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A systematic literature review of gray level co-occurence matrix on plants

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ABSTRACT

The Gray Level Co-Occurrence Matrix method includes contrast, correlation, energy and homogeneity then is processed using an artificial neural network method for its classification. This literature tries to learn about the process of the GLCM method. This is done to understand the methods that researchers use to collect data from various sources, process the data that has been collected, and classify the data so that it becomes information that is easier to understand. researchers collect, screen, and review the research found using a Systematic Literature Review approach. Researchers pooled research from ScienceDirect, Google Scholar, and Elsevier by selecting studies published from 2020 to 2023. The purpose of the researchers conducting this literature review was to understand the GLCM method in parks, gain an understanding of data collection techniques, methods, and study the results of the research. previously. This study collects and summarizes 12 studies. The study was conducted regarding the method of data collection, the methods used, and the results of the research.

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Introduction

Rice is a plant commodity that has been cultivated for centuries by farmers, especially in indonesia(Cybex, 2019). Plants that have high economic value will be needed forever because rice is a rice-producing plant for the needs of food consumption and nutritional needs for all human beings (Thoriq, 2022). Rice plants can be disturbed during the production period, rice is often disturbed by various factors such as pests, diseases and poor environmental conditions(Soleh, 2020) . In the cultivation of rice plants, there are obstacles faced by farmers including Bacterial Leaf Blight (Hanifah Fitri Yuniar, 2021). Therefore, an effective method is needed to be able to identify the condition of rice plants early so that farmers can take appropriate and fast action to improve crop quality and increase crop yields.

There are many ways that can be used to help farmers find out the condition of this rice plant so that they can deal with it quickly and precisely, one of which is by using the help of machine learning, which was previously proven to be able to solve topics like this (Al Rivan et al., 2020). As an example, research(Yuliany et al., 2022) carried out Classification of Pests on Rice Plants Using the Convolutional Neural Network (CNN) Method

This research was conducted to test the method of classifying and also to be able to provide information to farmers about which rice plants are affected by the disease, so farmers need to deal with it further. There are several previous studies with the same case study (Anggiratih et al., 2021)(Mohtar Khoiruddin, Apri Junaidi, 2022)(Kusanti et al., 2018)(Priyangka & Kumara, 2021)(Shrivastava & Pradhan, 2021)(Citra et al., 2023), this study used several methods, namely CNN, Naive Bayes (NB), Decision Tree (DT), KNN, Support Vector Machine (SVM), Random Forest (RF), Deep LearningEfficientnet B3 With Transfer Learning, Fuzzy Random Forest, etc. The results of previous studies have the best accuracy of 90%.

This article aims to examine studies related to the Gray Level Co-Occurence Matrix in plants. After that, classification of the Gray Level Co-Occurence Matrix methods was carried out based on the type of plant. It is hoped that this review can provide an overview to researchers in related fields regarding the latest methods related to GLCM.

Method

A Systematic Literature Review (SLR) study aims to identify key relevant studies, extract the necessary data, and analyze and synthesize the results to gain broader insight into the research area (van Dinter et al., 2021). Regardless of the field, discipline, or philosophical perspective, the author (Durach et al., 2017)stated that in order to perform SLR, it is necessary to perform six stages as below.

Research Questions
RQ1 : What data collection techniques do researchers use in Gray Level Co-Occurence research?
RQ2 : What are the methods used in Gray Level Co-Occurence research?
RQ3 : What are the Gray Level Co-Occurence results in the research?

Research Strategy

The researcher looking for papers from ScienceDirect, Google Scholar, and Elsevier using two keywords:

- "GRAY LEVEL CO-OCCURENCE MATRIX"
- "Plant"

Study Selection

Criteria should be established when evaluating manuscripts. The researcher has two types of criteria that can be used in writing papers: inclusion criteria and exclusion criteria. Here are some inclusion criteria for this study:

- The research collected is research conducted from 2020 to 2023.
- The researcher selects papers that are written in Indonesian and English.
- The study main topic must be GRAY LEVEL CO-OCCURENCE MATRIX on plant

The exclusion criteria for this study were:

- Research that is not included in the inclusion criteria.
- This research is not clear in describing the research flow and how to conduct research
- Research that fails to address the research objectives.

