

Article

Influence of Trust on Biomass Supply Decision-Making in China

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Abstract: Given the abundant straw resources in Northeast China and the huge external costs associated with fossil fuels, straw-based biomass power plants have emerged as a popular alternative to coal-fired power plants. The sustainability of these green alternatives depends on straw supply from farmers, yet little is known about their perceptions regarding such supply because of a lack of cooperation in the supply chain. To better understand farmers' opinions on supplying straw, this study examined their trust in middlemen, perceptions regarding risk in straw supply, the possibility of reducing transaction costs, and their willingness to supply straw. Data were collected from 275 farmers in the national bioenergy industry area in Wangkui County, Northeast China. We investigated the theoretical and empirical connections between trust and risk perception, trust and the possibility of reducing transaction costs, and trust and willingness to supply straw. The results indicated that education, income, and trust factors explained farmers' risk perceptions, the possibility that they will reduce transaction costs, and their willingness to supply straw. On the basis of the analysis, a model of the influence of trust on straw supply was established. The overall findings indicated that biomass power plants and middlemen must build trusting relationships with farmers to ensure sustainable biomass supply.

Keywords: trust; biomass supply; decision making; China

1. Introduction

Increasingly expensive fossil fuels and environmental degradation have compelled many nations to consider renewable energy sources. In China, the abundance of straw resources has prompted the pursuit of biomass power plant development as a long-term target, but such development has been confronted with obstacles due to a lack of cooperation in the straw supply chain. To create a straw supply market for biomass power plants, this study could contribute in explaining the formation of one of the function of the technological innovation systems (TIS), which not only includes science, but also includes the dimensions of creation of new knowledge [1], guidance for the direction of search processes [2,3], supply resources [4], facilitation of the creation of positive external economics [5,6] and facilitation of the formation of markets [7]. In these dimensions of TIS, the interaction of stakeholders during exchange of information, knowledge, and vision imply the role of trust. In biomass industry in China, policy support is necessary. There are related studies in TIS that makes explicit the relationships between system innovation dynamic and public policies [1,6–8]. The decision-maker can influence the level of uncertainty in the development of the technology [4,5,9]. In China, the central government has issued incentive policy and technology development policy to support biomass power industry development. However, the policy is only on the biomass power plant itself. There is no policy on promoting the supply chain. Therefore, based on the current situation, guaranteeing the sustainable

development of biomass power generation necessitates building trust among stakeholders. Trust pertains to the belief of an individual that others will fulfill their promises [10]. It is an important component of social systems [11,12], serving to smoothen the functioning of society and providing a foundation for interpersonal communication [13]. These are equally true for rural China's straw supply chain, whose sustainability is impeded by issues of trust. In the rural regions of the country, farmers are the stakeholders who decide on the quantity of straw to be supplied to biomass power plants and are therefore critical in the operation of the chain. However, their willingness to cooperate with biomass power plants is affected by risk perceptions regarding straw supply [14]. Such perceptions can be minimized by increasing the trustworthiness of chain stakeholders, which in turn, facilitates the rapid establishment of relationships among farmers, who are the straw suppliers; middlemen, who serve as the straw collectors; and biomass power plants, which are the straw users. For middlemen and biomass power plants, reducing costs is one of the most important objectives toward earning profits. The presence of trust can reduce transaction costs because it serves not only as the basis of all chain interactions but also as an efficient mechanism for fostering cooperation between farmers and middlemen and reducing risk perceptions.

No research has confirmed the mitigating role of trust in risk perceptions and transaction costs, and no study has been devoted to illuminating the function of trust in farmers' willingness to supply straw. The current study was conducted to create a win-win situation for biomass power plants, middlemen, and farmers. In interviews conducted for this research, biomass power plants and middlemen expressed their desire to mitigate transaction costs and risk perceptions as a means of augmenting straw supply and its resultant benefits. They also identified a desire for farmers to increasingly engage in straw supply activities. Meanwhile, farmers need assurance and low risk to be motivated to increase straw supply. These goals are likely achievable through trust. Accordingly, we determined how trust affects risk perceptions, transaction costs, and farmer engagement in straw supply activities. The aims of this work were threefold: (1) to contribute to the empirical understanding of farmers' perceptions of risk in supplying straw; (2) to identify opportunities for improving trust, reducing transaction costs, and increasing farmers' willingness to supply straw; and (3) to emphasize the importance of middlemen's behaviors in the motivation of farmers to supply straw. To these ends, we administered an opinion survey to 275 farmers in the national bioenergy industry area in Wangkui County, Northeast China in 2014. We inquired into the theoretical and empirical relationships between trust and risk perception, trust and the possibility of reducing transaction costs, and trust and willingness to supply straw. Multiple regression analysis was conducted to determine the factors that affect the aforementioned variables. The analytical results were then used as bases for constructing a model of the influence of trust on straw supply.

The rest of the paper is structured as follows: Section 2 provides the background of the study. Section 3 introduces the hypothetical model constructed on the basis of the theoretical and empirical analyses. Section 4 describes the methodology, and Section 5 presents the results. Section 6 discusses the findings, and Section 7 provides the conclusion and policy implications.

2. Study Background

The northeastern region of China is one of the agricultural bases in the country. Heilongjiang Province is the north borderland, where the content-rich black soil lends itself to cultivating many crops, including soybean, rice, and corn, whose by-product is straw. Among these, corn straw accounts for the bulk of the county's straw production. Crop straw output per capita in Northeast China is the highest in the country [15], with the total output being approximately 96,283,700 tons [16]. In autumn, crops such as corn are harvested and their roots are left underground. During the plowing season, corn stalk roots are ground with a machine and used as fertilizer. This process leads to an accumulation of straw, which is also harvested but end up as agricultural waste because households prefer to use coal or gas for heating. To eliminate unwanted straw, farmers commonly burn it in open fields, thereby polluting the air in rural and urban areas. The abundant crop straw produced in this region need not

be a problem if it is converted into biomass for electricity generation. Theoretically, the straw produced in Northeast China is sufficient to sustain the operation of more than three biomass power plants.

The as-yet unmaximized opportunity provided by straw abundance motivated us to conduct an empirical study on the national bioenergy industry of Wangkui County in Heilongjiang Province. The national bioenergy power plant in Wangkui County is one of the branches. Currently, 50 biomass projects associated with the National Bioenergy Power Plant in Beijing are distributed across 28 provinces in China. However, the whole industry shares common problems of shortage of collected straw, although straw is theoretically abundant. The facility chosen for investigation was the National Bioenergy Power Plant, which is a typical straw-based power generation factory with an installed capacity of 30 MW. The total investment infused into the plant was US\$2.3 million. The annual demand for processed crop straw is 200,000 tons, but the annual production of straw in recent years has been a substantial 2.516 million tons. Out of this production, only 0.5% is used to feed livestock, and 40% is used for daily life requirements. The volumes of total and residual crop straw production are shown in Table 1.

Table 1. Total straw production and straw available for biomass power generation.

Radius (km)	Total Straw Production (Million Tons)	Crop Straw Residue (Million Tons)	Dried Straw (Million Tons)
25	1.013	0.60	0.45
30	1.445	0.86	0.65
50	2.516	1.5	1.13

Note: 1 ton of raw straw = 0.75 tons of dried straw.

Despite the abundant straw production in the country, the survival of the National Bioenergy Power Plant is threatened by straw shortages. This is attributed mainly to difficulties in cooperating with farmers. Wangkui County spans 2320 km². If we assume that the biomass power plant is located in the center of the county, then the radius of the area is around 27 km. Because the farmland in Northeast China is huge, each farmer can own around six acres of farmland (0.02428 km²), from which 0.816 million tons of dried straw can be produced. Wangkui County consists of eight townships that are home to 181,289 farmers. Currently, less than 20% of the farmers provide straw to the power plant.

The business model that characterizes straw supply in Wangkui County is shown in Figure 1. Farmers provide straw to middlemen at a price of around US\$4.5/kg. Middlemen collect straw from farmers, transport and process the straw, and sell the processed material to the biomass power plant. Given that no formal straw market exists, the price of straw always fluctuates because of factors such as supply and demand and relationships with farmers. Some middlemen can obtain straw for free when they are trusted by farmers. For middlemen, building trust with farmers and reducing purchase price considerably guarantees them benefits. Unfortunately, the current tendency of farmers is to increase the price of straw. One of the drivers of such tendency is low trust in middlemen. The National Bioenergy Power Plant has been operating for nine years in Northeast China; the experience of biomass power plants with straw collection has relevance that extends beyond their boundaries and may contribute to our understanding of how farmers respond to issues of trust, risk perception, transaction cost, and straw supply.

