



Follow-up on fertilizer distribution to rice farming groups using the k-means algorithm classification approach

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ABSTRACT

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The distribution of fertilizers regulated in the Definitive Plan for Farmer Group Needs (RDKK) can be obtained by farmers through retail, which is specifically aimed at direct distributors, and the policies are regulated by the local regional government. The aim of this research is to develop a recommendation system that can assist the Pasuruan City Agriculture Service in making decisions regarding fertilizer distribution. In this research, an analysis and application of the K-Means classification method were carried out as a recommendation system for follow-up distribution of subsidized fertilizer. The K-Means method is used to group farmer groups based on several criteria, such as land area, amount of fertilizer received, and harvest yields. In this way, it is hoped that this method can provide more accurate recommendations for distributing subsidized fertilizer to rice farmer groups that need it. The research results show that the recommendation system developed can provide precise and accurate recommendations regarding the distribution of fertilizer to farmer groups. It is hoped that this system can help farmers increase their productivity and welfare.

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1. INTRODUCTION

The agricultural sector is one sector that has a strategic role in supporting the Indonesian economy (Budi Setiawan & Dian Wisika Prajanti, 2016).

An unfair and equitable distribution of wealth will make rich people richer and poor people poorer. Farmer groups are community organizations established to increase agricultural production. With the existence of farmer groups, the problems faced will be easier to solve. (Soekarwati, 1995)

This subsidized fertilizer is provided by the government as a producer, which is then distributed to distributors and then distributed back to official kiosks, which can only sell retail to farmer groups, but the journey to get subsidized fertilizer into the hands

of the people and communities is very complicated. Determining recipients of subsidized fertilizer often causes problems. Subsidized fertilizer assistance is urgently needed. Based on the evaluation of the implementation of this aid program, there is still distribution that is not on target. There are several previous studies, and one of them is to determine the effectiveness of equal distribution of fertilizer based on land area for rice farmers, while this research tries to assess the achievements, ratings, and classification of farmer groups to become a recommendation system for follow-up fertilizer distribution to rice farmer groups, which is the main priority. to get subsidized fertilizer assistance based on several criteria such as land area, amount of fertilizer received, and harvest results from the results of the analysis that has been carried out. The value of each of these criteria becomes a benchmark in selecting farmer groups that are the main priority recipients of subsidized fertilizer assistance. In this research, the farmer groups that are entitled to receive subsidized fertilizer assistance are those that have the largest cluster value and a land area of less than 2 hectares.

2. RESEARCH METHOD

According to the book (Hartono, 1989), system analysis is the decomposition of a complete information system into its component parts with the aim of identifying and evaluating problems, opportunities, obstacles that occur, and needs that arise. It is hoped that improvements can be proposed.

According to John Bruch and Gary Grudnitski (Hartono, 1989), system design can be defined as the depiction, planning, sketching, or arrangement of several separate elements into one complete and functioning unit.

To obtain the right method for research, it depends on the aims and objectives of the research. This stage involves designing the system in detail based on the results of the analysis of the existing system, resulting in a proposed new model, accompanied by a database design and program specifications shown in Figure

