



# Identification of Culinary Industry Cluster Development in Madura

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**Abstract.** This study aims to identify the potential of creative economy in Madura culinary industry subsector that can be developed as economic potential through cluster. This study uses analysis techniques are: PCA which is used to identify the characteristics of factors in each cluster classification and K-Mean is used to determine the distribution of culinary industry sub-sector business actors in Madura. The results of this study indicate that the Madura culinary industry sub-sector is divided into inactive cluster, active clusters and dynamic clusters. The problems that cause several industries are not included in the dynamic cluster are due to weak spatial identity, the absence of specialist suppliers, the absence of economic/industrial specialization, the absence of labor specialization, still using simple production technology and not being able to innovate products, and not having a network of business partners, resulting in minimal development of market information obtained. If these problems are not resolved, it can have an impact such as not be able to drive competitive advantages. Efficiency has not been created, high transaction costs and social costs. Therefore, the strategy needed to develop the culinary industry that is included in the inactive cluster and the active cluster towards a dynamic cluster can be done by: 1) Mapping the potential of local resources; 2) Building and Developing a network of specialist suppliers; 3) Development of economic/industrial specialization; 4) forming labor specialization; 5) Adoption and mastery of renewable technological developments in production activities and increasing business collaboration networks; 6) Expanding access to information exchange.

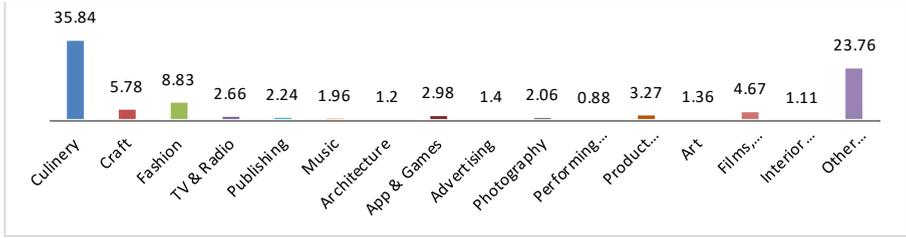
**Keywords:** Culinary Industry, Cluster, Madura.

## 1 Introduction

The important role of the creative economy can be shown by its contribution to the national economy. In 2015 the creative economy subsector contributed 852 trillion rupiah to the total national economy until 2019 the creative economy subsector contributed 1,153.4 trillion rupiah to the total national economy [1]. Based on data from the publication of creative economy statistics by Kementrian Pariwisata dan Ekonomi kreatif (2020), the development of the creative economy in East Java Province is dominated by the culinary industry subsector

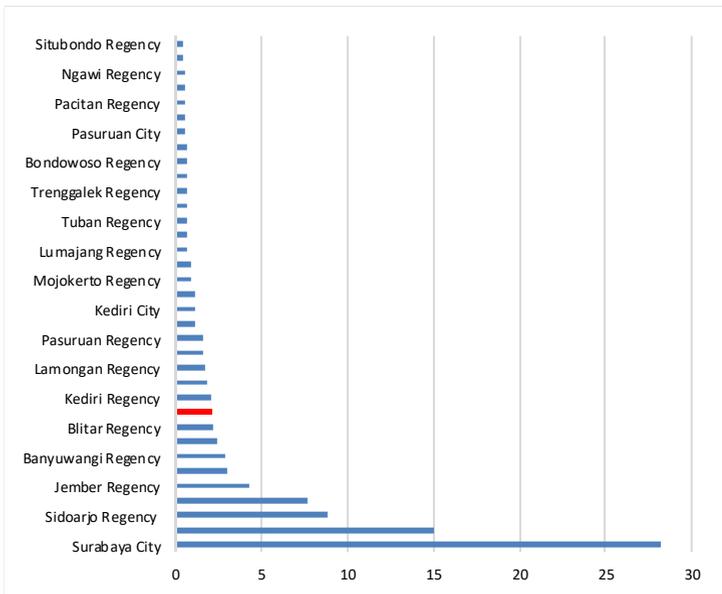
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**Fig. 1.** Percentage of Creative Economy for Each Subsector in East Java Province in 2019  
 Source: Kementrian Pariwisata dan Ekonomi kreatif (2020)

Madura is one of the regions that has creative economic potential in the culinary industry subsector that can be developed as an economic potential. Mainly because the contribution of the creative economy in Madura involves elements of socio-cultural diversity. The involvement of this local wisdom element greatly determines the direction of the development of the existing creative economy. The existence of elements of local wisdom is an alternative solution that can encourage the development of the creative economy to become more independent with its uniqueness or distinctiveness. Based on data from the publication of creative economy statistics by Kementrian Pariwisata dan Ekonomi kreatif (2020), Madura ranks 10th largest which contributes 2.10% of the total number of creative economy actors in East Java Province.



