

## Disparities Between Willingness to Pay and Willingness to Accept for Corn Stover Return-to-Field Technology: A Postprint Study

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### Abstract

Revealing the true willingness for ecological compensation among stakeholders in the practice of straw return technology is not only a challenging issue in research on measuring technological externalities, but also a critical factor in improving the accuracy and effectiveness of agricultural compensation policies. Previous studies have predominantly employed ecological service value estimation of farmland ecosystems to assess the external value generated by the technology. However, due to insufficient consideration of the equilibrium in the price-quantity relationship between both environmental stakeholder groups, the accuracy of such assessment results is often questioned. To address this, this study first clarifies stakeholder relationships: farmers, as practitioners of production technology and participants in environmental protection, should rightfully be beneficiaries of technological progress. Therefore, the measurement of technological externalities should fully respect farmers' willingness and interests. Second, the research methodology is established. This study adopts the internationally recognized Contingent Valuation Method (CVM) to elicit the Willingness to Pay (WTP) and Willingness to Accept (WTA) of 502 respondents in Xushui District, Hebei Province, for adopting straw return technology; combined with the multiple log-linear model estimation method, it estimates the maximum WTP value and minimum WTA value for respondents' main mechanical costs of applying straw return technology (including: straw crushing and rotary tillage fees). Results indicate: the expected value of WTP is 38.23 yuan · household<sup>1</sup> · a<sup>1</sup>, the expected value of WTA is 137.52 yuan · household<sup>1</sup> · a<sup>1</sup>, and the WTA/WTP ratio is 3.6-fold. This paper further analyzes the reasons for the disparity between WTP and WTA, employing regression models to examine the factors influencing this difference. Among these: mechanical costs exert a significant positive impact on the disparity and have become an important determinant affecting the promotion of corn straw return; four factors—labor ratio, information source, irrigation cost, and harvesting method—

all demonstrate negative correlations. Evidently, in the process of vigorously promoting full mechanization of corn production, rising mechanical costs partially offset the effects of national agricultural subsidy policies, resulting in low farmer enthusiasm for participating in straw return. Therefore, prompt follow-up by decision-making departments on technology value assessment and the establishment of direct compensation mechanisms targeting farmers constitute an effective pathway to fundamentally solve the problem of internalizing technological externalities.

## Full Text

### Study on the Disparity Between Willingness to Pay and Willingness to Accept for Corn Straw Returning Technology: A Case Study of Farmer Surveys in Xushui District, Hebei Province

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## Abstract

Revealing stakeholders' true willingness for ecological compensation in straw returning technology practice is not only a challenging issue in measuring technological externalities but also crucial for improving the accuracy and effectiveness of agricultural compensation policies. Previous studies have often estimated externality values by calculating the ecological service value of farmland ecosystems, yet these assessments are frequently questioned due to inadequate consideration of the equilibrium between environmental benefit providers and recipients regarding quantity-price relationships. This study first clarifies the principal-agent relationship: farmers, as practitioners of production technology and participants in environmental protection, should rightfully be beneficiaries of technological progress. Therefore, measuring technological externalities must fully respect farmers' wishes and interests.

Second, the research methodology is established. This study employs the internationally recognized Contingent Valuation Method (CVM) to elicit the willingness to pay (WTP) and willingness to accept (WTA) for straw returning technology adoption among 502 respondents in Xushui District, Hebei Province. Using multivariate log-linear model estimation, we calculate the maximum WTP and minimum WTA for the primary mechanical costs of straw returning (including straw pulverization and rotary tillage). Results indicate that the expected WTP value is 38.23 yuan · household<sup>-1</sup> · year<sup>-1</sup>, while the expected WTA value is 137.52 yuan · household<sup>-1</sup> · year<sup>-1</sup>, yielding a WTA/WTP ratio of 3.6. This

paper further analyzes the reasons for the disparity between WTP and WTA through regression modeling. Mechanical costs exhibit a significant positive effect on this disparity and have become a critical determinant affecting corn straw returning promotion. Four factors—labor ratio, information sources, irrigation costs, and harvesting methods—show negative associations. Evidently, in the vigorous promotion of comprehensive corn production mechanization, rising mechanical costs partially offset the effects of national agricultural subsidy policies, resulting in low farmer enthusiasm for participating in straw returning. Consequently, decision-making departments should promptly follow up with technological value assessments and establish direct compensation mechanisms targeting farmers as an effective approach to fundamentally solving the internalization of technological externalities.