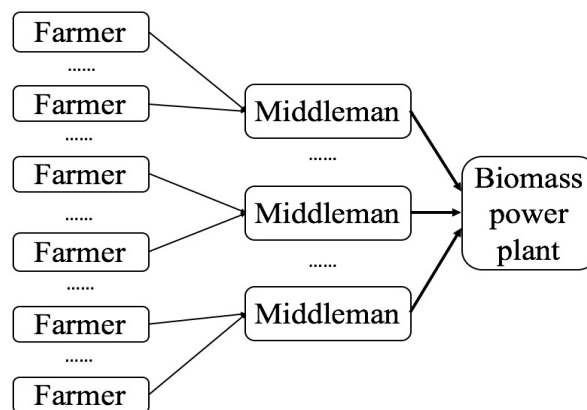


Figure 1. Biomass supply chain.

3. Methods

3.1. Hypothetical Model of the Influence of Trust on Straw Supply

Below, we outline the theoretical and empirical bases of the relationships proposed in the hypothetical model constructed in this work.

3.1.1. Theoretical Basis from Literature Review

The hypothetical model was tested in the context of a proposal to introduce a straw supply scheme in China. In the literature review part, previous study on relationship of trust, risk perception, transaction cost and public participation were examined as the basis for deriving our hypothesis.

Trust and Risk Perception

Trust is defined as an individual's confidence in another's intentions, motives, capabilities, and sincerity [17,18]. It also refers to one party's optimistic expectations in terms of the behaviors of another when the first party must make a decision on how to act [19,20]. In the risk communication literature, trust is regarded as a critical factor for mitigating risk perception and encouraging risk acceptance [21,22]. It has been studied in relation to various risk perception issues, including those related to climate change, radioactive waste, genetically modified food, and nuclear power plants [22,23]. Similarly, risk perception has been accorded a prominent place in the extant literature on trust [20,24–26]. Slovic et al., for example, pointed out that high public concern about a risk issue (e.g., nuclear power) is associated with distrust in managers responsible for addressing the issue, whereas low public concern (e.g., medical uses of radiation) is associated with trust in risk managers [27].

There are studies of farmers' perception or risk perception. For example, farmers' intentions towards biofuel crop production has examined in UK [28]. Farmers' decision-making was valued in biodiversity conservation activities [29]. Farmers' attitudes in decision making were also investigated in the previous study [30]. Farmers' behavior and decision-making has been paid attend gradually. There are empirical studies on the relationship of trust and risk perception [31]. However, there is no study on farmers' trust and risk perception in biomass supply field. In the biomass supply chain, the relationship between farmer group and middleman is key for collecting sufficient straw for biomass power plant. Because farmers who have risk perception towards supplying straw hesitate to supply straw, their trust perceptions may be influenced by middleman's behavior.

Therefore, our research question is "does trust influence farmers' risk perception in supply straw", if yes, "what kind of trust factors have impact on farmers' behavior?".

Trust and Transaction Cost

Transaction cost is often subdivided into information cost, negotiation cost, and monitoring cost [32,33]. There is a growing recognition that relationships play an important role in supply chain management [34], and such business relationships have been studied frequently on the basis of transaction cost economics [35]. However, this theory fails to account for the social exchange of trust and power, which are considered irrelevant to the study of economic exchange [36].

In previous studies, trust is considered a tool for reducing opportunistic behaviors. It mitigates transaction costs in business and can enable farmers to reduce risk and conflict, provide exchange credit, and offer warranty. Whenever trust exists, farmers can lower their guard and economize on transaction costs [37]. The economic value of trust must also be considered when it is based on non-contractual mechanisms [38]. Dyer stated that trust is a means of encouraging farmers and buyers to establish a relationship, which in turn, enhances productivity [38].

With respect to straw supply, farmers with high trust prefer to cooperate outright with middlemen instead of constantly calculating the risks involved in such cooperation because they trust that straw collectors will not deceive them. However, research has yet to identify the specific trust factors (e.g., a counterparty's behaviors and attitudes) that can affect transaction costs in bilateral trade. Williamson acknowledged that "a common characteristic of these studies [on transaction cost] is that direct measures of transaction costs are rarely attempted" [39]. In the straw collection process, a lengthy negotiation prevents middlemen from collecting straw at a volume sufficient to guarantee profit because the period at which straw can be collected is short. Collecting straw becomes difficult as the weather turns colder. In situations wherein farmers both collect and sell straw to middlemen, the latter are compelled to monitor straw quality (e.g., whether farmers add soil or water to straw in order to earn more profits). As can be seen, the absence of trust increases transaction costs (negotiation and monitoring costs). There are opposite which is about long-term relationship in general reduce transaction costs. In the case that little is known about the market potential of a technology, the size of the innovating entity is taken into account for the use of loans [40–42]. For example, in the case of a large multi-technological company, the size and the reputation of the firm could represent a guarantee of good investment. More difficult is the situation where little is known about the technology and the firm asking for private loans. In this case, access to private finance is facilitated through collateralized loans to secure debt [43]. However, long-term relationship with a bank can reduce the need for collaterals [44]: the probability of collateral being pledged decreases from 53 to 37 percent every 10 years of a bank-borrower relationship. This function of long-term relationship has also described in wind technology development study [45]. Although this study didn't test the relationship between long-term relationship and transaction cost because of the difficulty of collecting data related with long-term relationship, it is believed that the function of long-term relationship is significant in the supply chain.

Therefore, our research question is "can trust decrease transaction cost in straw transaction process?" "what trust factors can significantly decrease transaction cost?" Because of the difficulties in directly measuring transaction costs, the present study investigated the relationship between trust factors and the possibility that transaction costs will be reduced with reference to two questions. If a farmer has a personal relationship with a middleman or trusts the middleman, will he/she sell straw directly to the middleman without negotiation? If a farmer has a good relationship with a middleman or trusts the middleman, will he/she sell high-quality straw to the middleman or will he/she focus on earning more profits, regardless of the relationship?

Trust and Public Participation

Several studies have shown that public participation is an important mechanism for enhancing trust [46–49]. Some scholars asserted that members of the public must, for example, be involved in policy decision making and policy formulation activities [50], but others argued that the public's involvement in such endeavors may not necessarily enhance public trust and that ineffective public

participation may increase distrust [51]. In the same vein, trust is an avenue by which participation is enhanced. A study in Hong Kong discussed the effectiveness of trust as a means of developing an appropriate stakeholder participation strategy for environmental governance [52], and a study in China examined the relationship between trust in government and public participation in nuclear power development [53]. Focht and Trachtenberg proposed a trust-based framework for guiding the selection of an appropriate stakeholder participation strategy [54]. Trust has also been found to predict participation through a mediator. A study in France, for instance, quantitatively examined the relationship between trust and participation and found that effective commitment mediates between trust and participation in the governance of cooperatives among farmer members [55].

In the previous study, factors influencing farmers' participation have been investigated in selling agricultural land [56], environmental protection [57], land diversion schemes [58], and implementing energy efficiency and renewable energy measures [59,60]. A study of exploring the willingness of Cumbrian farmers to engage with bioenergy and wood biomass production was conducted. However, trust factor is missing in these studies. Through investigation, we found that Trust plays a role in facilitating farmers' participation in straw supply. Therefore, we derive our research question as "does trust factors has impact on farmers' willingness to participate straw supply? If yes, how much impact does trust has on straw supply?".

3.1.2. Empirical Basis

As previously stated, despite the abundant straw production in Wangkui County, the examined biomass power plant continues to encounter difficulties in collecting straw from farmers. To solve the straw collection problem, this study delved into the effects of trust on risk perceptions, the possibility that farmers will reduce transaction costs, and farmers' willingness to supply straw to allow for a broader analysis of the predictors of support for straw supply.

Interviews and a survey were conducted in September and October 2014 with a random sample of 275 respondents from villages located around the National Bioenergy Power Plant. The questionnaire contains questions on four farmer-related dimensions: (1) trust; (2) possibility of reducing transaction costs; (3) willingness to supply straw; and (4) sociodemographic characteristics.

