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The Experiment of Stem Cutting Planting Position in Increasing Sweet Potato (Ipomea batatas L.) Production in Horticulture Learning

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A B S T R A C T

This study aimed to discuss: (1) the effect of different positions of stem cuttings on sweet potato production; and (2) whether this practical experiment-based approach is effectively implemented in horticulture learning. This experimental research used a completely randomized design. The population was sweet potato plants. The research sample was the tip cuttings of sweet potato plants. The length of the cuttings was 30 cm, measured from the tip of the plant's stem with relatively the same number of segments. The number of treatments was 3: upright Po (180°), inclined P1 (45°) and flat P2. The number of repetitions was six times, and the number of samples for each treatment was 20 cuttings of the sweet potato stem tips. Thus, the number of sweet potato stem tip cuttings needed in this study is 3 X 6 X 20 cuttings = 360 (three hundred and sixty). Based on the ANOVA test, a significant value of 0,005 was obtained, far smaller than the determined significance level of 0,05. It means there is a significant difference between the weights of sweet potato tubers between treatments. In conclusion, there is a significant difference between the upright/90° and slanted/45° treatment and between the upright/90° and horizontal treatment. Meanwhile, the treatment between slanted/45° and horizontal showed no significant difference. Overall, the best sweet potato production is obtained by planting horizontally with an average tuber weight of 313 grams. It can be concluded that this practical experimental method is very effectively implemented in the horticulture learning process.

Keywords---cuttings, horticultural learning, planting position, production.

Introduction

Sweet potato (Ipomea batatas L.) is the main tuber crop produced and consumed mainly by developing countries, with about 90% grown in Asia and less than 5% in Africa and Latin America (Holwerda & Ekanayake, 1991). Sweet potato is a plant that grows well in hot and humid climates, with an optimum temperature of 27°C, humidity of 50-60% and a long exposure of 11-12 hours per day with rainfall of 750-1500 mm per year. Optimal production and growth for suitable sweet potato farming are during the dry season. Botanists and agricultural experts estimate that the origin of the sweet potato or sweet potato plant is New Zealand, Polynesia and Central America. Nikolai Ivanovich Vavilov, a Soviet botanist, confirmed that the primary center of origin of the sweet potato plant was Central America. Sweet potatoes began to spread worldwide, especially in countries with tropical climates in the16th century. The Spaniards spread sweet potatoes to Asia, especially the Philippines, Japan, and Indonesia (Jayanto, 2009).

Sweet potato stems grow up to 1-5 meters, 3-10 mm in diameter; inside the stems, there is latex. The color of the stems varies; some are green, some are yellow, and some are purple. The color of the leaves is purplish green. This plant's flowers include perfect trumpet-shaped flowers and light purple at the base and the ends. The tubers contain shoots that can grow. Depending on the variety, these tubers are usually

white, yellow, purple or orange and light purple. The texture of the meat is soft, and some is watery. The taste is sweet, and some are less sweet. Sweet potato includes a single leaf that grows on the stem. The shape of the leaves varies; some are round, like hands, and some resemble a heart, and some roots grow in the armpits of the leaves, which can grow and become tubers (Sivaci, 2006; Justamante et al., 2017).

Sweet potatoes can be used as a staple food, animal feed ingredients, and industrial raw materials. Besides that, sweet potato is an essential commodity, although it is less popular than other secondary crop commodities. This plant is very familiar to Indonesian people, especially among farmers, because of its various advantages. These advantages are because this plant is very easy to cultivate, not susceptible to disease and pests, is a producer of carbohydrates, the yield of the united land area is relatively high, is short-lived, contains lots of vitamins, and the leaves can be used for vegetables which are rich in vitamin A and iron. In addition, sweet potato tubers contain carbohydrates and high energy, which can restore energy quickly, as well as several substances that are very important for the body, such as vitamins, minerals, fiber and anthocyanins, especially in red and purple types of sweet potatoes which function as antioxidants. Sweet potato leaves contain 4.6% protein, 0.2% lipid, 9.1% carbohydrates, 6.2 mg iron, and 158 mg calcium. Besides that, it also contains anthocyanin and phenolic compounds and is an excellent source of vitamin A and ascorbic acid. Sweet potato tubers have quite a diverse composition. Among them contain 0.8 to 2% protein, 0.2 to 0.4% lipids and 25 to 30% carbohydrates. In addition, tubers also contain lots of vitamins, minerals (calcium and zinc), and some vitamin E (tocopherol) (Zannou et al., 2017).

Sweet potatoes produce more calories than potatoes, namely 113: 75 per hundred grams of material, besides being rich in vitamin A, which is approximately two and a half times the daily menu requirement for adults. When mixed with legumes, ascorbic acid, riboflavin, niacin, phosphorus, iron, and calcium from sweet potatoes can form an ideal food composition to prevent malnutrition. It is further said that sweet potatoes are consumed after processing, such as baked, steamed, fried, and others. Sometimes it is processed into syrup, baozi or pao-tsih (a Chinese bun), and sliced to make chips (Le & Lin, 2019; Alaie, 2020; Nturambirwe & Opara, 2020).In health, sweet potato is used in pharmacology because it contains certain compounds such as anthocyanins, carotenoids, phenolic compounds, trypsin inhibitory proteins and arabino-galactone compounds. Researchers have reported that sweet potato tuber and leaf extracts protect against cardiovascular disease. The high fiber content in these foods also helps the body to maintain a healthy digestive system (Zannou et al., 2017).

Sweet potato productivity in Indonesia is still low, namely 98.79 kg/ha, while in China, it reaches 208.58 kg/ha and in Japan 247.33 ku/ha. The low productivity of sweet potatoes will hamper the development of the agro-industry(Alimoeso, 2003). Factors that affect the low production of sweet potato tubers include low plant population per unit area, cultivation techniques are rarely carried out, high-intensity land use resulting in loss of soil nutrients carried by crops and soil erosion, the occurrence of major plant pest organisms (OPT) attacks, namely pests' holes when the growing season is not suitable (Suharno, 2020).

In increasing sweet potato production, proper cultivation techniques are needed, namely proper propagation techniques, proper planting methods and selection of appropriate varieties because each variety has different production potential. The most appropriate sweet potato plant propagation technique is to use stem cuttings. This is because sweet potato plants do not produce seeds. In addition, the propagation technique through cuttings is a simple and easy way for farmers to apply. It is expected that perfect sweet potato plants will be obtained through this propagation technique, namely plants that already have roots, stems and leaves in a relatively short time (Wudianto, 1998). Several factors influence cuttings' success, namely the cuttings' origin (the cuttings (the position on the mother plant), the length of the cuttings, and the environment (rooting medium, temperature, humidity, light). The length of the cuttings affects the formation of roots and shoots. The longer the cuttings, the greater the

carbohydrate content, producing more roots (Ahmad, 2021; Muli & Mwakina, 2016). In addition to these two factors, the position of planting material for cuttings also affects the growth of cuttings (Isa et al., 2015; Suminarti & Novriani, 2017). According to Aziz (1999), stem cuttings planted vertically will produce good growth, while cuttings planted horizontally will produce more shoots.

Horticulture courses is an elective course in the Biology Education study program, Faculty of Mathematics and Natural Science Education, IKIP Saraswati. One of the achievements of horticulture learning is that students can understand, plan, implement, evaluate, and communicate basic horticultural concepts and principles and apply basic horticultural knowledge in cultivating horticultural crops and making gardens. IKIP Saraswati, as an educational institution, needs to improve the quality of its graduates from year to year. To improve the quality of graduates, the quality of the learning process must also be continuously improved. Horticultural learning should be delivered by emphasizing students' involvement in an active learning process and training students to think critically and objectively (Oka et al., 2019). So, what they have experienced will become a new experience, so they will be more interested in learning. A teaching and learning process can be meaningful and valuable if it can create learning situations that stimulate learning activities and provide information on student results and awards for achievements(Rusman, 2017).

Horticulture is one of the introductory elective courses for students because horticulture is related to everyday life or real life. For example, in the future they want to farm sweet potatoes or see farmers experiencing problems in increasing sweet potato production, they can provide solutions and have skills in solving problems faced by farmers. The authors apply the experimental method to improve the quality of the horticulture learning process. All students taking horticulture courses are involved in the experimental process from the beginning to the end. With the hope of (1) increasing their motivation and activity in the learning process; (2) helping students to understand that the acquisition of knowledge is a continuous process; (3) using their cognitive, psychomotor, and problem-solving skills to identify problems, develop, and test the efficacy of the solutions they provide as a group; (4) foster collaboration between students and provide opportunities for students to exchange ideas, and acquire important leadership, communication, and coordination skills. Experiments are also able to foster student curiosity. However, they can also foster their rational and scientific way of thinking so that the experiment results can be accepted as a scientific product while the steps in its implementation as a scientific process (Peña-Claros et al., 2002; Zheng et al., 2016).

From the description above, the focus of discussion in this study is twofold, namely (1) the effect of different positions on planting cuttings on sweet potato production; and (2) whether the implementation of this practical experiment-based approach can increase student activity in the learning process, improve cognitive, affective, psychomotor skills, and encourage collaboration between students so that there are opportunities for students to exchange ideas, acquire important leadership, communication, and coordination skills.

Method

This type of research was experimental, using a completely randomized design. The population in this study was sweet potato plants. The research sample was the tip cuttings of sweet potato plants. Cuttings were taken from healthy trees in the morning because the water content was still high. The length of the cuttings was 30 cm, measured from the tip of the plant's stem with the same number of relative segments and cut with a sharp knife. To reduce evaporation, the leaves of the cuttings were pruned, and only three were left at the ends. Cuttings were stored for five days in a shady and humid place. The number of treatments was 3: P0(1800), inclined P1 (450) and flat P2. The number of repetitions was six times, and the number of samples for each treatment was 20 cuttings of the sweet potato stem tips. Thus, the number

of sweet potato stem tip cuttings needed in this study was 3 X 6 X 20 cuttings = 360 (three hundred and sixty). The research was conducted in an open place, namely in paddy fields. As a place for planting stem cuttings before planting, the medium was processed with a hoe and then harrowed until loose. Then make six bunds with dimensions: 30 cm high, 300 cm long, and 80 cm wide. The distance between the bunds was 75 cm. Each bund was planted with 60 cuttings of plant stems grouped into three groups. The first group, P0, with 20 cuttings in an upright position/900, P1, with 20 cuttings in an inclined position/450, and P2, were planted with 20 cuttings in a flat position. P0, P1 and P2 are placed randomly on each bund.

The data obtained from the fresh weight of sweet potato tubers were tested for normality and homogeneity. The normality test was performed using the Kolmogorov-Smirnov and Shapiro-Wilk statistics. At the same time, the homogeneity test was carried out with the Levene test. The significance level (α) is set at 0.05. The normality and homogeneity test criteria used were if the significance number (sig.) is more significant than the significance level (α). The statistical number was insignificant, meaning the sample data comes from a normally distributed population. Vice versa. If the requirements for normality and homogeneity have been met, then a parametric analysis with theanalysis of variance (ANOVA) test was carried out. If there is a significant difference, it is necessary to carry out further tests to find out which treatment groups are significantly different. Further tests were carried out with theleast significant difference (LSD) test. The horticultural learning process data were collected using observation sheets and formative tests.

Results

The data were collected by harvesting sweet potatoes after 137 days of age. Sweet potatoes that have been harvested are weighed per tree to calculate the wet weight. Before weighing, the sweet potato tubers are cleaned by cutting off the remnants of the stems or roots. The average fresh weight of sweet potato tubers in each treatment is presented in Table 1.

Table 1. The average wet weight of sweet potato tubers (grams) in each treatment

Repetition	Treatment			Number
	P_0	P_1	P_2	
I	250	308	395	953
II	245	300	353	898
III	241	300	303	844
IV	212	255	272	739
V	250	260	285	795
VI	210	245	270	725
Total	1408	1668	1878	4954
Average	234,67	278	313	

Based on Table 1 above, the average production of fresh-weight sweet potato tubers in each treatment can be described as shown in Figure 1.

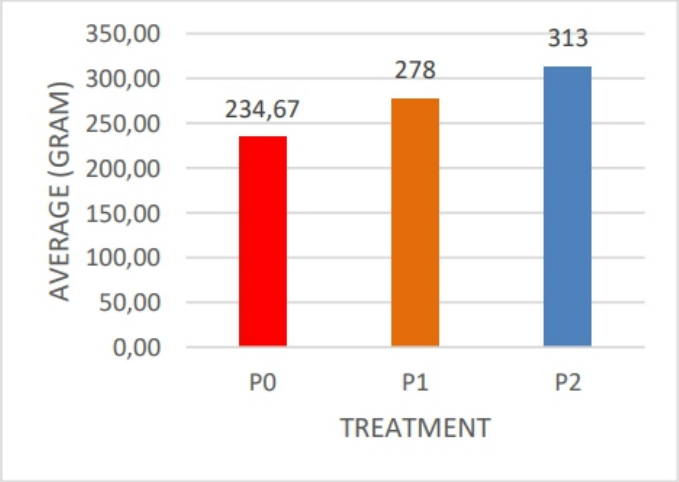

Figure 1. The average fresh weight production of sweet potato tubers in each treatment

Normality test

Before the ANOVA test is carried out, a prerequisite test is first carried out, namely the normality test. After calculating with SPSS, the normality test data is obtained, as shown in Table 2.

Table 2. The summary of the normality test

		Kolmogorov-Smirnov[a]		
	Treatment	Statistics	df	Sig.
Tuber weight	Upright	.300	6	.099
	Slant	.287	6	.133
	Horizontal	.245	6	.200*

Based on the data distribution normality test, it is found that all data obtained a significance value (sig.) above the specified significance level of 0.05. Thus, it can be said that the data is normally distributed.

Homogeneity test

After calculating with SPSS, the homogeneity test data is obtained, as shown in Table 3.

Table 3. The summary of the homogeneity test

Levene Statistics	df1	df2	Sig.
4.446	2	15	.030

Based on the homogeneity test, a significance value (sig.) of 0.030 is obtained, which is smaller than the predetermined significance level of 0.05; thus, the data is not homogeneous.

ANOVA test

The following data summary is obtained based on the ANOVA test that has been carried out with the help of SPSS.

Table 4. The summary of ANOVA test results

	Sum of squares	df	Mean square	F	Sig.
Between Groups	18477.778	2	9238.889	7.578	.005
Within Groups	18287.333	15	1219.156		
Total	36765.111	17			

Based on the ANOVA test that has been carried out, a significance value of 0.005 is obtained, which is much smaller than the predetermined significance level of 0.05. Thus, there is a significant difference in the weight of sweet potato tubers between treatments. Further tests are carried out to see which treatment has a significant difference. Assuming the data is not homogeneous, a further test is carried out with the Games-Howell test. The test results look like in Table 5 below.

Table 5. The summary of further test results

		Mean Difference			95% Confidence interval	
(I) treatment	(J) treatment	(I-J)	Std. Error	Sig.	Lower bound	Upper bound
Upright/90^0	Slant/45^0	-43.333*	13.601	.028	-81.48	-5.18
	Horizontal	-78.333*	21.968	.025	-144.70	-11.97
Slant/45^0	Upright/90^0	43.333*	13.601	.028	5.18	81.48
	Horizontal	-35.000	23.486	.347	-102.58	32.58
Horizontal	Upright/90^0	78.333*	21.968	.025	11.97	144.70
	Slant/45^0	35.000	23.486	.347	-32.58	102.58

*. The mean difference is significant at the 0.05 level.

Further tests show a significant difference between the upright/900and slanted/450treatments and between the upright/900and horizontal treatments. Meanwhile, the treatment between slanted/450and horizontal showed no significant difference. Overall, the best sweet potato yields are obtained by horizontal planting with an average tuber weight of 313 grams.The results of observations regarding activities show that students are very active, both when designing experiments, making observations during experiments, and discussing experimental results. The evaluation of the learning outcomes of students who have taken part in the experiment showed that: (1) practical experiments provide real-life ambiguity and complexity that help students redefine their theoretical understanding of various concepts; (2) the experiment allows students to develop their cognitive, psychomotor, and affective skills; (3) experiments foster collaboration between students and provide opportunities for students to exchange ideas, and acquire important leadership, communication, and coordination skills.