Fig 1 shows the criteria in this study.

Fig 1. The data selection process is depicted in

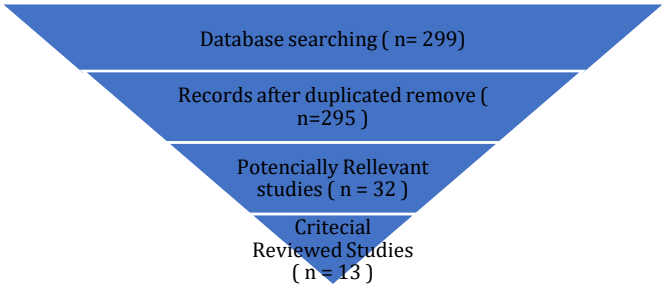

Fig. 2 The data selection

Quality Assessment

A quality assessment should be carried out to get a clear picture of the quality of a study. Quality assessment is carried out to make decisions regarding whether the data was found to be used in this study or not (Widodo et al., 2018). In this study, the data that has been found will then be evaluated using the question of the quality assessment criteria below:

- Was the research published from 2020 to 2023?
- Whether the research is written in Indonesian or English?
- Whether the research topic is GRAY LEVEL CO-OCCURENCE MATRIX on plant

If all the questions above are met, then the research can be continued in the literature review process.

Data Extraction

At this point, the data extracted from the reviewed journals is in what year the research was published, the data used in the reviewed research, and data collection techniques in the reviewed research, the method used in the GRAY LEVEL CO-OCCURENCE MATRIX process in the reviewed research. reviewed, and results on the study. the research reviewed. Then the researcher enters all the data into a spreadsheet document and the researcher will synthesize the data (*Peer Review Aplikasi Ekstraksi Fitur GLCM Deteksi Kerapatan Vegetasi.Pdf*, n.d.).

Data Synthesizing

At this stage, a total of 295 studies have been collected and selected based on titles and abstracts. From this process, 32 papers were produced. Furthermore, these 32 papers were selected using inclusion and exclusion criteria. From this process, 12 papers were obtained which were finally reviewed and analyzed. Data taken from main journals were analyzed and consolidated in Table 1.

Table 1. Papers were obtained which were finally reviewed and analyzed

Research	Language	Index	Year
(Tampinongkol, 2023)	Indonesia	sinta	2023
(Fikriah et al., 2022)	Indonesia	Sinta	2022

(Waail Al Wajieh & Luqman Al-Farisi, 2023)	Inggris	Internasional	2022
(Anggraini et al., 2020)	Inggris	sinta	2020
(Rizal et al., 2020)	Inggris	sinta	2020
(Sari & Sari, 2022)	Indonesia	Google scholar	2022
(Rosiva Srg et al., 2022)	Indonesia	sinta	2022
(Ilhamy & Sanjaya, n.d.)	Indonesia	Google scholar	2022
(Haris, 2020)	Indonesia	sinta	2020
(Ashraf & Khan, 2020)	Inggris	Internasional	2020
(Ahad et al., 2023)	Inggris	Internasional	2023
(Utaminingrum et al., 2022)	Inggris	Internasional	2021

Results and Discussions

The Data Collection Techniques

In conducting a study, researchers need data as research objects. The process of collecting and analyzing accurate data from multiple sources to find answers to research questions, trends, possibilities, etc., and to evaluate possible results is called data collection. During data collection, researchers must identify journal indexes, data sources, and methods used. It quickly became clear that there were many different ways to collect data. Previous researchers used a variety of different data collection techniques. indexed by Google sholar (Sari & Sari, 2022), (Ilhamy & Sanjaya, n.d.) . indexed Sinta (Tampinongkol, 2023), (Fikriah et al., 2022), (Anggraini et al., 2020), (Rizal et al., 2020), (Rosiva Srg et al., 2022), (Haris, 2020) and indexed Scopus in research (Waail Al Wajieh & Luqman Al-Farisi, 2023), (Ashraf & Khan, 2020),(Ahad et al., 2023), (Utaminingrum et al., 2022). The description of index data can be understood by looking at Figure 3.