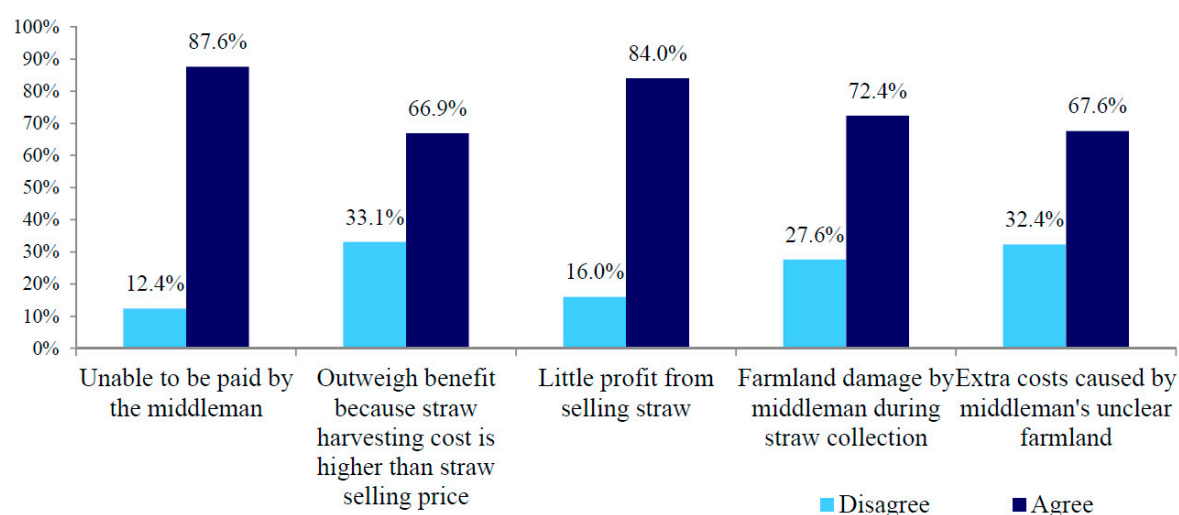
Several measures were adopted to minimize sampling bias. Farmers were selected randomly from different villages. The first group of farmers who supply crop straw to middlemen was introduced by village committees. Additional farmers were found through referrals by the first group of respondents (snowball effect). During the first phase of the study, 50 farmers were interviewed: 15 from a low-income village, 20 from a medium-income village, and 15 from a high-income village. The questionnaire was piloted by presenting two questions regarding transaction costs (i.e., negotiation and monitoring costs) to the respondents. After three pilot surveys, the questionnaire was modified and administered to the participants in the next phase of the study. In this stage, 300 farmers answered the questionnaires with assistance from the village committees. Out of the 300 questionnaires returned, 275 contained valid responses. The final sample was composed of 189 male and 86 female respondents. The age of the respondents ranged from 35 to 79, with a median age bracket of 45 to 54.

To gain additional insights into the factors affecting risk perceptions, the possibility of transaction cost reduction, and the willingness to supply straw, multiple regression analysis was conducted. Table 2 describes the variables that were employed in the analysis.

Table 2. Definition of variables.

Dependent Variables	Description
Risk perception	Respondent's views on his/her likelihood of exposure to a risk situation, such as economic loss (from 1 = very low to 4 = very high)
Possibility of reducing transaction costs	Respondent's views on his/her confidence in lowering straw transaction costs on the basis of trust (from 1 = strongly disagree to 5 = strongly agree)
Willingness to supply straw	Respondent's willingness to participate in straw supply activities (from 1 = strongly disagree to 5 = strongly agree)
Independent variables	Description
Gender	Dummy variable: 1 = male, 0 = otherwise
Age	Age of respondent in years
Education	Categorized as 1 = illiterate, 2 = primary school 1–2 years, 3 = primary school over 3 years, 4 = middle school, 5 = high school
Income	Income in US dollars
Transparency	Respondent's trust in the transparency of middlemen (from 1 = the least trust to 5 = the most trust)
Equal treatment	Respondent's trust in equal treatment by middlemen (from 1 = the least trust to 5 = the most trust)
Competence in handling conflict	Respondent's trust in middlemen's competence in handling conflict (from 1 = the least trust to 5 = the most trust)
Competence in helping others	Respondent's trust in middlemen's competence in helping others (from 1 = the least trust to 5 = the most trust)
Credibility	Respondents' trust in middlemen's credibility (from 1 = the least trust to 5 = the most trust)
Moral integrity	Five variables on respondents' trust in moral integrity: 1 = the least trust, 5 = the most trust
Care	Respondent's trust in middlemen's caring attitude (from 1 = the least trust to 5 = the most trust)
Humble attitude	Respondent's trust in middlemen's humble attitude (from 1 = the least trust to 5 = the most trust)

The survey results revealed that the farmers were divided with respect to views on straw supply and that their risk perceptions were all related to middlemen's behaviors (Figure 2). A substantial proportion of the respondents perceived straw supply as highly risky, particularly in terms of being cheated and earning little profit. Distrust factors were the most common drivers of these risk perceptions, making distrust the direct cause of farmers' low willingness to participate in straw supply activities and their perception of such participation as risky. For example, the farmers expressed concerns that their farmlands are being damaged and that middlemen may not clear their lands, causing them extra costs. The farmers were also troubled by the possibility that middlemen will not remit money to them after the latter have sold their straw.

**Figure 2.** Perceived risks in relation to the selling of crop straw.

To determine what aspects the respondents trust and distrust, they were asked about their views on farmers who supply straw to the biomass power plant. To help the respondents understand

trust-related concepts, we provided a set of seven attributes that embody the three dimensions of distrust and provided indicators for each attribute. These key dimensional attributes and indicators of trust (Table 3) were referenced from Mishra [61], Braithwaite [62], Denhardt [18], Poortinga and Pidgeon [22], and Mah et al. [23] and were adopted in the field survey.

Table 3. Key dimensions and indicators of distrust.

Dimensions of Distrust	Attributes	Indicators
Distrust in motives	Moral integrity	The middleman is dishonest when trading with farmers.
	Care	The middleman does not consider farmers' feelings when deciding on price.
	Equal treatment	The middleman looks down on poor farmers.
	Humble attitude	The middleman is disrespectful when trading with farmers.
Distrust in transparency	Transparency	The middleman is not open to farmers about the purchasing price of straw.
	Credibility	The middleman rarely fulfills his/her commitments.
Distrust in competence	Competence in handling conflict	The middleman cannot deal with conflict through a modest approach.
	Competence in helping others	The middleman cannot help farmers.

In relation to trust in motives, more than half of the farmers disagreed that middlemen have a humble attitude (52.7%), are competent in handling conflict (56.0%), provide equal treatment (57.8%), and are transparent (57.5%). About half (52.7%) of the respondents disagreed that middlemen consider their situation (“care” attribute), and 51.3% said that they cannot rely on middlemen to keep their promises on the basis of their previous experiences with them (“credibility” attribute). In terms of the “moral integrity” attribute, 45.5% of the respondents disagreed that middlemen are people of integrity, and 34.9% exhibited a neutral stance on this matter (Figure 3).

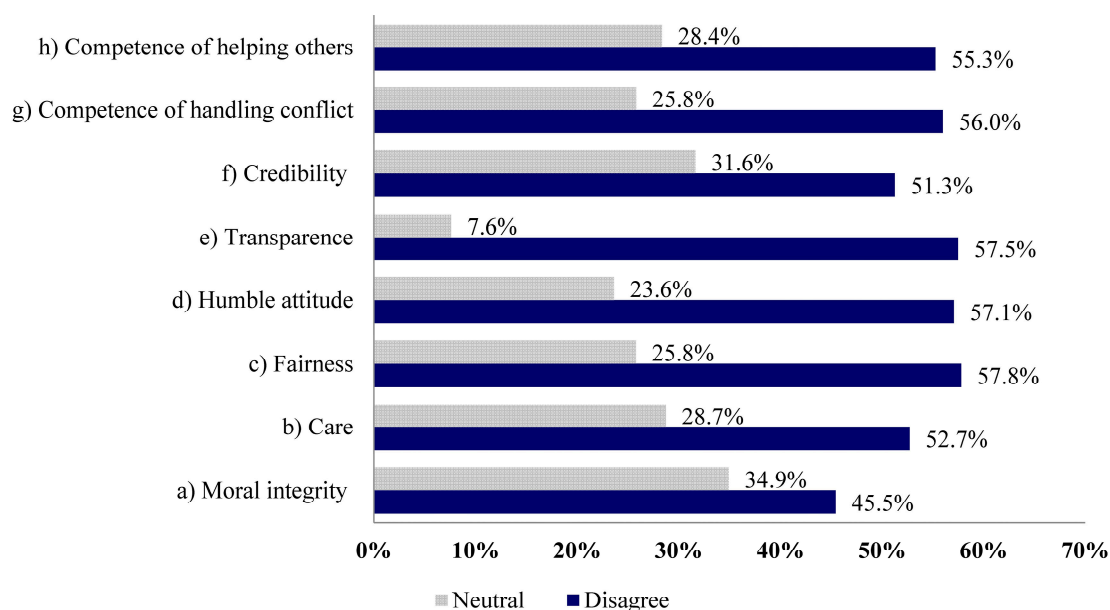


Figure 3. Farmers' perceptions of trust attributes.