Discussion

Based on the ANOVA test in Table 4, it can be seen that the calculated F value is 7.578 with a significance of 0.005, which is much smaller than the predetermined significance level of 0.05. It means that, in general, there is a significant difference between the weight of sweet potato tubers based on treatments. To see which treatment is significantly different, further tests are carried out. Further test results showed a significant difference between the treatment of planting upright cuttings/900and planting slanted cuttings/450and between the treatment of planting upright cuttings/900and planting horizontal cuttings. Meanwhile, the treatment between planting slanted cuttings/450and planting horizontal cuttings showed no significant difference. The best results for sweet potatoes are obtained by planting horizontal cuttings with an average tuber weight of 313 grams, this difference in production is due to the influence of hormones. Hormones or growth regulators in plants are non-nutrient organic compounds, which in small amounts, can support, inhibit and change plant physiological processes. There are three hormones

plants need in their growth process: Auxins, Gibberellins, and Cytokinins. If a plant lacks one of these hormones, its growth will be disrupted. Hormones can stimulate the accelerated release of roots, multiplication of roots and root nodes, stimulate the growth process utilizing cell division, increase the size of cells and cell tissues, stimulate the release of flowers and fruit simultaneously, stimulate the healing process from picking wounds or bite wounds from pests and diseases, stimulate the enlargement of rhizomes and tubers with extra fast and extra-large (Manurung et al., 2018).The role of auxins and cytokinins in growth was demonstrated by Nagarathna et al. (2010), in a study of Helianthus annuus. At the beginning of the study, auxin and cytokinin concentrations were measured at all axillary nodes to determine the translocation of each of these hormones. Based on the study results, auxin concentrations will decrease in axillary nodes far from shoots, whereas cytokinin concentrations will increase in axillary nodes far from shoots. Nagarathna decapitated the apical bud of H. annuus. The study's results stated that the lowest axillary nodes showed rapid growth compared to the other axillary nodes above because of the low auxin and high cytokinin concentrations in the lower axillary nodes. It shows that a balanced ratio between the hormones auxin and cytokinin is needed to stimulate shoot growth (Iráizoz et al., 2003; Paoli et al., 2022).

On horizontally planted cuttings, the auxin spreads evenly, resulting in more root and shoot growth. It is in line with Aziz (1999), which stated that cuttings planted horizontally would produce more shoots. The number of shoots produced will increase the number of leaves so that the carbohydrates produced through photosynthesis will increase. This increase in photosynthesis results will positively affect the weight gain of sweet potato tubers. On the other hand, an even distribution of auxin on cuttings planted horizontally will also promote better root growth. Good adventitious root growth will cause tubers to develop well because adventitious roots will develop into tubers. It aligns with Putri (2017), which states that the tuber development stage begins when adventitious roots grow and develop into tubers. The direction of tuber growth in sweet potato plants aged two days after planting (days after planting) was initially horizontal, 7 (days later), the direction of tuber growth was positive geotropism; and 30 days later, the direction of tuber growth occurred randomly with plagiotropic and positive geotropism growing directions. Tuber length and diameter development began when tubers began to form at 30 days and continued to increase in tuber length and diameter. Good root and shoot growth on cuttings planted horizontally causes higher production than those planted obliquely (450) and upright (900).

Meanwhile, in the treatment of planting slanted cuttings with a slope of 450, the tuber production was lower because the auxin synthesized in the apical shoots would be transported basipetally to the lower parts of the stem, eventually accumulating at the growing point under the apical shoots and in the roots, thereby hindering the growth of shoots and roots. Accumulation of auxin at the point of growth and roots will result in the initiation of the formation of more shoots and stunted roots. Inhibition of root formation will reduce the number of tubers produced because sweet potato tubers are formed from adventitious roots. In treating planting slanted cuttings with an upright position of 900, the tuber production is lower than the horizontal treatment, and the degree of inclination is 450.

Because the amount of auxin synthesized in apical shoots will be transported basipetally, more of it accumulates in the roots. Accumulation of auxin with higher concentrations in the roots will hinder the initiation of root formation. The more hindered the formation of roots will further reduce the number of tubers produced (Suriani & Darmadi, 2019).

The results of observations regarding the activities of students during the experiment are very active, both when designing the experiment, making observations during the experiment, and discussing the experimental data. The experiment can increase students' activity, motivation and involvement in the learning process. It is in line with Rusman (2017), who states that a teaching and learning process can be meaningful and valuable if it can create learning situations that stimulate learning activities, provide

information on student results and provide rewards for achievements achieved. Biology learning should be delivered by emphasizing the involvement of students in an active learning process and training students to think critically and objectively (Bakti et al., 2013). So, the students' experience will become a new experience, so they will be increasingly interested in learning (Suryani et al., 2019).Practical experiments provide real-life ambiguity and complexity that help students redefine their theoretical understanding of various concepts. It follows the statement (Sujarittham et al., 2019), which states that students must be involved in collaborative learning to develop their problem-solving skills and an effective way to apply the knowledge gained in real-life situations. The experiment-based learning model is integral to teaching and learning activities in horticulture courses because it allows educators to clarify concepts discussed in class through direct examples and enhance students' intellectual abilities through direct observation. It also enables students to understand and choose theories that support mapping practical problems, developing problem-solving skills, and applying acquired knowledge in different situations.

The experiments allow students to develop cognitive, psychomotor, and affective skills. As we know, one of the problems faced by our world of education is that the learning process is still weak; students are not encouraged to develop their thinking skills, while teachers still apply traditional teaching methods, which are oriented towards the cognitive measurement of students only. Meanwhile, in the constructivist learning paradigm, learning must measure three aspects: cognitive, affective, and psychomotor. To achieve these three aspects, more than learning activities in class are needed to apply the lecture method because teachers can only provide material. Theoretically, the students are not actively involved in learning, and even students need help to apply the material directly in the form of observations or experiments. This principle causes a paradigm shift in the educational process from the teaching paradigm to the learning paradigm. The teaching paradigm that focuses more on the role of educators in transforming knowledge for their students shifts to a learning paradigm that gives more roles to students to develop their potential and creativity (Oka, 2016). A critical review of this study reveals several benefits of using an experimental learning approach, such as student motivation, in-depth understanding of various concepts, increased problem-solving, critical reasoning, and inquiry skills in students, as well as higher academic achievement.

The experiments foster student collaboration and provide opportunities to exchange ideas and acquire important leadership, communication, and coordination skills. It is in line with the research results of Clobert et al. (2018), and (Sujarittham et al., 2019), which show that experimental-based horticulture learning can improve students' abilities to organize, communicate, and interpret the results obtained from direct observation. Most importantly, these experiments motivate students to develop curiosity, equip students with the skills necessary to conduct experiments and encourage the acquisition and development of basic biology concepts, social skills, and scientific attitudes.

Based on this, experiment-based learning is an effective learning strategy that aligns with the principles of the constructivism paradigm (Azis, 2019). This model allows students to organize knowledge from practical experience, collaborative activities, reflection, and interpretation of data. Experimental implementation can provide opportunities to help students develop logical thinking skills. It also stimulates the active involvement of students in formulating situations to solve problems, critical analysis of existing problems and facts, and the discovery and application of concepts and principles used in horticulture.

Conclusion

There is a significant difference between the treatment of planting upright cuttings/900and planting slanted cuttings/450 and between the treatment of planting upright cuttings/900 and planting horizontal

cuttings. Meanwhile, the treatment between planting slanted cuttings/450and planting horizontal cuttings showed no significant difference. Where the best sweet potato yields are obtained by planting horizontal cuttings with an average tuber weight of 313 grams, this practical experimental method is very effectively implemented in horticulture learning.

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Nutritional Content and Microbial Contamination of Fresh Cold and Frozen Bali Beef in Mambal RPH Production in Badung Regency, Bali Province

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A B S T R A C T

This study aims to determine the nutrition and microbial contamination of fresh, chilled, and frozen Bali beef. This study used a completely randomized design (CRD) direct pattern a 3x7, with 3 treatments and 7 repetitions of Bali beef. The treatments were: (P1) meat stored at room temperature (27°C-35°C) for less than 1 day (fresh meat), (P2) meat stored at 0°C-4°C for 1 day -2 days (cold meat), (P3) meat stored at a minimum temperature of -18°C with a storage time of 1-7 days (frozen meat). The variables observed in this study were the nutritional content of meat, namely water content, protein, fat, ash and carbohydrates as well as pathogenic bacterial contamination, namely Total Plate Count (TPC), Colliform and E-Colli. The results of this study showed that the nutritional content of water content and ash content in fresh, chilled and frozen meat had no significant effect. However, the protein content decreased significantly when the meat was frozen. The fat and carbohydrate content had the opposite result, namely, there was a significant increase when the meat was frozen. In terms of meat microbiological contamination on TPC, Coliform and E-colli variables, showed that frozen meat had the highest microbial population followed by fresh meat and cold meat had the lowest total pathogenic microbes.

Keywords---Bali beef, chilled meat, fresh meat, frozen meat.

Introduction

Meat is one of the livestock commodities that have high nutritional value because apart from being a source of highquality animal protein, meat is also a source of iron, vitamin B complex, fat, minerals and other substances that the body needs. The Provincial Government of Bali has issued Bali Governor Regulation Number 99 of 2018 concerning the Marketing and Utilization of Balinese Agricultural, Fishery and Local Industry Products. The Pergub also regulates the use of livestock products at least 30% of the needs of hotels and restaurants and at least 10% of the needs of the meat processing industry. To implement the Governor Regulation, especially for meat products, it is necessary to know the quality of meat in fresh, chilled or frozen form. This is very important to make a consumer consideration in choosing meat. The microbiological quality of meat is important to see aspects of meat safety, especially the contamination of pathogenic bacteria in meat which will later affect consumer health.

Meat is a food ingredient that is easily damaged or also known as perishable food, this is because meat contains quite good nutrients and has a favorable pH for microbial growth (Sarassati & Agustina, 2015), so common technologies are used in meat preservation such as refrigeration and freezing. Fresh meat, cold meat and frozen meat are types of meat that are grouped based on the physical condition of the meat. At present, many consumers consider the lack of quality of frozen meat compared to the quality of fresh meat and cold meat, making the market for selling frozen meat still lacking (Lu et al., 2022; Hu et al.,

al., 2022). This is supported by the results of research by Aritonang (2015), which suggests that as many as 70% of household consumers in the city of Padang prefer fresh meat becausethe quality of fresh meat is more guaranteed. Information from Balinese beef suppliers in Denpasar also complained about the difficulty of marketing frozen Bali beef in traditional markets (Sriyani et al., 2022). In addition to consumers' doubts about the hygiene of frozen meat, the lack of information about the quality of fresh, chilled and frozen beef also affects consumer tastes. Therefore, further research is needed to determine the nutritional content and microbial contamination of Bali beef under various fresh, chilled and frozen conditions (Qian et al., 2022).

Materials and Methods

The research material was a sample of beef loin in the Longissimus Dorsi (LD) muscle from a 3.5-year-old male Bali cattle with a slaughter weight of ±350 kg slaughtered at the Mambal Abiansemal Animal Slaughterhouse (RPH) Badung Bali. The samples consisted of 3 types, namely: fresh Bali beef, chilled Bali beef, and frozen Bali beef. The total number of samples used was 21 samples of loin Bali beef, each repeat sample weighing 250 g, divided into 7 samples of fresh Bali beef, 7 samples of chilled Bali beef and 7 samples of frozen Bali beef. For fresh meat stored at room temperature (27°C-35°C) with a storage time of less than 1-day, cold meat stored at cold temperatures (0°C4°C) with a storage period of 2 days and frozen meat stored in the freezer at a minimum temperature of -18°C with a storage time of 7 days (frozen meat).

Experimental design

To find out the differences in nutrient content and microbial contamination of fresh, chilled and frozen Bali beef, it was carried out using a Completely Randomized Design (CRD) with a 3x7 pattern, namely with 3 treatments of Bali beef, namely:

- Treatment 1 (P1) = Bali beef stored at room temperature (27°C -35°C) for less than 1 day (fresh meat);
- Treatment 2 (P2) = Bali beef stored at 0°C - 4°C for 2 days (cold meat);
- Treatment 3 (P3) = Bali beef stored at -18°C for 7 days (frozen meat).

Each research treatment was repeated 7 times so that the total sample required was 3x7 = 21 samples.

Meat chemical quality test method

Water content

The water content was determined directly using an oven at 1050C. First, the empty cup is dried in the oven at 1050C for 15 minutes and cooled in a desiccator, then weighed. A total of 1.5 grams of sample was put in a cup that had been weighed and then dried in an oven at 1050C for 3-4 hours. The cup containing the dried sample was then transferred to a desiccator, cooled for 30 minutes and then weighed. Drying was carried out until a constant weight was obtained. Calculation of water content can be calculated by the formula:

$$\% \text{ Moisture Content} = \frac{(\text{initial sample weight} - \text{final sample weight})(g)}{\text{initial sample weight}(g)} \text{ x } 100\%$$

Protein content

A total of 0.3 grams of sample was placed in a vapodest tube and added 1 grain of selenium catalyst and 5 ml of concentrated H2SO4, then digestion (heated to a boiling state) for 1.5 hours until the solution was clear. After cooling, 50 ml of distilled water and 20 ml of 40% NaOH were added and then distilled. The

water and 20 ml of 40% NaOH were added and then distilled. The distillation results were collected in an Erlenmeyer flask containing a mixture of 20 ml of H3BO3 and 2 drops of pink-green bromine cresol. After the volume of the reservoir (distillate) became 100 ml and bluish, the distillation was stopped and the distillate was titrated with 0.1 N HCL until it turned pink. The same treatment was also applied to blanks. With this method, the crude protein content is obtained which is calculated by the formula:

$$\% \text{ Crude Protein Content} = \frac{(S-B)\ x\ 0{,}1\ x\ 14\ x\ 6{,}25}{W\ x\ 1000}\ \text{x } 100\%$$

Note:
S: sample titrant volume
B: Blank titrant volume
W: dry sample weight

Fat level
Determination of fat content by the Soxhlet method. A sample of 2 grams of meat (A) was weighed and wrapped in filter paper and put in a tin, dried in an oven for 9 hours at 1050C. The soxtherm tube is dried in an oven for 3 hours at 1050C, then cooled in a desiccator and weighed (B). After drying, put the lead-containing sample into the Soxtherm tube, and fill the Soxtherm tube with 200 ml of n-Hexane until the sample is completely immersed. Extraction for 4 hours in the Soxtherm apparatus, then dry the Soxtherm tube in a forced oven for 15 minutes then dry it for 3 hours in a dry oven with a temperature of 1050C, cool in a desiccator for 30 minutes, weigh the Soxtherm tube containing fat extract ©. The percentage of fat content is calculated as follows:

$$\text{Fat content } (\%) = \frac{\text{C} - \text{B}}{\text{A}}\ x\ 100\%$$

Note:
A: sample weight (grams)
B: soxtherm tube weight (grams)
C: soxtherm tube weight + fat extract (grams)

Ash content
The porcelain cup was heated in an oven at 100-1050C for 30 minutes, then cooled in a desiccator and weighed until a constant weight was obtained. A total of 1 gram of meat sample was put into a porcelain cup and weighed, then burned until no longer smoking and roasted in a furnace at 6000C for 3 hours until it was white and the weight was constant. Turn off the furnace, leave it for 12 hours then cool it in a desiccator for 30 minutes. After that, the sample was weighed.

$$\text{Ash content } (\%) = \frac{\text{weight of ash}}{\text{weight of sample}}\ \text{x } 100\%$$

Microbiological quality test
Total Plate Count (TPC)
The steps for the TPC test were: smoothing the sample (beef) and weighing 5 grams of the sample. According to Waluyo (2008), the dilution stage starts with making a sample solution of 10 ml (a mixture

of 1 ml/gram sample and 9 ml of peptone solution). Take 1 ml of the solution and put it in the next test tube so that the desired dilution is obtained. Then take the solution from the last 2 test tubes (10-7 and 10-8), pour it into the petri dish, then add the media in the form of agar and rotate it like number 8 so that the sample and media are evenly mixed and solidify, then the tube is incubated at 37oC for 2 x 24 hours. The number of bacterial colonies can be calculated using the following formula:

$$\text{CFU} = \frac{\text{number of bacterial colonies}}{\text{dilution factor}} \times \textit{sampels poured}$$

Total coliform and escherichia coli

The method used to obtain total Escherichia coli and Coliform bacteria was the scatter method (Fardiaz, 1989) using EMBA media, namely as much as 5 grams of beef is put into an Erlenmeyer tube containing 0.1% peptone water solution with a volume of 45 ml so that a 10-1 dilution was obtained. This 10-1 dilution is then homogenized and diluted again by taking 1 ml through a pipette and then putting it into a test tube which already contains 9 ml of peptone solution so that 10-2 and 10-3 dilutions are obtained.

From the 10-1 dilution, 0.1 ml was taken using a sterile pipette and then poured on the surface of the solid EMBA media into a petri dish and then incubated at 37oC in an inverted state, and the results can be calculated after 24-48 hours. Planting was carried out at dilution levels of 10-1, 10-2and 10-3. To count the growing bacterial colonies using the cup count method, namely by selecting the number of colonies that grew in Petri dishes ranging from 30 - 300 colonies (Fardiaz, 1989).

$$\text{Formula: Colonies/gram} = \text{Number of Colonies per cup x } \frac{1}{\text{dilution factor}}$$

Statistical analysis

Data on nutrient content and microbial contamination of the meat obtained were analyzed using variance. If there is a significant difference ($P<0.05$) between treatments, then the analysis is continued with Duncan's multiple range test (Steel & Torrie, 1993). The analysis was assisted by the SPSS 20 program. The microbial data obtained before being analyzed were first transformed into a log x form.

Results and Discussion

Chemical quality of fresh, chilled and frozen Bali beef The results of the statistical analysis of testing the chemical content of meat (moisture content, protein content, fat content, ash content and carbohydrates) of fresh, chilled and frozen Bali beef can be seen in Table 1.