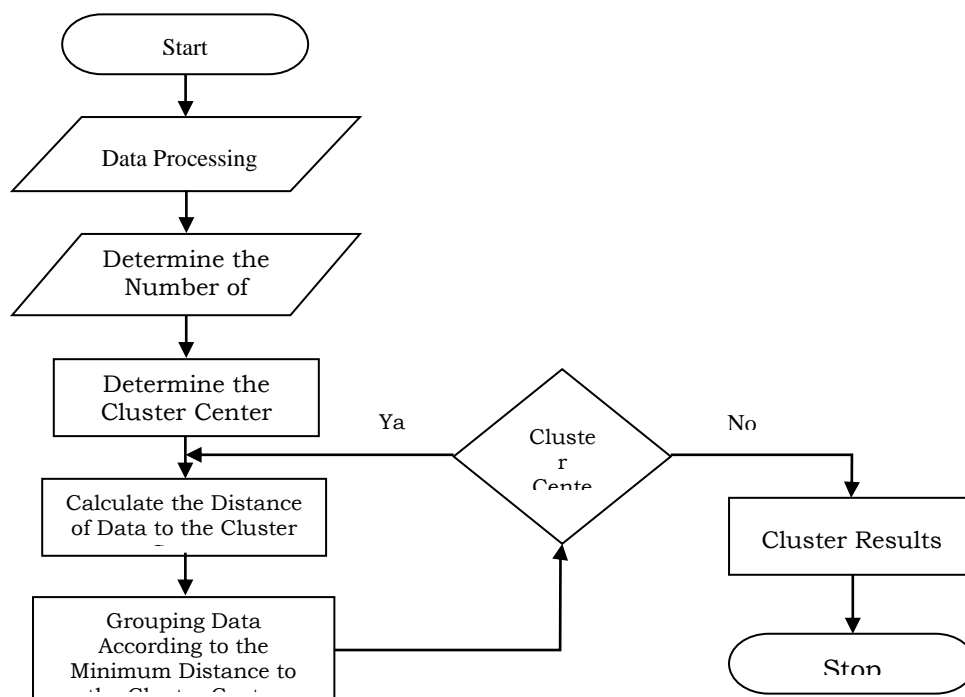


Figure 1. K-mean Clustering Workflow

From the results of this research design, it is hoped that the data will be clustered using the K-Means Method to be used to group farmer groups based on several criteria, such as land area, amount of fertilizer received, and harvest yields. Thus, the combination of these two methods is expected to provide more accurate recommendations for the distribution of subsidized fertilizer and inform rice farmer groups.

2.1 RDKK (Rencana Definitif Kebutuhan Kelompok) Farmer Group Dataset

Farmers who receive subsidized fertilizer are farmers who are required to get subsidized fertilizer. Farmers are required to have a farmer's card, which is integrated into e-RDKK. To get this card, farmers must have an eKTP, then carry out farming and join a farmer group that prepares their RDKK. For food crops, horticulture, and plantations, the maximum business area is 2 ha. All RDKK data that has been compiled is input into the e-RDKK system and approved by the Regency/City of Kadistan. The e-RDKK policy is to tighten the distribution of subsidized fertilizer so that it is not misused and prevents duplication among fertilizer recipients. In this research, the author limits data collection from the RDKK for 2022 to December 6, 2021, and December 7, 2022. Data collection in the research is as follows:

Table 1. Data Set of Farmers Receiving Fertilizer in 2022

No.	Poktan/Gapoktan Name	Land Area (Ha)	Amount Of Fertilizer Received	Harvest Products (Tons)
1	Poktan Petahuan Jaya	62	63.066	289
2	Poktan Subur Makmur	88	89.790	441
3	Poktan Baru Muncul Satu Gading	133	115.122	698
4	Poktan Baru Muncul Ii	43	44.337	227
5	Poktan Karangketug Jaya	130	133.734	655
6	Poktan Ketug Jaya Ii	38	38.508	191
7	Poktan Podoroso	90	92.244	457
8	Poktan Mardi Mulyo	36	37.008	195
9	Poktan Tani Mulyo I	95	97.284	500
10	Poktan Tani Mulyo Ii			
	Krapyakrejo	102	104.991	539
11	Poktan Tani Mulyo Iii	95	97.512	501
12	Poktan Tani Barokah	11	11.478	62
13	Poktan Abadi	101	101.275	545
14	Poktan Rogo Joyo	63	58.874	342
15	Poktan Sutojoyo	60	61.626	325
16	Poktan Sumber Rezeki	46	46.532	270
17	Sumber Tani	41	41.946	243
18	Poktan Sukun Indah	20	20.145	80
19	Poktan Dewi Sri	51	52.305	294
20	Poktan Makmur Jaya	53	54.302	305
21	Poktan Gotong Royong	70	53.067	475
22	Poktan Setia Kawan	53	53.931	311
23	Poktan Sekar Jaya	63	64.122	402
24	Poktan Sekar Makmur	50	51.138	321
25	Poktan Jaya Makmur	60	61.594	387
26	Poktan Petani Subur	93	95.298	360
27	Poktan Tani Lestari I	62	63.333	221
28	Poktan Tani Lestari Ii	64	65.679	229
29	Poktan Harapan Mulyo	76	77.541	270
30	Poktan Taruna Tani	176	179.850	626
31	Poktan Bugul Cahaya Makmur	102	104.238	459
32	Poktan Jelak Makmur	123	125.598	416
33	Poktan Kejobo Gayam	125	128.217	425