**Keywords:** Straw returning technology; Contingent Valuation Method (CVM); Willingness to pay (WTP); Willingness to accept (WTA); Disparity

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Straw returning is a crucial technical measure in conservation tillage that utilizes crop residue to cover soil surfaces, improve soil fertility, and reduce ineffective water evaporation [1-2], thereby strengthening resource conservation and environmental protection [3]. This practice has now been promoted in over 70 countries worldwide, with the United States, Canada, and Brazil applying it to 40%-70% of their cultivated land area [4]. Since the 1970s, China has conducted research on conservation tillage technology and theory. After nearly 30 years of study and demonstration, the practice has been promoted across 15 provinces (autonomous regions and municipalities), with mechanized straw returning for major crops such as wheat, corn, and rice covering nearly 15% of the nation's total cultivated area. Although straw returning technology has received significant attention and achieved considerable development in China [5], its monitoring, evaluation, and support systems remain incomplete compared with developed countries, constraining deeper and more large-scale development of the technology.

Straw returning is implemented with the government as the main actor. Within the constraints of limited funding and service scope, the “congestion level” of technology production and consumption varies, giving it quasi-public goods attributes. Due to positive soil, biological, and farmland effects [6-8], straw returning generates non-negative benefits for the ecological environment, demonstrating positive externalities [9]. Farmers possess a priori uncertainty regarding these technological externalities and cannot equally share in the social welfare of environmental protection, resulting in insufficient motivation to participate in environmental protection and clean production [10-11]. Revealing stakeholders' true willingness for ecological compensation in technology practice is not only key to addressing constraints on environmental technology development caused by unbalanced social welfare but also an effective pathway to improve agricultural ecological compensation policy performance. Economic value assessment theory posits that stated preference willingness for environmental goods includes

two measures: willingness to pay (WTP) and willingness to accept (WTA). Determining which scale expresses true compensation willingness has long been a research challenge. Empirical evidence demonstrates a certain degree of disparity between WTP and WTA [12-13]. Does research on farmers' compensation willingness for straw returning also exhibit such disparity? How can reasonable compensation standards be determined based on these two evaluation scales to provide references for decision-making? These questions are significant for effectively addressing reasonable returns for ecological investors (farmers).

Since 2000, domestic research on externality assessment of environmentally friendly technologies has gradually emerged. Scholars have conducted farmer surveys on willingness to pay for agricultural non-point source pollution prevention technologies, agricultural waste resource utilization technologies, and water-saving irrigation systems, analyzing influencing factors and conducting value assessments [14-16]. However, few empirical studies employ both WTP and WTA scales for technology assessment. Research on WTP-WTA disparities has primarily focused on watershed ecosystem valuation and natural recreation resource assessment [17-19], with limited cases in agricultural ecological compensation. Insufficient theoretical and empirical support in China has prevented effective follow-up on technology value assessment, resulting in unbalanced quantity-price relationships between environmental benefit stakeholders (government and farmers) and persistent bottlenecks in technology promotion. Therefore, this study examines straw returning technology—a key promoted technology in northern China—using the Contingent Valuation Method (CVM) and econometric modeling tools to analyze disparities between farmers' WTP and WTA values for technology compensation and their underlying causes. Based on these calculations, we propose regionally appropriate subsidy policy recommendations for agricultural clean production technologies.

## 1. Study Area Overview

Baoding's Xushui District is a major grain-producing county in central Hebei Province, comprising 304 administrative villages across 14 townships. The district enjoys superior agricultural production conditions, featuring a typical winter wheat/summer corn double-cropping system. The total area of various crops is approximately 72,000 hectares annually, with grain crops covering about 59,000 hectares. Annual straw output is approximately 706,000 tons, including 248,000 tons of wheat straw, 425,000 tons of corn straw, and 33,000 tons of other crop straw. The annual straw returning area is 46,000 hectares with 494,000 tons returned, accounting for 63.5% of planted area and 70.1% of total straw output. Silage and ammoniated straw total 108,000 tons, representing 15.3% of total straw output. The district's comprehensive straw utilization rate remains at 87.3%, with 12.7% unused. Wheat straw returning reaches 100%, while corn straw pulverization and returning reaches 85%.

