farmers acquire agricultural technology information. Farmers who can acquire information through these four channels have a higher level of potential information acquisition ability. The discrimination parameters of channels such as social networks, online platforms, and paper-based information are small and do not reach statistical significance, indicating that farmers' utilization of these three channels is roughly similar and less critical to farmers' access to information. This may be because the agricultural technology information delivered by social networks, online platforms, and paper-based means are less relevant and effective, and their contributions to farmers' access to information are low.

In terms of difficulty, the difficulty parameters of paper-based information and online platforms are the largest, indicating that it is most difficult for the sample farmers to obtain agricultural technology information from these two channels due to their low level of education and limited Internet usage habits. The difficulty parameters of the three channels, including agricultural demonstration bases, cooperatives, and enterprise technicians, are larger and statistically significant, which means that these channels are difficult to access but have a more important contribution to the information acquisition capacity. The difficulty of obtaining information from agricultural technology extension departments and social networks is the lowest, which means that these two channels are more available for most farmers.

When the estimates of the ability parameters lie in the interval [–3, 3], the bias in the potential prior distribution setting is negligible [58]. From the results in Table 4, the valuation interval of the information access capacity parameter of the interviewed farmers is [−0.848, 1.546], which is in line with the upper and lower limits. The total number of farmers whose information access ability parameter does not exceed 0 is 318, accounting for 52.74%, indicating that most farmers have a low capacity to access agricultural technology information. A total of 243 farm households, accounting for 40.3%, have a capacity parameter in the interval (0, 1). In addition, the ability parameters of 6.97% of farmers are greater than 1, demonstrating that few farmers possess a strong information acquisition ability.

Table 4. Estimation results of bivariate probit model and IV-probit model.

	Bivariate Probit				**IV-Probit**	
	y_a	y_b	**Pr(y_a = 0, y_b = 1)**		**Blind Adoption**	
	Coef.	**Coef.**	**dy/dx**	**dy/dx**	**Coef.**	**Coef.**
Prior adopters	0.454 ***	0.796 ***	0.057 ***	0.061 ***	0.991 ***	1.002 ***
	(0.053)	(0.062)	(0.019)	(0.019)	(0.235)	(0.247)
Information acquisition ability	0.699 ***	0.060	−0.178 ***	−0.171 ***	−0.751 ***	−0.659 ***
	(0.086)	(0.091)	(0.027)	(0.027)	(0.111)	(0.116)
Prior adopters × Information acquisition ability				−0.050 *		−0.359 ***
				(0.026)		(0.122)
Age	−0.024 ***	−0.015 *	0.003	0.003	0.019 *	0.019 *
	(0.008)	(0.008)	(0.002)	(0.002)	(0.011)	(0.011)
Years of Education	−0.008	−0.061 ***	−0.012 *	−0.013 **	0.012	0.002
	(0.020)	(0.021)	(0.006)	(0.006)	(0.025)	(0.025)
Village cadre	0.130	−0.421 **	−0.132 **	−0.122 **	−0.051	−0.020
	(0.185)	(0.194)	(0.056)	(0.056)	(0.265)	(0.273)
Agriculture acreage	0.001	0.001	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Land fragmentation	0.002	−0.020	−0.005	−0.003	−0.006	0.001
	(0.021)	(0.038)	(0.009)	(0.009)	(0.038)	(0.038)
Participation in cooperatives	0.406 ***	0.347 **	−0.032	−0.038	−0.240	−0.250
	(0.130)	(0.143)	(0.041)	(0.041)	(0.165)	(0.168)
Proportion of household agricultural income	−0.693 ***	−0.138	0.158 ***	0.161 ***	0.264	0.302
	(0.173)	(0.182)	(0.054)	(0.053)	(0.215)	(0.220)
Constant term	−0.138	−1.279 **			−5.845 ***	−5.840 ***
	(0.552)	(0.587)			(1.407)	(1.450)
Wald chi-squared value	297.9 ***				70.43 ***	
Likelihood-ratio test of rho = 0	47.505 ***					
Wald test of exogeneity					10.84 ***	11.22 ***

Note: The asterisks ***, **, and * denote significance at 1%, 5%, and 10% levels, respectively. Figures in parentheses are standard errors.

4.2. Herd Effect, Information Acquisition Ability and the Adoption of RCS by Farmers

The results of the likelihood–ratio test showed that the random perturbation term between the two equations was significantly correlated at the 1% level, demonstrating the need to estimate the two dependent variables using the bivariate probit model. The results of the estimation are shown in Table 2.