Table 1. Results of the nutritional content of fresh, chilled, and frozen Bali beef

Variable	Treatment [(1)]			SEM[(2)]
	P1	P2	P3	
Water Content (%)	72,18[a]	72,51[a]	71,94[a]	0,14
Protein Content (%)	24,26[a]	23,86[a]	23,14[b]	0,16
Fat Content (%)	1,97[b]	2,07[b]	2,32[a]	0,54
Ash Content (%)	1,10[a]	1,15[a]	1,10[a]	0,025

Note:
1. P1 : Bali beef in fresh condition
P2 : Bali beef in cold condition
P3 : Bali beef in frozen condition
2. SEM is "Standard Error of Treatment"

The results showed that there was no difference in meat water content (P>0.05) between fresh, chilled and frozen meat. Moisture content directly affects the quality of food ingredients. Moisture content is one of the determining factors for spoilage of food, including beef. Water contained in food is an excellent bacterial medium for the growth of pathogenic bacteria. The results of research on water content showed that the average moisture content of fresh, chilled and frozen meat ranged from 71-73 percent. This water content range is included in the normal category of beef moisture content according to the USDA, which is between 63-74 percent. Research Ernawati et al. (2018),obtained water content that was not significantly different between fresh, chilled and frozen beef in traditional markets and supermarkets. Research Diana et al. 2018 also obtained water content in fresh and thawed frozen meat statistically not significantly different with several thawing methods. A research study by Leygonie et al. (2012), reported that freezing causes water loss in meat because during freezing ice crystals form between and inside the meat fibers which physically damage the ultra-structure of meat fibers which causes there is no absorption of moisture into the intracellular space after the meat is thawed so that frozen meat has a lower water content. Ice crystals are formed by drawing water from the intracellular space into the intercellular space of the meat fibers. In this study, quantitatively, there was a decrease in the water content in frozen meat although not significantly different.

The results of this study showed a decrease in protein content in frozen meat (P<0.05). Protein Content Protein is a determining factor in determining the quality of a product in terms of product chemical properties. The results are shown in Table 1. The protein content between fresh and chilled meat was not significantly different, but frozen meat thawed at room temperature showed a significant decrease (P<0.05) compared to fresh and chilled Bali beef. This is due to the arena in which frozen meat during thawing experiences drip (drip loss). The liquid or drips that come out during the thawing process has the potential to reduce protein levels because some nutrients dissolve and are lost with the water. This is following the opinion of Badrin et al. (2019), who stated that the low protein content can be suspected due to drip loss, namely the liquid that comes out of the product. Another thing is also due to the hydrophilic nature of the protein, so it may dissolve with water (drips). This is following the opinion of Wulandari & Rahayu (2014), who stated that the hydrophilic nature of protein allows these components to dissolve and disappear with drips. Protein content in this study ranged from 23-25%. This range of protein levels is still included in the range of good-quality meat. Soeparno (2015), stated that the protein content of meat ranged from 19-22%. Freezing meat is one way of preserving meat, namely by freezing meat below the freezing point of the liquid contained in the meat, the freezing point of meat at a temperature of -20oC to -30oC. Meat that was stored at a less than optimal temperature (≥--20oC in this study (-180C) was probably produced by a slow freezing process. Slow freezing plus a length of storage may reduce the quality of frozen meat. Slow freezing will produce more liquid frozen meat (drip) including protein, which will reduce the quality of frozen meat, especially protein. Freezing speed determines the size of the ice crystals formed which will ultimately affect the quality of the product, in fast freezing soft ice crystals will form and if the freezing temperature decreases very quickly ultramicroscopic (very soft) ice crystals will form, the crystals formed will affect the amount of liquid which comes out when the meat is thawed again (drip), so it will affect the amount of liquid in the meat (Gracey, 1986). In cold meat, the protein content does not decrease significantly because the drip occurs very minimally.

The fat content in this study between fresh and chilled meat was not significantly different but in frozen meat there was a significant increase in fat content (P<0.05). The occurrence of drip during the thawing process causes water to come out of the meat but the fat contained in the meat cannot dissolve in water which causes the fat content to increase (Peck et al., 2005; Huang et al., 2022). The fat content of meat has a negative correlation with the water content of the meat, the higher the fat content, the lower the

water content of the meat (Minish & Fox, 1979). In this study, the water content in frozen meat was quantitatively the lowest. This is not following the research of Diana et al. (2018), who stated that thawing in general still maintains the chemical quality of frozen meat under normal conditions. Kartika et al. (2016), also stated that at temperatures of ≥40ºC, some proteins will be denatured, but they have not been able to exceed the melting point of fatty acids, so only a small amount of fat is degraded.The ash content of a food ingredient indicated the presence of inorganic mineral content in that food. Given the diversity of existing mineral sources, ash analysis is very important to determine nutritional quality and is often used as an indicator of food quality (Kanatt et al., 2005). In this study, the ash content of fresh, chilled and frozen meat did not show a significant difference (P>0.05). This is due to the possibility that what dissolves in the water that comes out of the meat/rips during the thawing process in frozen water is dissolved protein, not minerals. Especially proteins that are soluble in water. Dissolved proteins that may be lost with water during the thawing process include albumin and myoglobin proteins which are responsible for giving the red color to the meat. This is following the opinion of Aritonang (2015), which states that the components of water-soluble nutrients will also be lost with water during thawing, including albumin and myoglobin which is classified as sarcoplasmic proteins.

Microbiological quality of fresh, chilled and frozen Bali beef

The results of statistical analysis showed that the total plate count (TPC) of fresh Bali beef (P1) (2.3 x 105 cfu/g) chilled (P2) (1.8 x 105 cfu/g) and frozen (P3) (4, 9 x 108 cfu/g) was statistically significantly different (P<0.05). Tilapia TPC cold meat is the lowest followed by fresh meat and frozen meat. Total Coliform and E-Colli also showed the same trend as TPC where the lowest population was cold meat followed by fresh meat and the highest population was frozen meat (Table 2).

Table 2. Microbiological quality of fresh, chilled and frozen Bali beef

Variable	Treatment (1)		
	P1	P2	P3
TPC (*Total Plate Count*) (cfu/g)	$2,3 \times 10^{5b}$	$1,8 \times 10^{5a}$	$4,9 \times 10^{8c}$
Total *Coliform* (cfu/g)	$1,6 \times 10^{5a}$	$1,5 \times 10^{5a}$	$3,5 \times 10^{8b}$
Total *E-Colli* (cfu/g)	$9,2 \times 10^{3b}$	$6,1 \times 10^{3a}$	$1,4 \times 10^{7c}$

Note:

1. P1 : Bali beef in fresh condition
P2 : Bali beef in cold condition
P3 : Bali beef in frozen condition

The results showed that the TPC, Coliform and E-Colli values showed significantly different results (P<0.05). The lowest value of microbial count was in cold meat, followed by fresh meat and the highest microbial count was in frozen meat (Huffman, 2002). The low microbial population in cold meat is because storage at cold temperatures can slow down the growth of the microbial population. Candradewi & Priyanto (2000), Storage at a cold temperature of 50C can slow down damage by microbes in meat. In fresh meat, the high microbial population is thought to be due to the influence of the treatment of the meat during the cutting process. Initial microbial contamination in meat can occur at the time of slaughter, the tools used for removing blood are not sterile and others. Fresh meat that is at room temperature tends to develop more microbes than meat at cold temperatures (Pearce et al., 2011; Joo et al., 2013). The high population of frozen meat is caused by drip that occurs when the meat is thawing. The increase and decrease in the number of microbes can be influenced by the length of freezing, where each meat has a

a different moisture content, the higher the water content is not chemically bound, the more microbes will grow (Wulandari & Rahayu, 2014). The crystallization process forms ice in frozen meat and the water is chemically bound, so the water cannot be used by microorganisms, but if the thawing process is carried out again, the water can vice versa be used by microorganisms to reproduce (Buckle et al., 1987). Therefore, the role of water is very influential in the growth of microorganisms, so the material that has been thawed must be processed immediately to prevent the growth of more microorganisms. The results of this study are following the results of Dewi (2012), study which also found a higher TPC population in frozen meat than fresh meat.

Conclusion

The results of this study showed that the nutritional content of water content and ash content in fresh, chilled and frozen meat had no significant effect. However, the protein content decreased significantly when the meat was frozen. On the microbiological contamination of meat on the variable TPC, Coliform and E-colli showed that frozen meat had the highest microbial population followed by fresh meat and cold meat had the smallest total pathogenic microbes.

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Evaluation of Water Balance in the Jaro Irrigation Area, Tabalong Regency, South Kalimantan Province

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A B S T R A C T

In the Tabalong Regency, South Kalimantan Province, many irrigation networks have not worked optimally. The Jaro Irrigation Area is one of these irrigation networks, the majority of available fields are planted with Paddy. Evaluation of irrigation water to irrigate paddy fields is very important for optimal growth and development of paddy. The objective of this research is to evaluate the water balance, the potential area for paddy field area development can be obtained by applying the optimal crop pattern. Analysis of the rainfall data used in this study with statistical analysis in the form of validation and correction of rainfall data. Rainfall data wereobtained from the Tropical Rainfall Measurement Mission (TRMM) and the Meteorology, Climatology, and Geophysics Agency (BMKG) Jaro Station in the period 2013-2019, the data using statistical analysis obtained a correlation coefficient and regression equation. The regression equation is used to obtain the corrected rainfall value which will be used in the hydrological analysis. Water requirement analysis with several cropping pattern scenarios. Calculation of evapotranspiration using the Modified Penman method. The F.J. Mock method is used to develop the discharge value. Dependable discharge, 80%, is used to estimate water availability. Furthermore, an evaluation of the water balance is carried out for each scenario, and the result of information on surplus or deficit conditions can be obtained each month. Analysis of water demand discharge based on planting scenarios is divided into three. First Scenario with a high-yield paddy - a high-yield paddy according to the existing conditions at the research location. The second scenario is with a high-yield paddy - high-yield paddy - beans and the third scenario is with a high-yield paddy - paddy. According to the results of the water balance evaluation for the three scenarios, the potential area can be reached up to 900 ha from 850 ha with the chosen crop pattern in scenario number 2.

Keywords---Crop pattern, DI Jaro, water availability, water balance, water demand.

Introduction

In the Tabalong Regency, South Kalimantan Province, many irrigation networks have not been used optimally (Sujono, 2022). One of them is the Jaro Irrigation Area, business in the agricultural sector is dominated by rice plants, so the need for irrigation water to irrigate rice fields is very important for rice growth. The water balance is a description of the evaluation of water entering and leaving a hydrological system (DAS, reservoirs, lakes, runoff) in a certain period (Abdul-Ganiyu et al., 2015). The water balance can be used to determine the surplus or deficit of a hydrological system so that further action can be taken to overcome this (Putra et al., 2018).

In 2018, Jaro District had a rice harvest of 16,651 tons, with details of 12,750 tons of paddy rice and 3,901 tons of field rice. As for food crops other than rice, the biggest harvest was cassava with 275 tons. Rubber plants are plantation crop commodities that have the largest production in 2018, which is 6,328 tons with a planting area of 3,229 hectares (Hidayat et al., 2022).

Tabalong Regency with red-yellow Podzolic soil type with sedimentary rock parent material which is easily eroded. The slope is dominated by land with a low slope (0-5%), the rest has a moderate slope (15-40%) and more than 40%. The effective soil depth averages over 90 cm (97.8%), and the soil is mostly fine-textured (Akas et al., 2018).

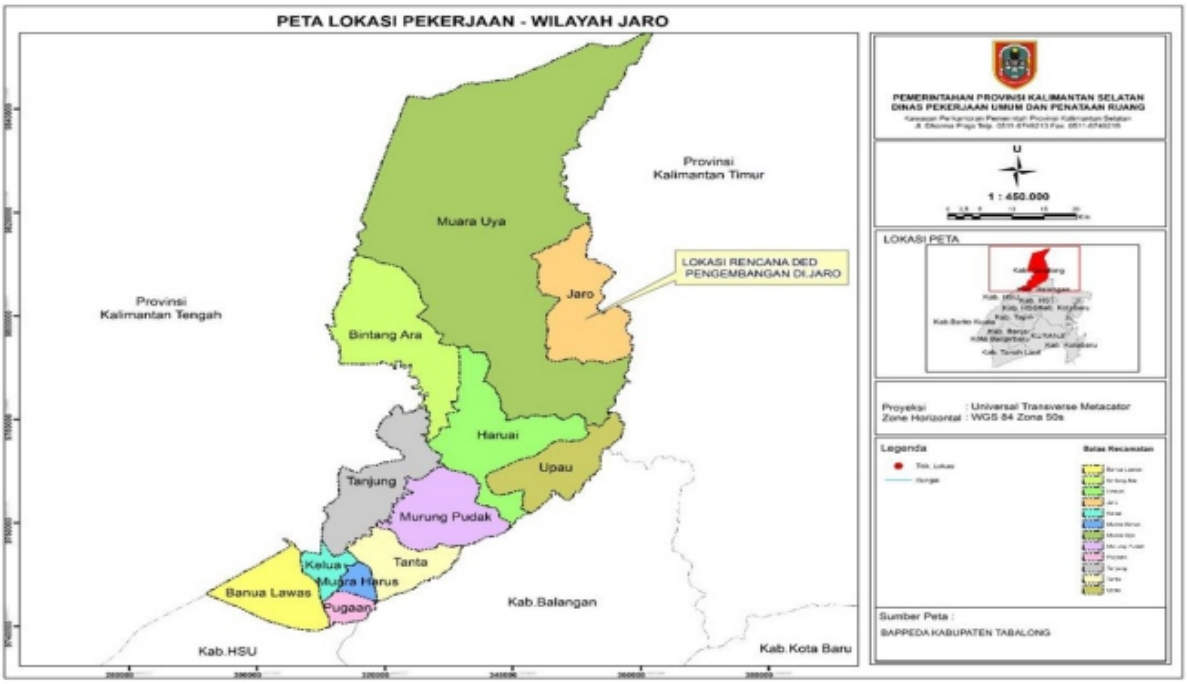


Figure I. DI Jaro, Tabalong Regency (Source PUPR Kalsel 2020)

Jaro District is an administrative area of Tabalong Regency with an altitude of 1500 meters above sea level. This sub-district is located between 2º south latitude and 166º east longitude. It is bordered to the north by North Kalimantan Province, to the east by Muara Uya District, to the south by Muara Uya District, and to the west by East Kalimantan Province (Budi, 2021).The water balance is one of the most important aspects of the hydrological system. The water balance is a comparison between the potential availability of water and the demand for water in a certain place in a certain period(Pamadya et al., 2022; Azmeri et al., 2019). Water balance analysis studies can find out whether the amount of water needed is in excess (surplus) or vice versa experiences a deficiency (deficit) (Qarinur et al., 2022; Duffková et al., 2019). By knowing these two factors, the utilization of water can be managed as well as possible (Zhao et al., 2023). Reliable debit or availability of discharge is a discharge that can be relied on in a river, both in the dry season and especially the rainy season. Several methods can be used to determine this reliable discharge, such as the empirical method, namely the FJ Mock method. Calculations using the FJ Mock method are based on approximate calculation approaches using rain data, climatology, and land cover vegetation (Sihombing et al., 2021).

Provision of irrigation water that is not appropriate, whether it is excess or deficiency will harm the growth of rice plants, so the discharge of irrigation water needs must be calculated and adjusted to the available irrigation area(Hariyadi, 2020). For this reason, optimizing maximum yields in DI Jaro with an evaluation of the available water balance. The purpose of this research is to evaluate the water balance in the Jaro Irrigation Area so that the potential area for land development can be obtained by applying the right cropping pattern (Singh et al., 2001; MartínezCasasnovas et al., 2005).

Method

The data used in this study is TRMM (Tropical Rainfall Measurement Mission) rainfall data obtained by accessing the site on the internet page, namely https://giovanni.gsfc.nasa.gov/giovanni from 2000-2019. Observational rainfall data were obtained from Jaro rain gauge data for 2013-2019 and the climatological data used was in the form of monthly data for 2000-2019, namely air humidity, air temperature, wind speed, and solar radiation obtained from the BMKG (Geophysics and Climatology Meteorology Agency). at Syamsudin Noor station. Before being used for data analysis, it is necessary to validate and correct TRMM rainfall data for 2000 – 2019 with observation posts using the Correlation Coefficient method which produces a determination value and continues data correction by selecting the regression equation with the highest determination value. The regression equation used is linear, geometric, logarithmic, and exponential regression (Gichamo et al., 2022; Ezuar et al., 2018). The criteria for the determination value (R2) according to Setyorini & Hardaningrum (2020), is a very low interpretation is 0.00-0.199, Low is 0.20-0.399, moderate is 0.40-0.599, strong is 0.60-0.799 and very strong is 0.80-1.000. After correcting the rainfall data, the data can be used in the analysis of rainfall in the calculation of the water balance.

Oldeman's classification is based on the amount of water needed by plants, especially rice (Ikhwali et al., 2022;Canet-Martí et al., 2023). In the Oldeman climate classification, wet months are determined when rainfall is more than 200 mm/month, dry months when rainfall is less than 100 mm/month, and humid months when rainfall is between 100-200 mm/month according to Oldeman (Qarinur et al., 2022; Ariyani et al., 2020). Calculation of the potential evapotranspiration value using the Penman formula Modification and effective rainfall for rice based on the KP-01 formula (2013), namely Re paddy = (R80 x 0.7) and pulses = (R80 x 0.5) observation period, R80 value is rainfall The mainstay is obtained from the Weibull equation.