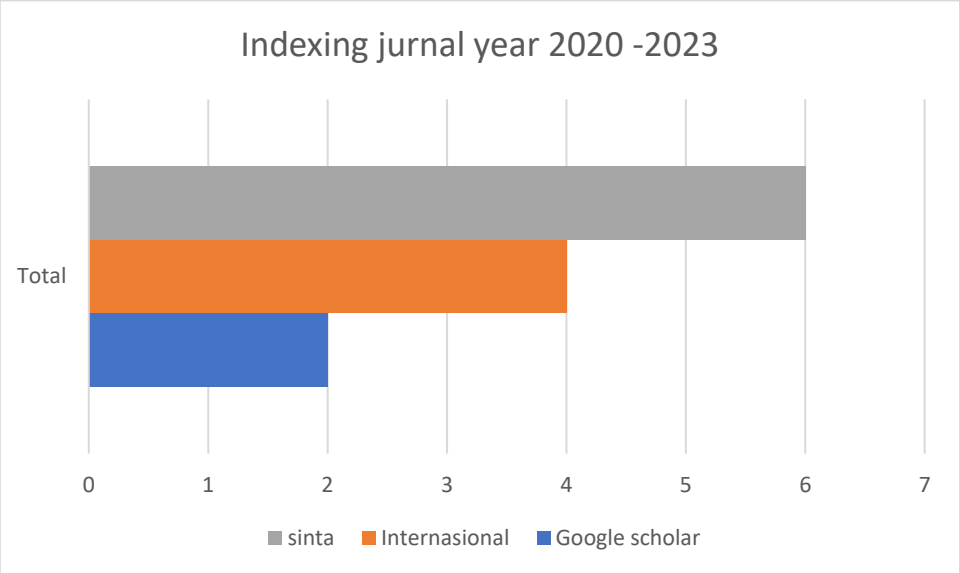

Fig. 3 The data Indexing jurnal

Table 2 Reviewed Paper (B)

Research	Metod	Result
(Tampinongkol, 2023)	GLCM and SVM	65%
(Fikriah et al., 2022)	GLCM, Naïve Bayes	84%
(Waail Al Wajieh & Luqman Al-Farisi, 2023)	GLCM,BPNN	70%

(Anggraini et al., 2020)	GLCM and K means clustering	83.33%
(Rizal et al., 2020)	GLCM	88%
(Sari & Sari, 2022)	GLCM, HSV, KNN	96%
(Rosiva Srg et al., 2022)	GLCM, KNN	90%
(Ilhamy & Sanjaya, n.d.)	GLCM and KNN	90%
(Haris, 2020)	GLCM, BPNN	93%
(Ashraf & Khan, 2020)	GLCM, SVM, Random Forest	86%
(Ahad et al., 2023)	GLCM,CNN and Seresnext101	98%
(Utaminingrum et al., 2022)	CLAHE,GLCM, BPNN	95%

The easiest and most commonly used in image analysis is the first order statistic computed from the histogram. Histogram features only reflect the distribution of gray levels. It does not reflect the object or pattern in the image and spatial interaction between pixels (Löfstedt et al., 2019). On the other hand, GLCM is a spatial dependence matrix where two pixels i (primary pixels) and j (neighboring pixel) have certain gray tones (Sharma & Verma, 2013).