The number of prior adopters has a significant positive effect on farmers' RCS understanding and adoption behavior. The more prior adopters in the farmers' information network, the higher the farmers' degree of understanding of the RCS and the higher the probability of the farmers' RCS adoption behavior. Information acquisition ability has a significantly positive effect on farmers' understanding of the RCS, but its effect on RCS adoption behavior is not significant. This suggests that information acquisition ability mainly affects the quality of farmers' own information but does not directly affect their decision-making outcomes.

We estimated the marginal effects of the probability, $\Pr(y_a = 0, y_b = 1)$, to analyze the factors influencing the adoption behavior under the condition that farmers do not understand the RCS and the results are displayed in Column 3 of Table 4. The coefficient of the number of prior adopters is significantly positive, and the probability of a farmer's blind adoption behavior increases by 5.7% for each unit increase in the number of prior adopters. This indicates that the probability that farmers ignore their own information and adopt the RCS increases with the number of prior adopters in their network, which strongly confirms the existence of a herding effect in the adoption of the RCS by farmers. The coefficient of information acquisition ability is significantly negative, and the probability of blind adoption behavior decreases by 17.8% for each unit increase in information acquisition ability. A possible reason for this is that high information accessibility means that farmers can actively use various channels and tools to obtain effective information, improve the accuracy of their personal information, and thus avoid blindly adopting the RCS.

Next, the paper examines the moderating effect of information acquisition ability on the relationship between the number of prior adopters and farmers' blind adoption behavior, with the aim of analyzing whether information acquisition ability can reduce farmers' herd behavior. Column 4 introduces the interaction term of information acquisition ability $\times$ prior adopters into a bivariate probit model to estimate its marginal effect on $\Pr(y_a = 0, y_b = 1)$. The coefficient of the interaction term is significantly negative at the 5% statistical level. This suggests that information acquisition ability weakens the role of others' adoption decisions in driving farmers' blind adoption, i.e., it inhibits farmers' herd behavior. This is because farmers with great information acquisition ability have more adequate and accurate external information and will rely more on their own analysis and judgment to make adoption decisions. Such behavior reduces farmers' uncertainty about their autonomous decision making and inhibits their herding behavior.

To avoid estimation biases due to endogeneity problems, this paper also uses a two-stage IV-probit for model estimation, and the second-stage results are shown in Columns 5 and 6. The Wald test rejects the null hypothesis at the 1% significance level, suggesting that there is an endogeneity problem with the explanatory variables and that instrumental variables need to be introduced. Both the weak instrumental variable test and the non-identifiable test of the equation strongly reject the null hypothesis, confirming that the instrumental variables are strongly correlated with the explanatory variables and that the equations are just-identified.

After controlling for the endogeneity problem, prior adopters still significantly and positively influenced farmers' blind adoption, suggesting that there is a herding effect in the process of farmers' RCS adoption. Hypothesis 1 of this paper was tested. After introducing the interaction term of prior adopters $\times$ information acquisition ability, the estimated coefficient is significantly negative at the 1% level. The results indicate that information acquisition ability can weaken the driving effect of others' adoption decisions on farmers' blind adoption, which verifies that information acquisition ability can reduce farmers' herd behavior. Therefore, hypothesis 2 of this paper is confirmed.

4.3. The Economic Rationality of Herd Behavior

According to the identification steps in Figure 1, this study can determine the sample farmers who have shown dominant herd behavior. Specifically, when a farmer believes that there are many prior adopters, they adopt the RCS despite not understanding it, then displaying herd behavior. The statistical results show that 381 farmers surveyed in this study adopted the RCS. Among them, 118 showed herd behavior in adopting the RCS, which accounted for 19.6% of all the samples and 31% of the farmers that adopted the RCS. We conducted an independent samples t-test to identify significant differences between herding and non-herding adopters in the three indicators of satisfaction with income from farming, gross income per hectare, and net income per hectare. The results are shown in Table 5.

Table 5. Grouping analysis of the RCS adopters by herding behavior.