Discharge analysis for calculating water availability uses the F.J. Mock method. The mainstay discharge is the minimum discharge of the river with the probability that the discharge is fulfilled in the percentage of 80% (Duffková et al., 2019; Liu et al., 2020). Analysis of water needs based on KP-01 with the calculation of water demand discharge based on planting scenarios (number of growing seasons and cropping pattern). Supporting data are evapotranspiration (Eto), calculation of effective rainfall (Re), planting area, cropping pattern, and TRMM climatological data. Water balance analysis with a comparison of water demand and water supply discharges, water demand discharge based on planting scenarios, and water availability discharges is the flow rate of the F.J. Mock method. If there is a water deficit, a change in the cropping pattern or a change in the schedule is made (Döll et al., 2003; Huber et al., 2011).

Results and Discussion

Data validation and correction

Rainfall validation and correction analysis was carried out using monthly TRMM rainfall data locations in DI Jaro monthly correlated with monthly rainfall data observed for the Jaro rain post for a period of 7 years from 2013 - 2019 Table 1. Regression Equation and Determination Value (R2) of Rainfall and Air Temperature TRMM.

Table 1. Regression equation values and TRMM rainfall determination values

Month	Regression Equation	Determination Value (R^2)	Interpretation
January	y = 0.4562x + 167.18	0.60	Strong
February	y = 0.9907x + 52.69	0.76	Strong
March	y = 0.244x + 238.72	0.09	Very low
April	y = -0.2809x + 334.2	0.07	Very low
May	y = 0.7091x + 21.487	0.85	Very strong
June	y = 0.266x + 143.59	0.11	Very low
July	y = 0.4623x + 56.881	0.62	Strong
August	y = -0.0527x + 132.52	0.00	Very low
September	y = 0.6999x + 19.728	0.42	Currently
October	y = 0.6112x + 58.495	0.70	Strong
November	y = 0.1101x + 272.16	0.05	Very low
December	y = -0.0487x + 323.77	0.00	Very low

From the results of Table 1 above the correlation between rainfall data from January to December in 2000 – 2019 TRMM rainfall data and observation data obtained a very strong coefficient of determination in May with a value of 0.85. The coefficient of determination is strong in January, February, July, and October with a value of 0.60 –0.76. The coefficient of determination is moderate in September with a value of 0.40 – 0.42. The coefficient of determination is very low in March, April, June, August, November, and December with a value of 0.00 – 0.09.

According to Balai Dam (2019) if the correlation coefficient value is <0.60, then the rain post cannot be used to calculate flood discharge at the dam, however, for this research, it will continue to correct TRMM rainfall data.

Average rainfall

Analysis of changes in rainfall using corrected rainfall data. The data comes from the TRMM location in DI Jaro. The average rainfall value using corrected rainfall data can be seen in Table 2 below:

Table 2. Average monthly rainfall value

Month	Rainfall 2000-2019
Jan	281.97
Feb	277,84
Mar	300.78
Apr	234.54
May	124,37
Jun	176,16
Jul	87.50
Aug	122.39
Sept	44,32
Oct	108.35
Nov	233,46
dec	306,37

Average monthly rainfall data with maximum rainfall in December 306.37 mm and minimum in September 44.32 mm. Another parameter to determine changes in rainfall patterns is the shift in wet months, humid months, and dry months with Oldeman's classification. The results of the analysis can be seen in Figure 1. below:

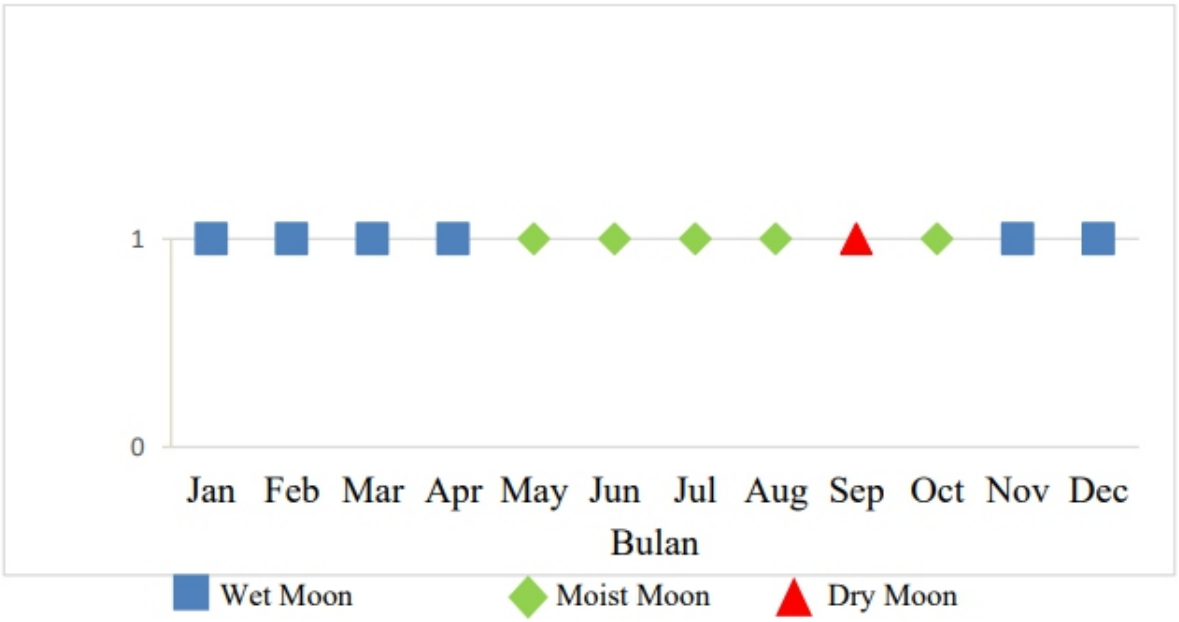
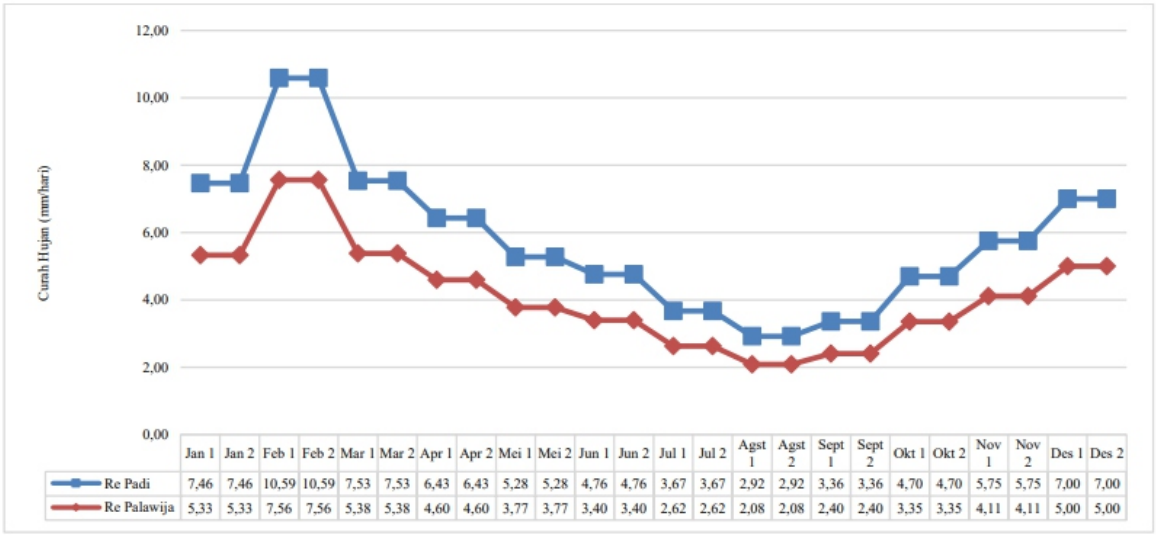


Figure 2. The shift of wet, wet, and dry months

Effective Rainfall

Effective rainfall is for Re padi and Re Palawija in DI Jaro using the corrected 15 daily average monthly TRMM data. The value of Rice Paddy and Rice Palawija is based on semi-monthly reliable rainfall data (R_{80}). The Weibull method is to sort from small to large. The results of calculating the effective rainfall for 15 days can be seen in Figure 2. as follows:



	Jan 1	Jan 2	Feb 1	Feb 2	Mar 1	Mar 2	Apr 1	Apr 2	Mei 1	Mei 2	Jun 1	Jun 2	Jul 1	Jul 2	Agst 1	Agst 2	Sept 1	Sept 2	Okt 1	Okt 2	Nov 1	Nov 2	Des 1	Des 2
Re Padi	7,46	7,46	10,59	10,59	7,53	7,53	6,43	6,43	5,28	5,28	4,76	4,76	3,67	3,67	2,92	2,92	3,36	3,36	4,70	4,70	5,75	5,75	7,00	7,00
Re Palawija	5,33	5,33	7,56	7,56	5,38	5,38	4,60	4,60	3,77	3,77	3,40	3,40	2,62	2,62	2,08	2,08	2,40	2,40	3,35	3,35	4,11	4,11	5,00	5,00

Figure 3. Re Paddy and Re Palawija

The results of the calculation of Re paddy for 15 days the maximum value is in February 1 and 2 with a value of 6.79 mm/day while the minimum value is in August 1 and 2 with a value of 1.03 mm/day. The results of the calculation of Re palawija for 15 days in 2000 - 2019 the maximum value is on February 1 and 2 with a value of 7.59 mm/day while the minimum value is on August 1 and 2 with a value of 2.08 mm/day.

Potential evapotranspiration

Calculation of potential evapotranspiration at the Jaro DI research site using the Modified Penman method. The climatological data parameters used from this method are the average monthly BMKG climatology, namely relative humidity (Rh), wind speed (U), solar radiation n/N, and air temperature (T). ETo calculation results, the maximum value in September is 4.33 mm/day, and the minimum value in June is 2.80 mm/day. The daily ETo value has increased and decreased in certain months. January to February increased by 0.47 mm/day, February to March decreased by 0.20 mm/day, March to April decreased 0.35 mm/day, April to May decreased by 0.08 mm/day, May to June decreased by 0.39 mm/day, June to July increased 0.37 mm/day, July to August increased 0.72 mm/day, August to September increased 0.44 mm/day, September to October decreased 0.30 mm/day, October to November decreased 0.11 mm/day, November to December decreased 0.04 mm/day.

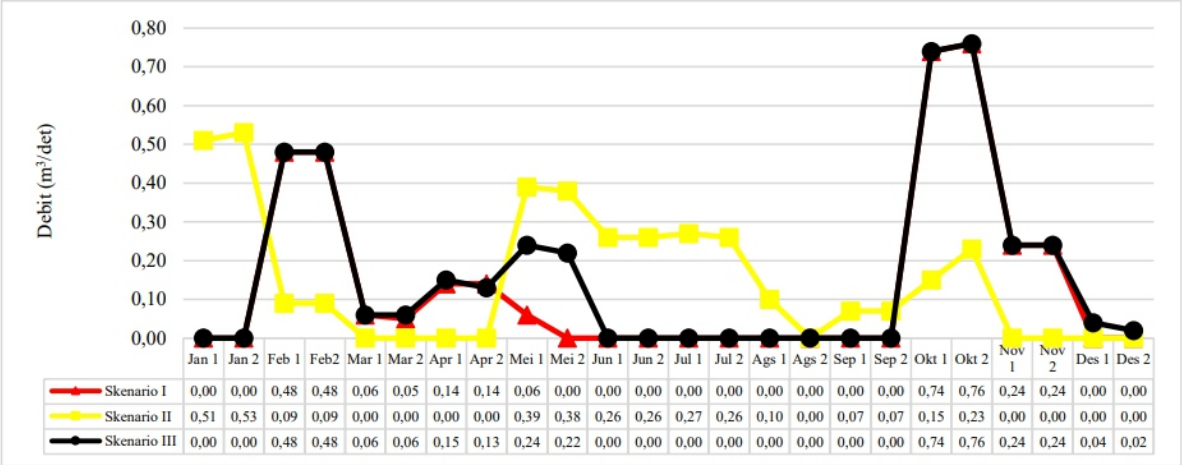
Table 3. Results of potential evapotranspiration (Eto)

Month	ETo mm/day
Jan	3.53
Feb	3.82
Mar	3,62
Apr	3,27
May	3,19
Jun	2.80
Jul	3,17
august	3.89
Sept	4,33
Oct	4.03
Nov	3.92
dec	3.88

Analysis of water needs

Analysis of the water needs of DI Jaro according to the scenario of the cropping pattern so that the water needs of the rice fields are met according to the planting area of 850 Ha. Scenario 1 is superior rice - superior rice with MT 1 scheduled for land preparation in October with a January harvest schedule, and MT 2 scheduled for land preparation in February with a harvest schedule in May. Scenario 2 is superior rice - superior rice - secondary crops with MT 1 scheduled for land preparation in January with an April harvest schedule, MT 2 scheduled for land preparation in May with a

harvest schedule in September, and MT 3 scheduled for land preparation in October with schedule harvest in December. Scenario 3 is superior rice – ordinary rice MT 1 is scheduled for land preparation in October with a January harvest schedule, MT 2 is scheduled for land preparation in February with a harvest schedule in May.

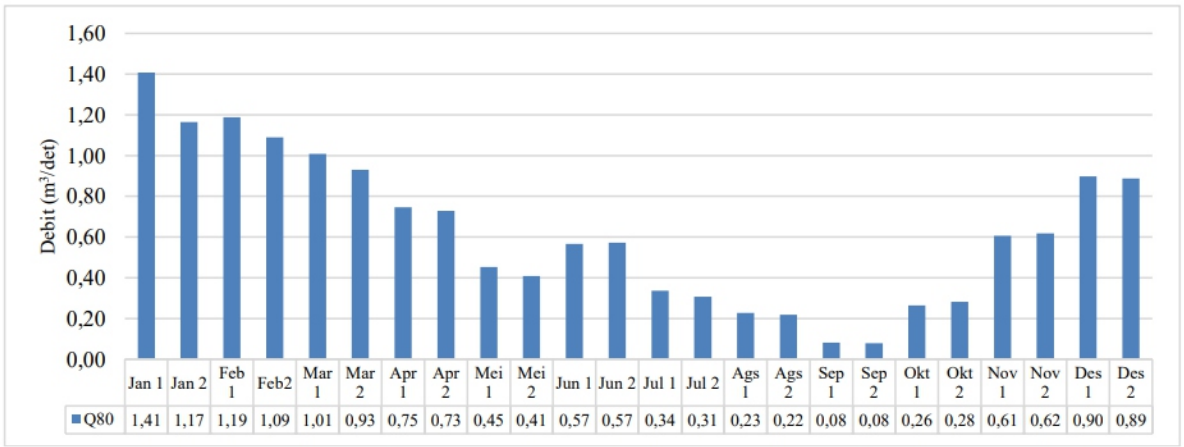


	Jan 1	Jan 2	Feb 1	Feb2	Mar 1	Mar 2	Apr 1	Apr 2	Mei 1	Mei 2	Jun 1	Jun 2	Jul 1	Jul 2	Ags 1	Ags 2	Sep 1	Sep 2	Okt 1	Okt 2	Nov 1	Nov 2	Des 1	Des 2
Skenario I	0,00	0,00	0,48	0,48	0,06	0,05	0,14	0,14	0,06	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,74	0,76	0,24	0,24	0,00	0,00
Skenario II	0,51	0,53	0,09	0,09	0,00	0,00	0,00	0,00	0,39	0,38	0,26	0,26	0,27	0,26	0,10	0,00	0,07	0,07	0,15	0,23	0,00	0,00	0,00	0,00
Skenario III	0,00	0,00	0,48	0,48	0,06	0,06	0,15	0,13	0,24	0,22	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,74	0,76	0,24	0,24	0,04	0,02

Figure 4. Water needs 3 scenarios

Analysis of water availability

Analysis of water availability in Jaro DI with an area of 1016 Ha so that the mid-month water availability discharge value is obtained using the Mock method. To find out the 80% reliable discharge is based on a debit value that is close to or equal to the probability (P) value of 80%, it can be seen in Table 4. as follows:

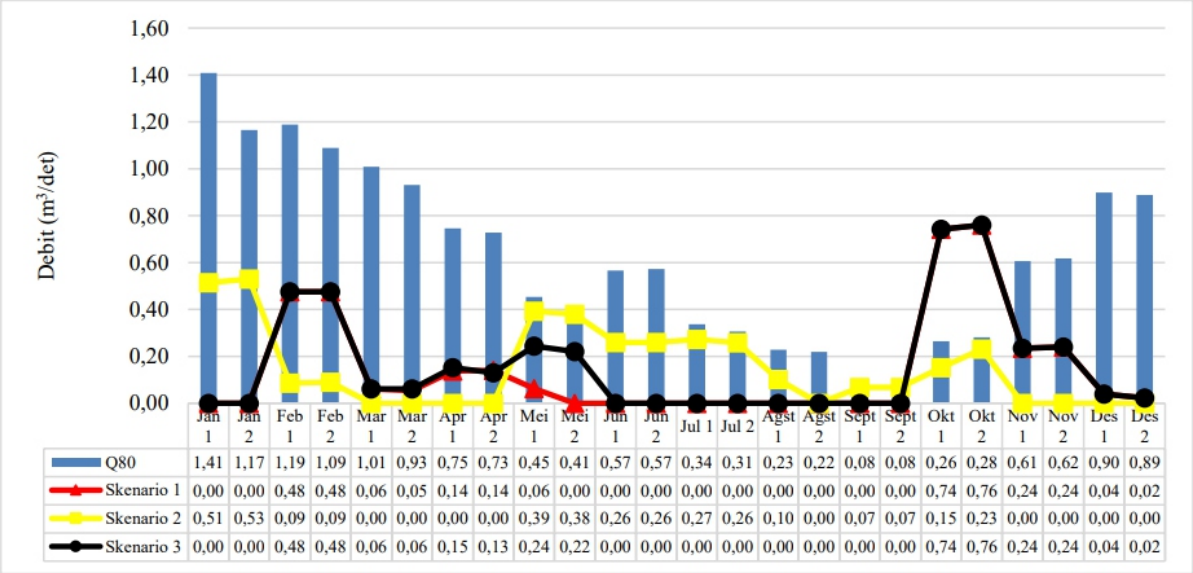


	Jan 1	Jan 2	Feb 1	Feb2	Mar 1	Mar 2	Apr 1	Apr 2	Mei 1	Mei 2	Jun 1	Jun 2	Jul 1	Jul 2	Ags 1	Ags 2	Sep 1	Sep 2	Okt 1	Okt 2	Nov 1	Nov 2	Des 1	Des 2
Q80	1,41	1,17	1,19	1,09	1,01	0,93	0,75	0,73	0,45	0,41	0,57	0,57	0,34	0,31	0,23	0,22	0,08	0,08	0,26	0,28	0,61	0,62	0,90	0,89

Figure 5. Water availability in an area of 1016 ha

Water balance analysis

The water balance with an area of 850 ha using the surplus and deficit of water is obtained from the results of reducing the discharge of water availability with water demand if the result is positive then it is a surplus and if it is negative then it is a deficit (Chen et al., 2010; Sun et al., 2006). From Figure 5 below, it can be concluded that the water deficit scenario 1 is October 1, and October 2. Scenario 2 does not have a water deficit month or all months have a surplus of water, meaning that the availability of water is sufficient to meet their needs. Scenario 3 water deficit on October 1, October 2.