34	Poktan Tani Makmur	137	140.604	465
35	Poktan Tani Baru Satu Kepel	129	132.429	436
36	Poktan Tani Baru Dua Krajan	101	103.341	340
37	Poktan Tani Subur Kepel	133	136.221	448
38	Poktan Tani Makmur I	35	35.841	131
39	Poktan Tani Makmur Ii	18	18.303	67
40	Poktan Bunga	30	30.873	179
41	Poktan Tani Mulyo	66	55.671	394
42	Poktan Petamanan Rejo	46	46.737	275
43	Poktan Sumber Tirto	48	49.503	308

Primary data obtained from the RDKK in 2022 contained 1657 farmers who were members of 43 farmer groups (Poktan) from 4 sub-districts in the Pasuruan City area.

3. RESULTS AND DISCUSSIONS

Application of the K-means method to the Farmer Group dataset in Pasuruan City is known: Number of Clusters: 3, Number of Data = 43, Number of attributes = 3

3.1 Data Centroid

By using this centroid, the data that has been obtained can be clustered into three clusters determined randomly to be used as initial clusters.

Results and discussions can display data in the form of tables or images. Results must be supported by related references or can be compared with previous research.

Table 2. Initial Cluster Determination

Poktan/Gapoktan Name	Land Area (Ha)	Amount Of Fertilizer Received (Kg)	Harvest Products (Tons)
Poktan Tani Mulyo III	95,12	97.512	500,91
Poktan Tani Makmur	137,10	140.604	465,45
Poktan Sumber Tirto	48,30	49.503	308,10

3.2 Calculation of distances to clusters

The following is the formula used using the Euclidean distance space equation:

$$PP1 = \sqrt{(x1 - y1)^2 + (x2 - y1)^2 + (x3 - y1)^2}$$

$$PP2 = \sqrt{(x1 - y2)^2 + (x2 - y2)^2 + (x3 - y2)^2}$$

$$PP3 = \sqrt{(x1 - y3)^2 + (x2 - y3)^2 + (x3 - y3)^2}$$

Information :

x = data record or dataset of fertilizer recipients

y = data centroid

Table 3. Finding the shortest distance

Name Poktan/Gapoktan	Land Area (Ha)	Amount of Fertilizer Received (Kg)	Production result Tons	Pp1/C1	Pp2/C2	Pp3/C3	Closest Distance
Poktan Petahuan Jaya	61,5	63066	288,6	34446,67	77538,2	13563,0	13563,02
Poktan Subur Makmur	0	89790	1	063	385	2043	043
	87,6		441,2	7722,233	50814,0	40287,2	7722,233
	0		7	97	2986	3927	97