	Herding Adopters		Non-Herding Adopters		Mean Difference	Std. Err.	P
	Mean	Std. Err.	Mean	Std. Err.			
Satisfaction with income from farming	3.322	0.087	3.586	0.046	0.264 ***	0.090	0.002
Gross income per hectare (CNY)	55,703.595	3207.825	58,855.05	2247.015	3151.44	3983.925	0.214
Net income per hectare (CNY)	25,781.625	2028.75	29,846.37	1666.845	4064.76	2835.87	0.076
N	118		263				

Note: The asterisks *** denote significance at the 1% level.

Satisfaction with farming income is significantly lower for the herding adopters than for the non-herding adopters, with a difference in means of 0.264. Although the two groups of adopters do not show a significant difference in the mean of total income per hectare, there is a significant difference in the mean of net income per hectare at the 10% significance level. The mean net income per hectare of the herding adopters is lower than that of non-herding adopters by 4064.76 CNY. Rapidly rising consumer demand for crayfish in China has resulted in higher income from crayfish sales for all farmers engaged in rice–crayfish coculture, but the lack of knowledge and management capability of the herding adopters has resulted in less effective cost control and factor allocation, leading to lower net income per hectare and income satisfaction. These significant differences suggest that herd behavior in the adoption of RCS by farmers is not economically rational.

5. Discussion

The herd effect frequently arises in people's decision-making behaviors ([59–62]); however, the herd behavior of farmers in the adoption of circular farming models has not been sufficiently studied. The findings of this study confirm that farmers' blind adoption behavior of RCS is boosted by the number of prior adopters, although information acquisition ability can reduce the probability of farmers' herd behavior.

The first question explored in this study is whether there is a herd effect in the adoption of the RCS by farmers. Based on information cascade theory, we elaborated a procedure to identify the herd behavior of farmers based on their belief that there are many prior adopters and their adoption of the RCS despite not understanding it. Therefore, a bivariate probit model with RCS knowledge and amount of adoption behavior as dependent variables was constructed to test the effect of the number of prior adopters on them. The results showed that the number of prior adopters has a significant positive effect on both RCS understanding and the adoption behavior of farmers. The findings match those observed in earlier studies about farmers' adoption of the circular agriculture model ([4,13,20]). Contrary to earlier findings, however, our estimation of the marginal effects of the joint probability $Pr(y_a = 0, y_b = 1)$ found that prior adopters also drive the blind adoption behavior of farmers. This finding validates the information cascade theory and supplements it with a measure of an individual's neglect of their own information.

Another important question explored in this study is whether information acquisition capability can reduce the herd behavior of farmers. We use the IRT model to measure farmers' information acquisition ability based on their utilization of seven information channels and then introduce this variable into a bivariate probit model to estimate its parameters. The results found that information access ability can effectively reduce farmers' blind adoption behavior and weaken the role of prior adopters in driving farmers' blind adoption. The positive role of information acquisition capability in agricultural technology diffusion has been confirmed by existing studies about the effect of information acquisition capability on farmers' acceptance of new ideas and technologies [45,53]. Surprisingly, the findings of this study suggest that information acquisition ability also restrains farmers from blindly following the herd in the adoption of circular farming models. These findings suggest that policymakers should pay attention to the improvement of farmers' information acquisition ability.

In addition, to confirm the economic outcomes of farmers' herd behavior in RCS adoption, this paper examined whether there is a significant difference in farming income between herding and non-herding adopters through an independent samples t-test. The results showed that both satisfaction with farming income and net income per hectare of RCS adopters with herding behavior were significantly lower than those of RCS adopters without herding. This finding suggests that the herd behavior in the adoption of RCS is economically irrational, which prevents the RCS from guaranteeing high-efficiency yields and sustainable agricultural development. Therefore, the agricultural sector should strengthen the regulation of the rice–crayfish industry and control the blind expansion of RCS through strict measures.

6. Conclusions

The RCS is a circular agricultural model that can achieve resource reuse and chemical fertilizer and pesticide reduction, which can also bring higher income to farmers compared to planting rice alone. However, in the promotion process of the RCS in China, there has been a phenomenon of blindly following the trend, leading to the poor management of many rice fields, which is not conducive to the stability of grain yield and the sustainable development of the RCS.

This paper analyses the formation mechanism and influencing factors of farmers' herd behavior under the framework of information cascade theory. Using micro-survey data from 603 farmers, this paper examines the existence of the herd effect in the adoption of RCS by farmers and the inhibitory effect of information acquisition capability on herd behavior based on a bivariate probit model. To address possible endogeneity issues, we also conducted a robustness test using the IV-probit model. Furthermore, this study tests for between-group differences in agricultural income between farmers with herding adoption and non-herding adoption.