Chi-square tests were performed to assess whether socioeconomic characteristics significantly differ between respondents who have varying levels of trust in middlemen. The results suggested that education ($p = 0.000$) and annual income ($p = 0.000$) significantly differed across the four groups of respondents with different trust levels (Table 4). As shown in Table 4, the farmers with a high level of education exhibited high trust, whereas those with low education exhibited a low level of trust. Of the respondents, 17% expressed distrust in middlemen, whereas 14% indicated that they feel they can always trust middlemen. Several respondents stated that they can trust middlemen sometimes (40.0%) or most of the time (29.0%).

Table 4. Trust levels in relation to demographic characteristics.

Demographic Characteristic	TRUST LEVEL			
	Distrust (%)	Trust Sometimes (%)	Trust Most of the Time (%)	Always Trust (%)
Percentage of respondents	17.0	40.0	29.0	14.0
Gender ($p = 0.968$)				
Female	22.0	37.0	27.0	14.0
Male	19.0	39.0	30.0	13.0
Education *** ($p = 0.000$)				
Illiterate	38.0	55.0	7.00	0.00
Primary school 1–2 years	44.0	50.0	2.00	4.00
Primary school over 3 years	12.0	57.0	28.0	3.00
Middle school	4.00	16.0	56.0	24.0
High school	2.00	12.0	49.0	37.0
Age ($p = 0.325$)				
35–44	13.0	30.0	39.0	18.0
45–55	16.0	37.0	32.0	15.0
>55	36.0	49.0	10.0	5.00
Annual income *** ($p = 0.000$)				
Less than US\$3,266	43.0	52.0	5.00	0.00
US\$3267–US\$5717	13.0	45.0	40.0	2.00
More than US\$5718	0.00	13.0	42.0	45.0

Note: *** indicates <0.001 significance level in chi-square test.

The survey was also intended to study the extent to which trust level influences farmers' risk perceptions, the possibility that transaction costs will be reduced, and the farmers' willingness to supply straw (Figure 4a–c). Compared with the farmers with low trust, those with high trust levels tended to exhibit low risk perceptions, a positive probability that they will reduce transaction costs, and a strong willingness to supply straw. Figure 4d indicates that risk perception and the probability that transaction costs will be reduced were negatively correlated.

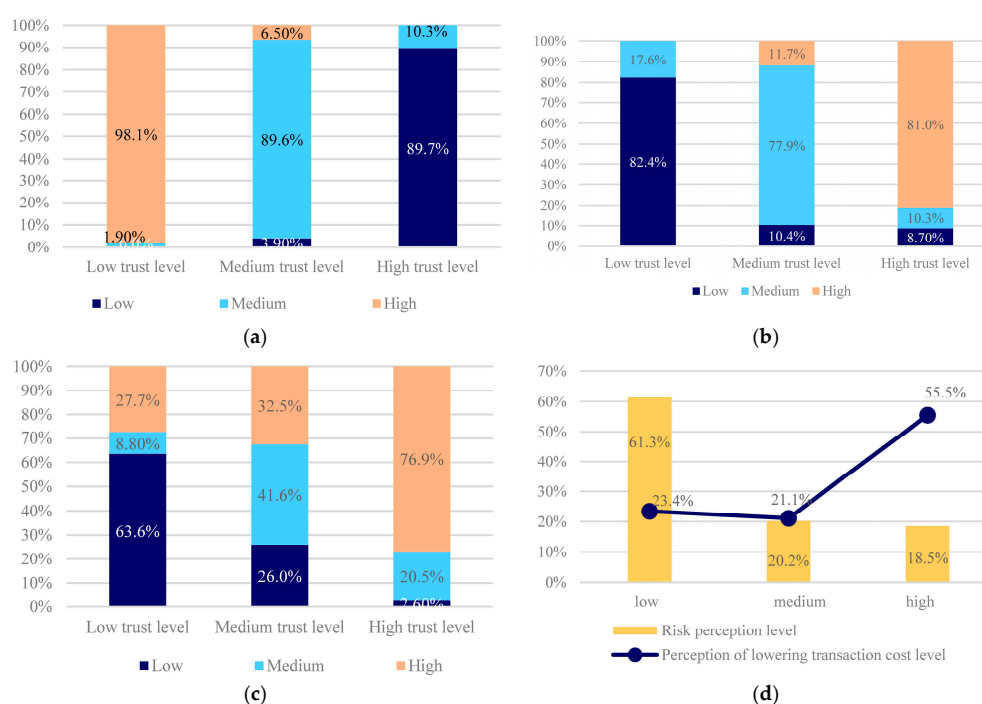


Figure 4. Trust, risk perception, possibility of transaction cost reduction, and willingness to supply straw. (a) Trust level and risk perception; (b) Trust level and possibility of reducing transaction cost; (c) Trust level and farmers' willingness to supply straw; (d) Risk perception, and possibility of reduced transaction cost.

In line with the theoretical and empirical bases, we considered risk perception, the possibility that transaction costs will be reduced, and farmers' willingness to supply straw as the dependent variables and regarded trust and trust factors as the independent variables. Some specific trust behaviors of middlemen influenced fluctuation in the independent variables. As illustrated in Figure 4a–c, the higher the farmers' trust in middlemen, the lower their risk perceptions, the more positive their possibility of reducing transaction costs, and the stronger their willingness to supply straw. Figure 4d indicates clear relationships between farmers' risk perceptions and the possibility of transaction cost reduction. With consideration for these findings, we formulated the following hypotheses:

H1. Trust factors (integrity, care, equal treatment, humble attitude, transparency, credibility, competence in handling conflict, and competence in helping others) have a direct positive relationship with each of the dependent variables (risk perception, possibility of transaction cost reduction, and willingness to supply straw) in the straw supply chain.

H2. A substantial level of trust leads to low risk perceptions, a strong willingness to supply straw, and a high possibility of transaction cost reduction; high risk perceptions and a low possibility of transaction cost reduction diminish farmers' willingness to supply straw.

4. Results

The first hypothesis was tested by regression analysis conducted using SPSS 22.0 (IBM, Chicago, IL, USA), and the second hypothesis was verified by path analysis using AMOS 21.0 (IBM, Chicago, IL, USA).

4.1. Regression Analysis

Using a theory-based approach, we carried out multiple regression analysis to evaluate the extent to which trust factors (i.e., transparency, equal treatment, competence in handling conflict, competence in helping others, credibility, moral integrity, care, and humble attitude) explain and predict the farmers' risk perceptions, possibility of reducing transaction costs, and willingness to supply straw. The results showed that risk perception was affected by demographics and trust attributes, both of which explained 63.8% of the variance in risk perception, $F(7, 267) = 70.046$, $p < 0.001$, Adj. $R^2 = 0.638$. In relation to demographic factors, the farmers are more likely to perceive the risk in straw supply as high if they have low income (Table 5). With regard to trust attributes, the results. The results also indicated that a high transparency, equal treatment, competence in helping others, moral integrity, care, and a humble attitude reduced risk perception:

Table 5. Regression of trust factors that influence risk perception, possibility of transaction cost reduction, and willingness to supply straw.

Variable	Risk Perception	Possibility of Transaction Cost Reduction	Willingness to Supply Straw
No. of observations	275	275	275
Adjusted R-square	0.638	0.789	0.378
F-value	70.046 ***	171.393 ***	55.579 ***
Income	−0.216 ***	<i>n.s.</i>	<i>n.s.</i>
Education	<i>n.s.</i>	<i>n.s.</i>	0.152 **
Transparency	−0.095 *	−0.085 **	<i>n.s.</i>
Equal treatment	−0.132 *	0.124 **	<i>n.s.</i>
Competence in helping others	−0.151 ***	<i>n.s.</i>	<i>n.s.</i>
Credibility	<i>n.s.</i>	0.418 ***	0.246 ***
Moral integrity	−0.114 *	0.389 ***	0.308 ***
Care	−0.199 ***	<i>n.s.</i>	<i>n.s.</i>
Humble attitude	−0.223 ***	0.113 **	<i>n.s.</i>

Notes: (1) Only significant variables are displayed in the table; (2) * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; (3) *n.s.* = non-significant.

The beta weights revealed the significant effects of transparency, equal treatment, credibility, moral integrity, and humble attitude on the possibility that lowering transaction costs will be reduced; these attributes explained 78.9% of the variance in such possibility, $F(6, 268) = 171.393$, $p < 0.001$, Adj. $R^2 = 0.789$). Thus, decreased transparency and increased equal treatment, credibility, moral integrity, and humble attitude were associated with a positive possibility that transaction costs will be reduced.

The regression modeling of the farmers' willingness to supply straw indicated that education, credibility, and moral integrity were significant predictors, accounting for 37.8% of the total variance in the willingness to supply straw, $F(3, 271) = 48.331$, $p < 0.001$, Adj. $R^2 = 0.378$. The higher the educational level, credibility, and moral integrity, the higher the farmers' willingness to supply straw.