Poktan Baru Muncul Satu Gading	132,78	115122	698,11	17611,14437	25483,06252	65620,21339	17611,14437
Poktan Baru Muncul Ii	43,23	44337	227,29	53175,7293	96267,34036	5166,634522	5166,634522
Poktan Karangketug Jaya	130,46	133734	655,36	36222,34651	6872,627607	84231,75588	6872,627607
Poktan Ketug Jaya Ii	38,12	38508	191,49	59004,83883	102096,4155	10995,62306	10995,62306
Poktan Podoroso	90,00	92244	456,69	5268,188078	48360,02373	42741,27863	5268,188078
Poktan Mardi Mulyo	36,12	37008	194,65	60504,80388	103596,4031	12495,52097	12495,52097
Poktan Tani Mulyo I	94,89	97284	499,70	228,0033267	43320,03411	47781,40687	228,0033267
Poktan Tani Mulyo Ii Krapyakrejo	102,42	104991	539,36	7479,102373	35613,09358	55488,50829	7479,102373
Poktan Tani Mulyo Iii	95,12	97512	500,91	0	43092,03504	48009,41	0
Poktan Tani Barokah	11,19	11478	62,46	86035,15815	129126,6902	38025,81151	38025,81151
Poktan Abadi	100,74	101275	544,69	3763,258817	39329,09664	51772,56713	3763,258817
Poktan Rogo Joyo	63,30	58874	342,25	38638,33886	81730,12617	9371,07423	9371,07423
Poktan Sutojoyo	60,12	61626	325,06	35886,44792	78978,16229	12123,01762	12123,01762
Poktan Sumber Rezeki	45,75	46532	269,97	50980,54698	94072,24745	2971,245766	2971,245766
Sumber Tani	41,25	41946	243,42	55566,62271	98658,29639	7557,28008	7557,28008
Poktan Sukun Indah	19,80	20145	79,50	77368,18434	120459,6754	29358,90383	29358,90383
Poktan Dewi Sri	51,00	52305	294,22	45207,49403	88299,20799	2802,035679	2802,035679
Poktan Makmur Jaya	52,95	54302	305,47	43210,46257	86302,1893	4799,002973	4799,002973
Poktan Gotong Royong	69,72	53067	475,20	44445,01469	87537,02648	3567,979432	3567,979432
Poktan Setia Kawan	52,62	53931	310,80	43581,43537	86673,17913	4428,00293	4428,00293
Poktan Sekar Jaya	62,55	64122	402,45	33390,16105	76482,06228	14619,31141	14619,31141
Poktan Sekar Makmur	49,90	51138	321,06	46374,3708	89466,159	1635,052146	1635,052146
Poktan Jaya Makmur	60,10	61594	386,68	35918,19871	79010,07678	12091,2611	12091,2611
Poktan Petani Subur	93,00	95298	359,70	2218,499664	45306,14487	45795,05089	2218,499664
Poktan Tani Lestari I	61,80	63333	220,61	34180,16562	77271,42459	13830,28335	13830,28335
Poktan Tani Lestari Ii	64,05	65679	228,64	31834,17954	74925,40984	16176,20284	16176,20284
Poktan Harapan Mulyo	75,66	77541	270,08	19972,34342	63063,33254	28038,03913	19972,34342
Poktan Taruna Tani	175,50	179850	626,48	82338,13498	39246,34915	130347,4509	39246,34915
Poktan Bugul Cahaya Makmur	101,70	104238	459,10	6726,133166	36366,01778	54735,23433	6726,133166
Poktan Jelak Makmur	122,55	125598	416,05	28086,1416	15006,08835	76095,11279	15006,08835
Poktan Kejobo Gayam	125,10	128217	424,71	30705,1092	12387,07281	78714,12384	12387,07281

Poktan Tani Makmur	137,10	140604	465,45	43092,03504	0	91101,17916	0
Poktan Tani Baru Satu Kepel	129,15	132429	435,70	34917,07748	8175,057992	82926,13758	8175,057992
Poktan Tani Baru Dua Krajan	100,80	103341	340,06	5831,221768	37263,22865	53838,03508	5831,221768
Poktan Tani Subur Kepel	132,90	136221	448,35	38709,05412	4383,03536	86718,15468	4383,03536
Poktan Tani Makmur I	34,95	35841	131,33	61672,13676	104763,5826	13663,15011	13663,15011
Poktan Tani Makmur li	17,85	18303	67,07	79210,22577	122301,7069	31200,94584	31200,94584
Poktan Bunga	30,12	30873	179,30	66639,80777	109731,4252	18630,4541	18630,4541
Poktan Tani Mulyo	66,00	55671	393,60	41841,14774	84933,06015	6168,61796	6168,61796
Poktan Petamanan Rejo	45,60	46737	274,90	50775,52715	93867,23799	2766,200559	2766,200559
Poktan Sumber Tirto	48,30	49503	308,10	48009,41	91101,17916	0	0

Below, the cluster grouping matrix data will be displayed; value 1 means the data with the smallest value is in the group (data group), and the author only displays some of the data from the total 43 Farmer Group data.