The main findings of this study are as follows. First, the larger the number of prior adopters, the higher the probability of blind adoption behavior by farmers, indicating the existence of the herd effect in the adoption of RCS by farmers. Second, the improvement of farmers' information acquisition ability can significantly inhibit the herd behavior of farmers in the adoption of RCS, and the stronger the information acquisition ability, the lower the likelihood of farmers' herd behavior. Third, herding adopters displayed significantly lower satisfaction with farming income and net income per hectare than non-herding adopters, suggesting that such herd behavior, which ignores the farmers' own information, is not economically rational.

When farmers adopt the RCS, they are prone to show herd behavior, which needs to be regulated and guided. The government should formulate strict regional planning for RCS, clearly delineate basic farmland protection areas, and supervise the proportion of trenches dug in rice paddies in line with requirements. Given the inhibitory effect of information ability on farmers' herding behavior, attention should be paid to improving farmers' information acquisition ability. The channels for obtaining information need to be expanded.

Combining the traditional technology promotion channels such as agricultural extension services, agribusinesses and farmers' cooperatives with newly developing channels such as web-based information platforms and technical guide manuals will be favorable.

Two limitations to our study should be addressed in future research. First, herd behavior in farmers' adoption of a circular agriculture model is a complex process, and this paper has only explored it from the perspective of information acquisition ability. Economic factors, social networks, and other factors could be analyzed in further research. Second, the conclusions of this study are based on cross-sectional data from Hubei and Jiangsu provinces in China, but it remains to be determined whether consistent conclusions can be drawn in other regions and countries.

Author Contributions: W.H. methodology, data curation, writing—original draft; C.Y. conceptualization, supervision; R.M. and K.L. writing—review and editing. All authors have read and agreed to the published version of the manuscript.

Funding: This research was financially supported by the Hunan Province Philosophy and Social Science Foundation of China (Grant No. 20YBQ111), the National Social Science Foundation of China (Grant No. 21CGL030), and National Natural Science Foundation of China (Grant No. 72003201).

Institutional Review Board Statement: Ethical review and approval were waived for this study because there was no ethics committee in China.