4.2. Path Model

The estimation procedure of AMOS 21.0 was implemented to construct a path model for verifying the second hypothesis. A comparison structural model that includes all the observed variables (i.e., trust, risk perception, possibility of reducing transaction costs, and willingness to supply straw) was also established. Mean values were used for the trust and risk perception variables. The goodness of fit of the models was assessed using three practical fit indices: the comparative fit index (CFI), the Tucker–Lewis index (TLI), and the root mean square error of approximation (RMSEA). In line with the recommendations in [63], the cutoff values employed for these indices were $CFI > 0.90$, $TLI > 0.95$, and $RMSEA < 0.10$ for good fit (< 0.05 for very good fit) [64].

The chi-square value of the structure structural model was nonsignificant ($\chi^2(1) = 2.804$, $p = 0.094$), indicating no significant difference between the structural model and the model generated by the computer (i.e., path model). The practical fit indices indicated good model fit for structural model ($CFI = 0.997$, $TLI = 0.982$, $RMSEA = 0.081$). Figure 5 presents the structural model with standardized path coefficients and significance levels. As expected, trust significantly predicted risk perception and the possibility of transaction cost reduction. Risk perception negatively predicted the farmers' willingness to supply straw, whereas the possibility of transaction cost reduction was positively associated with such willingness. Trust did not directly and significantly predict the farmers' willingness to supply straw.

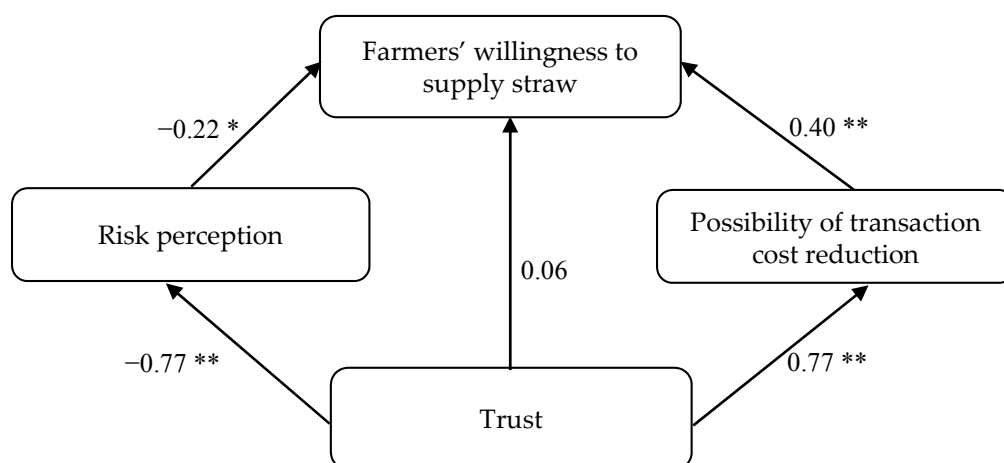


Figure 5. Structural model. Notes: (1) * $p < 0.01$, ** $p < 0.001$; (2) Numbers are standardized beta coefficients.

5. Discussion

In line with the vital role of trust in straw supply, we developed and tested two sociopsychological models, namely, (1) the regression model of the relationship between trust factors and the farmers' risk

perceptions, possibility of reducing transaction costs, and willingness to supply straw and (2) the path model of causal relationships.

5.1. Factors Affecting Risk Perception

The results showed that lack of trust was associated with high risk perception. Specifically, the farmers' lack of trust in middlemen's provision of equal treatment, competence in helping others, moral integrity, care, and humble attitude likely led to perceptions of great risks (Table 5). This result is consistent with those of previous research on the relationship between risk perception and trustworthiness in a nuclear power plant [23]. This result of this study also consistent with result of study on public acceptance of recycled water, which indicated that higher trust associated with lower perception of risk [65]. The trust factor that exerted the strongest influence on the likelihood of high risk perception was humble attitude (i.e., whether the respondents perceive a good attitude and respect as they trade with middlemen), followed by care. This finding may be attributed to the fact that farmers, especially low-income farmers, consider themselves belonging to the bottom group of society. They feel inferior to high-income individuals and desire to be respected by others. Our results suggest that middlemen play a significant role in shaping farmers' perceptions of risk in crop straw supply and that they directly influence important ideas regarding risk management in cooperating with farmers.

5.2. Factors Affecting the Possibility of Transaction Cost Reduction

The regression model verified whether trust and demographic factors explain the possibility that transaction costs will be reduced in the straw supply process. Trust factors determined the possibility that the farmers will reduce transaction costs but with a slightly different dynamic when compared with the findings on risk perception. Demographic factors did not significantly predict the possibility of transaction cost reduction, but both credibility and moral integrity were identified as strong predictors of such possibility. This finding is consistent with those of previous studies in which trust factors affected transaction costs [66,67]. However, in previous studies, quantities analysis was not conducted to test the degree that trust factors influencing on transaction cost. As an exploring study, this study quantified trust factors and possibility of lowering transaction cost.

A likely explanation for this result is that during the transaction process, farmers can clearly remember middlemen's behaviors, particularly whether they deceive farmers. Thus, credibility and moral integrity are vital criteria for farmers in decisions regarding doing business with middlemen, including those revolving around reducing transaction costs. Interestingly, transparency exerted a negative effect on the possibility of transaction cost reduction. Farmers are empowered to reduce transaction costs because China is a renqing ("relationship of mutual help and interest" or "complementary relationship") society. Brisk trading would provide middlemen with a good image and increase farmers' appreciation of them. In this case, a farmer helps a middleman obtain more benefits. The middleman would then owe the farmer renqing. If the farmer asks the middleman for help, then the middleman would be obligated to return the favor. People usually use renqing to establish or extend their relationships.

5.3. Factors Affecting Willingness to Supply Straw

The farmers with a high level of education tended to exhibit a strong willingness to supply straw (Table 4) possibly because such farmers are concerned about high environmental risk, which is one of the important factors preventing them from burning straw on farmlands. The best way to deal with excess straw in an environment-friendly manner is to sell it to middlemen. Generally, farmers with high education earn high incomes and are thus minimally concerned about income from selling crop straw. By contrast, farmers with low education have low perceptions of environmental risk. Their only purpose for selling straw is to obtain economic benefits. When they feel that they cannot derive

satisfactory profits from selling straw, their willingness to supply straw diminishes. Farmers who are not concerned about environmental problems prefer to burn straw in an open field.

The farmers' willingness to supply straw depended on their trust in middlemen's credibility and moral integrity (Table 5). The results showed that middlemen's credibility, commitment, and integrity toward the farmers significantly predicted their willingness to supply straw. Thus, credibility and moral integrity were critical determinants of the quantity of straw supplied to the biomass power plant. This implies that middlemen's behaviors considerably affect farmers' willingness to supply straw. That is, farmers prefer to cooperate with middlemen who have high credibility and integrity. Although in this study, we didn't test the correlation between "price offered to farmers" and "farmers' willingness to supply straw", because the price offered to farmers is so low that many farmers don't care about that amount of income from selling straw. The correlation between "price offered to farmers" and "farmers' willingness to supply straw" may not strong. Instead, other factors related with farmers' characteristics and middlemen's behavior have significant impact on farmers' willingness to supply straw.

5.4. Relationships among Risk Perception, Possibility of Transaction Cost Reduction, Willingness to Supply Straw, and Trust

The regression analysis result (as shown in Table 5, trust predicted the farmers' risk perceptions to a lesser extent than it did the possibility of transaction cost reduction (63.8% and 78.9%, respectively), indicating that increasing trust can more effectively elevate the possibility of transaction cost reduction. This is a new finding as previous studies focused mainly on the relationships among trust, risk perception, and willingness. Siegrist et al., for example, demonstrated that when social trust is controlled, the relationship between perceived risks and benefits diminishes [68], and Ross validated the relationships among trust, risk perception, and the acceptance of recycled water [65]. No research has probed into the associations among trust, the possibility of transaction cost reduction, and the willingness to supply straw. A possible reason for this deficiency is that all transaction costs, including negotiation and monitoring costs, are related to middlemen's behaviors. Trust decreases negotiation costs by fostering the type of cooperation in which actors quickly arrive at a resolution rather than implement a tactical approach characterized by cautious and slow resolution [69]. Trust also decreases monitoring costs as a result of each party's confidence in the other's performance [70]. This phenomenon is consistent with previous studies in which trust was concluded as not only minimizing transaction costs but also creating value in an exchange relationship [71–73]. Middlemen's behaviors affect farmers' trust in them, which in turn, influence their decision to supply straw. Trust therefore more strongly predicts the possibility of transaction cost reduction than risk perceptions.