Table 4. Data Sharing Group 1

NO.	PP1	PP2	PP3
1	0	0	1
2	1	0	1
3	1	0	0
4	0	0	1
5	0	1	0
6	0	0	1
7	1	0	0
8	0	0	1
9	1	0	0
10	1	0	0
11	1	0	0
12	0	0	1
13	1	0	0
14	0	0	1
15	0	0	1
16	0	0	1
17	0	0	1
18	0	0	1
19	0	0	1
20	0	0	1
21	0	0	1
22	0	0	1
23	0	0	1
24	0	0	1
25	0	0	1
26	1	0	0
27	0	0	1
28	0	0	1
29	1	0	0
30	0	1	0
31	1	0	0
32	0	1	0
33	0	1	0
34	0	1	0
35	0	1	0

36	1	0	0
37	0	1	0
38	0	0	1
39	0	0	1
40	0	0	1
41	0	0	1
42	0	0	1
43	0	0	1

3.3 Determine the center of the new cluster.

Land area	: PP1 = $\frac{1074,71}{11} = 97,70$
Fertilizer Amount	: PP1 = $\frac{1078636,00}{11} = 98057,82$
Yields	: PP1 = $\frac{5109,66}{11} = 464,51$
Land area	: PP2 = $\frac{952,76}{7} = 136,11$
Fertilizer Amount	: PP2 = $\frac{976653,00}{7} = 139521,86$
Yields	: PP2 = $\frac{3472,08}{7} = 496,01$
Land area	: PP3 = $\frac{1187,89}{25} = 47,52$
Fertilizer Amount	: PP3 = $\frac{1179919,00}{25} = 47196,76$
Yields	: PP3 = $\frac{6524,12}{25} = 260,96$

3.4 3rd iteration

Repeat step 2 until the data position does not change.

Table 5. Determination of Centroid: 2

Name Poktan/Gapoktan	Land Area (Ha)	Amount of Fertilizer Received	Harvest Yield (Tons)
Poktan Tani Mulyo Iii	97,70	98.058	464,51
Poktan Tani Makmur	136,11	139.522	496,01
Poktan Sumber Tirto	45,68	44.675	249,67

Table 6. 3rd Iteration Results

Poktan	Ll	Jpd	Hp	Pp1/c1	Pp2/c2	Pp3/c3	Closest distance	Cluster
P1	15,5 3	24,38	6,3	98034,54	139498 ,4	44651, 39	44651,39	3
P2	87,6	89790	441,27	8267,857	49731, 91	45115, 33	8267,857	1
P3	132, 78	11512 2	698,11	17065,82	24400, 69	70448, 39	17065,82	1
P4	43,2 3	44337	227,28 8	53721,37	95185, 28	338,84 42	338,8442	3
P5	130, 46	13373 4	655,35 6	35676,71	5790,0 53	89059, 87	5790,053	2
P6	38,1 2	38508	191,49	59550,47	101014 ,4	6167,3 74	6167,374	3
P7	90	92244	456,69	5813,829	47277, 9	47569, 38	5813,829	1