Previous research has used different (Rizal et al., 2020) This method applies the approach of image processing and texture analysis to classify images. The training process involves building a pattern model, while the testing process involves pattern matching and results classification. Combinasion method used for classification is the K-NN method. (Sari & Sari, 2022),(Rosiva Srg et al., 2022), (Ilhamy & Sanjaya, n.d.) Testing image features that have gone through the pre-processing process, feature extraction will be compared with database images using the K-NN method based on Euclidean distance . The SVM model was analyzed using the RBF kernel function (radial basis function) with parameters γ = 100 and C = 1. (Tampinongkol, 2023) Based on the entropy and energy values obtained, the degree of similarity between the two classes of spot disease and blight has a fairly high degree of similarity. (Ashraf & Khan, 2020)_Random Forest has two hyper parameters, No. of features to consider at each split is normally set to n where n is No. of featuresin classification. (Fikriah et al., 2022) the Naïve Bayes classification method by adding Instance Randomize to that step to look for accuracy, the magnitude of the Mean Absolute Error, the Root Mean Squared Error, the relative Absolute Error as well as the confusion matrix. Classification is done by choosing a fold in Cross-Validation of 10. The Back-Propagation Neural Network (BPNN) technique to determine the accuracy value that will be used as a determinant of the categorization of the Longan leaf image. The eccentricity and metric parameters are key components of the method (Waail Al Wajieh & Luqman Al-Farisi, 2023), (Haris, 2020), (Utaminingrum et al., 2022),

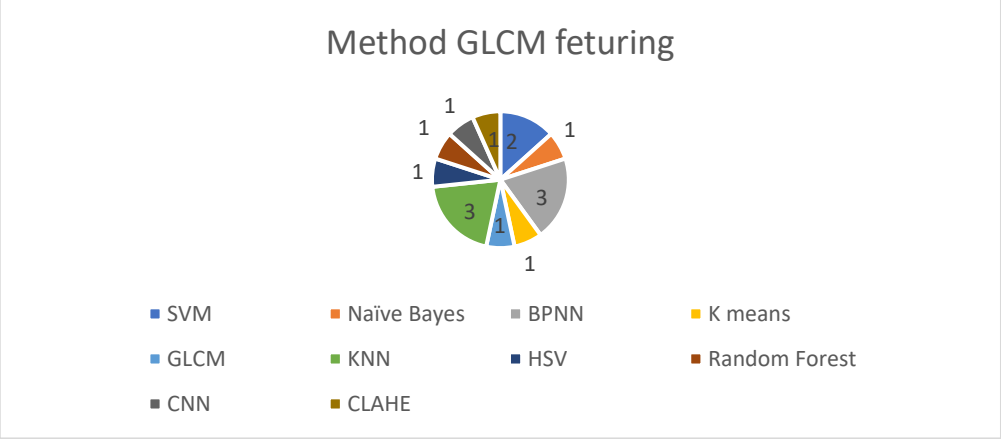

Fig. 4 The method GLCM Feturing

From the figure above it is explained that not only the GLCM method was used in previous research. 3 studies using the GLCM and KNN methods (Sari & Sari, 2022) (Rosiva Srg et al., 2022) (Ilhamy & Sanjaya, n.d.), 3 research using the GLCM and BPNN methods (Waail Al Wajieh & Luqman Al-Farisi, 2023) (Haris, 2020) (Utaminingrum et al., 2022), 2 research using the GLCM and SVM methods

(Tampinongkol, 2023) (Ashraf & Khan, 2020), then the GLCM and Naive Bayes Methods, CNN, K Means, HSV, Random Forest and Clahe 1 research.

The Result

In applying the texture feature extraction process using the GLCM matrix on images that have variations in object direction. From the experimental results, the angle of 0 degrees is the dominant feature for images with low varying textures, while angles of 45 and 90 degrees are the dominant feature for images with high varying textures(Veronica et al., 2019).