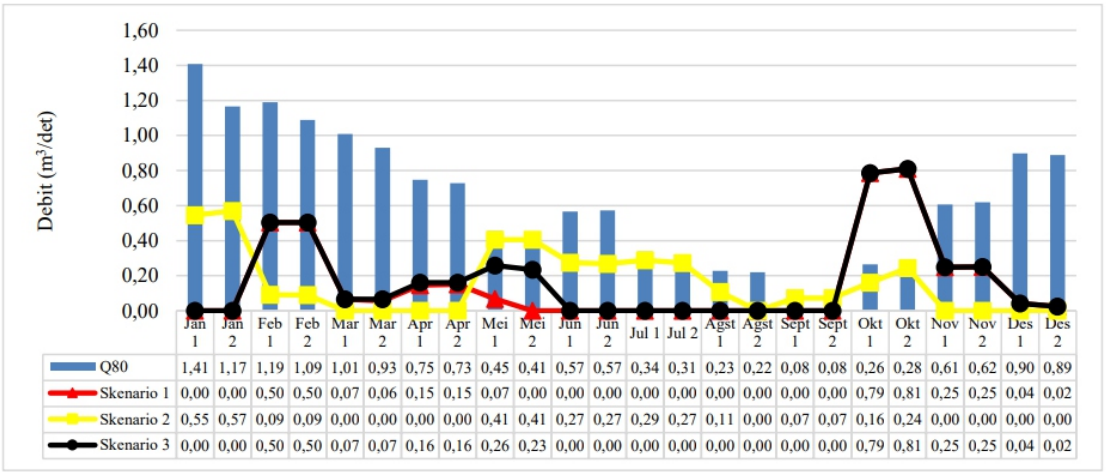


	Jan 1	Jan 2	Feb 1	Feb 2	Mar 1	Mar 2	Apr 1	Apr 2	Mei 1	Mei 2	Jun 1	Jun 2	Jul 1	Jul 2	Agst 1	Agst 2	Sept 1	Sept 2	Okt 1	Okt 2	Nov 1	Nov 2	Des 1	Des 2
Q80	1,41	1,17	1,19	1,09	1,01	0,93	0,75	0,73	0,45	0,41	0,57	0,57	0,34	0,31	0,23	0,22	0,08	0,08	0,26	0,28	0,61	0,62	0,90	0,89
Skenario 1	0,00	0,00	0,48	0,48	0,06	0,05	0,14	0,14	0,06	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,74	0,76	0,24	0,24	0,04	0,02
Skenario 2	0,51	0,53	0,09	0,09	0,00	0,00	0,00	0,00	0,39	0,38	0,26	0,26	0,27	0,26	0,10	0,00	0,07	0,07	0,15	0,23	0,00	0,00	0,00	0,00
Skenario 3	0,00	0,00	0,48	0,48	0,06	0,06	0,15	0,13	0,24	0,22	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,74	0,76	0,24	0,24	0,04	0,02

Figure 6. Water supply and water demand for 3 scenarios with a land area of 850 ha

Land development water balance analysis

The water balance for land development with an area of 900 ha using a surplus of water deficit is obtained from the results of reducing the debit of water availability with water demand if the result is positive then it is a surplus and if it is negative then it is a deficit (Herrera et al., 2010). From Figure 5 below, it can be concluded that the water deficit scenario 1 is October 1, and October 2. Scenario 2 does not have a water deficit month or all months have a surplus of water, meaning that the availability of water is sufficient to meet their needs. Scenario 3 water deficit on October 1, October 2.



	Jan 1	Jan 2	Feb 1	Feb 2	Mar 1	Mar 2	Apr 1	Apr 2	Mei 1	Mei 2	Jun 1	Jun 2	Jul 1	Jul 2	Agst 1	Agst 2	Sept 1	Sept 2	Okt 1	Okt 2	Nov 1	Nov 2	Des 1	Des 2
Q80	1,41	1,17	1,19	1,09	1,01	0,93	0,75	0,73	0,45	0,41	0,57	0,57	0,34	0,31	0,23	0,22	0,08	0,08	0,26	0,28	0,61	0,62	0,90	0,89
Skenario 1	0,00	0,00	0,50	0,50	0,07	0,06	0,15	0,15	0,07	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,79	0,81	0,25	0,25	0,04	0,02
Skenario 2	0,55	0,57	0,09	0,09	0,00	0,00	0,00	0,00	0,41	0,41	0,27	0,27	0,29	0,27	0,11	0,00	0,07	0,07	0,16	0,24	0,00	0,00	0,00	0,00
Skenario 3	0,00	0,00	0,50	0,50	0,07	0,07	0,16	0,16	0,26	0,23	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,79	0,81	0,25	0,25	0,04	0,02

Figure 7. Water supply and water demand for 3 scenarios with a land area of 900 ha

Analysis of rainfall on the water balance of DI Jaro using TRMM rainfall and air temperature data which was previously validated and corrected with Jaro rain post-observation data. The results of data validation using the Correlation Coefficient method which produces a determination value with a strong to very strong interpretation is then corrected using the selected regression equation value according to the largest R2 value. TRMM data after correction is used for rainfall analysis and water balance analysis. Changes in rainfall, namely an increase in monthly rainfall in the shifting months of wet, humid, and dry months.

As a result of changes in rainfall, there is an increase in the value of effective rainfall and evapotranspiration as parameters in calculating water demand and availability (De Fraiture & Wichelns, 2010; Olmstead et al., 2007). Water demand discharge scenario 1 is a planting scenario according to existing conditions on October 1 and 2. Scenario 2 does not have a water deficit month or all months have a surplus of water, meaning that the availability of water will meet their needs. Scenario 3 in the month of the deficit on October 1 and 2.

Conclusion

Analysis of water demand discharge based on planting scenarios is divided into 3 scenarios. scenario 1 with a cropping pattern of superior rice - superior rice according to existing conditions, scenario 2 with a cropping pattern of superior rice - superior rice - secondary crops, and scenario 3 with a superior rice cropping pattern - ordinary rice. Scenario 1 discharge water demand maximum value on October 1 is 0.74 m3/s and October 2 is 0.76 m3/s, Scenario 2 maximum value on January 1 is 0.51 m3/s and January 2 is 0. 53 m3/s, Scenario 3 maximum value on October 1 is 0.74 m3/s and October 2 is 0.76 m3/s. Analysis of the highest peak water availability discharge occurred on January 1 with a discharge value of 1.41 m3/s and February 1 with a discharge value of 1.19 m3/s while the minimum discharge occurred on September 1 of 0.08 m3/s and the month September 2 of 0.08 m3/sec. From the results of the data on water availability and water demand, the potential for land development and the application of the right cropping pattern is obtained by 50 ha with the application of the Scenario 2 cropping pattern with the MT 1 schedule for land preparation in January with the April harvest schedule, the MT 2 schedule for land preparation in May with harvest schedule in September, MT 3 land preparation schedule in October with harvest schedule in December.

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Nutritional Content and Sensory Properties of Sere Kedele from Various Producers in Gianyar Regency, Bali

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ABSTRACT

Sere kedele is a traditional food from fermented soybeans produced by people on the southeast coast of Bali. The purpose of this study was to determine the nutritional content and sensory properties of sere kedele from various producers in Gianyar Regency. The survey results showed that in Gianyar Regency there are 4 producers of sere kedele, namely 2 producers in Blabatuh Village (Banjar Pokas and Banjar Teruna), 1 producer in Sukawati Village, and 1 producer in Buruan Village. Sere kedele products were sampled from all producers and then analyzed for its nutritional content and sensory properties. The design used was a Completely Randomized Design (CRD) with 4 replications. The results of the analysis showed that the water content of sere kedele ranged from 57.68% to 60.84%, ash content from 2.24% to 3.06%, fat content from 7.84% to 12.40%, dissolved protein content from 2.18% to 4.30%, carbohydrate content from 22.77% to 26.51%, glutamic acid content from 0.52 % to 6.97 %, total microbes from 10.78 log cfu/ml to 11.50 log cfu/ml, total lactic acid bacteria from 10.54 log cfu/ml to 10.77 log cfu/ml. Sensory properties of sere kedele for color ranged from yellow to yellowish brown with criteria liked, aroma from disliked to liked, taste from fair to savory with criteria from disliked to very much like, and overall acceptance ranged from dislike to very much like. Sere kedele in Banjar Teruna, Blahbatuh Village, had the best nutritional content and sensory properties, with water content of 57.68%, ash content of 2.85%, fat content of 12.40%, soluble protein content of 4.30%, carbohydrate content of 22.77%, glutamic acid of 6.79 %, total microbes of 10.78 log cfu/g, total lactic acid bacteria of 10.77 log cfu/g, had a yellowish-brown color with criteria like, like for aroma, very much like for its savory taste and very much like for the overall acceptance.

Keywords---Gianyar Regency, nutritional content, sensory properties, sere kedele.

Introduction

One of the traditional Balinese food made from soybeans through spontaneous fermentation is sere kedele. Sere kedele is still found in several regencies in Bali, such as in Gianyar and Klungkung regencies. Sere kedele as a traditional food plays an important role in the fulfillment of nutrition for the community, since soybean is a nutrient dense food. Soybeans contain amino acids and isoflavone aglycones compounds which are beneficial for health. Isoflavones can reduce DNA damage caused by cyclophosphamide (Ribeiro et al., 2007), suppress lipoprotein oxidation (Takahashi et al., 2005), and reduce the risk of cardiovascular disease (Rimbach et al., 2008). Sere kedeleis derived from the word sere which means shrimp paste and kedele which means soybeans. Balinese people generally recognize

terasi as sere, where the word sere is used due to the aroma produced from the mixture of fermented soybeans and the spices resemble the aroma of shrimp paste (Widyantari et al., 2017). Sere kedele is generally produced by home industries traditionally which is consumed as a complement or substitute for side dishes and sere kedele is mixed with rice to obtain a menu combination to improve protein quality and digestibility (Sutiariet al., 2011; Widyantari et al., 2017).The fermentation process in sere kedele is carried out spontaneously because there is no addition of other ingredients which trigger the fermentation process.

Fermentation time varies from producer to manufacturer. Generally, fermentation is carried out for 2 days in a closed or slightly open container. After the fermentation is complete, the spices are added and the sere kedele is ready to be consumed. Sere kedele photo can be seen in Figure 1.

Figure 1. *Sere kedele* (private collection)

Sere kedele is like fermented soy products. Fermented soybean products include tempeh, soy sauce, miso, and natto. Making sere kedele is almost similar to making natto in Japan. The process of making natto goes through the stages of cleaning and sorting dry soybeans, soaking, sorting wet soybeans, steaming, inoculating the Bacillus subtilis natto, transferring into containers, then continuing with the fermentation process and sorting the products. Usually, natto is eaten for breakfast along with rice (Sahirman, 2019; Chan et al., 2021). Both products have a slightly slippery (sticky) texture and have a distinctive and strong flavor (Liu et al., 2021). The difference is that the sere kedeleundergoes spontaneous fermentation, while Bacillus subtilis natto is added to the process of making natto. Koswara (1997), reported that the microbes that play a role in the fermentation process of sere kedele spontaneously come from the air, containers or leaves used as a cover. The containers commonly used in the manufacture of sere kedelecan be in the form of besek or winnower made of bamboo that is not covered or covered with leaves.

Based on previous surveys and studies conducted by Widyantari et al. (2017), reported that there were differences in the boiling time made by producers in the manufacture of sere kedele in Gianyar Regency, which ranged from 3 to 7 hours while the fermentation time was between 1 to 3 days with the condition of the fermentation container used was besek either closed or slightly open. Soybeans that have been fermented spontaneously are then added with fine spices. At the stage of adding this seasoning, there are variations that are carried out before the fermentation process and after and whether or not there is the addition of oil. The spices used in making sere kedele vary including garlic, galangal, turmeric, aromatic ginger, chili, salt and a little of cooking oil. The differences in the production process of sere kedele in Gianyar Regency will affect the nutritional content and sensory properties of sere kedele, thus further

research needs to be done. This study aimed to determine the nutritional content and sensory properties of sere kedele from various producers in the Gianyar Regency (Adeyemo & Onilude, 2013; Mielenz et al., 2009; Yadnya et al., 2016).

Research Methods

Sere kedele sampling in Gianyar Regency was carried out using a saturated sampling technique, which is a sampling technique in which all members of the population are used as samples (Sugiyono, 2017). Based on the survey results, there are 4 producers in Gianyar Regency including 2 producers in Blahbatuh Village, precisely in Banjar Teruna and Banjar Pokas, 1 producer in Sukawati Village and 1 producer in Buruan Village. The design used was a Completely Randomized Design (CRD) with 4 replications to obtain 16 experimental units. Sere kedele purchased from various producers were brought to the laboratory using a cool box and ready to be analyzed.Analysis of water content was carried out using the drying method (Sudarmadji & Haryono, 1997), ash content using the oven method (Sudarmadji & Haryono, 1997), fat content using the Soxhlet method, soluble protein content based on the Lowry method with a spectrophotometer (Apriyantono et al., 1989), carbohydrate content using Carbohydrate by different analysis (BeMiller, 2017), glutamic acid (Lawal et al., 2011), modified total microbes (Mailoa et al., 2017), and total lactic acid bacteria (Hidayat et al., 2013). Sensory testing of color was carried out with score and hedonic tests and aroma, taste and overall acceptance were carried out by hedonic tests. The data obtained were analyzed by variance and if the treatment had an effect on the observed parameters, then the analysis was continued with Duncan's test (Gomez & Gomez, 2010).Results and DiscussionBased on the results of a survey conducted in 2021, it was found that in Gianyar regency there are 4 producers of sere kedele, including 2 producers in Blahbatuh Village, namely in Banjar Pokas and Teruna, 1 producer in Sukawati Village and 1 producer in Buruan Village. Each producer has differences in the duration of boiling the soybeans, and the amount and type of seasoning added, while the fermentation time for each producer is the same, which is 2 days. The addition of spices in all manufacturers is done after the fermentation process is complete. The process of making sere kedele in various producers in Gianyar Regency can be seen in Table 1.

Table 1. Sere kedele production process in several producers in Gianyar Regency

Stages of the Process	Sukawati Village	Blahbatuh Village (Banjar Teruna)	Blahbatuh Village (Banjar Pokas)	Buruan Village
Boiling time soya bean	6 hours	4 hours	4 hours	5 hours
Fermentation time	2 days (anaerobic at room temperature)	2 days (anaerobic at room temperature)	2 days (anaerobic at room temperature)	2 days (anaerobic at room temperature)
Fermentation Container	Closed Besek	Closed Besek	Closed Besek	Closed Besek
Added seasoning	Seasoned after fermentation without oil	Seasoned after fermentation with oil	Seasoned after fermentation with oil	Seasoned after fermentation without oil

Table 1 showed that the two producers in Blahbatuh Village (Banjar Teruna and Banjar Pokas) have the same boiling time of soybeans and the addition of coconut oil at the final stage, while in Sukawati Village, they boiled it for about 6 hours and in Buruan Village they boiled it for about 5 hours and both did not add coconut oil. Boiling of sere kedele in various producers in Gianyar Regency varies from 4 to 6 hours, while the duration of fermentation, the time of adding spices and the fermentation container

container used by each village had similarities, where it took 2 days of fermentation and the time of adding spices after fermentation using a closed besek. The spices added in the manufacture of sere kedele differ in number and type. The spices in making sere kedele can be seen in Table 2.

