**PSYCHOANALYSIS OF FARMERS’ IRRATIONAL DROUGHT-CONTROL BEHAVIORS**

Xinyue Dong¹, Yonggong Liu¹*, Qingkan Li²,³

**Abstract**

The global climate change has greatly increased the drought frequency in China. To control the drought, it is necessary to analyze the behavioral psychology of farmers. In this paper, the psychology of farmers’ irrational drought-control behaviors is studied based on their behavioral decisions. The influencing factors of irrational drought-control were discussed from the economics perspective. The results show that the rationality of farmers’ drought-control behaviors depends on the agronomics of water-saving irrigation measures, and the transformation of crop type and planting structure; Economically, the rationality of drought-control behaviors hinges on the farmers’ willingness to pay for irrigation water, that is, the farmers’ affordability of irrigation water. The research lays a theoretical basis for further psychology research on farmers’ drought-control behaviors.

**Key words:** Drought, Irrational Control, Psychology, Economics, Affordability.

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**INTRODUCTION**

Plowland is the primary source of both cereals and income of most farmers in China. There are quite different climate and precipitation conditions in the north and south of China (Duinen, Filatova, Geurts, & Veen, 2015). Food is subject to natural conditions, for example, the rice will not grow well under unfavorable conditions especially poor precipitation and irrigation. More than others, the geographical environment in the south is rather complex and the abnormal climate frequently appears in recent years, coupled with backward infrastructure in many rural areas, aging and rundown water conservancy facilities, drought has played increasingly adverse effect on crops (Hossain, Chowdhury, & Paul, 2016, Mohmmed, Li, Elaru et al., 2018). In China, as one of the types of natural disasters caused by climate change, drought severely heads off agricultural production, greatly reduces crop yields and farmers’ income (Perdue & Brown, 2018). It spreads over due to individual’s psychological features, social capital, rural infrastructure, economic level and government policies. The drought control directly responds to human’s behavioral psychology (Viscusi & Gayer, 2016).

Most of the farmers fight against drought by using irrigation methods. However, it is very unwise in the development and utilization of water resources, and as a consequence, the contradiction between the new problems continuously emerging and old problems unaddressed in a timely and effective manner gets so acute that normal and orderly maintenance and operation of irrigation facilities are seriously hampered (Hyland, Shevlin, Adamson, & Boduszek, 2015; Lanzini & Khan, 2017). In contrast, farmers’ attitudes toward agricultural irrigation and their willingness to pay for irrigation services will be also susceptible to their behavioral psychology (Press-Sandler, Freud, Volkov et al., 2016). Farmers’ irrational drought-fighting behaviors will have direct concern with effective implementation of agricultural irrigation system reform. Viewed from...
the economics, it involves the study of the affordability of farmers for water irrigation services (Lazzeri, 2015). For this purpose, this paper analyzes the farmers’ psychology that responds to irrational drought-fighting behavior decisions, and reveals factors influencing drought control from the economics perspective.

**PRIORITY ANALYSIS OF FARMERS’ DROUGHT-FIGHTING MEASURES**

Drought poses a serious threat to agricultural production and survival of human. It attributes to insufficient precipitation in a long time, and leads to less river flow, and soil moisture and nutrient loss (Dhesi & Ausloos, 2016). Subject to different drought degrees, it can be classified into permanent, seasonal, temporary and concealed droughts. When farmers suffer drought, they will adopt rational or irrational strategies against it. Survey shows that rational control measures used by large-scale farmers against drought are efficient (Frikkie, Bahta, & Walter, 2018). Some scholars have found from psychology perspective that farmer’s own characters, psychological state, social experience and other factors will influence the choice of drought control behaviors so that the differences between individuals evolve but will be restricted by economic factors (Parida, Dash, Bhardwaj et al., 2018). Drought control is one of the farmers’ risk treatment strategies. Farmers will timely adjust crops to be planted and production inputs to adapt to regional climate. They will also take control measures against drought, including engineering and non-engineering measures (Keshavarz & Karami, 2016).

Drought will ruin crops in different degrees, which depends mainly on the sensitivity and adaptability of crops to drought climate. As shown in Tables 1 and 2, there are needs for engineering and non-engineering measures against drought, each of which are also divided into 3 levels, As can be seen, those ranked at a top frequency are the Building the dikes and dams, Clean or dig the drainage system and the Drought-resistant crops; in Table 2, it can be clearly seen that the top rank of frequency in Levels 1, 2 and 3 are respectively Replant, Adjust seeding or harvest date and Rotation round irrigation, etc. It is known from analysis that in the face of drought, farmers can prefer the first three types of engineering and non-engineering measures.