The results of the GLCM method research are below 70%, namely (Tampinongkol, 2023), (Waail Al Wajieh & Luqman Al-Farisi, 2023). In detail, research (Tampinongkol, 2023) obtained results of 65% and research (Waail Al Wajieh & Luqman Al-Farisi, 2023) obtained results of 70%. Research (Fikriah et al., 2022), (Anggraini et al., 2020), obtained results in the range of 81% -85%. Research (Fikriah et al., 2022) obtained a yield of 84%, research (Anggraini et al., 2020) obtained a yield of 83.33%. Research results with a range of 86% -90%, namely(Rizal et al., 2020), (Rosiva Srg et al., 2022), (Ilhamy & Sanjaya, n.d.), (Ashraf & Khan, 2020). Research (Rizal et al., 2020) obtained a yield of 88%. Research(Rosiva Srg et al., 2022), (Ilhamy & Sanjaya, n.d.) obtained 90% of the research they conducted, while (Ashraf & Khan, 2020) obtained results of 86%. For research with a range of 91% -95%, namely (Haris, 2020), (Utaminingrum et al., 2022). In detail, research (Haris, 2020) obtained a yield of 93%. Research (Utaminingrum et al., 2022) obtained a yield of 95%. The best results from the studies reviewed were (Sari & Sari, 2022), (Ahad et al., 2023) studies with close to 100% yields. It is stated in detail that research (Sari & Sari, 2022) obtained 96% results, research (Ahad et al., 2023) obtained 98% results close to perfect. The results are shown in Fig 5 .

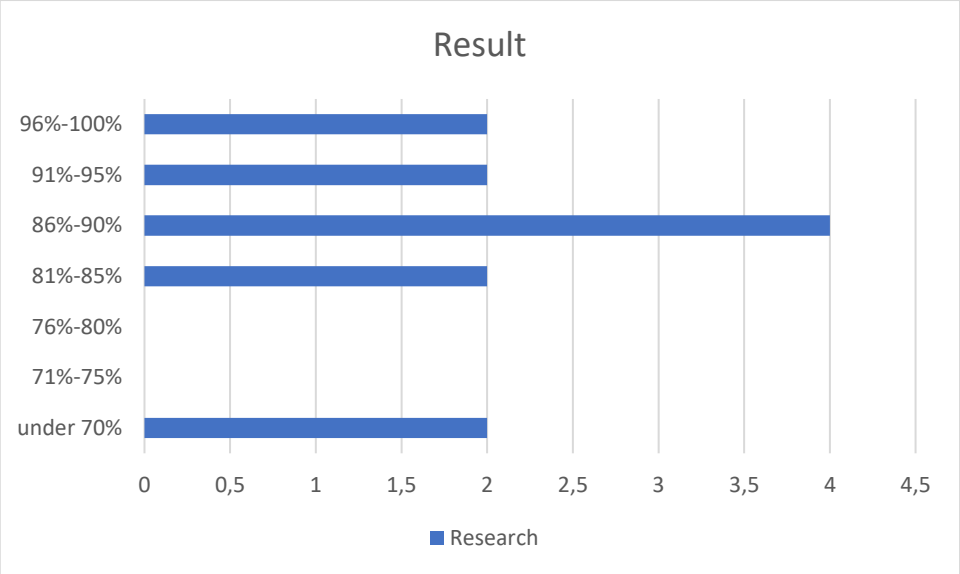

Fig. 5 The result

Conclusions

After reviewing the titles, abstracts, and content of studies found on ScienceDirect, Google Scholar, and Elsevier, 12 studies were selected for further consideration. The study was conducted on data collection techniques, methods, and results. The conclusion of this review is that the results of the GLCM method in plants without using other methods are not optimal at 88%. according to the results of the merger of GLCM, CNN and Seresnext101 the results are 98% close to perfect. Because this study did not examine the GLCM method in depth, further research is needed, particularly a review of the literature on "GLCM features in organs and animals" originating from more diverse sources. This study only obtained 12 research reports to be reviewed as works of literature review. Future research would be better off using more research reports to be examined in a more detailed and in-depth literature review.

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