With the path analysis via the structural model, we further investigated the causal relationships among trust, risk perception, the possibility of transaction cost reduction, and the willingness to supply straw. Although both risk perception and the possibility of transaction cost reduction equally predicted the farmers' willingness to supply straw, risk perceptions were related to a lesser extent to such willingness than to the possibility of transaction cost reduction. This further emphasizes the importance of middlemen's trustworthy behaviors in straw-purchasing activities.

5.5. Model of the Influence of Trust

On the basis of the statistical analysis results, we established a model of the influence of trust on farmers' risk perceptions, possibility of transaction cost reduction, willingness to supply straw, and demographic characteristics (Figure 6). The model provided the following insights: First, demographic characteristic and trust factors affected the farmers' risk perceptions and willingness to supply straw. Second, a correlation existed between trust and demographic characteristics, risk perceptions, the possibility of transaction cost reduction, and willingness to supply straw. The model also indicated that demographic characteristics and trust factors influenced the farmers' risk perceptions and willingness to supply straw in different ways. The significant trust attributes differed among risk perceptions, the possibility of transaction cost reduction, and the willingness to supply straw. Whereas care, a humble

attitude, and competence in helping others influenced risk perception, credibility and moral integrity affected the possibility that farmers will reduce transaction costs. Credibility and integrity also exerted effects on the farmers' motivation to engage in straw supply. These findings point to the significance of trust in farmers' decision making regarding cooperating with middlemen to supply straw.

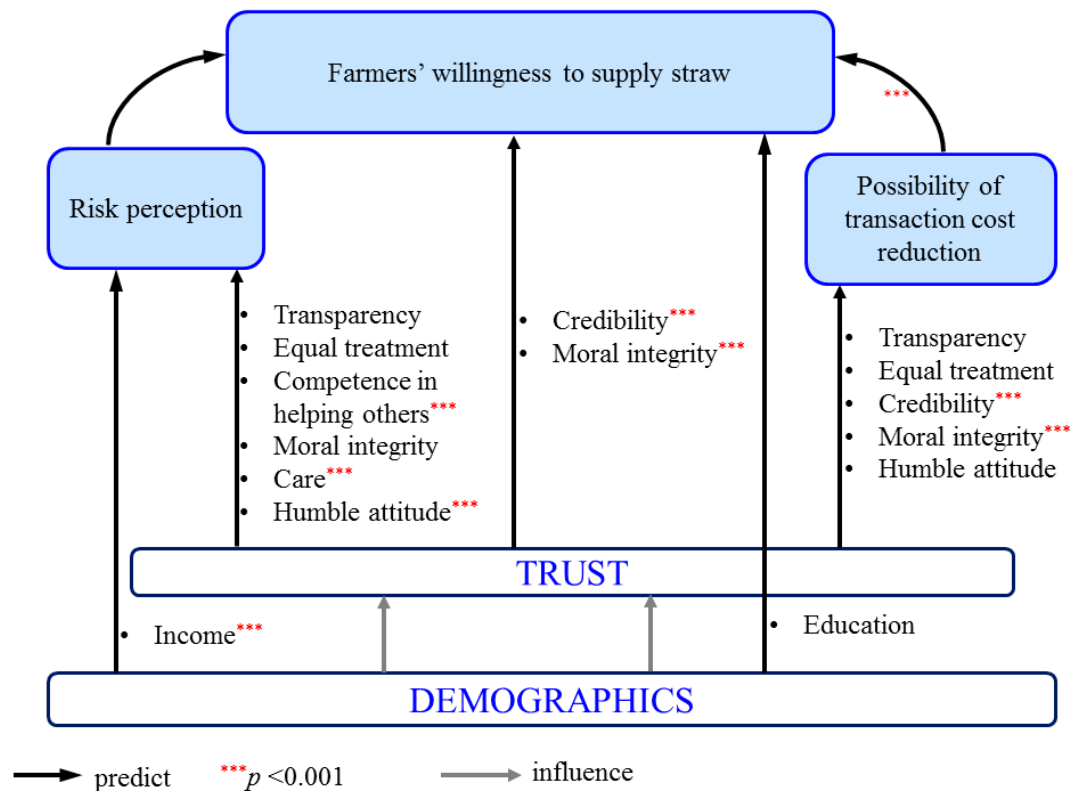


Figure 6. Model of the influence trust.

5.6. Interaction between Trust and Contracts Toward Maintaining Long-Term Relationships in the Straw Supply Chain

Maintaining a long-term relationship necessitates both trust and contracts. A contract alone cannot guarantee relationships that span a long-term horizon. Legal contracts create external control intended to reduce opportunistic behaviors, while trust acts as a self-enforcing safeguard, which is a more effective and less costly alternative to a formal contract [74]. In the Chinese market, trust and contracts have a special relationship given the country's culture and imperfect legal system. Guanxi ("personal relationship") serves as the prevailing principle that underlies the Chinese business culture. A guanxi relationship emphasizes the role of trust and discounts the effects of contracts. Among Chinese partners, trust is based on reciprocal, rather than contractual, obligation.

The importance of guanxi is visibly observed in the straw supply process. It is particularly essential in villages because of the village culture of gossip and close relationships with neighbors. Middlemen who cultivate guanxi with farmers can purchase straw at a cheaper price or acquire it for free and easily maintain long-term relationships with them. This is reflected in the results derived by Wang et al., who indicated that trust directly affects the orientation toward long-term relationships and that no interaction effect is expected between trust and contractual obligation [75]. Transaction costs are reduced because no negotiation takes place. Farmers trust middlemen and their risk perceptions decrease, which increases their motivation to supply straw, as confirmed by our results. In this situation, middlemen can conserve time in the straw collection process. A contract based on trust guarantees the quantity of straw that middlemen collect annually. The biomass power plant can also predict the quantity of raw materials that they receive on an annual basis.

6. Policy Implications

This study puts forward policy recommendations concerning farmers' willingness to supply straw given that collecting a sufficient quantity of crop straw is critical to the development of biomass power plants. To enhance farmers' willingness to supply straw, the most effective approach would be to increase the possibility that farmers will reduce transaction costs. Doing so necessitates that middlemen improve their credibility and moral integrity. That is, middlemen must be committed to their work as this dedication would directly enhance farmers' willingness to supply straw. Reducing risk perception is also important—a goal that can be achieved by enhancing the caring and humble attitudes of middlemen and their competence in helping others. These attributes are important to low-income farmers. The power plant operators can also enhance their caring attitude and competence in helping others by understanding the risk perceptions of farmers, particularly those with low incomes, and supporting middlemen by, for instance, increasing the price at which they purchase straw from them. To guarantee the quantity of straw supply, middlemen and farmers should enter into a contract. The contract can be built on trust, thereby enabling the parties to maintain a long-term relationship informally and provide safeguards for reducing uncertainty in profit generation and business operation.

Taken together, the results of this research present valuable empirical and theoretical contributions to the current supply chain in the biomass industry of China by providing a comprehensive conceptualization of trust factors and the relationships among trust, risk perception, possibility of transaction cost reduction, and willingness to supply straw. This study highlights the importance of trust factors in the straw supply chain. The findings also extend our understanding of the influence exerted by the possibility of transaction cost reduction on the willingness of farmers to supply straw by demonstrating that a positive possibility of cost reduction translates to high motivation for engagement. Finally, our research revealed that in the straw supply chain, the behaviors of middlemen and support from the power plant are critical to cultivating trusting relationships with farmers. In the future, formal contracts will be needed as part of the development of the straw supply market.

7. Conclusions

This study derived four main findings with respect to improving farmers' willingness to supply straw. First, our analysis identified factors of trust that significantly influence farmers' risk perceptions, the possibility that they will reduce transaction costs, and their willingness to supply straw. In particular, care, a humble attitude, and competence in helping others significantly affected risk perceptions, whereas credibility and moral integrity significantly influenced the possibility of transaction cost reduction. Credibility and moral integrity also strongly affected the farmers' willingness to supply straw. Our findings suggest that middlemen need to direct as much attention to building trust as that devoted to economic benefits as they communicate with farmers.

Second, we discovered that increasing trust exerted a greater effect on the possibility of transaction cost reduction than on risk perception and willingness to supply straw. Previous research focused only on the relationship between trust and risk perception.

Third, the structural model revealed that the possibility of transaction cost reduction more strongly influenced the farmers' willingness to supply straw than did risk perception. The second and third insights indicate that as straw collectors, middlemen are principal mediators between the biomass power plant and farmers. Altering the manner by which middlemen conduct themselves can effectively enhance farmers' trust in such agents.