**ANALYSIS OF FARMERS’ AFFORDABILITY BASED ON ECONOMICS**

**Causes for farmers’ irrational drought-fighting behaviors**

In the face of drought, the control measures taken against it may be rational for farmers as deciders, but in the long run, it is irrational since deciders’ decisions may seep into long-term development and application. As shown in Figure 1, a framework for evaluating how crops are vulnerable to precipitation changes. The vulnerability of crops to drought depends on how they are sensitive and adaptable to drought. That is to say, the more sensitive and inadaptable they are to the drought, the stronger the vulnerability. In Figure 1, some crops that are

**Table 1. Farmers’ drought management engineering measures**

<table>
<thead>
<tr>
<th>Code</th>
<th>Engineering requirements</th>
<th>First</th>
<th>Second</th>
<th>Third</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Building dikes and dams</td>
<td>431</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>B</td>
<td>Building water kiln and well</td>
<td>345</td>
<td>242</td>
<td>4</td>
</tr>
<tr>
<td>C</td>
<td>Clean or dig the drainage system</td>
<td>209</td>
<td>360</td>
<td>80</td>
</tr>
<tr>
<td>D</td>
<td>Irrigation or furrow irrigation</td>
<td>34</td>
<td>297</td>
<td>250</td>
</tr>
<tr>
<td>E</td>
<td>Sprinkler irrigation or drip irrigation</td>
<td>10</td>
<td>98</td>
<td>276</td>
</tr>
<tr>
<td>F</td>
<td>No-till or less tillage</td>
<td>3</td>
<td>38</td>
<td>205</td>
</tr>
<tr>
<td>G</td>
<td>Drought-resistant crops</td>
<td>1</td>
<td>4</td>
<td>304</td>
</tr>
</tbody>
</table>

**Table 2. Farmers’ drought management non-engineering measures**

<table>
<thead>
<tr>
<th>Code</th>
<th>Engineering requirements</th>
<th>First</th>
<th>Second</th>
<th>Third</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Replant</td>
<td>440</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>B</td>
<td>Replanting other crops</td>
<td>352</td>
<td>268</td>
<td>4</td>
</tr>
<tr>
<td>C</td>
<td>Adjust seeding or harvest date</td>
<td>92</td>
<td>341</td>
<td>63</td>
</tr>
<tr>
<td>D</td>
<td>Adjust irrigation and drainage intensity or irrigation time</td>
<td>36</td>
<td>267</td>
<td>241</td>
</tr>
<tr>
<td>E</td>
<td>Participate in agricultural insurance</td>
<td>20</td>
<td>53</td>
<td>260</td>
</tr>
<tr>
<td>F</td>
<td>Rotation round irrigation</td>
<td>1</td>
<td>6</td>
<td>311</td>
</tr>
</tbody>
</table>
sensitive and more adaptable to the drought are not so much the case. There are many factors influencing farmers’ irrational drought-fighting behaviors, including membership, resources and environment, which are subdivided into agronomic and water-saving irrigation measures, transformation in crop varieties and planter structures.

**Figure 1. Diagrammatic sketch of research method**

Analysis of Farmers’ affordability for drought irrigation

In terms of overall affordability for irrigation services, the irrigation water expenditures as percentage of total income, agricultural production cost, output value and net yield are all generally lower. However, as payers for water rates, farmers’ willingness to pay for irrigation service charge has a great relationship with their psychological factors. The farmers’ willingness-to-pay trend is shown in Figure 2.

**Figure 2. Statistics of farmers’ willingness to pay (yuan/m³)**

It is obvious that farmers are more willing to accept low water price. The farmers’ willingness-to-pay median is RMB 0.15. 35.76% of farmers prefer to pay for water of RMB 0.1-0.15 / m³, that is, the irrigation water price of RMB 0.1-0.15 / m³ is a reasonable range that farmers prefer. According to the survey, in the case that the irrigation cost is not high, the farmers’ willingness-to-pay trend varies greatly when the irrigation water price hikes up. In this section, we conduct a questionnaire survey among farmers, where a total of 10 prices are set. The findings show that no matter how expensive the irrigation water is, there are still farmers who prefer maintaining the status quo. Most farmers adjust their planter structures with the increase of water price, and resort to dryland crops or derelict land. On the whole, the current irrigation water price has a certain rise space in relation to the farmers’ affordability.

