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IDENTIFICATION OF CROP PATTERNS AND OPTIMIZATION OF CROP ROTATION FOR RISK MITIGATION IN THE NATHSAGAR DAM BACKWATER REGION OF SHEVGAON AND NEVASA TEHSILS, AHMEDNAGAR DISTRICT, MAHARASHTRA

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ABSTRACT:

Crop failures, market swings, and climate variability are only a few of the major obstacles facing agriculture in the backwater area of the Nathsagar Dam in the Shevgaon and Nevasa tehsils of Ahmednagar District, Maharashtra. In order to reduce these risks and improve agricultural resilience and sustainability, this study intends to identify existing crop trends and suggest optimal crop rotation options. The study examines crop distribution and conventional cropping techniques using field surveys.

Taking into account variables including soil type, water availability, crop compatibility, and market dynamics, it creates crop rotation plans that are optimal using statistical modelling and economic analysis. Policymakers, agricultural planners, and local farmers can benefit from the findings, which promote sustainable measures to enhance soil health, control pests and diseases, and boost output. The goal of this research is to guarantee long-term food security and economic stability in the backwater area of the Nathsagar Dam, which adds to the larger conversation on sustainable agriculture.

KEYWORDS: *Crop rotation, market fluctuations, agricultural resilience, risk mitigation, sustainable agriculture, agricultural planning, and economic analysis.*

INTRODUCTION:

The foundation of the Indian economy is still agriculture, which makes a substantial contribution to economic stability, food security, and livelihoods. However, a number of hazards, such as crop failures, market volatility, and climate uncertainty, are making the sector more and more susceptible. In this regard, improving crop patterns and rotations through understanding and optimisation becomes essential to boosting agricultural sustainability and resilience. With an emphasis on the Nathsagar Dam backwater area in the Shevgaon and Nevasa tehsils in the Ahmednagar District, Maharashtra, this study seeks to determine current agricultural trends and suggest crop rotation techniques that are optimised to reduce these hazards.

The Jayakwadi Dam, also called the Nathsagar Dam, is an essential irrigation source that supports a variety of agricultural operations in the area. This dam's backwater region, which includes the tehsils of Shevgaon and Nevasa, offers a distinctive agricultural landscape with a range of crops grown all year round. Farmers in this area deal with issues like degraded soil, pest infestations, volatile market pricing, and shifting weather patterns despite the presence of irrigation. These problems call for the creation of strong crop rotation programmes as well as a thorough examination of the cropping techniques now in use.

Understanding the geographical and temporal distribution of the various crops cultivated in the area is necessary to identify crop patterns. Understanding farmer choices, resource use, and the ecological dynamics of the agricultural system are all made possible by this process. Climate, market pressures, and local knowledge have all shaped the traditional farming patterns in Shevgaon and Nevasa over the course of generations. To make sure they are in line with sustainable agricultural practices, these patterns must be reevaluated in light of contemporary farming technology and shifting environmental factors.

A key tactic for raising agricultural sustainability and productivity is crop rotation optimisation. Crop rotation is the practice of planting various crops on the same land in succession to increase overall agricultural productivity, improve soil health, and lower the incidence of pests and diseases. A successful crop rotation plan takes into account a number of variables, including market dynamics, crop compatibility, soil type, and water availability. Improving crop rotation in the Nathsagar Dam backwater area can have a number of positive effects, such as better water management, more soil fertility, and higher farmer profits. One of the most important steps towards sustainable agriculture in the Nathsagar Dam backwater region is the identification and optimisation of crop patterns and rotations. The goal of this research is to offer useful information and suggestions that will help Shevgaon and Nevasa tehsils' farming systems become more resilient. This will benefit not just the local farming community but also Maharashtra's larger agricultural industry.

MATERIALS AND METHOD

1 Objectives:

1. To Determine Current Crop Patterns by Conduct field surveys to examine crop distribution in the Nathsagar Dam backwater area.
2. To improve soil health and farm productivity, develop optimised crop rotation strategies based on crop compatibility, soil type, water availability, and market dynamics.
3. To Assess and Reduce Agricultural Risks for Determine how well crop rotation plans reduce risks associated with crop failures, market swings, and climate variability.