**Fig. 2.** Development of the Distribution of Regency / City Creative Economy Actors in East Java Province in 2019 (percent)  
 Source: Statistik Ekonomi Kreatif, 2020

The distribution of the creative economy is divided in each district in Madura whose distribution has been included in the spatial and regional planning documents in each district in Madura, namely in Bangkalan District Regional Regulation Number 10 of 2009 concerning Spatial and Regional Plans for 2009 - 2029; Pamekasan District Regional Regulation Number 16 of 2012 concerning Spatial and Regional Plans for 2012 - 2032; and Sumenep District Regional Regulation Number 12 of 2013 concerning Spatial and Regional Plans for 2013 - 2033. The spatial and regional planning documents regulate that the potential of the culinary industry subsector is spread across Bangkalan Regency, Pamekasan Regency and Sumenep Regency. The potential of the culinary subsector in Bangkalan Regency is located in Socah Village, Socah District and in Macajah Village, Tanjung Bumi District. In Pamekasan district, it is located in Soro' Papagan village, Pademawu sub-district and in Bandaran village, Tlanakan sub-district. In Sumenep district, it is located in Kertasada village and Kebun Kelapa village in Kalianget sub-district, Tanamerah village in Saronggi sub-district, and Rombasan village and Karduluk village in Pragaan sub-district. The development of the culinary creative industry subsector in Madura needs to increase its growth in order to increase people's income. The level of per capita income will certainly affect the poverty rate in Madura. The higher the per capita income, the more people's welfare increases and poverty will decrease [2]. From 2021 to 2023, the average per capita income of Madurese people is still below East Java Province even though from 2021 to 2023 it has an upward trend. Likewise, the poverty rate in Madura from 2021 to 2023 shows a downward trend, although the poverty rate in Madura is still higher than the average level of East Java Province.

**Table 1.** GDP per capita ADHB (Thousand Rupiah) and Percentage of Poor Population in Madura and East Java Province in 2019-2023

Region	GRDP Per Capita Based on Current Prices			Percentage of Poor Population		
	2021	2022	2023	2021	2022	2023
Bangkalan	23.147,7	25.134,3	25.408,1	21,57	19,44	19,35
Pamekasan	20.596,4	22.225,7	23.978,2	15,30	13,93	13,85
Sumenep	31.177,3	35.324,2	37.370,1	20,51	18,76	18,70
East Java Province	59.988,4	66.246,9	71.121,9	11,40	10,38	10,35

Source: *Badan Pusat Statistik (2023)*

A high rate of economic growth supported by the growth of the industrial sector will encourage increased demand for labor, which in turn will expand employment opportunities. The increase in new employment opportunities will boost the level of community income, so that people's purchasing power will increase. Furthermore, the expansion of employment opportunities means a reduction in unemployment and an increase in community income, which in turn is expected to improve welfare and reduce poverty levels [3]. Therefore, one way to develop the potential of the creative economy in Madura is to map and develop creative economy industry clusters [4]. Fadlan, Pane, &

Rangkuty (2024) also revealed that the existence of creative industries can help increase income for workers and help prosper in addition to reducing unemployment [5]. Based on Marshall's cluster theory, there are three types of external savings that arise in industrial clusters, namely 1) concentration of skilled workers, 2) proximity to specialist suppliers, and 3) available facilities obtaining information and knowledge. Large number of skilled workers will facilitate labor savings. The proximity of suppliers will generate savings due to specialization arising from the division of labor between firms in complementary activities and processes [6]. Other benefits of industrial clusters include 1) forming a spatial identity; 2) economic specialization; 3) supplier specialization; 4) easy access to information exchange; 5) formation of a specialist workforce, and 6) can increase industrial competition [7]. Previous researchers such as Ferdj & Djeflat (2024) in their research suggested that clusters are an important driver or tool for regional development to increase productivity and innovation and subsequently have a positive impact on the overall physical, social and cultural infrastructure [8]. In this study the author analyzes cluster development in the culinary industry subsector in accordance with the superior potential that exists in Madura. The author in this study uses PCA (*Principal Component Analysis*) and *K-Means Clustering* analysis which is used to analyze and identify culinary industry subsector groups based on indicators from cluster theory so that it is expected to provide deeper insight into the differences and similarities between culinary industries which can then be formed further development strategies related to culinary industry clusters in Madura. The author uses PCA (*Principal Component Analysis*) and *K-Means Clustering* analysis because previous researchers such as (Oliynyk, DKK, 2021) and Eminawati et al., (2020) used regression analysis which can only identify the influence between indicators of industrial cluster forming variables [9, 10]. The results of this study can be used as input to policy makers to pay more attention and increase the role of potential development and culinary industry clusters in Madura.

## 2 Literature Review

A cluster is a geographical concentration of interconnected companies and institutions in a particular sector [11]. Cluster development, as formulated by Bouchra & Hassan (2023), contains four determinants or known as the diamond model that leads to industrial competitiveness, namely: (1) input factors, (2) demand conditions, (3) supporting and related industries, and (4) firm and competitor strategies [11]. The following are the factors in Porter's diamond model:

1. Input Factors. Input factors in Porter's analysis are variables that already exist and are owned by an industrial cluster such as human resources, capital, physical infrastructure, information infrastructure, science and technology infrastructure, administrative infrastructure, and natural resources. The higher the quality of these input factors, the greater the opportunity for the industry to increase competitiveness and productivity.
2. Demand conditions. According to the diamond model, it is associated with sophisticated and demanding local customers. The more advanced a society is and the more demanding local customers are, the industry will always strive to improve

product quality or innovate to meet the high demands of local customers. However, with globalization, demand conditions not only come from local but also come from abroad.