This study conducted grain production tracking surveys in Xushui from 2010-2014, revealing the following trends in corn production costs and prices: First,

mechanical costs increased most dramatically. As shown in [Figure 1: see original paper], the proportion of pesticide, irrigation, and seed costs remained relatively stable year-to-year, while fertilizer costs' proportion declined annually, but mechanical costs' proportion rose continuously, reaching a 158.6% increase in 2014 compared with 2010. Mechanical costs have become the most significant explicit cost. Second, straw returning costs constitute the highest proportion of mechanical costs. According to [Figure 2: see original paper], in 2014 Xushui' s corn production mechanical cost composition showed that machine tillage and pulverization costs accounted for 29.8% and 26.4% of total mechanical costs, respectively, with average costs reaching 903 yuan  $\cdot$  hm<sup>2</sup> and 799.5 yuan  $\cdot$  hm<sup>2</sup>. These two most important straw returning cost items have reached 56.2% of total mechanical costs, becoming the largest individual payment. Third, corn market purchase prices declined annually. Survey data show Xushui' s average corn market price was 1.9 yuan  $\cdot$  kg<sup>-1</sup> in 2010, falling to 1.74 yuan  $\cdot$  kg<sup>-1</sup> in 2015, an 8.4% decrease. Rising production costs coupled with falling market prices have reduced farmers' incomes year by year.

## 2. Methodology

### 2.1 CVM Method Connotation and Characteristics

The Contingent Valuation Method (CVM) is an important international approach for valuing environmental goods and ecosystem services [20]. In a hypothetical market environment, CVM reveals people' s willingness to pay (WTP) for environmental goods and resource conservation, or their willingness to accept (WTA) compensation for environmental degradation and resource loss. In other words, CVM guides respondents to state their willingness to pay or accept compensation in monetary terms under simulated market conditions [21-23]. CVM holds unique advantages for environmental goods lacking real market price information and unable to reflect non-use values, benefiting from its data sources and potential. CVM research subjects are typically individuals, but may also be companies or organizations. It examines group behavior and statements, attempting to understand behavioral characteristics and their underlying reasons. Based on welfare economics theory of constant consumer utility [24-26], CVM uses WTP and WTA as evaluation scales to scientifically measure consumers' willingness to pay for environmental improvements and willingness to accept compensation for environmental degradation by establishing indirect utility function models under constrained conditions [23][27-30]. CVM employs social surveys to collect data, guiding individuals to price environmental goods and services, and scientifically determines environmental goods' values based on empirical research to provide scientific foundations for decision-making or policy formulation.

### 2.2 Data Sources

Data primarily originate from farmer surveys conducted by the research team in 19 administrative villages across 10 townships in Xushui District in July 2014. The CVM survey employed an anchored payment card approach [22][31]

and utilized methods including pre-surveys, question filters, follow-up certainty questions, and compensation for lost work time<sup>1</sup> to effectively avoid bias and elicit true compensation willingness (WTP and WTA) [32]. The survey collected 513 questionnaires; after excluding those with substantial missing data or obvious biases, 502 valid questionnaires remained, yielding a 97.9% effectiveness rate. Survey content 主要包括 three sections: farmers' individual socioeconomic characteristics, awareness of environmental protection and agricultural policies, and compensation willingness for technology participation. In the core valuation questions, the WTP scenario assumed the government was launching a corn straw pulverization and returning subsidy program but required individuals to bear returning costs (pulverization and rotary tillage fees) due to limited funds, asking respondents whether they would pay these costs. If willing (WTP>0), the maximum payment amount was solicited. The WTA scenario assumed the government would provide subsidies to farmers participating in straw returning programs, asking whether they would accept compensation and the minimum acceptable amount. WTP and WTA bidding values used identical options (unit: yuan/0.067hm<sup>2</sup>)<sup>1</sup>: 0, 1-9, 10-20, 21-30, 31-40, 41-50, 51-60, 61-70, 71-80, 81-90, 91-110, 111-130, 131-150, 151-170, 171-190, 191.

<sup>1</sup>Compensation for lost work time refers to income compensation provided to respondents for production time lost due to survey participation. This study's compensation standard was 30 yuan per household.

### 2.3 Model Construction

This study applies CVM and multiple linear regression models for analysis. The dependent variables are payment and compensation willingness values for returning costs (i.e., straw pulverization and rotary tillage fees), with regression analysis examining how relevant variables affect respondents' selected bid values. Using multiple linear regression estimation in Eviews 9.0 statistical software [33], we obtain optimal linear unbiased estimators of influencing factors to determine logarithmic estimates of WTP and WTA. Drawing on the renowned Cobb-Douglas production function model [34], we construct a functional relationship between compensation willingness and influencing factors.