Data Availability Statement: The data that are presented in this study are available upon request from the corresponding author. The data are not publicly available due to privacy restrictions.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Xu, Q.; Peng, X.; Guo, H.; Che, Y.; Dou, Z.; Xing, Z.; Hou, J.; Styles, D.; Gao, H.; Zhang, H. Rice-crayfish coculture delivers more nutrition at a lower environmental cost. *Sustain. Prod. Consum.* **2022**, *29*, 14–24. [CrossRef]
2. Zhou, Y.; Yan, X.-Y.; Gong, S.-L.; Li, C.-W.; Zhu, R.; Zhu, B.; Liu, Z.-Y.; Wang, X.-L.; Cao, P. Changes in paddy cropping system enhanced economic profit and ecological sustainability in central China. *J. Integr. Agric.* **2022**, *21*, 566–577. [CrossRef]
3. Anastacio, P.M.; Frias, A.F.; Marques, J.C. Impact of crayfish densities on wet seeded rice and the inefficiency of a non-ionic surfactant as an ecotechnological solution. *Ecol. Eng.* **2000**, *15*, 17–25. [CrossRef]
4. Nordin, S.M.; Zolkepli, I.A.; Rizal, A.R.A.; Tariq, R.; Mannan, S.; Ramayah, T. Paving the way to paddy food security: A multigroup analysis of agricultural education on Circular Economy Adoption. *J. Clean. Prod.* **2022**, *375*, 134089. [CrossRef]
5. Atinkut, H.B.; Yan, T.; Zhang, F.; Qin, S.; Gai, H.; Liu, Q. Cognition of agriculture waste and payments for a circular agriculture model in Central China. *Sci. Rep.* **2020**, *10*, 10826. [CrossRef] [PubMed]
6. Gwara, S.; Wale, E.; Odindo, A. Behavioral intentions of rural farmers to recycle human excreta in agriculture. *Sci. Rep.* **2022**, *12*, 5890. [CrossRef]
7. Branca, G.; Perelli, C. 'Clearing the air': Common drivers of climate-smart smallholder food production in Eastern and Southern Africa. *J. Clean. Prod.* **2020**, *270*, 121900. [CrossRef]
8. Khan, F.; Ali, Y. Moving towards a sustainable circular bio-economy in the agriculture sector of a developing country. *Ecol. Econ.* **2022**, *196*, 107402. [CrossRef]
9. Lopez-Serrano, M.J.; Velasco-Munoz, J.F.; Aznar-Sanchez, J.A.; Roman-Sanchez, I.M. Farmers Attitudes towards Irrigating Crops with Reclaimed Water in the Framework of a Circular Economy. *Agronomy* **2022**, *12*, 435. [CrossRef]
10. de Lauwere, C.; Slegers, M.; Meeusen, M. The influence of behavioural factors and external conditions on Dutch farmers? decision making in the transition towards circular agriculture. *Land Use Policy* **2022**, *120*, 106253. [CrossRef]
11. Case, S.D.C.; Oelofse, M.; Hou, Y.; Oenema, O.; Jensen, L.S. Farmer perceptions and use of organic waste products as fertilisers—A survey study of potential benefits and barriers. *Agric. Syst.* **2017**, *151*, 84–95. [CrossRef]
12. Van, V.H.; Heo, Y.; Doanh, N.K. 'They convert, I also convert': The neighborhood effects and tea farmers' intention to convert to organic farming. *Renew. Agric. Food Syst.* **2023**, *38*, E11. [CrossRef]
13. Quoc, T.-N.; Tuyen, T. The role of peer influence and norms in organic farming adoption: Accounting for farmers' heterogeneity. *J. Environ. Manag.* **2022**, *320*, 115909. [CrossRef]
14. Kreft, C.; Angst, M.; Huber, R.; Finger, R. Farmers' social networks and regional spillover effects in agricultural climate change mitigation. *Clim. Chang.* **2023**, *176*, 8. [CrossRef]
15. Moritz, L.; Kuhn, L.; Bobojonov, I. The role of peer imitation in agricultural index insurance adoption: Findings from lab-in-the-field experiments in Kyrgyzstan. *Rev. Dev. Econ.* **2023**, *27*, 1649–1672. [CrossRef]
16. Luo, T.Y.; Yang, H.F.; Zhao, J.H.; Sun, J.X. Farmers? Social Networks and the Fluctuation in Their Participation in Crop Insurance: The Perspective of Information Diffusion. *Emerg. Mark. Financ. Trade* **2020**, *56*, 1–19. [CrossRef]