Fourth, trust predicted risk perception and the possibility of transaction cost reduction—a finding that helps clarify the process underlying the increase in farmers' willingness to supply straw. Changing middlemen's behaviors, such as moral integrity and care, would increase farmers' trust and thereby mitigate risk perception and increase the possibility that farmers will reduce transaction costs. The farmers' motivation was predicted by both risk perception and the possibility of cost reduction. This finding serves as a valuable reference for improving the straw supply process in China.

This study intended to solve straw supply problem from psychology perspective. Although in the biomass industry field, technology is still key point, software such as policy, regulation, relationship are significant to improve the supply situation and cannot be neglected. Because farmers are the suppliers for biomass power plant, this study focuses on increasing farmers' motivation to supply straw. This study contributes to solve biomass supply problem in rural area and gives enlightens for policy and regulation making regarding biomass power industry development in China, that is farmer group should be paid attention on in the biomass supply chain.

This study conducted from the psychological perspective. To analyze the whole industry is necessary to fully understand the weakness and improvement aspects of this industry. Therefore, future studies would focus on institutional analysis of biomass power industry to further develop

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Author Contributions: For research articles with several authors, a short paragraph specifying their individual contributions must be provided. Lingling Wang and Tsunemi Watanabe conceived and designed the experiments; Lingling Wang contributed data collection; Lingling Wang and Tsunemi Watanabe analyzed the data and wrote the paper.

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References

- Hekkert, M.; Suurs, R.; Negro, S.; Kuhlmann, S.; Smits, R. Functions of innovation systems: A new approach for analysing technological change. *Technol. Forecast. Soc.* **2007**, *74*, 413–432. [CrossRef]
- Jänicke, M. The Political system's capacity for environmental policy. In *National Environmental Policies*; Jänicke, M., Jörgens, H., Weidner, H., Eds.; Springer: Berlin/Heidelberg, Germany, 1997; pp. 1–24.
- Jänicke, M. Trend-setters in environmental policy: The character and role of pioneer countries. *Environ. Policy Gov.* **2005**, *15*, 129–142. [CrossRef]
- Oxera. Discount Rates for Low Carbon and Renewable Generation Technologies. Consulted November. 2012. Available online: <http://hmccc.s3.amazonaws.com/Renewables%20Review/Oxera%20low%20carbon%20discount%20rates%20180411.pdf> (accessed on 30 October 2016).
- Johnson, A.; Jacobsson, S. Inducement and blocking mechanisms in the development of a new industry: The case of renewable energy technology in Sweden. In *Technology and the Market: Demand, Users and Innovation*; Coombs, R., Green, K., Richards, A., Walsh, W., Eds.; Edward Elgar: Cheltenham, UK, 2001; pp. 89–111.
- Corsatea, T.D. Increasing synergies between institutions and technology developers: Lessons from marine energy. *Energy Policy* **2014**, *74*, 682–696. [CrossRef]
- Bergek, A.; Jacobsson, S. *The Emergence of a Growth Industry: A Comparative Analysis of the German, Dutch and Swedish Wind Turbine Industries*; Metcalfe, S., Cantner, U., Eds.; Change, Transformation and Development, Physica-Verlag: Heidelberg, Germany, 2003; pp. 197–227.
- Bergek, A.; Jacobsson, S.; Sandén, B.A. 'Legitimation' and 'development of positive externalities'. Two key processes in the formation phase of technological innovation systems. *Technol. Anal. Strateg. Manag.* **2008**, *20*, 575–592. [CrossRef]
- Bergek, A.; Hekkert, M.P.; Jacobsson, S. *Functions in Innovation Systems: A Framework for Analysing Energy System Dynamics and Identifying Goals for System-Building Activities by Entrepreneurs and Policy Makers*; RIDE/IMIT Working Paper No. 84426-008; Edward Elgar: Cheltenham, UK, 2008.
- Chang, L.; Ouzrout, Y.; Nongillard, A.; Bouras, A.; Jiliu, Z. Multi-criteria decision making based on trust and reputation in supply chain. *Int. J. Prod. Econ.* **2014**, *147*, 362–372. [CrossRef]
- Vakis, R.; Sadoulet, E.; de Janvry, A. *Measuring Transactions Costs from Observed Behavior: Market Choices in Peru*; Department of Agricultural & Resource Economics, UC Berkeley: San Francisco, CA, USA, 2003.

12. Ruben, R.; Hualiang, L.; Kuiper, W. Marketing chains, transaction costs and resource intensification. Efficiency and trust within tomato supply chains in Nanjing City. In Proceedings of the Economic Transition and Sustainable Agricultural Development in East Asia Conference, Nanjing, China, 20–22 October 2003; pp. 54–76.
13. Qin, X.; Shen, J.; Meng, X. Group-based trust, trustworthiness and voluntary cooperation: Evidence from experimental and survey data in China. *J. Socio Econ.* **2011**, *40*, 356–363. [[CrossRef](#)]
14. Wang, L.; Watanabe, T. Factors affecting farmers' risk perceptions regarding biomass supply: A case study of the national bioenergy industry in northeast China. *J. Clean. Prod.* **2016**, *139*, 517–526. [[CrossRef](#)]
15. National Bureau of Statistics China (NBSC). *China Environmental Statistical Year Book*; NBSC: Beijing, China, 2010.
16. Wang, L.; Watanabe, T.; Xu, Z. Monetization of external costs using lifecycle analysis—A comparative case study of coal-fired and biomass power plants in Northeast China. *Energies* **2015**, *8*, 1440–1467. [[CrossRef](#)]
17. Mellinger, G.D. Interpersonal trust as a factor in communication. *J. Abnorm. Soc. Psychol.* **1956**, *52*, 304. [[CrossRef](#)]
18. Deutsch, M. Trust and suspicion. *J. Confl. Resolut.* **1958**, *2*, 265–279. [[CrossRef](#)]
19. Rotter, J.B. Generalized expectancies for interpersonal trust. *Am. Psychol.* **1971**, *26*, 443. [[CrossRef](#)]
20. Mayer, R.C.; Davis, J.H.; Schoorman, F.D. An integrative model of organizational trust. *Acad. Manag. Rev.* **1995**, *20*, 709–734.
21. Cvetkovich, G. *Social Trust and the Management of Risk*; Routledge: London, UK, 2013.
22. Poortinga, W.; Pidgeon, N.F. Exploring the dimensionality of trust in risk regulation. *Risk Anal.* **2003**, *23*, 961–972. [[CrossRef](#)] [[PubMed](#)]
23. Mah, D.N.Y.; Hills, P.; Tao, J. Risk perception, trust and public engagement in nuclear decision-making in Hong Kong. *Energy Policy* **2014**, *73*, 368–390. [[CrossRef](#)]
24. Susan, D.; Holmes, J.G. The dynamics of interpersonal trust: Resolving uncertainty in the face of risk. In *Cooperation and Prosocial Behavior*; Cambridge University Press: New York, NY, USA, 1991; p. 190.
25. March, J.G.; Shapira, Z. Managerial perspectives on risk and risk taking. *Manag. Sci.* **1987**, *33*, 1404–1418. [[CrossRef](#)]
26. Sitkin, S.B.; Pablo, A.L. Reconceptualizing the determinants of risk behavior. *Acad. Manag. Rev.* **1992**, *17*, 9–38.
27. Slovic, P.; Flynn, J.H.; Layman, M. Perceived risk, trust, and the politics of nuclear waste. *Science* **1991**, *254*, 1603–1607. [[CrossRef](#)] [[PubMed](#)]
28. Mattison, E.H.A.; Norris, K. Intentions of UK farmers toward biofuel crop production: Implications for policy targets and land use change. *Environ. Sci. Technol.* **2007**, *41*, 5589–5594. [[CrossRef](#)] [[PubMed](#)]
29. Farmar-Bowers, Q.; Lane, R. Understanding farmers' strategic decision-making processes and the implications for biodiversity conservation policy. *J. Environ. Manag.* **2009**, *90*, 1135–1144. [[CrossRef](#)] [[PubMed](#)]
30. Willcock, H.; Deary, I.; Edward-Jones, G.; McGregor, M.; Sutherland, A.; Dent, B.; Morgan, O.; Grieve, R. The role of attitudes and objectives in farmer decision making: Business and environmentally-oriented behaviour in Scotland. *J. Agric. Econ.* **1999**, *50*, 286–303. [[CrossRef](#)]
31. Burda, D.; Teuteberg, F. The role of trust and risk perceptions in cloud archiving—Results from an empirical study. *J. High Technol. Manag. Res.* **2014**, *25*, 172–187. [[CrossRef](#)]
32. Hobbs, J.E. Measuring the importance of transaction costs in cattle marketing. *Am. J. Agric. Econ.* **1997**, *79*, 1083–1095. [[CrossRef](#)]
33. Rindfleisch, A.; Heide, J.B. Transaction cost analysis: Past, present, and future applications. *J. Mark.* **1997**, *61*, 30–54. [[CrossRef](#)]
34. Narasimhan, R.; Kim, S.W. Effect of supply chain integration on the relationship between diversification and performance: Evidence from Japanese and Korean firms. *J. Oper. Manag.* **2002**, *20*, 303–323. [[CrossRef](#)]
35. Klein, S.; Frazier, G.L.; Roth, V.J. A transaction cost analysis model of channel integration in international markets. *J. Mark. Res.* **1990**, *27*, 196–208. [[CrossRef](#)]
36. Williamson, O.E. Calculativeness, trust, and economic organization. *J. Law Econ.* **1993**, *36*, 453–486. [[CrossRef](#)]
37. Fafchamps, M.; Minten, B. Relationships and traders in Madagascar. *J. Dev. Stud.* **1999**, *35*, 1–35. [[CrossRef](#)]
38. Dyer, J.H. Effective interfirm collaboration: How firms minimize transaction costs and maximize transaction value. *Strateg. Manag. J.* **1997**, *535*–556. [[CrossRef](#)]