3. Supporting and Related Industries. The existence of supporting and related industries will increase efficiency and synergy in the cluster. Synergy and efficiency can be created, especially in transaction costs, sharing technology, information and certain skills that can be utilized by other industries or companies. Another benefit of supporting and related industries is the creation of competitiveness and increased productivity.
4. Company and competitor strategies are also important because these conditions will motivate companies or industries to always improve the quality of products produced and always look for new innovations. With healthy competition, companies will always look for suitable new strategies and strive to always improve efficiency. From these determinants, according to Carey *et al.*, (2024) cluster grouping is divided into inactive clusters, active clusters and dynamic clusters [12].
  - a. Inactive clusters are characterized by undeveloped products (tending to maintain existing products), undeveloped technology (using existing technology, usually traditional, no investment equipment and machinery), local markets (fighting over existing markets, not motivated to expand markets, this encourages competition at the price level not quality) and dependence on intermediaries/traders, the level of skill of the actors is static (hereditary skills) and the level of trust between actors and between actors is low (low social capital), market information is very limited (only certain individuals or groups have access to direct buyers). In other words, inactive clusters show business groups that have no spatial identity, no specialist suppliers, no business specialization, no specialist workforce, low product competition and lack/limited access to information.
  - b. Active clusters are characterized by product development in accordance with market demand (quality), technology development for quality production in the market, development of joint activities for production and markets (e.g. joint purchase of raw materials, joint marketing offices and so on). In other words, the active cluster shows business groups that do not have spatial identity, no business specialization, low product competition and limited access to information.
  - c. Dynamic clusters are characterized by the formation of specialization among companies from the cluster, the cluster is able to create new products needed by the market/consumers, technology develops in accordance with the innovation of the products produced, the development of partnerships with related industries both in product development, technology development as part of related industries, the development of cluster institutions and the development of market information. In other words, this dynamic cluster shows business groups that have spatial identity, have specialist suppliers, have economic specialization, have a specialist workforce, have competitive competitiveness and have access to information exchange.

Based on this, this study uses the framework that has been put forward by Porter (1998) which is adopted into the cluster division [12]. Some previous researchers have revealed the results that cluster support based on its maturity level in the Eskisehir-Bilecik-Kutahya region showed significant differences in the effectiveness of various cluster strategies. Focusing on variables on the labor market with raw material costs

has varying impacts depending on the type of cluster [13]. The importance of clusters in enhancing competitiveness and economic growth. Although there is successful cluster research and policies around the world, a comparison of clusters with territorial-production complexes highlights differences in their formation, objectives, and socio-economic effects [14]. Clustering also contributes to technological innovation and supply chain efficiency [15].

The author in this study uses PCA (*Principal Component Analysis*) and *K-Means Clustering* analysis which is used to analyze and identify culinary industry subsector groups based on indicators from cluster theory so that it is expected to provide deeper insight into the differences and similarities between culinary industries which can then be formed further development strategies related to culinary industry clusters in Madura. The author uses PCA (*Principal Component Analysis*) and *K-Means Clustering* analysis because previous researchers such as Oliinyk, DKK (2021) and Eminawati et al., (2020) used regression analysis which can only identify the influence between indicators of industrial cluster forming variables [9, 10]. While the K-means method in previous studies was used to group agricultural companies based on the innovation barriers they face. K-modes was chosen because it is more suitable for handling categorical data compared to K-means. This study closes the knowledge gap by providing deeper insights into the profile of innovation barriers in the agricultural sector and how these barriers can be grouped to support more effective innovation policies [15].

### 3 Methodology

This research was conducted through a questionnaire with the target respondents of the culinary industry business actors. The technique used in this research is a non-probability sampling technique, namely snowball sampling [17]. Snowball sampling is a sampling technique that is initially small in number, then gets bigger. Researchers chose snowball sampling because in determining the sample, the researcher first only determines one or two people, but because the data obtained is deemed insufficient or incomplete, the researcher looks for other people to complete data. Snowball sampling is used for sampling creative industries in predetermined business fields [18]. If referring to the number of samples according to Kerlinger & Lee (2000) the minimum number of research samples is 30 [19]. The number of respondents in this study amounted to 39. The analysis used in this study is PCA (Principal Component Analysis) and K-Means Clustering.