Table 2. Seasonings in making Sere kedele per 5 Kg Soybeans

Name of Material	Sukawati Village	Blahbatuh Village (Banjar Teruna)	Blahbatuh Village (Banjar Pokas)	Buruan Village
Garlic (g)	300	250	300	300
Galangal (g)	200	150	200	200
Turmeric (g)	200	250	200	200
Aromatic ginger (g)	150	100	150	150
Chili (g)	200	200	250	200
Salt (g)	250	150	200	250
Coconut oil (ml)	-	60	50	-
Lemongrass (g)	300	-	-	-

The results of the analysis of the nutritional content of sere kedele including water content, ash content, fat content, protein content, and carbohydrate content from various producers in Gianyar Regency can be seen in Table 3.

Table 3. The nutritional content of Sere kedele from various producers in Gianyar Regency

Name of Village/Banjar	Water Content (%)	Ash Content (%)	Fat Content (%)	Protein Content (%)	Carbohydrate Content (%)
Sukawati Village	60.52 a	2.24 c	8.54 c	2.18 d	26.51 a
Blahbatuh Village (Banjar Teruna)	57.68 c	2.85 b	12.40 a	4.30 a	22.77 c
Blahbatuh Village (Banjar Pokas)	58.57 b	3.06 a	9.56 b	3.17 b	25.64 b
Buruan Village	60.84 a	2.79 b	7.84 d	2.73 c	25.78 b

The average value followed by different letters in the same column shows a very significant difference ($P<0.01$)

The results of the analysis of glutamic acid, total microbes and total LAB of sere kedele from several producers in Gianyar Regency can be seen in Table 4.

Table 4. Content of glutamate acid, total microbes and total lactic acid bacteria (LAB) in Sere Kedele from several producers in Gianyar Regency

Name of Village/Banjar	Glutamate Acid (%)	Total microbes (log cfu/g)	Total LAB (log cfu/g)
Sukawati Village	0.52 d	11.50 a	10.54 d
Blahbatuh Village Banjar Teruna	6.97 a	10.78 d	10.77 a
Blahbatuh Village Banjar Pokas	5.33 b	10.80 c	10.76 b
Buruan Village	2.09 c	10.99 b	10.73 c

The mean value followed by different letters in the same column shows a very significant difference ($P<0.01$)

The results of the analysis of variance showed that the sere kedele produced by each producer in Gianyar Regency had a very significant effect ($P<0.01$) on the water content. The highest water content in sere kedele samples produced in Buruan Village while the lowest water content in sere kedele samples in Banjar Teruna, Blahbatuh

Village. Based on the results of the survey, it is known that sere kedele produced by producers in Buruan Village has a boiling time of about 5 hours and sere kedele produced by producers in Banjar Teruna, Blahbatuh Village, boils soybeans for about 4 hours. The longer the boiling time of soybeans, the higher the water content of sere kedele. This is due to differences in water absorption into soybean seeds and differences in seed development in each soybean boiling treatment. At the time of boiling soybeans, water will enter the soybean seeds so that it will increase the weight of the water in it and the water content will increase (Banobe et al., 2019). Lola (2009), stated that the increase in water content occurred due to the absorption of water by the material. This also happened in the study reported by Putri et al. (2021), that the boiling time of soybeans had a very significant effect on the water content of fermented soybeans. Soybeans boiled for 180 minutes had a higher water content of 35.45% than soybeans boiled for 60 minutes, which was 21.45%.Sere kedele produced by each producer in Gianyar Regency had a very significant effect ($P<0.01$) on the ash content. The highest ash content was found in sere kedele samples produced in Banjar Pokas, Blahbatuh Village, while the lowest ash content was in sere kedele samples produced in Sukawati Village. Sere kedele in Buruan Village and sere kedele in Banjar Teruna, Blahbatuh Village, had almost the same ash content. The decrease in ash content was caused by the long boiling factor of soybeans such as sere kedele produced in Sukawati Village, which was 6 hours. The longer the soybeans are boiled, the more minerals will dissolve into the water and make the ash content of the soybeans decrease. This is reinforced by the statement from Fennema (1996), which states that the mineral content in food cannot be damaged by light, oxidizing agents, and extreme pH. However, the loss of minerals is caused by washing or heating processes. This opinion is supported by Lola (2009), which states that the reduction in ash content may be caused by the leaching of mineral compounds into boiling water. In the study of Putri et al. (2021), there was also a decrease in the ash content of fermented soybeans with the longer boiling treatment which indicated that the minerals contained in soybeans were abundant in the soybean epidermis.The results of the analysis of variance showed that the sere kedele produced by each producer in Gianyar Regency had a very significant effect ($P<0.01$) on fat content. The highest fat content was found in the sere kedele samples produced in Banjar Teruna, Blahbatuh Village, while the lowest fat content was in the sere kedele samples produced in Buruan Village. Based on the survey results, it is known that the increase in fat content in sere kedele produced in Banjar Teruna, Blahbatuh Village, is probably caused by the addition of oil to the spices used, while sere kedele produced in Buruan Village there is no addition of oil. Boiling also causes fat to melt into boiling water causing a reduction in fat content (Lola, 2009). This is in accordance with the results of the survey and analysis that in Buruan Village with 5 hours of boiling time, the fat content is lower than in Banjar Teruna, Blahbatuh Village, with 4 hours of boiling.

Sere kedele produced by each producer in Gianyar Regency had a very significant effect ($P<0.01$) on the dissolved protein content. The highest soluble protein content was in sere kedele samples produced in Banjar Teruna, Blahbatuh Village, while the lowest soluble protein content was in sere kedele samples in Sukawati Village. Sere kedele produced in Buruan Village and sere kedele in Banjar Pokas, Blahbatuh Village, had almost the same dissolved protein content. Based on the results obtained, it showed that the decrease in protein content was affected by the boiling time. The longer the boiling or steaming, the more protein is lost (Kristiningrum & Susanto, 2016).

Boiling treatment causes protein to be denatured, resulting in protein damage. The more denatured protein causes a decrease in protein content (Komolafe & Obayanju, 2003).The results of the analysis of variance showed that the sere kedele produced by each producer in Gianyar Regency had a very significant effect ($P<0.01$) on the carbohydrate content. The highest carbohydrate content was found in the sere kedele samples produced in Sukawati Village, while the lowest carbohydrate content was in the sere kedele samples from Banjar Teruna, Blahbatuh Village. Sere kedele in Buruan Village and sere kedele in Banjar Pokas, Blahbatuh Village have almost carbohydrate content. The increase in carbohydrate content occurs with the longer boiling. Boiling time in Sukawati Village for 6 hours causes carbohydrate levels to increase while boiling time in Blahbatuh Village for 4 hours causes carbohydrate levels to decrease. Ikanone & Oyekan (2014), stated that boiling can maintain the value

of carbohydrate content more. Amon et al. (2014), reported an increase in carbohydrate content with longer boiling time in taro flour research. The carbohydrate content by the difference in the proximate test is strongly influenced by the content of other nutrients (Pratama et al., 2014).Sere kedele produced by each producer in Gianyar Regency had a very significant (P<0.01) effect on glutamic acid. The highest glutamic acid content was found in the sere kedele sample produced in Blahbatuh Banjar Teruna Village, namely 6.97%, while the lowest glutamic acid content was in the sere kedele sample in Sukawati Village, namely 0.52%. According to Fauzy et al. (2016), glutamic acid is part of the main framework of various types of protein molecules found in food. The decrease in the value of glutamic acid is caused by protein denaturation due to too high heating. Denaturation occurs in structural changes because there are broken bonds. This is in accordance with the results of the study, namely the sere kedele produced in Sukawati Village has less glutamic acid, namely 0.52%, due to boiling which was carried out for 6 hours (Tomaschunas et al., 2012; Jayachandran & Xu, 2019; Dai et al., 2017).

The four samples of sere kedele produced by each producer in Gianyar Regency had a very significant (P<0.01) effect on total microbes. The highest microbial total was found in the sample of sere kedele produced in Sukawati Village, namely 11.50 log cfu/g, while the lowest total microbial count was in the sample of sere kedele in Blahbatuh Village, Banjar Teruna, namely 10.78 log cfu/g. Microbes are organisms that are able to adapt and live in various types of environments. One of the places where the microbial environment lives is water (Mudatsir, 2007). Sere kedele produced in Sukawati Village has a higher moisture content of 60.52% compared to sere kedele produced in Blahbatuh Village, Banjar Teruna, 57.68%, so the total microbes are higher.

The results of the analysis of variance showed that the four samples of sere kedele produced by each producer inGianyar Regency had a very significant (P<0.01) effect on the total LAB. The highest total LAB was found in the sere kedele sample produced in Blahbatuh Village, Banjar Teruna, namely 10.77 log cfu/g, while the lowest total LAB was in the sere kedele sample in Sukawati Village, namely 10.54 log cfu/g. According to Zakaria et al. (2013),high heating causes contaminant bacteria to be destroyed, so that the proliferation of lactic acid bacteria is not hampered and can multiply optimally. This is in accordance with the results of the study, namely the sere kedeleproduced in Sukawati Village had a smaller total LAB of 10.54 log cfu/g due to boiling which was carried out for 6 hours. Sensory properties of sere kedele produced by each producer in Gianyar Regency were carried out by scoring tests on color and taste and hedonic level tests on color, flavor, taste, and overall acceptance. The average value of the results of the analysis of the color, flavor, taste, and overall acceptance of sere kedele can be seen in Table 5.

Table 5. Average score and hedonic test values on color, flavor, taste and overall acceptance of Sere kedele

Name of Village/Banjar	Color		Flavor	Taste		Overall Acceptance
	Score *	Hedonic ***	Hedonic ***	Score **	Hedonic ***	Hedonic ***
Sukawati Village	4.13 a	3.60 a	2.07 c	2.00 c	2.27 d	2.47 d
Blahbatuh Village (Banjar Teruna)	4.20 a	4.07 a	4.00 a	4.40 a	4.53 a	4.67 a
Blahbatuh Village (Banjar Pokas)	4.47 a	3.73 a	3.27 b	3.20 b	3.73 b	3.73 b
Buruan Village	3.27 b	3.67 a	3.40 b	2,60 bc	3.00 c	3.20 c

The average value followed by different letters in the same column shows a significant difference (P<0.05)
* 1 = clear, 2 = light yellow, 3 = yellow, 4 = yellowish brown, 5 = brown
** 1 = not savory, 2 = normal, 3 = slightly savory, 4 = savory, 5 = very savory
*** 1 = dislike very much, 2 = dislike, 3 = normal, 4 = like, 5 = very much like

The results of the analysis of variance from the scoring test on color, the four samples of sere kedele produced by each producer showed that the effect was very significant (P < 0.01). The highest average value in the sample of sere kedele produced in Banjar Pokas Blahbatuh Village, which was 4.47 (yellowish brown) had no significant

effect on sere kedele in Banjar Teruna, Blahbatuh Village, which was 4.20 (yellowish brown) and sere kedele in Sukawati Village with value 4.13 (yellowish brown). The lowest average value was found in the sere kedele sample produced in Buruan Village with a value of 3.27 (yellow). Sere kedele from various producers in Gianyar Regency has a yellow to yellowish brown color. Research Putri et al. (2021), reported that prolonged boiling treatment resulted in the color of fermented soybeans becoming yellow to light brown. Boiling time can cause color changes in soybeans because the pigments contained in soybeans are increasingly damaged and the color of soybeans becomes pale with increasing of boiling time. Mulyatiningsih (2007), stated that foodstuffs will look less attractive if the boiling process is too long because the pigments in foodstuffs are unstable during the cooking process.The results of the analysis of hedonic test variance on color, the four samples of sere kedele showed that the effect was not significant (P> 0.05). The average value of the lowest to highest sere kedele ranged from 3.60 (normal to like) to 4.07 (like). The highest average value in succession to the lowest was obtained in the sample of sere kedele in Banjar Teruna, Blahbatuh Village with a value of 4.07 (like), sere kedele in Banjar Pokas, Blahbatuh Village, the value of 3.73 (normal to like), sere kedele in Blahbatuh Village). Panelists liked the color of sere kedelebetween yellow to yellowish brown.

Hedonic test on flavor, the four samples of sere kedele produced by each producer showed a very significant effect (P < 0.01). The highest average value was found in the sere kedele sample produced in Banjar Teruna, Blahbatuh Village, which was 4.00 (like) while the lowest was in the sere kedele sample in Sukawati Village, namely 2.07 (dislike). The panelists gave the usual assessment on the sample of sere kedele produced in Buruan Village, namely 3.40 and sere kedele in Banjar Pokas, Blahbatuh Village, which was 3.27. This is different from the study by Sipayung et al. (2019), which stated that the panelists gave an assessment of the aroma of sere kedele given the duration of fermentation as the treatment with the help of Bacillus subtilis, resulting in the aroma criteria of neither like nor dislike to like.

The results of the analysis of the variance from scoring test on taste, the four samples of sere kedele produced by each producer showed that the effect was very significant (P < 0.01). The highest average value for the sere kedelesample produced in Banjar Teruna, Blahbatuh Village, was 4.40 (savory) and the lowest average value for the sere kedele sample in Sukawati Village was 2.00 (normal). The panelists gave a score of 2.60 with the criteria of ordinary to slightly savory on samples of sere kedele produced in Buruan Village and slightly savory on sere kedele in Banjar Pokas, Blahbatuh Village, which was 3.20. In relation to the taste of food, in Indonesia, it is known that there is a savory taste response that reveals its own taste impression. Several studies mentioned that the savory taste in tempe, soy sauce, moromi products (Setyaningsih, 1998; Ikasanti, 2001; Martoyo, 2001; Saleha, 2003). Boiling can cause a more intense savory taste (Shi et al., 2020). Hedonic test on taste, the four samples of sere kedele showed a very significant effect (P < 0.01). The highest average value is found in the sere kedele sample produced in Banjar Teruna, Blahbatuh Village, which is 4.53 (like to very like) and the lowest average value in the sere kedele sample in Sukawati Village is 2.27 (dislike). The panelists gave a normal assessment of the sere kedele sample in Buruan Village, namely 3.00 and a normal rating to liking the sere kedele sample produced in Banjar Pokas, Blahbatuh Village, which was 3.73 (Wang et al., 2019; Eshak, 2016; Endrizzi et al., 2015; Kusfriyadi & Nabilah, 2022).

Hedonic test on overall acceptance, the four samples of sere kedele produced by each producer showed a very significant effect (P < 0.01). Table 5 shows that the average value of sere kedele ranged from 2.47 (dislike) to 4.67 (like to very much like). The highest average value is found in the sere kedele sample produced in Banjar Teruna, Blahbatuh Village, which is 4.67 (like to very much like) and the lowest average value in the sere kedele sample in Sukawati Village was 2.47 (dislike). The panelists gave a normal assessment of the sere kedele sample produced in Buruan Village, namely 3.20 and a normal rating to liking the sere kedele sample in Banjar Pokas, Blahbatuh Village, which was 3.73. Overall acceptance showed how much a product can be accepted by the panelists. Overall acceptance assessment is generally a combination of all aspects such as color, aroma, taste and texture (Purwandari et al., 2021).

Conclusion

Sere kedele in Banjar Teruna, Blahbatuh Village, had the best nutritional content and sensory properties. Sere kedele in Banjar Teruna, Blahbatuh Village, had the best nutritional content and sensory properties, with water content of 57.68%, ash content of 2.85%, fat content of 12.40%, soluble protein content of 4.30%, carbohydrate content of 22.77%, glutamic acid of 6.79 %, total microbes of 10.78 log cfu/g, total lactic acid bacteria of 10.77 log cfu/g , had a yellowish-brown color with criteria like, like for aroma, very much like for its savory taste and very much like for the overall acceptance.

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The Conservation Status of Euphorbia L. in the Fergana Valley of Central Asia

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A B S T R A C T

In this article, the Euphorbia L category, species, and distribution levels located in the Fergana Valley Natural Area are listed based on the International Red Book categories. Based on the IUCN categories, 24 species were evaluated. In the study of Central Asian herbarium funds, samples are taken, and virtual herbarium funds and targeted Field Research were used. Distribution is a narrow circle of euphorbia mucronate Prok at risk of extinction, category (EN) corresponded to criterion B, and based on the data, the types of synopsis GeoCAT maps were brought.

Keywords---Conservation status, Critically Endangered, Endangered, Euphorbia, Fergana Valley, GeoCAT, IUCN, Left Concern.

