RETRACTED ARTICLE: Application of active remote sensing in confirmation rights and identification of mortgage supply-demand subjects of rural land in Guangdong Province

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\textbf{ABSTRACT}

In recent years, the remote sensing data plays an increasingly significant role in Land use prediction modeling. The effects of land conversion and agricultural bio production are evaluated using remote sensing and economic analysis. It is impossible to over-emphasize the advantages of the vibrant, efficient hybrid mortgage market in Guangdong as it is inseparably linked to economic development. This paper explores specifically the main variables affecting residential mortgage demand and other restrictions on households’ use of a mortgage using the Fuzzy Systematic Evaluation System (FSES). Furthermore, this objective has been accomplished by examining and analyzing the available mortgage products in Guangdong through questionnaire survey responses. In addition, the high-interest rates, low income, and house prices result in high and unreasonable repayment-to-earnings mortgages ratios. Moreover, the cumulative effect of this is to make households on low and mid-income prices to the mortgage market. While higher house prices are found in this study to increase mortgage demand, they trigger banks to offer fewer and charge higher rates, particularly after the boom, and especially for highly leveraged households.

\textbf{Introduction of mortgage supply-demand of rural land in Guangdong province}

Rural finance reforms are increasingly important with the continued healthy and fast development of the rural economy (Endsley, 2019; Gharbia et al., 2018; Hanewald et al., 2020). In vast rural areas, through the use in the collateral of poultry, livestock, and other economic analysis, a new way of guarantee financing has begun to arise (Da, 2019; Gao et al., 2019; Zhang et al., 2019). In this way, the problem of farmers’ lack of funds and impact on productiveness can be effectively solved, and moving resources can be fully utilized to solve severe issues (Allen et al., 2019; Sun, 2019). The land mortgage right is the system in which the power of contractual land government is ensured as the creditor’s right by the land contractual right holder (Tong & Xiao, 2019). To activate rural capital, improve rural assets’ collateral property, and play agricultural land ownership rights capital role (Dhote et al., 2019).

The mortgage financing reform of agricultural land management rights is one of the most important measures to reform the “three power division” of agricultural land in China (Anderson & Kurzer, 2020), (Ba & Xia, 2019). The coordination of Multi-Interest Relations in the process of reform and implementation involves new risks resulting from the linkage between risks of intangible capital mortgage and rural environments (Garai & Garg, 2019; Muturi, 2019; Sheikh, 2019). Thus each risk indicator as a basis for risk prevention is measured by the construction of the Agricultural Land management risk mortgage indicator system (Fuster et al., 2019), (Tiwari, 2019). The rural land property mortgage loan is a major innovation in the rural financial system, which enables the revival of the stock and efficiency of rural land resources to be improved, which are important to the rural economy and financial development (Badun & Krišto, 2020; Etyang & Mwengei, 2019; Garai & Garg, 2019). Rural land mortgage loans are important to rural development (Amin, 2019; Gallus, 2019). As an innovative financial enterprise, however, the practice of mortgage loans for rural property rights has some risks or problems (Adzorgenu-Amponsah, 2019). To identify and effectively prevent risks based on rural economic security, agriculture production, and farmers’ life and operations have been analyzed (Duszak, 2019). Figure 1 shows the geographical location of the Guangdong province.

In this paper, Fuzzy Systematic Evaluation System (FSES) has been proposed to analyze the affecting variables residential mortgage demand and other restrictions on households’ use of a mortgage in Guangdong Province using active remote sensing (Muhammed Shafi et al., 2018; Sathishkumar & Cho, 2020). The
Guangdong province is detected and monitored to classify the high and low demand for a mortgage product, which utilizes the multi-resolution analysis process while examining the image frequencies of the various province of Guangdong.

The main contributions of the paper are,

- To propose the Fuzzy Systematic Evaluation System (FSES) with active remote sensing for identifying the mortgage supply-demand subjects of rural land in Guangdong province.
- Designing the second generation product demand analysis of Guangdong province.
- The experimental results have been performed, and the proposed method has performance and accuracy in detecting the demand area.

The rest of the paper discussed as follows: Section 1 and section 2 discuss the mortgage supply-demand of rural land in Guangdong province. In section 3, Fuzzy Systematic Evaluation System (FSES) has been proposed. In section 4, the experimental results have been performed. Finally, section 5 concludes the research article.

**Literature survey**

Amna Butt et al. (Kahn & Kay, 2019) proposed the Supervised Classification maximum likelihood algorithm (SCMLA) for land-use change mapping and analysis utilizing remote sensing and GIS. The river basin was classified as five main categories of land. Settlements, vegetation, and water. Agriculture, bare soils/rocks. The transformations in land cover/use represented a severe threat to resources in the water.