**PSYCHOLOGICAL ANALYSIS OF IRRATIONAL DROUGHT-FIGHTING BEHAVIORS**

Analysis of factors influencing farmers’ demand for drought control measures

The threat of drought to crops should be noticeable. As the primary means of controlling drought, water source determines the damage of drought to crops to a large extent. The anomalous percentage of precipitation reflects the deviation of rainfall in a period from the average for previous years based on long-term sequence rainfalls, so it has significant research significance. The precipitation anomalies (%) of the drought indices in the abnormal years are shown in Figure 3. It is clear that the precipitation value in each year is quite different, especially when the precipitation anomalies fluctuate greatly.

**Figure 3. Percentage deviation of drought indices in abnormal precipitation years**

The distribution of crop vulnerability indices is shown in Figure 4. The mean value of the crop
vulnerability indices is 2.248. When farmers suffer a drought, their demand for water infrastructure and for new varieties with prominent drought-resistance will be stronger. Farmers’ demands for drought control also involve rainfall level, irrigation water price, technology inputs and emergency response building, etc.

The farmers’ drought control efficiency depends partially on advanced irrigation technology. The water demand is subject to different crops. The surface water irrigation quota for staple crops is shown in Figure 5. As we see, the surface irrigation quota of corn is the maximum, followed by wheat and beans, while the minimum is artichoke. Therefore, in addition to precipitation and irrigation water sources, the optional varieties of crops are also important measures for fighting against drought.

**Figure 4. Distribution of drought vulnerability index of peasant households**

**Figure 5. Surface water irrigation quota for major crops**

**Analysis of farmers’ irrational drought-fighting behavior from the economics perspective**

Agronomic and water-saving irrigation measures, transformation of crop varieties and planter structures are all fundamental to farmers’ control over drought. After well gasping the growth and water utilization of crops under drought conditions, appropriate drought control strategies can be developed in light of regional conditions. It is also possible to regulate water resources. There are distinctive varieties of crops in different areas of China under the climatic and precipitation conditions. However, evaluating from the efficiency of water resources in the growth process, depletable water resources appear to be particularly important. Given the comparison between agricultural output value and irrigation water price, the efficiency $\rho$ per unit of water is calculated by Formulas (1) and (2):

$$f = \sum_{i=1}^{n} y_i * p_i / L$$

(1)

$$\rho = f / w$$

(2)

where, $f$ represents the area planted by the farmers; $y_i$ and $p_i$ represent the total yield and sale price of the crop $i$, respectively; $w$ represents the surface water irrigation quota.

**Figure 6. The relationship curve between drought risk and cost**

Drought control costs are invoked by the engineering and non-engineering measures and irrigation water prices. Regional consumption has an adverse impact on efficiency per unit of water. The curve of drought risk as a function of cost is shown in
Figure 6. As the drought risk threshold increases, the costs involved by drought control hike up, but are optimal at a point, once exceeded, the drought control cost will steeply rise up. To respond to the impact of the drought on the economy, we should intensify the construction of water conservancy infrastructure, improve crop’s adaptability to arid climate, develop favorable non-engineering measures, and help farmers diversify response strategies. Further, the government should support and standardize the development of agricultural cooperative organizations, and enhance farmers’ defiance of drought.

CONCLUSION

To address the concern of farmers, this paper analyzes the farmers’ psychology behaviors deriving irrational fight against drought from the angle of farmers’ behavioral decisions, and explores the factors influencing it economically. Here come specific conclusions:

(1) The crop’ vulnerability to arid climate depends on how crop is sensitive and adaptive to drought. If it is sensitive and less adaptable to this extreme climate, its vulnerability is severe. There are many factors influencing rational drought-fighting behaviors of farmers, including membership, resources and environment.

(2) When drought occurs, famers’ demand for water infrastructure will be strong, so does their demand for new varieties with drought-tolerance. There are also needs for rainfall, irrigation water price reduction, technological inputs and other emergency facilities.

(3) Drought-fighting costs include inputs in engineering and non-engineering measures and reduction of irrigation water prices. The regional consumption has an adverse impact on the efficiency per unit of water. The drought control cost builds up as the drought risk threshold increases, but has an optimal level. When exceeding this level, the control cost increases dramatically.

REFERENCES