Introduction

Fergana Valley, as one of the densely populated (300–400 people per 1 km2) areas in Central Asia (CEPF, 2017) is of particular importance for the relevance of the problem of shrinking and preserving natural landscapes as a result of anthropogenic factors. In the last decade throughout the region, the impact of human beings on the environment has increased sensitively. This led to a sharp reduction in the population of species with local endemic, rare and high economic importance (Elliott et al., 2001). The presence of one reserve (sari–bucket, Kyrgyzstan) and 5 natural monuments in the Fergana Valley further complicated the situation (Tajibaev et al., 2018).

Carried out throughout the Valley flora to this day (1871–2020) in Floristic and geobotanic Research tasks, the identification and preservation of species in need of protection in the composition of phytosenoses are not defined as a priority task (Gulomov, 2022), which means that there is a need for modern research under the takh did or for the protection of vulnerable species at the national and international levels. Including, studies are being carried out to assess the taxonomy, geography, pharmaceutical characteristics and anthropogenic effects on growth areas of the Euphorbia genus species distributed in the Fergana Valley (Corbane et al., 2015; Phillips et al., 2016).

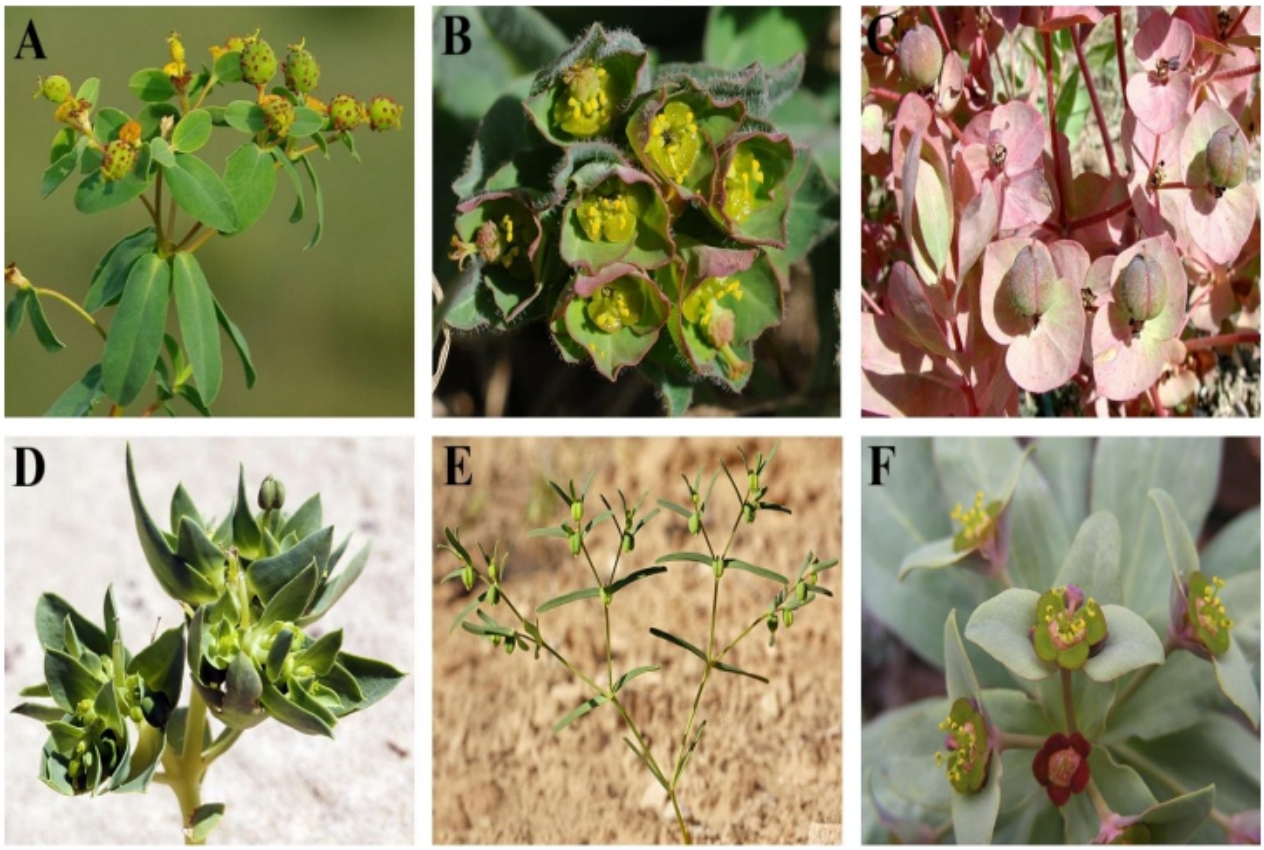

Figure 1. Species of Euphorbia distributed in the Fergana Valley (Central Asia): A) E. pachyrrhiza (photo by); B) E. alatavica (photo by V. Epictetov); C) E. ferganensis (photo by N. Beshko); D) E. turczaninowii (photo by P. Gorbunov); E) E. inderensis (photo by P. Gorbunov); F) E. rapulum (photo by L. Valdshmit).

As one of the main centers of distribution of Euphorbia species, the territories of Turkey (103 species), Iran (90 species), Syria (50 species) and Pakistan (46 species) are listed, according to the results of a study carried out in recent years, 96 endemic species distributed in the territory of South Asia were evaluated at a global level (CR, EN, Wu) 2020). As a continuation of these studies, for the first time, the results of the GeoCAT map of the distribution of 24 species distributed in the Fergana Valley and their assessment by IUCN categories were presented (Duenas et al., 2021; Köndgen et al., 2008).

Materials and Methods

Study area

This study was conducted in the elliptical–shaped Fergana Valley (Fig.1). The valley represents less than 1% of Central Asia and covers an area of 22,000 km2. It is 300 km long (east to west) and 80–100 km wide (north to south). The elevation of the valley is approximately 3,300 m in the eastern part of Kyrgyzstan and 1,050 m in the western part (Tajikistan, Khojand) (Kaparkar, 2019).

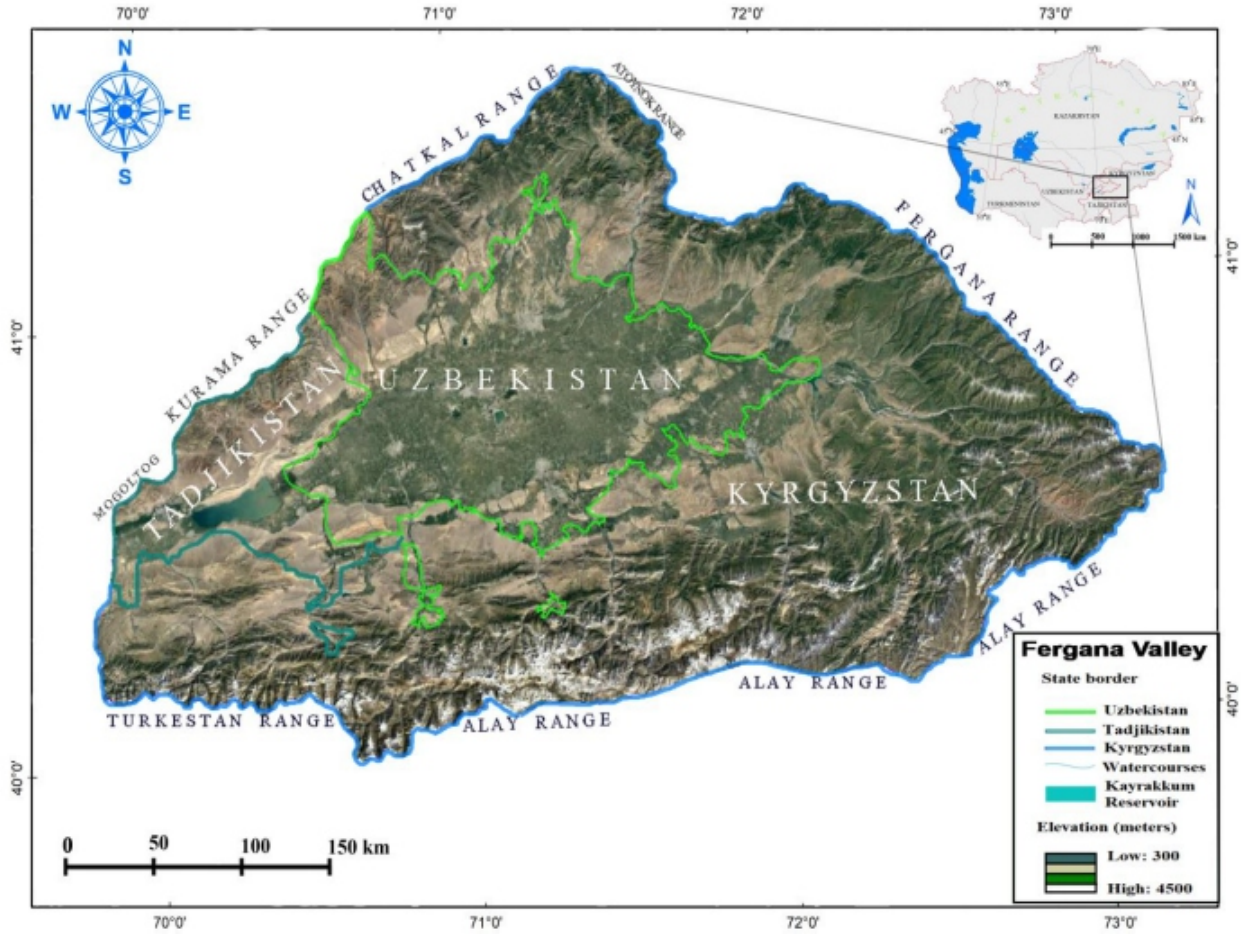

Figure 2. General topography of the Fergana Valley in Central Asia

Analysis of the herbarium specimens

The National Herbarium of Uzbekistan (TASH), Khujand State University and Moscow State University in the assessment of the species in the herbarium funds (https://plant.depo.msu.ru, accessed on 5 August 2022) analyzed a total of more than 560 samples and about 100 herbarium samples collected during a targeted field study conducted in 2022. Global Biodiversity Information Facility (https://www.gbif.org/ru, accessed on 7 September 2022) used international databases as an additional source of information. Taxon nomenclature Plants of the World Online (http://www.plantsoftheworldonline.org, accessed on 5 October 2022), International Plant Name Index (https://www.ipni.org, accessed on 6 October 2022) checked from international bases.

Assessment of conservation status of the taxon

To classify the threat status of taxa, it was brought by the IUCN (International Union for the Conservation of Nature) based on the relevant categories (CR, LC+EN) (IUCN, 2012B). The minimum living space (AOO) was assessed based on a grid cell defined by 2 km2 users recommended by IUCN. The geographic coordinates of the herbarium samples representing the growth points of the Google Earth Pro 7.1 program (https://www.Google.com/earth/, accessed on 3 September 2022) were georeferenced using and combined with the coordinates obtained during field research. GeoCAT of the evaluated species (Geospatial Conservation Assessment Web Tool; Bachman et al., 2011) the coordinates determined when making a map of CSV based on an online application by transferring to the

file view (http://geocat.kew.org/editor, accessed on 10 September 2022) prepared (Listed in Appendix A).

Results and Discussion

For the first time, 24 species of the Euphorbia genus distributed in the Fergana Valley of the Central Asian region were evaluated by the IUCN Red List categories (Table 1). Euphorbia mochranulata Prakh. (Tithymalus mucranulatus Prokh.) originally dialled type samples were dialled from the Tashkent region (west of the Chatkal Ridge) (Masar Babai Togdar auf dem Aktau bei Tashkent, 12. VII. 1880 (LE)). Herbarium specimens of the species are kept in the appropriate funds (LE, TASH). The label addresses of the preserved samples showed them to be dialled in 4 areas located at a distance of 30–60 km, and they are located from the Chatkal Ridge (Obraztsi sobrannie v nizovyakh r. Chatkal (Uzbekistana, Dolina Chatkala bliz ustya Akbulaka, osipi, 25 VI 1972. R. Gamelin, No. 337 I 14. VII. 1973. R.Kamelin, sn (LE); Parkenta (Tashkent ABL. Parkentasky r–n, Bashi–kizil–say, Salikhova, Amiraev, 21. VI. 1961 (LE) is represented by some herbarium samples sought. The species was last sought after by K. Sh. Tajibaev from Fergana Valley (Zapad. Tien–Cheerful. Kuraminsky HR. Bass. Reg. Chadak. Spusk s uroch. Betagalik V dolinu Kainlisay, 2700 m. 05.08.2012). Since the limited distribution area and population of the species are not fully studied, it becomes the basis for assessing the category (EN) under the threat of extinction of the IUCN red book by Criterion B.

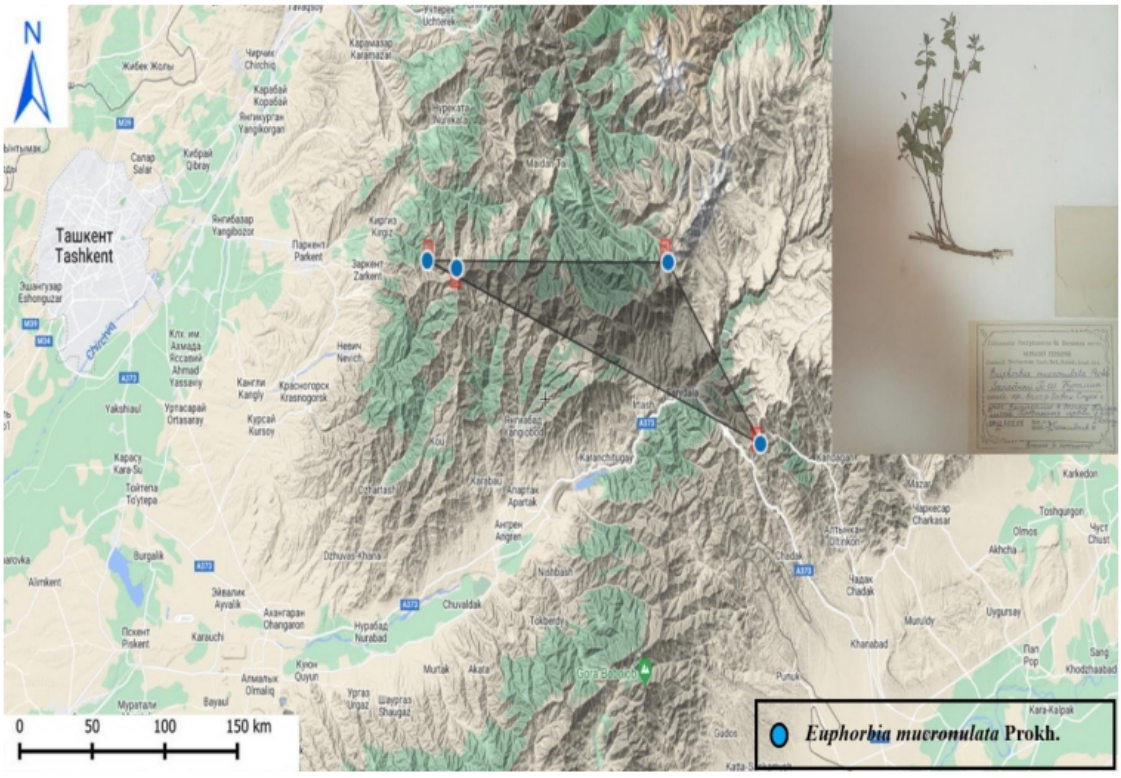

Figure 3. Euphorbia mucronulata Prokh. distribution GeoCAT map and herbarium (TASH)

It is required to carry out repeated field research to protect the species as an endemic of the flora of Uzbekistan, and to search for new growth areas. In addition, the exact number and composition of the species population may be weaker and more diffuse than predicted. The reason is that no targeted studies have been carried out on areas adjacent to the previously recorded areas of the species (Zhao et al., 2022; Jassbi, 2006).

Today, attention to this category of species is growing from a pharmaceutical point of view. This requires monitoring the distribution areas of the species and determining the state of their population. In the Fergana Valley, due to the growing influence of anthropogenic factors, there is a serious threat to the distribution areas of the species (Cazalis et al., 2022; Leroux et al., 2010).