Following established academic transformation conventions—where dummy variables (social resources and policy variables) enter the model in level form and quantitative variables (production and operation variables) undergo logarithmic transformation before regression analysis—we obtain the multivariate logarithmic regression model:

Where: A is the constant term, I represents individual attributes, P represents production and operation, S represents social resources, and C represents policy items;  $\alpha_i$  denotes individual attribute coefficients,  $\beta_j$  denotes production input coefficients,  $\gamma_k$  denotes social resource coefficients, and  $\delta_l$  denotes relevant policy coefficients. Expanding the characteristic variables yields the general form of the multivariate linear logarithmic regression model for WTP and WTA:

Where: A and B are constant terms,  $\beta_1, \beta_2, \dots, \beta_i$  and  $\gamma_1, \gamma_2, \dots, \gamma_i$  represent regression coefficients;  $\epsilon_i$  represents the random error term.

## 2.4 Variable Selection

Based on field surveys, this study selected 16 explanatory variables across four categories: individual attributes, social resources, production and operation, and policy awareness. All explanatory variable definitions and assignments are shown in .

<sup>1</sup>The bidding value units for WTP and WTA in this study are yuan/0.067hm<sup>2</sup>, using “mu” (1 mu = 0.067hm<sup>2</sup>), a common measurement unit in Chinese agricultural production.

## 3. Results

### 3.1 Descriptive Statistics and Frequency Distribution of WTP and WTA

Although respondents were familiar with straw returning, 45 of the 502 valid questionnaires (8.96%) showed zero payment willingness. Among zero WTP samples, most respondents indicated manual corn harvesting without mechanical harvesting, while a few stated they would not pay returning costs even with mechanical harvesting. Similarly, 44 respondents (8.76%) were unwilling to accept compensation, consistent with zero WTP. Frequency distributions of WTP and WTA are shown in (using SPSS 19.0 and Excel 2007). The most frequently selected bid value was 51–60 yuan/household for both WTP (18.33% of valid samples) and WTA (17.93%). Since the 2014 average costs for corn straw pulverization and rotary tillage in Xushui reached 53.3 yuan/0.067hm<sup>2</sup> and 60.2 yuan/0.067hm<sup>2</sup>, respectively, many respondents were only willing to bear one cost item, with the remainder covered by government compensation, making this bid value the most popular choice.

These probability differences between WTP and WTA directly lead to disparities in their cumulative probability distribution curves. As shown in [Figure 3: see original paper], the WTP cumulative probability distribution curve lies above the WTA curve, with WTP's cumulative probability exceeding WTA's at every bid amount. Since the area above the cumulative probability curve represents the sample population mean, WTA's average value significantly exceeds WTP's. Additionally, statistical analysis of the WTA/WTP ratio for 502 respondents, presented in [Figure 4: see original paper], reveals that 42.03% of respondents had WTA equal to WTP (showing no disparity), 34.46% had ratios concentrated in the 1–5 interval, and 4.58% had ratios in the 10–50 interval. Sample statistics show WTP's arithmetic mean was 46.87 yuan/household with a median of 48 yuan/household, while WTA's arithmetic mean was 69.04 yuan/household with a median of 65 yuan/household. The mean WTA/WTP ratio was 1.47, and the median ratio was 1.35, with minimal difference between the two.

### 3.2 Multiple Regression Analysis Results and Mean Estimation of WTP and WTA

Considering explanatory variables' effects on compensation willingness, we employed multivariate linear logarithmic modeling to estimate WTP and WTA values. Regression results are shown in : (1) Since zero and negative values have no logarithm, the adjusted sample size was 298. (2) The WTP and WTA models' F-statistics were 28.0970 and 13.3335, respectively, both with probability values of 0.0000, rejecting the null hypothesis that all explanatory variable coefficients are zero and confirming overall statistical significance. Model goodness-of-fit tests showed Adjusted  $R^2$  values of 59.35% and 38.23%, respectively, both higher than unweighted adjusted values from original equations (19.07% and 38.08%), indicating good overall fit after weighted least squares estimation. (3) Weighted-corrected original models passed heteroskedasticity White tests, with autocorrelation testing and correction performed. The final linear logarithmic model equations are:

$$E(WTP) = EXP(0.551890 - 0.216820 \ln PEST + 0.213109 \ln IRRI + 0.748319 \ln MECH - 0.079364 \ln FAMI -$$

$$E(WTA) = EXP(-1.225795 - 0.231280 \ln LABO - 0.239742 \ln INFO - 0.107993 \ln IRRI + 1.150542 \ln MECH - 0$$