17. Shikuku, K.M. Information exchange links, knowledge exposure, and adoption of agricultural technologies in northern Uganda. *World Dev.* **2019**, *115*, 94–106. [CrossRef]
18. Cai, J.; De Janvry, A.; Sadoulet, E. Social Networks and the Decision to Insure. *Am. Econ. J.-Appl. Econ.* **2015**, *7*, 81–108. [CrossRef]
19. Le Thi Hoa, S.; Bond, J.; Nguyen Tien, D.; Hoang Gia, H.; Nguyen Thi Hong, M.; Huynh Thi Anh, P. Farmers' barriers to the access and use of climate information in the mountainous regions of Thua Thien Hue province, Vietnam. *Clim. Serv.* **2021**, *24*, 100267. [CrossRef]
20. Niu, Z.H.; Chen, C.; Gao, Y.; Wang, Y.Q.; Chen, Y.S.; Zhao, K.J. Peer effects, attention allocation and farmers' adoption of cleaner production technology: Taking green control techniques as an example. *J. Clean. Prod.* **2022**, *339*, 130700. [CrossRef]
21. Munshi, K. Social learning in a heterogeneous population: Technology diffusion in the Indian Green Revolution. *J. Dev. Econ.* **2004**, *73*, 185–213. [CrossRef]
22. Bramoulle, Y.; Djebbari, H.; Fortin, B. Identification of peer effects through social networks. *J. Econom.* **2009**, *150*, 41–55. [CrossRef]
23. Smith, L.; Sorensen, P.N.; Tian, J. Informational Herding, Optimal Experimentation, and Contrarianism. *Rev. Econ. Stud.* **2021**, *88*, 2527–2554. [CrossRef]
24. Morone, A.; Samanidou, E. A simple note on herd behaviour. *J. Evol. Econ.* **2008**, *18*, 639–646. [CrossRef]
25. Zhou, R.T.; Lai, R.N. Herding and information based trading. *J. Empir. Financ.* **2009**, *16*, 388–393. [CrossRef]
26. Bikhchandani, S.; Hirshleifer, D.; Welch, I. A Theory of Fads, Fashion, Custom, and Cultural Change as Informational Cascades. *J. Political Econ.* **1992**, *100*, 992–1026. [CrossRef]
27. Anderson, L.R.; Holt, C.A. Information Cascades in the Laboratory. *Am. Econ. Rev.* **1997**, *87*, 847–862.
28. Huck, S.; Oechssler, J. Informational cascades in the laboratory: Do they occur for the right reasons? *J. Econ. Psychol.* **2000**, *21*, 661–671. [CrossRef]
29. Cerroni, S. Eliciting farmers' subjective probabilities, risk, and uncertainty preferences using contextualized field experiments. *Agric. Econ.* **2020**, *51*, 707–724. [CrossRef]
30. Barbieri, C.; Mahoney, E. Why is diversification an attractive farm adjustment strategy? Insights from Texas farmers and ranchers. *J. Rural Stud.* **2009**, *25*, 58–66. [CrossRef]
31. Ghadim, A.K.A.; Pannell, D.J.; Burton, M.P. Risk, uncertainty, and learning in adoption of a crop innovation. *Agric. Econ.* **2005**, *33*, 1–9. [CrossRef]
32. Ouattara, P.D.; Kouassi, E.; Egbendewe, A.Y.G.; Akinkugbe, O. Risk aversion and land allocation between annual and perennial crops in semisubsistence farming: A stochastic optimization approach. *Agric. Econ.* **2019**, *50*, 329–339. [CrossRef]
33. Reimer, A.P.; Houser, M.K.; Marquart-Pyatt, S.T. Farming decisions in a complex and uncertain world: Nitrogen management in Midwestern corn agriculture. *J. Soil Water Conserv.* **2020**, *75*, 617–628. [CrossRef]
34. Ford, J.L.; Kelsey, D.; Pang, W. Information and ambiguity: Herd and contrarian behaviour in financial markets. *Theory Decis.* **2013**, *75*, 1–15. [CrossRef]
35. Hou, J.; Wang, X.; Xu, Q.; Cao, Y.; Zhang, D.; Zhu, J. Rice-crayfish systems are not a panacea for sustaining cleaner food production. *Environ. Sci. Pollut. Res.* **2021**, *28*, 22913–22926. [CrossRef]
36. Xu, Q.; Liu, T.; Guo, H.; Duo, Z.; Gao, H.; Zhang, H. Conversion from rice-wheat rotation to rice-crayfish coculture increases net ecosystem service values in Hung-tse Lake area, east China. *J. Clean. Prod.* **2021**, *319*, 128883. [CrossRef]
37. Chatzimichael, K.; Genius, M.; Tzouvelekas, V. Informational cascades and technology adoption: Evidence from Greek and German organic growers. *Food Policy* **2014**, *49*, 186–195. [CrossRef]
38. Chaudhuri, S.; Roy, M.; McDonald, L.M.; Emendack, Y. Reflections on farmers' social networks: A means for sustainable agricultural development? *Environ. Dev. Sustain.* **2021**, *23*, 2973–3008. [CrossRef]
39. Wang, Y.; Moehring, N.; Finger, R. When my neighbors matter: Spillover effects in the adoption of large-scale pesticide-free wheat production. *Agric. Econ.* **2023**, *54*, 256–273. [CrossRef]
40. D'Souza, A.; Mishra, A.K. Adoption and Abandonment of Partial Conservation Technologies in Developing Economies: The Case of South Asia. *Land Use Policy* **2018**, *70*, 212–223. [CrossRef]
41. Santos, P.; Barrett, C.B. Identity, Interest and Information Search in a Dynamic Rural Economy. *World Dev.* **2010**, *38*, 1788–1796. [CrossRef]
42. Diekmann, F.; Loibl, C.; Batte, M.T. The Economics of Agricultural Information: Factors Affecting Commercial Farmers' Information Strategies in Ohio. *Rev. Agric. Econ.* **2009**, *31*, 853–872. [CrossRef]
43. Wang, K.-Y.; Huang, Y.-S. Effects of Transparency on Herding Behavior: Evidence from the Taiwanese Stock Market. *Emerg. Mark. Financ. Trade* **2019**, *55*, 1821–1840. [CrossRef]
44. Zhu, J.; Zheng, S.; Kaabar, M.K.A.; Yue, X.-G. Online or offline? The impact of environmental knowledge acquisition on environmental behavior of Chinese farmers based on social capital perspective. *Front. Environ. Sci.* **2022**, *10*, 1052797. [CrossRef]
45. Yang, W.; Qi, J.; Arif, M.; Liu, M.; Lu, Y. Impact of information acquisition on farmers' willingness to recycle plastic mulch film residues in China. *J. Clean. Prod.* **2021**, *297*, 126656. [CrossRef]
46. Solano, C.; Leon, H.; Perez, E.; Herrero, M. The role of personal information sources on the decision-making process of Costa Rican dairy farmers. *Agric. Syst.* **2003**, *76*, 3–18. [CrossRef]
47. Llewellyn, R.S. Information quality and effectiveness for more rapid adoption decisions by farmers. *Field Crops Res.* **2007**, *104*, 148–156. [CrossRef]