39. Williamson, O.E. *The Economic Institutions of Capitalism*; Simon and Schuster: New York, NY, USA, 1985.
40. Williamson, O.E. Strategizing, economizing and economic organization. *Strateg. Manag. J.* **1991**, *12*, 75–94. [[CrossRef](#)]
41. Vicente-Lorente, J.D. Specificity and opacity as resource based determinants of capital structure: Evidence from Spanish manufacturing firms. *Strateg. Manag. J.* **2001**, *22*, 157–177. [[CrossRef](#)]
42. Wang, T.; Thornhill, S. R&D investment and financing choices: A comprehensive perspective. *Res. Policy* **2010**, *39*, 1148–1159.
43. Leitner, Y. Using collateral to secure loans. *Bus. Rev. Q.* **2006**, *2*, 9–16.
44. Boot, A.; Anjan, W.A.; Thakor, V.; Udell, G.F. Secured lending and default risk: Equilibrium analysis. Policy implications and empirical results. *Econ. J.* **1991**, *101*, 458–472. [[CrossRef](#)]
45. Corsatea, T.D.; Giaccaria, S.; Arántegui, R.L. The role of sources of finance on the development of wind technology. *Renew. Energy* **2014**, *66*, 140–149. [[CrossRef](#)]
46. Denhardt, R.B. Trust as capacity: The role of integrity and responsiveness. *Public Organ. Rev.* **2002**, *2*, 65–76. [[CrossRef](#)]
47. Wynne, B. Public engagement as a means of restoring public trust in science—hitting the notes, but missing the music? *Public Health Genom.* **2006**, *9*, 211–220. [[CrossRef](#)] [[PubMed](#)]
48. Brunk, C.G. Public knowledge, public trust: Understanding the ‘knowledge deficit’. *Public Health Genom.* **2006**, *9*, 178–183. [[CrossRef](#)] [[PubMed](#)]
49. Stebbing, M. Avoiding the trust deficit: Public engagement, values, the precautionary principle and the future of nanotechnology. *J. Bioeth. Inq.* **2009**, *6*, 37–48. [[CrossRef](#)]
50. Rowe, G.; Frewer, L.J. Evaluating public-participation exercises: A research agenda. *Sci. Technol. Hum. Values* **2004**, *29*, 512–556. [[CrossRef](#)]
51. Hopt, K.J.; Von Hippel, T. *Comparative Corporate Governance of Non-Profit Organizations*; Cambridge University Press: Cambridge, UK, 2010.
52. Tsang, S.; Burnett, M.; Hills, P.; Welford, R. Trust, public participation and environmental governance in Hong Kong. *Environ. Policy Gov.* **2009**, *19*, 99–114. [[CrossRef](#)]
53. He, G.; Mol, A.P.; Zhang, L.; Lu, Y. Public participation and trust in nuclear power development in China. *Renew. Sustain. Energy Rev.* **2013**, *23*, 1–11. [[CrossRef](#)]
54. Focht, W.; Trachtenberg, Z. A trust-based guide to stakeholder participation. In *Swimming Upstream: Collaborative Approaches to Watershed Management*; MIT Press: London, UK, 2005; pp. 85–136.
55. Barraud-Didier, V.; Henninger, M.-C.; El Akremi, A. The relationship between members’ trust and participation in the governance of cooperatives: The role of organizational commitment. *Int. Food Agribus. Manag. Rev.* **2012**, *15*, 1–24.
56. Zollinger, B.; Krannich, R.S. Factors influencing farmers’ expectations to sell agricultural land for non-agricultural uses. *Rural Sociol.* **2002**, *67*, 442–463. [[CrossRef](#)]
57. Wilson, G.A. Factors influencing farmer participation in the Environmentally Sensitive Areas scheme. *J. Environ. Manag.* **1997**, *50*, 67–93. [[CrossRef](#)]
58. Brotherton, I. Farmer Participation in Voluntary Land Diversion Schemes: Some Observations from Theory. *J. Rural Stud.* **1989**, *5*, 299–304. [[CrossRef](#)]
59. Bailey, J.A.; Gordon, R.; Burton, D.; Yiridoe, E.K. Factors which influence Nova Scotia farmers in implementing energy efficiency and renewable energy measures. *Energy* **2008**, *33*, 1369–1377. [[CrossRef](#)]
60. Convery, I.; Robson, D.; Ottitsch, A.; Long, M. The willingness of farmers to engage with bioenergy and woody biomass production: A regional case study from Cumbria. *Energy Policy* **2012**, *40*, 293–300. [[CrossRef](#)]
61. Mishra, A.K. Organizational responses to crisis. In *Trust in Organizations: Frontiers of Theory and Research*; Sage Publication: London, UK, 1996; p. 261.
62. Braithwaite, V. Communal and exchange trust norms: Their value base and relevance to institutional trust. *Trust Gov.* **1998**, *1*, 46–74.
63. Hu, L.-T.; Bentler, P.M. Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychol. Methods* **1998**, *3*, 424. [[CrossRef](#)]
64. Steiger, J.H. *EzPATH: A Supplementary Module for SYSTAT and SYGRAPH*; Systat: Evanston, IL, USA, 1989.
65. Beccerra, M.; Gupta, A.K. Trust within the organization: Integrating the trust literature with agency theory and transaction costs economics. *Public Adm. Q.* **1999**, *23*, 177–203.

66. Brouthers, K.D.; Brouthers, L.E. Why service and manufacturing entry mode choices differ: The influence of transaction cost factors, risk and trust. *J. Manag. Stud.* **2003**, *40*, 1179–1204. [[CrossRef](#)]
67. Siegrist, M.; Cvetkovich, G.; Roth, C. Salient value similarity, social trust, and risk/benefit perception. *Risk Anal.* **2000**, *20*, 353–362. [[CrossRef](#)] [[PubMed](#)]
68. Ross, V.L.; Fielding, K.S.; Louis, W.R. Social trust, risk perceptions and public acceptance of recycled water: Testing a social-psychological model. *J. Environ. Manag.* **2014**, *137*, 61–68. [[CrossRef](#)] [[PubMed](#)]
69. March, J.G. Variable risk preferences and adaptive aspirations. *J. Econ. Behav. Organ.* **1988**, *9*, 5–24. [[CrossRef](#)]
70. Chiles, T.H.; McMackin, J.F. Integrating variable risk preferences, trust, and transaction cost economics. *Acad. Manag. Rev.* **1996**, *21*, 73–99.
71. Gulati, R. Does familiarity breed trust? The implications of repeated ties for contractual choice in alliances. *Acad. Manag. J.* **1995**, *38*, 85–112. [[CrossRef](#)]
72. Barney, J.B.; Hansen, M.H. Trustworthiness as a source of competitive advantage. *Strateg. Manag. J.* **1994**, *15*, 175–190. [[CrossRef](#)]
73. Dyer, J.H.; Chu, W. The role of trustworthiness in reducing transaction costs and improving performance: Empirical evidence from the United States, Japan, and Korea. *Organ. Sci.* **2003**, *14*, 57–68. [[CrossRef](#)]
74. Uzzi, B. Social structure and competition in interfirm networks: The paradox of embeddedness. *Adm. Sci. Q.* **1997**, *42*, 35–67. [[CrossRef](#)]
75. Wang, C.L.; Shi, Y.; Barnes, B.R. The role of satisfaction, trust and contractual obligation on long-term orientation. *J. Bus. Res.* **2015**, *68*, 473–479. [[CrossRef](#)]



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