Using formulas (5) and (6) to calculate model estimates of WTP and WTA, we further applied mean estimation formulas (7) and (8) to obtain expected mean values:

$$E(WTP) = \frac{\sum_{i=1}^n AWTP_i \cdot n_i}{N} = 38.23 \text{ yuan}/(\text{household} \cdot \text{year})$$

$$E(WTA) = \frac{\sum_{i=1}^n AWTA_i \cdot n_i}{N} = 137.52 \text{ yuan}/(\text{household} \cdot \text{year})$$

Where  $E(WTP)$  is the expected (average) willingness to pay;  $E(WTA)$  is the expected (average) willingness to accept;  $AWTP_i$  is the model-calculated WTP estimate at the  $i$ th level, and  $AWTA_i$  is the model-calculated WTA estimate at the  $i$ th level;  $n_i$  is the number of samples with payment willingness equal to  $AWTP_i$  or compensation willingness equal to  $AWTA_i$  in the valid sample; and  $N$  is the total valid sample size. Therefore, the multivariate linear logarithmic model estimation yields an average WTP of 38.23 yuan/(household · year) and an average WTA of 137.52 yuan/(household · year) for straw returning costs (pulverization plus rotary tillage) in the Xushui region.

In summary, for straw returning compensation in the central Hebei Plain, the same respondents showed significant WTP-WTA asymmetry, with WTA exceeding WTP by 3.6 times. Empirical research in this field both domestically and internationally shows that both evaluation scales deviate substantially from economic theory expectations, with common ratio ranges of 2-10 [18][35-36]. Our findings align with previous research, demonstrating that in agricultural technology compensation, WTA typically exceeds WTP.

#### 4.1 Analysis of Factors Influencing WTP-WTA Asymmetry

This study further investigates WTP-WTA asymmetry. First, samples with  $WTP=0$ ,  $WTA=0$ , and  $WTA < WTP$  were excluded, yielding 419 valid samples. Second, dependent and explanatory variables were determined. The logarithm of the difference between WTA and WTP [ $\ln(WTA-WTP)$ ] for the 419 samples served as the dependent variable, while eight determinants screened from models (5) and (6) served as explanatory variables: labor ratio (LABO), pesticide costs (PEST), irrigation costs (IRRI), mechanical costs (MECH), and household income (HOUS) as quantitative indicators, and information sources (INFO), harvesting methods (HARV), and policy awareness (POLI) as dummy variables. Regression analysis results are presented in .

Results indicate that WTP-WTA disparity is determined by five factors: labor ratio, information sources, irrigation costs, mechanical costs, and harvesting methods, with no significant association with other factors. Mechanical costs show a significant positive effect on disparity—respondents with higher mechanical cost inputs exhibit greater WTP-WTA differences. Labor ratio, irrigation costs, information sources, and harvesting methods show negative effects: respondents with fewer agricultural workers, lower irrigation cost inputs, less access to information, and manual harvesting methods exhibit greater WTP-WTA disparity. This demonstrates that mechanical costs have become a decisive factor affecting agricultural mechanization technology promotion. As large-scale corn production mechanization expands in northern China, mechanical costs have risen substantially, leading farmers to desire higher compensation while maintaining or reducing their cost burden. This compensation willingness disparity continues to hinder technology promotion. Additionally, four factors—number of agricultural workers, production methods, management level, and information exchange—show negative associations. Better coordination among these elements indicates stronger agricultural focus and environmental awareness, greater willingness to bear income losses for environmental improvement, and expectations for reasonable government compensation, resulting in less pronounced WTP-WTA disparity.

#### 4.2 Theoretical Explanations

**4.2.1 Income Effect Explanation** As a special commodity, agricultural technology products feature diffusion sharing and continuity characteristics, making price determination difficult. Since most environmentally friendly tech-

nologies lack market competitiveness, governments somewhat “compel” farmers to adopt new technologies that are not uniquely essential for farmers. From a microeconomic perspective, the income elasticity of demand for technology products is less than zero, classifying them as “inferior goods.” When other conditions remain constant, the income effect for inferior goods is an inverse relationship between quantity demanded and real income: as real income increases, quantity demanded decreases, and vice versa [37-38]. Our econometric analysis shows that the same respondent’s WTP for straw returning technology is significantly negatively correlated with household income, while WTA shows no income correlation. Thus, farmers with higher non-agricultural incomes do not increase their demand for this technology product, while those relying primarily on agriculture, despite lower household incomes, show stronger preferences and are willing to incur additional expenses to obtain the technology. Therefore, income changes constitute an important cause of WTP-WTA asymmetry.