P8	36,1 2	37008	194,65	61050,45	102514 ,3	7667,2 99	7667,299	3
P9	94,8 9	97284	499,7	774,6228	42237, 88	52609, 52	774,6228	1
P10	102, 42	10499 1	539,35 5	6933,587	34530, 9	60316, 63	6933,587	1
P11	95,1 2	97512	500,91	547,0364	42009, 88	52837, 53	547,0364	1
P12	11,1 9	11478	62,46	86580,79	128044 ,7	33197, 64	33197,64	3
P13	100, 74	10127 5	544,68 6	3218,182	38246, 9	56600, 7	3218,182	1
P14	63,3	58874	342,25	39184,02	80648, 04	14199, 22	14199,22	3
P15	60,1 2	61626	325,05 9	36432,1	77896, 08	16951, 08	16951,08	3
P16	45,7 5	46532	269,97	51526,21	92990, 18	1857,0 16	1857,016	3
P17	41,2 5	41946	243,42	56112,28	97576, 23	2729,1 06	2729,106	3
P18	19,8	20145	79,5	77913,81	119377 ,6	24530, 7	24530,7	3
P19	51	52305	294,22	45753,16	87217, 13	7630,0 37	7630,037	3
P20	52,9 5	54302	305,47	43756,13	85220, 11	9627,0 69	9627,069	3
P21	69,7 2	53067	475,2	44990,83	86454, 89	8394,9 69	8394,969	3
P22	52,6 2	53931	310,8	44127,11	85591, 1	9256,1 09	9256,109	3
P23	62,5 5	64122	402,45	33935,89	75399, 95	19447, 51	19447,51	3
P24	49,9	51138	321,06	46920,06	88384, 07	6463,3	6463,3	3
P25	60,1	61594	386,68	36463,92	77927, 97	16919, 47	16919,47	3
P26	93	95298	359,7	2761,812	44224, 09	50623, 05	2761,812	1
P27	61,8	63333	220,60 54	34725,69	76189, 39	18657, 93	18657,93	3
P28	64,0 5	65679	228,63 71	32379,69	73843, 38	21003, 92	21003,92	3
P29	75,6 6	77541	270,08 1	20517,75	61981, 3	32865, 92	20517,75	1
P30	175, 5	17985 0	626,47 65	81792,38	40328, 37	135175 ,5	40328,37	2
P31	101, 7	10423 8	459,1	6180,185	35283, 89	59563, 3	6180,185	1
P32	122, 55	12559 8	416,04 89	27540,24	13924, 09	80923, 11	13924,09	2
P33	125, 1	12821 7	424,70 6	30159,22	11305, 09	83542, 13	11305,09	2
P34	137, 1	14060 4	465,44 51	42546,2	1082,5 75	95929, 19	1082,575	2
P35	129, 15	13242 9	435,69 66	34371,21	7093,1 17	87754, 14	7093,117	2
P36	100, 8	10334 1	340,05 59	5284,648	36181, 21	58666	5284,648	1
P37	132, 9	13622 1	448,34 75	38163,2	3301,2 03	91546, 16	3301,203	2
P38	34,9 5	35841	131,32 73	62217,74	103681 ,5	8834,8 94	8834,894	3
P39	17,8 5	18303	67,072 73	79755,85	121219 ,7	26372, 74	26372,74	3
P40	30,1 2	30873	179,3	67185,46	108649 ,4	13802, 28	13802,28	3
P41	66	55671	393,6	42386,89	83850,	10996,	10996,87	3

P42	45,6	46737	274,9	51321,19	95 92785, 16	87 2062,0 59	2062,059	3
P43	48,3	49503	308,1	48555,1	90019, 1	4828,2 59	4828,259	3

This method consists of three criteria: land area, amount of fertilizer received, and crop yield. The value of each of these criteria becomes a benchmark in selecting farmer groups that are the main priority recipients of subsidized fertilizer assistance. Determining the recommendations in Table 6 of the K-Means results for grouping farmer groups based on clustering shows that the superior group is in cluster 3, the medium group is in cluster 1, and the lower group is in cluster 2. Cluster 3 and Cluster 1 are the relevance or link between the Harvest Results parameters and land area. Next, the Euclidean Distance Formula process is carried out. If there is new input data, it will be indexed into the existing data.

4. CONCLUSION

This research aims to assist the Pasuruan City Agriculture Service in determining the selection of farmer groups that are prioritized for receiving subsidized fertilizer. This research also makes a significant scientific contribution to the development of data analysis methods to support agricultural policy, as well as providing a basis for further research into the more efficient and sustainable management of agricultural resources. The decision-making system for selecting priority farmer groups to receive subsidized fertilizer uses the K-Means Clustering Method. The implementation of the K-Means Clustering algorithm is used for analysis and decision-making regarding the selection of farmer groups that receive subsidized fertilizer. The superior group is found in cluster 3, the medium group is in cluster 1, and the lower group is in cluster 2. The results of this test show that in the group ranking, Tani using the manual method has the same results as the results of the system created using the Confusion Matrix with the best recommendation value, namely 78%, meaning that the research is feasible and successful.