PCA (Principal Component Analysis) which is used to identify the characteristics of factors in each cluster classification. Principal Component Analysis is a statistical technique for transforming most of the original variables used that are correlated with each other into a new set of smaller, independent variables (no longer correlated). Introduced by Beattie & Esmonde-White, (2021) it describes the variation of multivariate data for a set of uncorrelated variables [20]. Principal component analysis is useful for reducing data, making it easier to interpret the data. The steps taken to determine the main component are as follows:

- a. Standardize the data to have an equal value scale using Z-score.
- b. Calculate the covariance matrix to determine the correlation of each variable
- c. Calculate the eigenvalue using the equation

$$|\lambda I - R| = 0 \quad (1)$$

and eigenvector with the formula

$$(R^T v = \lambda^T v) \quad (2)$$

- d. Determine the number of principal components that may be formed by considering eigenvalues greater than or equal to 1
- e. Calculate transformation datasetnew results reduction with PCA with Equation:

$$PC_{at} = \vec{v}_{1a}z_1 + \vec{v}_{2a}z_2 + \dots + \vec{v}_{ap}z_p \quad (3)$$

- f. Form a correlation matrix component that shows the magnitude of the variable correlation to the component score formed with the equation:

$$rx_p, PC_t = \vec{v}_{1a}\sqrt{\lambda_t} \quad (4)$$

Before clustering, assumptions need to be met first so that the resulting cluster is representative. According to Santoso (2017)[21], the assumptions in cluster analysis are:

- a. Kaiser-Mayer-Olkin (KMO) is an index used to measure overall sampling adequacy and measure sampling adequacy.
- b. Measure of Sampling (MSA) is an assessment of the eligibility of each variable for principal component analysis using the MSA criteria. Variables that have a small sampling adequacy measure (<0.5)
- c. Interpretation of the factors formed

After using a PCA analysis, the researcher then used a K-Mean analysis to determine the distribution of business actors in the culinary industry sub-sector in Madura. K-means clustering is a clustering technique that seeks to partition the N individuals in a multivariate dataset into groups (k groups). The most common approach in implementing K-Means is to partition the N individuals into k groups that minimize the within-group sum of square of all variables. The goal of cluster analysis is to group observational data into groups until the group members within are homogeneous, while between groups are heterogeneous. The process in K-Means clustering is as follows:

- a. Determine the amount of k, k= number of clusters
- b. Randomly initiate a number of k centroid values.
- c. Calculate the distance of each data to each cluster centroid using euclidean distance. The euclidean distance between objects i and j is formulated with:

$$d(x, y) = \sqrt{\sum_{k=1}^n (x_{ik} - x_{jk})^2} \quad (5)$$

- d. Clustering data based on the closest distance between each data to the centroid
- e. Determine the new centroid by calculating the average of all data at the same cluster center

$$C_{kj} = \frac{x_1 + x_2 + \dots + x_{aj}}{a}, j = 1, 2, 3, \dots, p \tag{6}$$

- f. Repeat step c and continue iterating until the cluster centroid is fixed and the cluster members do not move (converge).

## 4 Discussion

The type of data used in this study is primary data in the form of cross section data with samples or objects, namely districts / cities in the Madura Region. The sample of respondents of the culinary industry business actors was 39.

**Table 2.** Description of PCA analysis results of the culinary industry.

Variable	Mean	Std. Deviation	Analysis N
Spatial Identity	2.72	1.050	39
Specialist Supplier	3.28	.456	39
Specialization in Economics	2.64	.873	39
Specialist Labor	2.90	1.314	39
Competition	1.28	.510	39
Information Exchange Access	3.26	.595	39

Source: Data Processed (2024)

The number of observations of culinary subsector business actors in Madura as many as 39 respondents consists of culinary business actors in Socah District, TanjungBumi District, Pademawu District, Tlanakan District, Kalianget District, Saronggi District and Pragaan District.

### 4.1 Assumption Test

KMO is a method used to test the adequacy of data, while the MSA criteria is used to test the eligibility of each variable. The KMO test is an index of distance comparison between the correlation coefficient value and the partial correlation, with the initial estimation that the number of samples does not meet the criteria for further analysis.

**Table 3.** KMO and MSA Test Results Culinary Industry

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.533
Bartlett's Test of Sphericity	Approx. Chi-Square	32.488
	df	15
	Sig.	.006

Source: Data Processed (2024)

The test to determine whether the data is suitable for PCA analysis is to use the *Kaiser-Meyer Olkin (KMO) test* tool and *Bartlett's test of sphericity and anti-image*.

According to Nurhartonosuro, (2023) & Santoso (2017)[22], at this stage, the hypothesis used is:

H0 = sample (factor) is not sufficient for further analysis

H1 = sample (factor) is sufficient for further analysis

Criteria for acceptance or rejection of H0, based on the likelihood / significance value (sig.) ie:

Probability Value (Sig.) > 0.05 then H0 is accepted.

Probability Value (Sig.) < 0.05 then H0 is rejected.

The MSA numberranges from 0 to 1, with the following criteria:

- MSA= 1 then the factor can be correctly estimated by other factors
- MSA> 0.5 then the factor can be estimated and can be analyzed further
- MSA< 0.5 then the factor cannot be estimated and cannot be analyzed further, or excluded from other factors

Based on the results of this study for the culinary industry, the *KMO and Bartlett's test* value is 0.648 with a significance value of 0.000. Because the MSA value is > 0.5 and the significance is <0.05, this indicates that the sample and supporting factors above can be analyzed using factor analysis (H0 is rejected).

#### 4.2 PCA Analysis Results

To identify the factors included in each component, the *output* was used from the *factoring* process in the form of a *component matrix*.

**Table 4.** Component matrix of culinary industry.

	Component Matrix		
	1	2	3
Spatial Identity	-0.332	-0.092	.842
Specialist Supplier	-0.531	.378	.481
Specialization in Economics	-0.849	-0.131	.167
Specialist Labor	-0.456	.264	.760
Competition	-0.754	-0.322	.438
Information Exchange Access	-0.474	-0.020	.161

Extraction Method: Principal Component Analysis.