(Butt et al., 2015) suggested the Risk Identification Framework and Indicator System Construction (RIF-ISC) for mortgage financing risk of agricultural land management rights. When evaluating the financing risk of farmland management rights, it is important to integrate these market risk, financial risk, political risk, financial risks, and financial institution risks.

(Noh et al., 2020) introduced the Attitude, Interest, Opinions, and planned behavior theory (AIO-TPB) for analyzing customer behavior in choosing conventional mortgage products. Results showed that consumers would buy houses in 3 clusters through mortgages (Adiyanto et al., 2017). The first clusters are respondents with monotonous, introverted, conservation, and conformist personalities who chose a mortgage.

(Palacios-Argüello et al., 2020) initialized the Analytic Hierarchy Process (AHP) for the construction of the mortgage risk index system for farmland management rights. Calculations were made, and the weights of each indicator were obtained, and a consistency test was passed to give insight into the mortgage financing risk of land management rights in agriculture.

(Zhaogang, 2019) proposed the Rural Land Contract Mortgage Model (RLCMM) for green agricultural products. Research shows that the function of household financing by rural land contracts is of great importance to meet the enormous demand for capital on the Chinese agrarian scale and modernization.

To overcome these issues, in this paper, Fuzzy Systematic Evaluation System (FSES) with active remote sensing for identifying the mortgage supply-demand subjects of rural land in Guangdong province.
remote sensing for identifying the mortgage supply-demand subjects of rural land in Guangdong province. Considering uncertainties in pixel/segment image classification, a fluctuating inference system can be beneficial. The lack of the step-by-step method in the existing for classification of image based on fuzzy logic still suffers. The accuracy evaluation is finally carried out, and the outcomes are compared to the standardized testing approaches with crisp thresholds.

**Fuzzy systematic evaluation system**

In this paper, the Fuzzy Systematic Evaluation System (FSES) with active remote sensing for identifying the mortgage supply-demand subjects of rural land in Guangdong province.

**The pre-processing mortgage product**

According to the decomposition process, the Fuzzy Systematic Evaluation System (FSES) method which effectively utilizes in the mortgage product analysis strategies of Guangdong. The FSES method generated matrix has been represented as the $m \times n$ which has real or complex matrix $M$ that is denoted in the form of factorization such as $\Sigma V^T$. $U$ is the unitary matrix which may be in real or complex whose size is $m \times m$. $\Sigma$ is the rectangular matrix that size has been $m \times n$ which has non-negative real numbers as shown in the orthogonal matrix is represented as follows,

$$AA^T = U\Sigma V^* V\Sigma U^T = U\Sigma^2 U^T$$

(1)

Where $AA^T$ is the vectors of columns of $m \times m$ matrices.

$$A^T A = V\Sigma U^T U \Sigma V^T = V\Sigma^2 V^T$$

(2)

$A^T$ is the eigen vector of $n \times n$ matrix column $\Sigma$ is the singular value which is having the non-negative values that is represented as

$$\Sigma = diag(\sigma_1, \sigma_2, \ldots, \sigma_n)$$

(3)

Where $\sigma$ is the singular value of the $A$.

The diagonal or singular value reflects the amount of variation in the mortgage product demand following various market strategies has been correlated in the matrix that is represented as follows,

$$\begin{align*}
\sigma_1 & \quad 0 \quad \cdots \quad 0 \quad 0 \quad \cdots \quad 0 \\
0 & \quad \sigma_2 \quad \cdots \quad 0 \quad 0 \quad \cdots \quad 0 \\
\cdots & \quad \cdots \quad \cdots \quad \cdots \quad \cdots \quad \cdots \\
0 & \quad 0 \quad \cdots \quad \sigma_r \quad 0 \quad \cdots \quad 0 \\
0 & \quad 0 \quad \cdots \quad 0 \quad \sigma_{r+1} \quad \cdots \quad 0 \\
\cdots & \quad \cdots \quad \cdots \quad \cdots \quad \cdots \quad \cdots \\
0 & \quad 0 \quad \cdots \quad 0 \quad 0 \quad \cdots \quad \sigma_n \\
0 & \quad 0 \quad \cdots \quad 0 \quad 0 \quad \cdots \quad 0
\end{align*}$$

In the above matrix, the first variant value is denoted as the greatest data variant, and other variant values are depends on the orthogonal direction of data variant values. The FSES performs the rotation operation and aligns the transformed axis in the maximum data variant direction with respect market demand of the mortgage products. The dimensionality of the product matrix is reduced by the low-rank decomposition under market demand. The data variant, which is having the highest rank that will be eliminated from the product list, helps to improve the efficiency of demand for the product based on market analysis. According to the above mention pros of FSES is the main reason to preprocess the mortgage product data. Besides, the second generation product transform helps to examine product demand. The detailed explanation of the second-generation product analysis process is explained as follows.