**4.2.2 Prospect Theory Explanation** Behavioral economics’ prospect theory posits that people are risk-averse when facing potential gains but become risk-seeking when confronting potential losses [39-40]. For example, when farmers participate in technology projects under uncertain conditions, they tend to undervalue externality values and are unwilling to invest additional costs, showing lower WTP. However, when expected risks materialize, people are more sensitive to losses than gains, valuing loss reductions significantly higher than foregone gains of equal amount, resulting in valuation disparities for the same technology. Simultaneously, farmers use the status quo as a reference point in technology decisions [41]. Non-participation means being unable to reduce or avoid already-incurred technology costs, while continued participation offers opportunities for economic compensation and potential loss recovery. Therefore, to avoid wasting previous investments, farmers choose to continue participating in technology projects in subsequent production decisions, preferring less input for more compensation. This decision-making outcome lowers WTP and raises WTA.

**4.2.3 Public Goods Theory Explanation** Agricultural production technology possesses quasi-public goods attributes, manifested in partial competitiveness in consumption and divisibility of utility. Although technology is theoretically provided to society and its utility should be shared publicly, no production technology can benefit all farmers; technology benefits are limited to farmers within its promotion scope. Based on WTP and WTA statistics, follow-up certainty questions revealed that only 19.5% of respondents were “not very willing” (WTP=0), while 80.5% expressed varying payment amounts (WTP>0). This indicates that most respondents possess some awareness and preference for clean production technology and are willing to adopt it. However, they still hope the government can provide more economic and technical support through subsidies during technology activities.

## Conclusions and Recommendations

Based on comparative analysis, we propose the following conclusions and policy recommendations:

1. Using multivariate linear logarithmic modeling and mean estimation, we calculated WTP for straw returning technology compensation at 38.23 yuan · household<sup>1</sup> · year<sup>1</sup> and WTA at 137.52 yuan · household<sup>1</sup> · year<sup>1</sup> in the study area. Therefore, based on CVM assessment, the estimated compensation standard range for straw returning technology in the central Hebei Plain is 38.23-137.52 yuan · household<sup>1</sup> · year<sup>1</sup>, with an average compensation willingness of 87.88 yuan · household<sup>1</sup> · year<sup>1</sup>, which can serve as an important basis for formulating straw returning subsidy standards.
2. Respondents' household labor ratio, information sources, irrigation costs, mechanical costs, and harvesting methods are important factors causing WTP-WTA disparity. Except for mechanical costs, all other factors show negative associations with asymmetry. In summary, substantial technology cost increases exacerbate compensation willingness disparity, while agricultural industry weakness, farmer income, and social pressure create differences in farmers' technology acceptance and application preferences.
3. WTA exceeds WTP by 3.6 times, showing obvious asymmetry consistent with domestic and international research in this field. This conclusion indicates that income losses from straw pulverization technology application far exceed individual welfare improvements.

Based on these conclusions, scientific and meticulous externality assessment is urgently needed for implemented and planned straw pulverization and returning technology promotion. This should quantitatively determine ecological environmental function values and commodity service values generated by technology, accurately understand farmers' income losses and compensation willingness, and establish fair and effective compensation policy mechanisms. Government decision-making should address three issues: First, establish a subsidy policy mechanism targeting farmers through simple, effective approaches to implement direct subsidies for returning farmers, with recommended subsidy periods extending 1-2 years beyond the project term to fundamentally address collective interest losses from farmer participation. Second, strengthen theoretical research on technology value assessment methods, establishing a technical value assessment system centered on CVM and econometric models, supplemented by mean estimation and cost accounting methods, based on equilibrium point measurement of quantity-price relationships between benefit stakeholders. Third, improve supervision mechanisms for agricultural technology extension, establish long-term training and service supervision mechanisms, create information resource sharing service platforms, explore effective clean technology publicity and training formats, and provide reasonable compensation to farmers following the beneficiary-pays (compensation) principle.

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