In table 4, it can be seen that the members of each component are determined by the *factor loading* value. each factor that describes the correlation value between one factor and the three new components formed.

*Component 1 (Principal Component 1)* consists of spatial identity, specialist suppliers, economic specialization, specialist labor, competition and access to information exchange with low values. Henceforth this component 1 is called the inhibiting factor that makes the culinary industry subsector in Madura become undeveloped/inactive.

*Component 2 (Principal Component 2)* consists of specialist suppliers and specialist labor whose values are already high compared to component 1, however the value of

spatial identity, economic specialization, competition, access to information exchange is still low/negative. Henceforth, component 2 is called the inhibiting and supporting factors that make the culinary industry subsector in Madura active.

Component 3 (Principal Component 3) consists of spatial identity, specialist suppliers, economic specialization, specialist labor, competition and access to information exchange with high scores. Henceforth this component 3 is called the supporting factors that make the culinary industry subsector in Madura become developed/dynamic.

The magnitude of the influence of the three components above on the development of the culinary industry subsector in Madura can be determined by calculating the total variance explained. The calculation of total variance explained consists of two parts, namely initial eigenvalues and extraction sums of squared loadings. Analysis of initial eigenvalues and extraction sums of squared loadings is used to determine the magnitude of the influence of each principal component on the development of the culinary industry subsector in Madura. In addition, it is used also to determine the magnitude of the cumulative influence of all principal components on the development of the culinary industry subsector in Madura.

**Table 5.** Total Variance explained of culinary industry subsector.

Component	InTotal Variance Explained						
	Initial Eigenvalues			Extraction Sums of Squared Loadings			
	Total	%of Variance	Cumulative %	Total	% Variance	of	Cumulative %
1	1.649	27.483	27.483	1.649	27.483		27.483
2	1.403	23.391	50.874	1.403	23.391		50.874
3	1.166	19.438	70.312	1.166	19.438		70.312
4	.947	15.782	86.094				
5	.554	9.232	95.326				
6	.280	4.674	100.000				

Extraction Method: Principal Component Analysis.

Source: Data Processed (2024)

In table 5 is the value of the initial eigenvalues and extraction sums of squared loadings of factors affecting the development of the culinary industry subsector in Madura. Furthermore, the analysis of these values is carried out. Based on the initial eigenvalues and extraction sums of squared loadings contained in the table above, it can be seen that the first principal component has an influence of 27.48%, the second principal component has an influence of 23.39%, the third principal component has an influence of 19.43%. Thus, it can be said that based on the cumulative percent of variance value, the three components provide an influence of 70.31% as a factor in the development of the culinary industry subsector in Madura, while 29.69% is influenced by other factors.

### 4.3 K-Means Culster Analysis Results

**Table 6.** Final output of culinary industry cluster centers.

Final Cluster Centers	Cluster		
	1	2	3
Zscore: Spatial Identity	-0.53722	-0.22099	0.42734
Zscore: Specialist Supplier	-0.25310	0.03937	0.05625
Zscore: Economic Specialization	-0.73411	-0.02936	0.46836
Zscore: Specialist Labor	-1.19053	0.74164	0.83922
Zscore: Competition	-0.55266	-0.16077	1.73334
Zscore: Information Exchange Access	-0.17895	-0.15093	0.34497

Source: Data Processed (2024)

The cluster center value is the end of the *clustering* process. The cluster center value is still related to the standarization shown by the value on the z-score with the conditions:

- Positive Z-score (+)= data above the overall average
- Negative Z-score (-)= data below the overall average

The final results of the cluster analysis with K-Means Cluster are interpreted as follows:

1. Cluster 1 contains the average value of the culinary subsector creative economy cluster indicators, namely Spatial Identity (- 0.53722), Specialist Suppliers (-0.25310), Economic Specialization (-0.73411), Specialist Labor (-1.19053), Competition -0.55266), and Access to Information Exchange (-0.17895). All average values of creative economy cluster indicators are *negative*, which means they are below the overall average value. It can be concluded that Cluster 1 contains *inactive* clusters.
2. Cluster 2 contains the average value of the culinary subsector creative economy cluster indicators, namely Spatial Identity (- 0.22099), Specialist Suppliers (0.03937), Economic Specialization (-0.02936), Specialist Labor 0.74164), Competition (-0.16077) and Access to Information Exchange (-0.15093). The average value of the specialist supplier and specialist labor indicators is positive, which means it is above the overall average, while the other indicators are negative, which means they are below the average value. It can be concluded that cluster 2 contains active clusters.
3. Cluster 3 contains the average culinary subsector creative economy cluster indicators, namely Spatial Identity (0.42734), Specialist Suppliers (0.05625), Economic Specialization (0.46836), Specialist Labor (0.83922), Competition (1.73334) and

Access to Information Exchange (0.34497). seen from the average value of all cluster indicators is positive which means it is above the average value. It can be concluded that cluster 3 contains Dynamic clusters.