**B. Second generation product transform for demand analysis in provinces of Guangdong**

This method examines the remote sensing concepts in the lifting sequence scheme. Considered $f$ is the input product on-demand which is divided into odd $y_1$ and even $\lambda_1$ samples based on the market condition using the downsampling and shifting process. Further, the product has been divided into detailed coefficient using prediction operator that is denoted as follows based on various provinces in Guangdong,

$$y_2 = y_1 - P(\lambda_1)$$

(4)

After getting the detailed coefficient value, approximation value is obtained as follows,

$$\lambda_2 = \lambda_1 + U(y_2)$$

(5)

Based on the derived prediction operator ($P$) and updating operator ($U$), the image has been divided into sub-images, which help to extract the effective market demand based on the province of Guangdong. Along with the easiest decompose process, the method computes the sub-images in a quicker manner, which utilizes the multi-resolution analysis process while examining the image frequencies. It easily adapts to any extent, transformed image to analyze the mortgage product demand in each province of Guangdong. Due to the advantages of Second-generation product transform has been utilized by several researchers. According to the above mention pros of the second generation, Second generation product transform is the main reason for analyzing the demand for mortgage products in the various province of Guangdong. From the decomposed image, different products are retrieved and fed into the fuzzy assisted SES system.
Proposed product recognition system

The above Figure 2 shows that the developing stage of the proposed Mortgage product Detection system. The first step is preprocessing the recorded Guandong using a remote sensing SES referencing approach. After that, the Guandong region image has been decomposed into different sub-bands with the help of the Second generation product transform for demand analysis in provinces of Guandong. From the decomposed image, various scale-invariant and demand of the product have been analyzed following the province using demand redundancy methods to optimize the product demand. Further Classification has been done through Fuzzy assisted SES Network.

D. product preprocessing based on the retrieved image using remote sensing

The first and foremost step in mortgage product demand analysis is based on preprocessing the recorded Guandong image regions. Hence, the preprocessing is done by applying the common systematic assessment model. At first, the referencing method is applied to an image in which various demand of the product has been analyzed as follows,

\[ CzCAR = Cz - (Fp1 + AF3 + F7 + \ldots + Fz + MA1 + MA2)/34 \]  
(6)

In the Equation (6) \( Cz - (Fp1 + AF3 + F7 + \ldots + Fz + MA1 + MA2) \) these are represented as the position of nodes on the leaf.

Here SES is used to remove unwanted demand of the product based on the region analysis using matrix representation as follows,

\[ M = U \sum V^* \]  
(7)

Where \( U \) is the \( mxm \) = left Orthogonal matrix as represented as \( U = [u_1, u_2, \ldots, u_m] \) and \( \sum V^* \) are the rectangular diagonal matrix and the conjugated transpose the \( V \) \( = [v_1, v_2, \ldots, v_n] \) of the \( mxm \) = Right Orthogonal Matrix as represented as follows,

\[ AA^T = U\Sigma V^* V\Sigma U^T = U\Sigma^2 U^T \]  
(8)

Where \( AA^T \) is the eigen vectors of columns of \( mxm \) matrices

\[ A^T A = V\Sigma U^T U\Sigma V^T = V\Sigma^2 V^T \]  
(9)

Where \( A^T \) A eigen vector of \( mxn \) matrix column

\( \Sigma \) is the singular value which is having the non-negative values that is represented

\[ \Sigma = \text{diag}(\sigma_1, \sigma_2, \ldots, \sigma_n) \]  
(10)

Where \( \sigma \) is the singular value of the \( A \)

This process is repeated to the entire direction of the image to determine the data variants and other orthogonal direction. Besides, the rotation operation needs to be performed to eliminate the high data variant for the bipolar and unipolar direction. Thus the process is repeated continuously to eliminate the unwanted demand of the product in Guandong regions. The preprocessed values are fed into the next decomposition process for dividing the product demand into different sub-bands regions of the Guandong regions.