REFERENCES

- Anggreini, N. L., & Tresnawati, S. (2020). KOMPARASI ALGORITMA K-MEANS DAN K-MEDOIDS UNTUK MENANGANI STRATEGI PROMOSI DI POLITEKNIK TEDC BANDUNG. *Jurnal TEDC*, 14(3).
- Budi Setiawan, A., & Dian Wisika Prajanti, S. (2016). Strategies To Develop Food Crop Commodity To Improve The Prosperity Of Rural Farmers In GrObogan District. *Journal of Indonesian Applied Economics*, 6(2). <https://doi.org/10.21776/ub.jiae.2016.006.02.3>
- C. Zhang dan F. Fang, 2015. "An Improved K-means Clustering Algorithm". *Journal of International & Computational Science*. pp.193-199
- Chasanah, T. T., & Widiyono. (2017). Penentuan Strategi Promosi Penerimaan Mahasiswa Baru Dengan Algoritma Clustering K-Means. *Jurnal IC-Tech*, 12(1).
- Hartono, Jogiyanto, 1989. *Analisis & Disain Sistem Informasi: Pendekatan Terstruktur Teori dan Praktek Aplikasi Bisnis*, Andi Offset, Yogyakarta.
- Indonesia, K. P. R. (2013). Peraturan Menteri Pertanian Nomor: 69/Permentan/SR.130/11/2012 Tentang Kebutuhan Dan Harga Eceran Tertinggi (HET) Pupuk Bersubsidi Untuk Sektor Pertanian Tahun Anggaran 2013.
- Keputusan Menteri Pertanian Republik Indonesia Nomor 04/Kpts/RC.210/B/01/2022 tentang Pedoman Teknis Pelaksanaan Penyediaan dan Penyaluran Pupuk Bersubsidi Tahun Anggaran 2022
- Madhulatha, T. S. (2012). An overview of clustering methods. *IOSR Journal of Engineering*, 2(4), 719-725. <https://doi.org/10.3233/ida-2007-11602>

- Murnasih. (2013). Peraturan Menteri Pertanian Nomor 82/Permentan/OT.140/8/2013 Tentang Pedoman Pembinaan Kelompok Tani Dan Gabungan Kelompok Tani. *Journal of Chemical Information and Modeling*, 53(9).
- Nugraha, D. D., Naimah, Z., Fahmi, M., & Setiani, N. 2016. "Klasterisasi Judul Buku dengan Menggunakan Metode K-Means". Seminar Nasional Aplikasi Teknologi Informasi (SNATI). Yogyakarta: ISSN: 1907 -5022. pp: G1-G4.
- Peraturan Perubahan Gubernur. 2008. Alokasi Pupuk Bersubsidi Sektor Pertanian. Di Jawa Timur.
- Peraturan Menteri Perdagangan RI, No. 21/M-DAG/PER/6/2008.
- Peraturan Menteri Perdagangan RI, Nomor 17/M-DAG/PER/6/2011
- Peraturan Gubernur. 2009. Jawa Timur No. 158/2008. Tentang Kebutuhan dan Penyaluran Serta Harga Eceran Tertinggi [HET] Pupuk Bersubsidi Untuk Sektor Pertanian Provinsi Jawa Timur
- Prabowo Angga, Guruh Putro Dirgantoro, 2023, "Pengelompokan Pupuk Bersubsidi Di Kabupaten Bojonegoro Menggunakan Metode K -Means Clustering". *Jurnal Multidisciplinary Applications of Quantum Information Science* Vol. 2 No. 2
- Purwanto; Syukur, M; Santoso, P. 2007. Penguatan Kelompok Tani dalam Mendukung Pembangunan Pertanian di Jawa Timur
- Rismawan, T., & Kusumadewi, D. S. (2008). Aplikasi K-Means Untuk Pengelompokkan Mahasiswa Berdasarkan Nilai Body Mass Index (Bmi) & Ukuran Kerangka. *Seminar Nasional Aplikasi Teknologi Informasi*, 21(01).
- Santoso R.F, Hidayat N, Sutrisno, 2020. Implementasi Metode Fuzzy AHP (Analytical Hierarchy Process) – COPRAS (Complex Proportional Assessment) untuk Rekomendasi Penentuan Kelompok Tani Terbaik. *Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer* Vol. 4, No. 10, Oktober 2020, hlm. 3542-3551
- Smith, John. 2016. *Performance and Effectivity of Human Resource*. Published by Harper T & Row, New York.