**Table 7.** ANOVA output of culinary industry.

	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df		
Zscore: Spatial Identity	2.912	2	.894	36	3.258	.050
Zscore: Specialist Supplier	.228	2	1.043	36	2.112	.041
Zscore:Economic Specialization	5.699	2	.739	36	7.713	.027
Zscore:Specialist Labor	14.870	2	.229	36	64.813	.000
Zscore: Competition	11.257	2	.430	36	26.170	.000
Zscore: Exchange Access	1.162	2	.991	36	1.173	.321

Source: Data Processed (2024)

In table 7, it is known that the test results with ANOVA obtained a result that access to information exchange shows a significant difference between culinary industries. This is evidenced by the probability value of the F statistic which is less than the 5% significance level.

**Table 8.** Output number of cases in each culinary industry cluster.

Number of Cases in each Klaster		
Cluster	1	24.000
	2	8.000
	3	7.000
Valid		39.000
Missing		.000

Source: Data Processed (2024)

From the information above, the number of members of each cluster is obtained. Cluster 1 consists of 24 culinary industries, cluster 2 consists of 8 culinary industries, and cluster 3 consists of 7 culinary industries.

**Table 9.** Culinary industry cluster composition.

Case Number	Region	Qcl_1	Qcl_2
1	Socah Subdistrict Socah	1	1.71264
2	Socah Subdistrict Socah	1	2.93816
3	Socah Subdistrict Socah	1	2.03465
4	Socah Subdistrict Socah	1	2.83309
5	Socah Subdistrict Socah	1	2.03465
6	Socah Subdistrict Socah	1	2.18281
7	Socah Subdistrict Socah	1	.99565
8	Socah Subdistrict Socah	1	.99565

**Table 9 (Continued).** Culinary industry cluster composition.

Case Number	Region	Qcl_1	Qcl_2
9	Socah Subdistrict Socah	1	2.18227
10	Macajah Subdistrict Tanjungbumi	2	2.57202
11	Macajah Subdistrict Tanjungbumi	2	1.66108
12	Macajah Subdistrict Tanjungbumi	2	2.14705
13	Soro' Papagan Subdistrict Pandemawu	1	1.35505
14	Soro' Papagan Subdistrict Pandemawu	1	2.15226
15	Soro' Papagan Subdistrict Pandemawu	1	1.62863
16	Soro' Papagan Subdistrict Pandemawu	1	2.29841
17	Soro' Papagan Subdistrict Pandemawu	1	1.62863
18	Bandaran Subdistrict Tlanakan	2	.80982
19	Bandaran Subdistrict Tlanakan	2	1.60639
20	Bandaran Subdistrict Tlanakan	2	1.72030
21	Bandaran Subdistrict Tlanakan	2	.80982
22	Bandaran Subdistrict Tlanakan	2	1.62345
23	Kertasada Subdistrict Kalianget	3	2.24072
24	Kertasada Subdistrict Kalianget	3	1.57687
25	Kertasada Subdistrict Kalianget	3	2.09051
26	Kertasada Subdistrict Kalianget	1	1.30798
27	Kebun Kelapa Subdistrict Kalianget	1	2.94916
28	Kebun Kelapa Subdistrict Kalianget	1	2.01288
29	Marengan Laok Subdistrict Kalianget	1	1.48359
30	Marengan Laok Subdistrict Kalianget	1	1.44861
31	Tanamerah Subdistrict Saronggi	3	2.45786
31	Tanamerah Subdistrict Saronggi	3	2.25298
32	Tanamerah Subdistrict Saronggi	3	2.20464
33	Rombasan Subdistrict Saronggi	1	1.57687
34	Rombasan Subdistrict Saronggi	1	1.57687
36	Karduluk Subdistrict Pragaan	1	2.00578
37	Karduluk Subdistrict Pragaan	1	2.49417
38	Karduluk Subdistrict Pragaan	1	2.64586
39	Karduluk Subdistrict Pragaan	1	2.64586

Source: Data Processed (2024)

Judging from the Table 9, the cluster column shows the cluster number of villages and sub-districts in the distribution of the culinary industry, the distance to the cluster center column shows the distance between the data and the cluster center. The smaller the distance, the more similar the cluster are:

• Cluster 1 shows the inactive industry cluster. From the research results, it was found that the culinary industry included in the inactive cluster are Socah Village; Soro' Papagan Village; Kebun Kelapa Village; Marengan Laok Village; Rombasan Village; and Karduluk Village. These villages are included in the inactive industry cluster because:

1. It has no spatial identity  
The absence of characteristics that signify spatial identity in the industry so that it cannot make the industry develop. According to the determination of business location can affect the success of the business [23].
2. Does not have specialist suppliers  
The craft industry in Kalianget Timur Village still does not have a specialist supplier. All raw materials used in the production process are obtained from their own search in the nearest market.
3. Absence of economic specialization (Industry).  
The culinary industry in the village does not yet have a business partner in developing its production process. All product processing processes such as raw material preparation, processing, packaging to marketing are only carried out by workers in each industry so that this affects the achievement of the product output produced and the level of labor productivity used. The level of labor productivity is said to work effectively if it has a productivity level (LUR) exceeding 50% [24]. The level of labor productivity in the culinary industry in the village shows a productivity level value below 50%, which means it is low.