E. product demand analysis for each region of Guandong

Here the Guandong region images are split into odd and even samples \( y_1, \lambda_1 \) that decompose the image into approximation and detailed coefficients. According to the even sample details, the detailed coefficients related frequencies are extracted in the multi-direction as follows,

\[ y_2 = y_1 - P(\lambda_1) \]  
(11)

After deriving the detailed coefficients, the approximate coefficients are retrieved as follows,

\[ \lambda_2 = \lambda_1 + U(y_2) \]  
(12)

From the above Equations (11 & 12) \( P \) represented as the prediction operator, and \( U \) is the updating operator,
which is used to analyze the detailed and approximate coefficient efficiently. The decomposed bands are fed into the next stage for extracting the meaningful demand of the product, which are described as follows.

**F. product demand extraction based on the various region using remote sensing images**

The key points are identified in the decomposed image based on keypoint location, detection, orientation, and descriptors with the help of Gaussian filter with Min-Max values as represented as follows,

\[ D(x, y, \sigma)(\text{Filter band}) = L(x, y, K, \sigma) \]

\[ = \text{Convolution band} - L(x, y, K, \sigma) = \text{Blur value} \]

\[ (13) \]

\[ L(x, y, K, \sigma) = G(x, y, k, \sigma) \ast I(x, y) \]  \hspace{1cm} (14)

Taylor series estimation based on the key point from the image, point location is estimated as follows,

\[ D(x) = D + \frac{\partial D^T}{\partial x} x + \frac{1}{2} x^T \frac{\partial^2 D}{\partial x^2} x \]  \hspace{1cm} (15)

The magnitude and orientation estimation based on key points as represented as follows,

\[ m(x, y) = \sqrt{(L(x+1, y) - L(x-1, y))^2 + (L(x, y+1) - L(x, y-1))^2} \]  \hspace{1cm} (16)

\[ \theta(x, y) = \tan^{-1} \left( \frac{L(x+1, y) - L(x-1, y)}{L(x, y+1) - L(x, y-1)} \right) \]  \hspace{1cm} (17)

Where, \( m(x, y) = \text{magnitude of the key band}, \theta(x, y) = \text{orientation the key point band} \)

After estimating the key points and the related orientation in the sub-bands, the related statistical demand of the mortgage products is extracted based on all the sub-region of Guangdong, and it has been listed in the online portal system for easy access.

**G. product selection based on the demand**

The next crucial step is Product selection, different bands in the previous step have a variety of Product which are difficult to analyze. Hence, the dimensionality of the Product selection is reduced, and the optimal Product selection is used effectively to recognize the required product in all the sub-regions of Guangdong. Product selection is made with the help of the memetic redundancy approach. During the selection process, the similarity of the mortgage products and non-demand product information is estimated using the memetic approach. According to the mutual information, the average value is calculated for every Product selection as follows,

\[ D(S, c) = \frac{1}{|S|} \sum_{i \in S} I(f_i; C) \]  \hspace{1cm} (18)

Where S represented as the redundancy value of the particular product set the average value of the particular mutual information between the two different products which is defined as follows,

\[ R(S) = \max_i \left[ \frac{1}{|S|} \sum_{i \in S} I(f_i; C) - \frac{1}{|S|^2} \sum_{i,j \in S} I(f_i; f_j) \right] \]  \hspace{1cm} (19)

Based on the above process, the product is categorized according to the importance and impact of the demand. These two characteristics are considered, and the similarity value is estimated. Afterward, the difference between the values is calculated in which minimum values are chosen as the optimized product demand for all regions. The selected product is used to detect the demand concerning sub-regions of Guangdong, which are classified as follows.

**H. Product detection and final classification based on the demand**

A reactive, optimized FSES uses the select functions as the input to complete the last step in the imaging detection in which mortgage product is classified according to the region. The network effectively categorizes the products chosen as the fuzzy networks are tracked. The fuzzy network comprises multiple layers, such as the product layer, demand layer, Matching layer, and Classification layer. The network layers are capable of performing while the chosen functions suffer from unwanted product demand, as each layer uses the mortgage product to obtain optimal efficiency. The reactive Objective function helps to update weight and bias value respectively based on the demand,

\[ f(x) = (f_1(x), f_2(x), \ldots, f_k(x))^T \]  \hspace{1cm} (20)

According to the above objective function, the weights are updated continuously with the previous value and analyzed using sigmoid as well as Gaussian function which is represented as follows with maximum recognition ratio of the mortgage product in accordance to the demand of the sub-regions in Guangdong province,

\[ \text{Net output} = \sum_{i=1}^{N} x_i \ast w_i + b \]  \hspace{1cm} (21)

In fuzzy classifications, the likelihood of every pixel/segment belonging to a particular class, which is stated by membership functions, is considered rather than a binary decision making. A membership feature offers a membership degree of 0–1, whereby 1 means full membership and 0 means, not membership. Implementing fuzzy logic ensures that boundary values are no longer clear thresholds, membership features in which a particular probability for each
parameter is used to allocate to a particular class. $\mu_A(y)$ is known as a membership degree and $\mu_A$ is a fuzzy membership function over domain $Y$, which varies from 0 to 1 over domain $Y$. $\mu_A(y)$ can be a Gaussian, Trapezoidal, triangular, or additional standard functions that rely on the remote sensing images.