Table 1. Red List of Euphorbia species distributed in the Fergana Valley (EOO, the extent of occurrence; AOO, area of occupancy; Critically Endangered – CR, Endangered – EN, Least Concern – LC)

№	Accepted taxon name	Conservation status (IUCN)			GeoCAT map	Endemism status	Number of coordinates	General distribution	Preserved Herbaria
		EOO km^2	AOO km^2	Category					
1	*Euphorbia alaica* (Prokh.) Prokh.	133,362.758	56.000	LC+EN	Fig.4.(A)	Mountainous Central Asia	14	UZ, KG, TJ	LE, FRU
2	*Euphorbia alatavica* Boiss.	860,884.454	92.000	LC+EN	Fig.4.(B)	–	23	KG, TJ, KZ, CN	LE, MW, FRU, W,
3	*Euphorbia ferganensis* B. Fedtsch.	152,342.215	128.000	LC+EN	Fig.4.(C)	Mountainous Central Asia	34	UZ, KG, TJ	LE, MW,TASH, FRU, P, W
4	*Euphorbia helioscopia* L.	9,360,407.601	192.000	LC+EN	Fig.4.(D)	–	51	UZ, KG, TJ, KZ, TM, AFG et al.	LE, MW, TASH, FRU, TAD
5	*Euphorbia humifusa* Willd.	7,485,397.786	84.000	LC+EN	Fig.4.(E)	–	23	ASIA et al.,	LE, FRU, TASH
6	*Euphorbia humilis* Ledeb.	3,894,499.752	72.000	LC+EN	Fig.4.(F)	–	18	UZ, KG, TJ, TM, KZ, IRN, CN	LE, MW, TASH, FRU, TAD, E, G
7	*Euphorbia inderiensis* Less. ex Kar. & Kir.	5,308,736. 406	256.000	LC+EN	Fig.4.(G)	–	66	UZ, KG, TJ, TM, KZ, IRN, AFG, PK, CN	LE, MW, TASH, FRU, TAD
8	*Euphorbia virgata* Waldst. & Kit.	561,116.604	264.000	LC+EN	Fig.4.(H)	–	72	TJ, IRN, AFG,	LE, MW, TASH, FRU, TAD, NSK, P.
9	*Euphorbia monocyathium* Prokhanov	123,716.003	68.000	LC+EN	Fig.5.(I)	–	18	KG, TJ, KZ, CN	LE, MW,TASH, FRU, TAD, P
10	*Euphorbia mucronulata* Prokh.	405.187	16.000	EN	Fig.5.(J)	Endemic	1	UZ	LE, TASH
11	*Euphorbia pachyrrhiza* Kar. & Kir.	263,988.989	72.000	LC+EN	Fig.5.(K)	–	19	KG, TJ, KZ, MN, CN	LE, MW, FRU ALTB, TASH
12	*Euphorbia rapulum* Kar. & Kir.	726,358.643	128.000	LC+EN	Fig.5.(L)	–	35	UZ, KG, TJ, TM, KZ, CN	LE, MW, TASH, FRU, TAD, WU
13	*Euphorbia sewerzowii* (Prokh.) Pavlov	79,993.021	44.000	LC+EN	Fig.5.(M)	Mountainous Central Asia	11	UZ, KG	MW, AA, TASH, FRU, TAD
14	*Euphorbia szovitsii* Fisch. & C.A. Mey.	1,879,618.577	112.000	LC+EN	Fig.5.(N)	–	28	UZ, KG, TJ, TM, IRN, AFG, PK et al.	LE, MW, FRU, TASH
15	*Euphorbia talastavica* (Prokh.) Prokh.	77,170.430	48.000	LC+EN	Fig.5.(O)	–	13	UZ, KG, KZ	LE, TASH, FRU
16	*Euphorbia tibetica* Boiss.	1,593,734.550	52.000	LC+EN	Fig.5.(P)	–	13	KG, TJ, PK, CN.	LE, MW, TASH, FRU, TAD, E, WU, P, WAG, W, US
17	*Euphorbia transoxana* (Prokh.) Prokh.	116,141.336	44.000	LC+EN	Fig.6.(Q)	Mountainous Central Asia	12	UZ, KG, TJ.	LE, MW, TASH, FRU, TAD, E, W, P
18	*Euphorbia turczaninowii* Kar. et Kir.	1,456,087.249	92.000	LC+EN	Fig.6.(R)	–	23	UZ, KG, TJ, TM, IRN, AFG, MN, CN.	LE, TASH, FRU
19	*Euphorbia turkestanica* Regel	818,168.241	40.000	LC+EN	Fig.6.(S)	–	11	UZ, KG, TJ, TM, KZ, IRN, CN.	LE, MW, TASH, FRU, TAD, E, P
20	*Euphorbia lamprocarpa* (Prokh.) Prokh.	901,612.360	232.000	LC+EN	Fig.6.(T)	–	59	UZ, KG, TJ, KZ, CN	LE, MW, TASH, FRU, TAD
21	*Euphorbia franchetii* B. Fedtsch.	2,670,659.236	180.000	LC+EN	Fig.6.(U)	–	46	UZ, KG, TJ, KZ, IRN, AFG, CN.	LE, MW, AA, TASH, FRU, TAD, BRNU, CSBG (NS), PE, P, W, NY
22	*Euphorbia glomerulans* Prokh.	2,371,413.747	148.000	LC+EN	Fig.6.(V)	–	40	Central Asia, Eurasia.	LE, TASH, FRU
23	*Euphorbia chamaesyce* L.	620,086.434	28.000	LC+EN	Fig.6.(W)	–	9	UZ, KG, TJ, TM, KZ, IRN, AFG et al.	LE, MW, TASH, FRU, PE, P, W, ERE, COI
24	*Euphorbia sarawschanica* Regel	93,446.637	88.000	LC+EN	Fig.6.(X)	Mountainous Central Asia	23	UZ, KG, TJ, KZ.	LE, TASH, FRU

GeoCAT map of the distribution of species of the genus Euphorbia distributed in the Fergana Valley

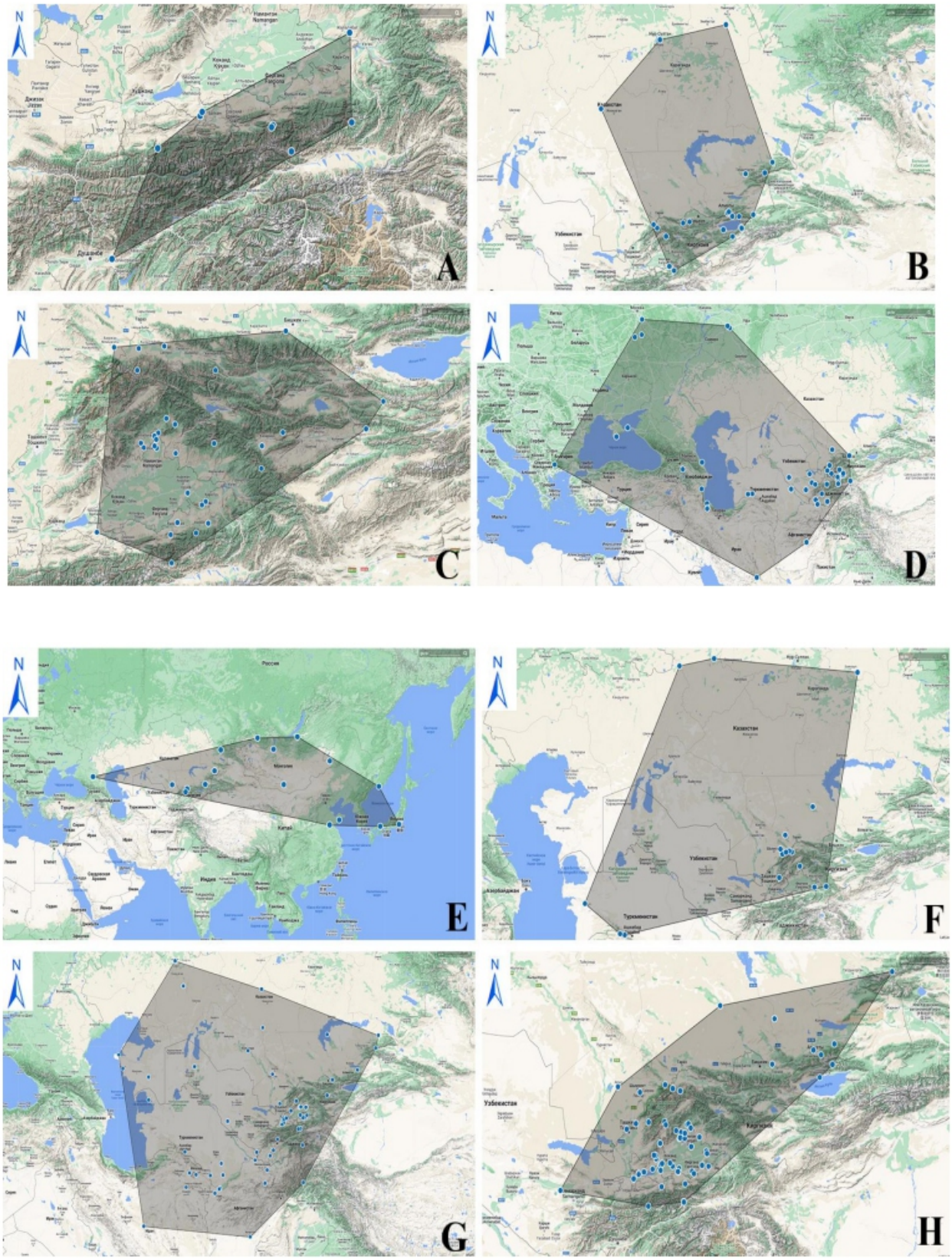

Figure 4. A) E. alaica B) E. alatavica C) E. ferganensis D) E. helioscopia E) E. humifusa F) E. humilis G) E. inderiensis H) E. virgata

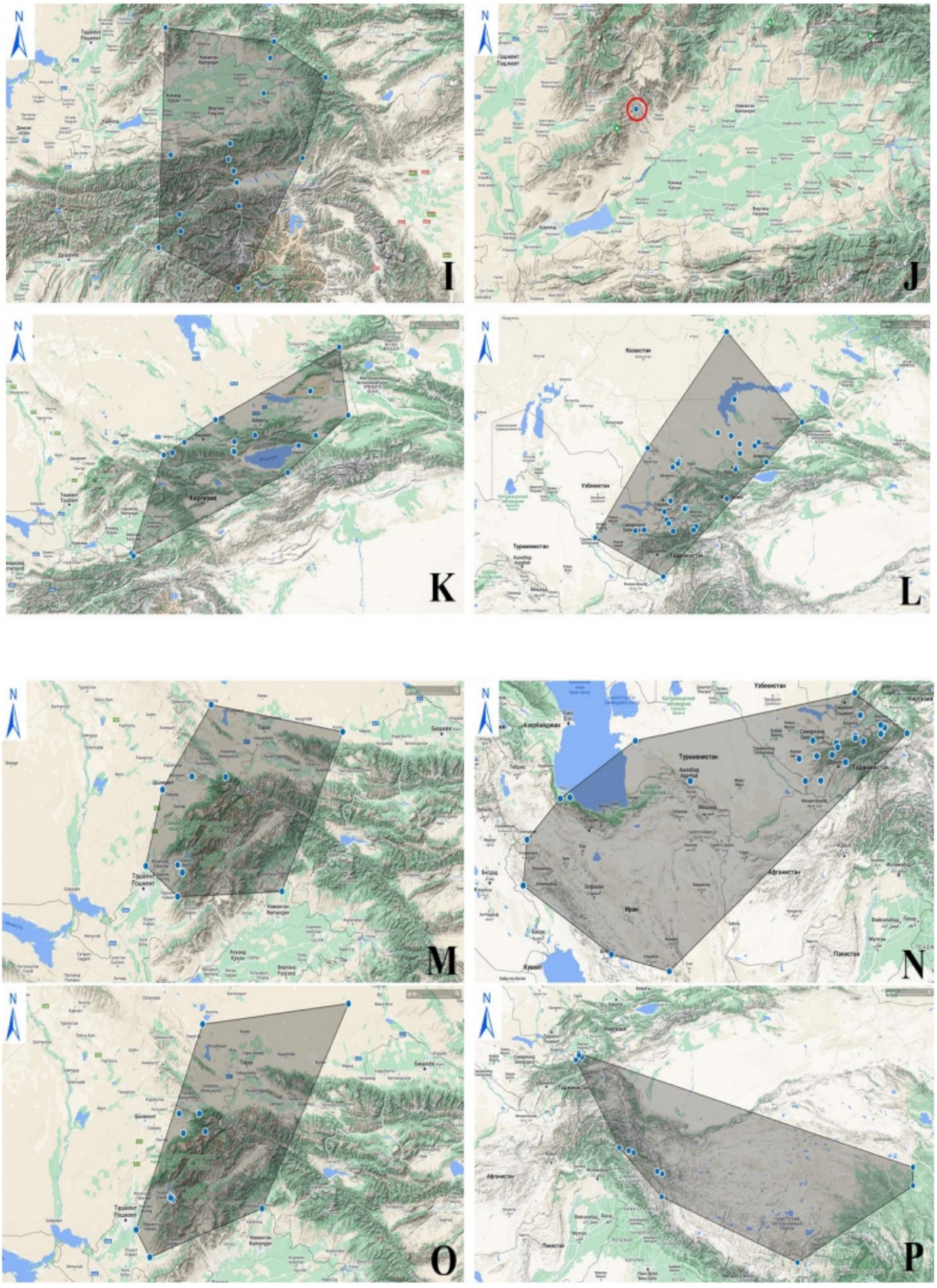

Figure 5. I) E. monocyathium J) E. mucronulata K) E. pachyrrhiza L) E. rapulum M) E. sewerzowii N) E. szovitsii O) E. talastavica P) E. tibetica

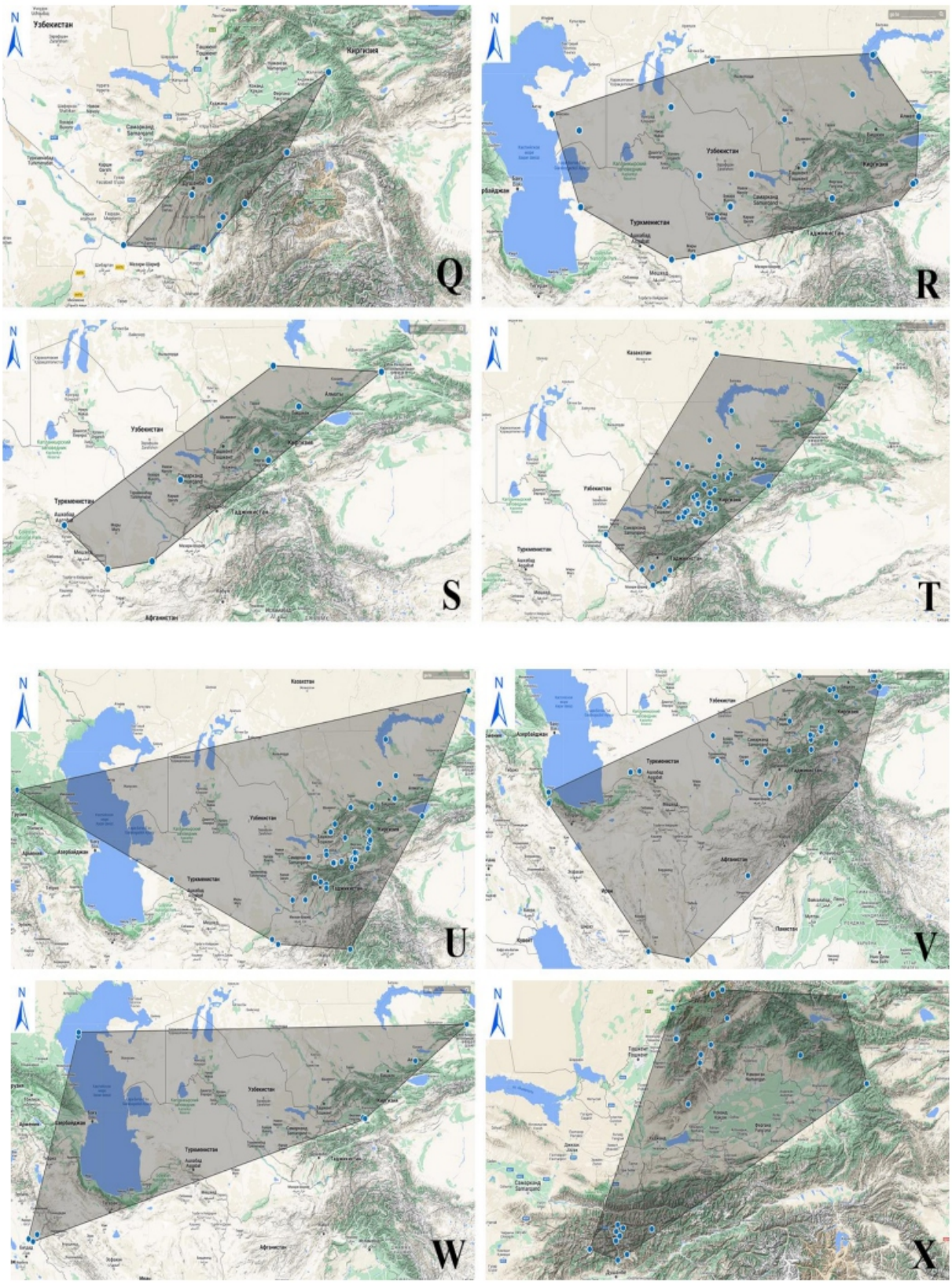

Figure 6. Q) E. transoxana R) E. turczaninowii S) E. turkestanica T) E. lamprocarpa U) E. franchetii V) E. glomerulans W) E. chamaesyce X) E. sarawschanica

Conclusion

Our study examined the distribution of the Euphorbia L category in the mountain, desert, adir and other areas of the Fergana Valley natural border of Central Asia. It turned out that 25 species belonging to the genus Euphorbia l have spread. In the course of the study, it was found that the species Euphorbia L category is widespread, but due to the influence of anthropogenic factors, their populations are shrinking and there are species with protection. Collected evidence E for Central Asia. sarawschanica Regel, E.transaxana (Prakh.) Prakh., E.sewerzawii (Prakh.) Pavlov, E.ferganensis B. Fedtsch, E.alaica (Prakh.) Prakh. endem, E.mochranulata Prakh. Endem is contributed to the chotkol and Kurama mountain ranges.

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