**Table 10.** Labor productivity level in cluster 1 of the culinary industry subsector.

Region	Average Workforce/Industry (Person)	Production Capacity Per Day (pcs)	Labor Productivity Level
Socah Subdistrict Socah	1	.50	50,00
Soro' Papagan Subdistrict Pandemawu	2	.63	31,67
Kebun Kelapa Subdistrict Kalianget	3	1.33	44,44
Marengan Laok Subdistrict Kalianget	2	1.00	50,00
Rombasan Subdistrict Pragaan	2	.83	41,67
Karduluk Subdistrict Pragaan	2	.73	36,67

Source: Data Processed (2024)

4. Absence of specialized labor  
The low level of labor productivity in the craft industry in Socah Village; Soro' Papagan Village; Kebun Kelapa Village; Marengan Laok Village; Rombasan Village; Karduluk Village indicates that a specialist workforce has not been formed. The level of labour productivity in the craft industry is low due to the absence of

a clear division of work specialization based on production process activities that are intertwined between other similar business partners. Level of labor productivity affects the development of a business [25].

5. Lack of Competitiveness in Business Competition

Factors that can affect the high or low competitiveness of a product are the use of production technology and product innovation of a business [26]. The culinary industry in these villages is still weak in mastering production technology. The production technology used is relatively simple compared to other culinary industries. Whereas the use and mastery of renewable technology can improve the quality and efficiency of production so that it can compete in the market [26]. Addition, the majority of culinary industries in these villages have never made changes to product innovation

6. No access to information exchange.

The lack of optimization of a business product in reaching consumers may be due to the weakness or lack of optimization of the business network that supports these business activities. Business networks involve other business units in business activities carried out by producers both in production and marketing of products. Manufacturers use intermediaries because they create greater efficiency in providing goods to target market [28]. Based on the field results, the culinary industry in these villages has not collaborated with other similar industry networks both in terms of information exchange related to market change trends and related to product marketing development.

- Cluster 2 shows the active industry cluster. Based on the research results, it was found that the culinary industry included in the active cluster is Macajah Village in Tanjung Bumi Sub-district and Bandaran Village in Tlanakan Sub-district. The village is included in the active industry cluster because:

1. There are no characteristics that indicate the spatial identity of the industry so that it cannot make the industry develop. According to the determination of business location can affect the success of the business [29].
2. Low economic (industrial) specialization.
3. The culinary industry in Macajah Village and Bandaran Village does not yet have a business partner in developing its production process. All work processes from making designs, production processes, finishing to sales are carried out by workers in each industry so that this affects the achievement of the product output produced and the level of productivity used. The level of labor productivity is said to work effectively if it has a productivity level (LUR) exceeding 50% [24]. The level of labor productivity in the craft industry in Macajah Village and Bandaran Village shows a value below 50%, so it can be said that the level of labor productivity is low.

**Table 11.** Labor productivity level in cluster 2 of the culinary industry subsector.

Region	Average Work-force/Industry (Person)	Production Capacity Per Day (pcs)	Labor Productivity Level
Macajah Subdistrict Tanjung Bumi	4	1.67	41,67
Soro' Papagan Subdistrict Pandemawu	3	1.43	47,78

Source: Data Processed (2024)

4. Low Competitiveness of Business Competition.

Factors that can affect the high or low competitiveness of a product are the use of production technology and product innovation of a business [25]. The culinary industry in these villages is still weak in mastering production technology. The production technology used is relatively simple compared to other similar culinary industries. Whereas the use and mastery of renewable technology can improve the quality and efficiency of production so that it can compete in the market [30]. There are 62,5% of craft industries in Macajah Village and Bandaran Village that still use simple production technology. Addition, the majority of culinary industries in the village have never made changes to product innovation.

5. No access to information exchange.

The lack of optimization of a business product in reaching consumers may be due to the weakness or lack of optimization of the business network that supports these business activities. Business networks involve other business units in business activities carried out by producers both in production and marketing of products. Manufacturers use intermediaries because they create greater efficiency in providing goods to target markets [31]. Based on the field results, the culinary industry in these villages has not collaborated with other similar industry networks both in terms of information exchange related to market change trends and related to product marketing development.

- Cluster 3 shows the dynamic industry cluster. From the research results, it was found that the culinary industry is included in the dynamic cluster, namely Kertasada Village and Tanamerah Village. The village is included in the dynamic industry cluster because:

1. There are distinctive features that signify spatial identity

Kertasada village is known as the center of amplang crackers. And Tanamerah Village is known as the center of cassava chips. According to the determination of business location can affect the success of the business [29].

2. Have specialist suppliers

Supplier selection is one of the important decisions because it will affect the smooth running of production, where suppliers are the ones who supply raw materials to the company. If the supplier has poor performance in responding to the fulfillment of raw material requests, it will cause problems that can harm the company. Companies must choose the best suppliers because relationships with suppliers can be short-term or long-term cooperation partners. Improper supplier selection will result in company sales because it is related to production activities

and also products that will be marketed. By choosing the best supplier, the raw materials obtained will be of high quality so that product quality can be maintained [32]. Based on field results, the culinary industry in Kertasada Village, Kalianget Subdistrict and Tanamerah Village, Saronggi Subdistrict takes the main raw materials from Madura. The culinary industry in both villages has cooperation with specialized suppliers who guarantee the quality and continuity of their raw materials.