Triangular function:

$$\mu_A(y) = 1 - \frac{|a - y|}{\lambda}, \text{ for } 0 \leq |a - y| \leq \lambda; \mu(y) = 0$$ (22)

Trapezoidal function

$$\mu_A(y) = \min \{2 - 2\left(\frac{|a - y|}{\lambda}\right), 1\}, \text{ for } -\lambda \leq |a - y| \leq a + \lambda; \mu(y) = 0$$ (23)

Figure 3 shows the remote sensing image classification utilizing fuzzy logic. The rural land highly demands the online mortgage product. The efficiency of the proposed system is evaluated using the following experimental results at the lab-scale, and the work is in progress.

**Experimental results and discussion**

**Overall performance ratio**

The classification images of online mortgage product demand in rural land have been analyzed. Classification or clustering is a process by which data points with similar properties are classified into the same cluster automatically. The Fuzzy logic has been utilized to classify the product demand region image. The training can be measured using statistical methods: minimal, maximum, average, and standard deviation for each band for all three groups. The most relevant evaluation of the signature file creates a percentage error matrix based on pixel counts, and pixels were assigned to each class in each sample of training. The proposed FSES method improves the classification performance ratio. Figure 4 shows the overall performance ratio FSES method.

**Accuracy ratio**

Considering that detection of change regarding classification techniques can lead to inaccurate change detection by errors of different dates, the accuracy of classification of each land type has been tested. The classification accuracies can be assessed by two different types of measurement: the first is coefficient and overall accuracy, which are widely applied in remote sensing applications. Three different data sets have been computed for these two measures. Total agreement measures were calculated, which are the sum of the disagreements in quantity and allocation. The proposed FSES method enhances the accuracy ratio in terms of remote sensing image classification. Figure 5 shows the accuracy ratio of the proposed FSES method.

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**Figure 3.** Remote sensing image classification utilizing fuzzy logic.
Efficiency ratio

Remotely sensed imaging classes include grouping image data in a limited number of discrete classes. Nevertheless, geographical phenomena are not random and often not displayed with a normal distribution in image data. In remote sensing or GIS images, a pixel could be a combination of class covers, in-class variability, or other intricate patterns of the surface, which can not be described correctly by a particular class. These can be affected by the class ground truth and the spatial image resolution. For supervised image classification, a fuzzy membership matrix was used. The initialization of partial pixel membership would identify mixed pixels and lead to better results in the classification efficiently. Figure 6 shows the efficiency ratio of the proposed FSES method.

Error rate

Many sources of error can affect the results of classifications, including classification error, registration error, and inadequate training quality. Such errors generate uncertainties at the various levels of the classification process, which may impact the accuracy of the classification as well as the area of the estimated area of the land cover classes. Analysts can assess the effectiveness of the resulting thematic map for the intended applications with accuracy assessment. The proposed FSES method reduces the error rate when compared to other existing methods. Figure 7 shows the error rate of the proposed FSES method.

The proposed fuzzy systematic evaluation system with active remote sensing has been proposed to detect the mortgage supply-demand of rural land in Guangdong province. The dimensionality of the Product selection is reduced, and the optimal Product selection is used effectively to recognize the required product in all the sub-regions of Guandong. Product selection is made with the help of the memetic redundancy approach. During the selection process, the similarity of the mortgage products and non-demand product information is estimated using the memetic approach. The proposed FSES method enhances the classification accuracy, performance,
and reduces the error rate of the remote sensing image.

Conclusion

This paper presents the Fuzzy Systematic Evaluation System (FSES) with active remote sensing for identifying the mortgage supply-demand subjects of rural land in Guangdong province. Among intelligent systems, the fuzzy system has many benefits and has the potential to be utilized in remote sensing applications. The proposed fuzzy theory is an effective process for the classification of remote sensing images of the product demand region in Guangdong. It can easily integrate specific provisions that can be well classified, and it offers classification results in membership values. Furthermore, the hierarchical framework is used to decrease fuzzy rules, making the system flexible and realistic. Fuzzy sets not only allow the definition of uncertain, vague, or probabilistic spatial data, their relationships, and operations as well. The proposed FSES method enhances the overall performance, accuracy and reduces the misclassification of image.

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