48. Houser, M.; Marquart-Pyatt, S.T.; Denny, R.C.H.; Reimer, A.; Stuart, D. Farmers, information, and nutrient management in the US Midwest. *J. Soil Water Conserv.* **2019**, *74*, 269–280. [CrossRef]
49. Adegbola, P.; Gardebroek, C. The effect of information sources on technology adoption and modification decisions. *Agric. Econ.* **2007**, *37*, 55–65. [CrossRef]
50. Williamson, S.; Little, A.; Ali, M.A.; Kimani, M.; Meir, C.; Oruko, L. Aspects of cotton and vegetable farmers' pest management decision-making in India and Kenya. *Int. J. Pest Manag.* **2003**, *49*, 187–198. [CrossRef]
51. Beethem, K.; Marquart-Pyatt, S.T.T.; Lai, J.; Guo, T. Navigating the information landscape: Public and private information source access by midwest farmers. *Agric. Hum. Values* **2023**, *40*, 1–9. [CrossRef]
52. Abdulai, A. Information acquisition and the adoption of improved crop varieties. *Am. J. Agric. Econ.* **2023**, *105*, 1049–1062. [CrossRef]
53. Yue, S.; Xue, Y.; Lyu, J.; Wang, K. The Effect of Information Acquisition Ability on Farmers' Agricultural Productive Service Behavior: An Empirical Analysis of Corn Farmers in Northeast China. *Agriculture* **2023**, *13*, 573. [CrossRef]
54. Shantha, K.V.A. The evolution of herd behavior: Will herding disappear over time? *Stud. Econ. Financ.* **2019**, *36*, 637–661. [CrossRef]
55. Mallek, R.S.; Albaity, M.; Molyneux, P. Uncertainty, Trust and Herding Behaviour. *Rev. Dev. Financ.* **2021**, *11*, 94–107.
56. Wei, Y.; Mueller, D.; Sun, Z.; Lu, M.; Tang, H.; Wu, W. Exploring the emergence and changing dynamics of a new integrated rice-crawfish farming system in China. *Environ. Res. Lett.* **2023**, *18*, 064040. [CrossRef]
57. Abdul-Salam, Y.; Phimister, E. Efficiency Effects of Access to Information on Small-scale Agriculture: Empirical Evidence from Uganda using Stochastic Frontier and IRT Models. *J. Agric. Econ.* **2017**, *68*, 494–517. [CrossRef]
58. Edelen, M.O.; Reeve, B.B. Applying item response theory (IRT) modeling to questionnaire development, evaluation, and refinement. *Qual. Life Res.* **2007**, *16*, 5–18. [CrossRef]
59. Ding, A.W.; Li, S. Herding in the consumption and purchase of digital goods and moderators of the herding bias. *J. Acad. Mark. Sci.* **2019**, *47*, 460–478. [CrossRef]
60. Youssef, M. What Drives Herding Behavior in the Cryptocurrency Market? *J. Behav. Financ.* **2022**, *23*, 230–239. [CrossRef]
61. Luo, P.; Wu, B.; Law, R.; Xu, Y. Herding behavior in peer-to-peer trading economy: The moderating role of reviewer photo and name. *Tour. Manag. Perspect.* **2023**, *45*, 101050. [CrossRef]
62. Vedadi, A.; Warkentin, M.; Dennis, A. Herd behavior in information security decision-making. *Inf. Manag.* **2021**, *58*, 103526. [CrossRef]