3. Economic specialization (industry)

Industrial specialization is very important for the division of production activities between entrepreneurs so that production becomes more effective and efficient [33]. All culinary production work processes in the village are carried out between similar industry partners who are also in the village area so that this affects the achievement of the product output produced and the level of productivity used. The level of labor productivity is said to work effectively if it has a productivity level (LUR) exceeding 50% [23]. The level of labor productivity in the culinary industry in the village shows a value above 50% so that it can be said that the level of labor productivity is high.

**Table 12.** Labor productivity level in cluster 3 of the culinary industry subsector.

Region	Average Workforce/Industry (Person)	Production Capacity Per Day (pcs)	Labor Productivity Level
Kertasada Subdistrict Kalianget	4	4.17	104,17
Tanamerah Subdistrict Saronggi	3	4.57	152,22

Source: Data Processed (2024)

4. Presence of specialized labor.

The high level of labor productivity in the culinary industry in Kertasada Village and Tanamerah Village indicates the formation of a specialist workforce. The level of labor productivity in the culinary industry is high because there has been a clear division of work specialization based on production process activities that are intertwined with other similar business partners. The level of labor productivity affects the development of a business.

5. Have competitive business competitiveness.

The culinary industry in these two villages has a strong competitive advantage in the market. This advantage is supported by several important factors such as the culinary industry having strong product differentiation through the development of distinctive flavours and packaging, thus being able to uniquely position their products in the market. The competitive advantage is also supported by their ability to maintain consistent product quality, which is made possible by the standardization of production processes and the use of quality raw materials supplied by specialist suppliers.

6. Have access to business information exchange  
Business owners in both villages are active in seeking market information and collaborating with various parties to develop their businesses. In terms of access to information and business development, businesses in this cluster show proactive characteristics. 71% of business owners conduct independent research to understand market trends, 14,5% collaborate with other business owners and only 14,15% are not active in seeking information. This shows the high awareness of business actors on the importance of understanding the market for business development.

#### 4.4 Culinary Industry Cluster Development Strategy

Based on the results of this study, the development strategy to be able to increase the level of the culinary industry cluster in Madura from cluster 1 (inactive industry cluster) and from cluster 2 (active industry cluster) to cluster 3 (dynamic cluster) is:

1. Mapping the potential of local resources. Cultural characteristics will create uniqueness that can represent the identity of a region.  
Mapping spatial information systems (location) can assist in policy making for the advancement of the creative economy [34]. To create a spatial identity, it is necessary to know the characteristics or uniqueness of an area. Distinctive features indicate the existence of a spatial identity in the industry so that it can make the industry develop. According to [26], determining the location of a business can affect the success of the business. The uniqueness and characteristics will reflect the characteristics of the uniqueness of a region that can be used as a branding strategy in creative economic development. The government has a strategic role in determining and managing the spatial identity of a cluster. The government can develop a branding strategy to create a strong image that is easily recognized by the wider community.
2. Development of economic/industrial specialization  
To be able to meet market demand, industries should collaborate with other businesses that specialize in certain areas. When a production process is specialized, it means that it has reached a certain level of efficiency and expertise that focuses on manufacturing a particular product or providing a particular service in a more standardized, structured and quality-focused manner. Collaboration with other business partners will be more effective than individualized industries. Industry specialization is very important for the division of production activities between entrepreneurs so that production becomes more effective and efficient [26].
3. Adopting and mastering renewable technological developments in production activities and enhancing business collaboration networks  
In order to improve the quality and capacity of the products produced, it is necessary to adopt and master the technology used. In addition, it is also necessary to collaborate both among similar industries and collaboration with the private sector and government to be able to create innovation. Product innovation in a business is important in order to improve the performance and sustainability of the industry [34]. As a driver of economic policy, the government can have introduced various programs and regulations to encourage the development and

application of new technologies in the industry.

4. Expand access to information exchange.

Basically, the success of a product in reaching consumers depends on the business network. A strong network is a determining factor in the marketing reach of a product. The way to improve access to information exchange is by developing relationships or collaboration between similar business actors in a cluster or from other clusters. Participating in forums and organizations to learn about market trends and product marketing development is important to improve access to information exchange.

## 5 Conclusion and Recommendation

The results of this study indicate that the culinary industry in Madura is classified into three types of clusters, namely inactive clusters, active clusters and dynamic clusters. The problems that result in some culinary industries in Madura entering into active clusters are due to weak spatial identity, lack of economic/industrial specialization, still using simple production technology and unable to innovate products, and not having a network of business partners resulting in minimal development of market information obtained. Therefore, the strategy needed to develop the culinary industry that is included in the active cluster towards a dynamic cluster by: 1) Mapping the potential of local resources; 2) Development of economic/industrial specialization; 3) Adoption and mastery of renewable technological developments in production activities and increasing business collaboration networks; 4) Expanding access to information exchange.

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