2. Methodology:

In order to reduce agricultural risks and advance sustainable farming in the Nathsagar Dam backwater area, the extensive methodology guarantees a full grasp of existing crop trends, the formulation of crop rotation schemes supported by science, and practical application.

A. Field Surveys: To acquire information on the sorts of crops being grown today, planting and harvesting schedules, and farmer preferences, conduct thorough field surveys.
B. Secondary Data Analysis: To supplement primary data, gather historical agricultural information from government papers, research institutes, and local agricultural departments.

C. Risk Assessment: To maintain stability against market swings and weather variability, evaluate the possible hazards connected to various crop rotation plans using risk analysis tools.

2.1 Crop Combination - Weaver's Method:

Crop combination analysis using Weaver's Method determines dominant and related crop types by calculating the percentage of various crops in a particular area. To help with agricultural planning and optimisation, researchers calculate the crop combination pattern by adding up the squared proportions of all the crops and comparing the resulting index values.

$$SD = \frac{\sqrt{\sum d^2}}{n}$$

Were,
d = the difference between the actual crop percentages in a given county and the appropriate percentage in the theoretical curve.
n = the number of crops in a given combination.

2.2 Selection of Study Area:

In this study, we focus on Ahmednagar district, Maharashtra, particularly Shevgaon and Newasa, covering 2,375.28 sq km. Located between 19°12'14" and 19°33'57" N latitude and 74°56'48" to 75°32'44" E longitude, this area near the Jayakwadi dam includes 232 villages. About 90% (2137.1 sq km) is used for farming, 1% (26.32 sq km) is forested, and 9% (211.09 sq km) for other purposes, with an average annual rainfall of 503.7 mm.

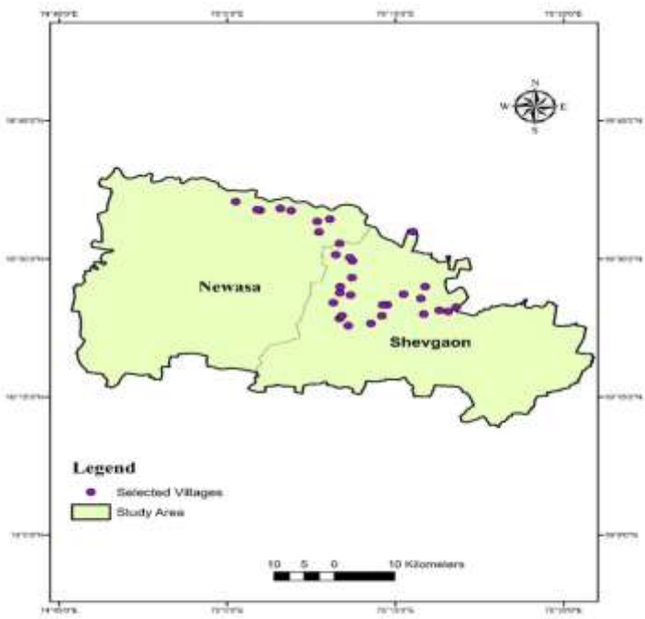

Figure – 1: Location Map of the Study Area.

Analysis and Results:

Table No. 1.1 Selected village wise Crop Combination Values

Sr. No.	Name of Village	Wheat	Jawar	Bajara	Other Cereal	Pulses	Sugarcane	Fruit, Vegetables and Spices	Oil Seed	Fiber	Fodder Crop	Total Deviation	Crop Combination Type
1	Karhetakali	10.72	23.05	47.63	60.06	14.32	229	10.29	19.9	23.1	305.3	739.31	Four Crop Combination
2	Khanapur	0.04	29.7	48.84	0.02	0.88	195	15.84	0.14	18.5	66.84	375.52	Two Crop Combination
3	Antarwali Bk.	6.25	0.84	0.52	21.89	8.08	0.01	0.07	1.46	6.02	19.25	71.4	Three Crop Combination
4	Ghotan	2.76	5.74	9.26	6.5	0.2	0.01	0.02	0.87	0.41	3.72	22.85	Two Crop Combination
5	Erandgaon	0.16	3.38	7.29	1.93	0.02	10.3	0.01	4.18	0.31	3.96	24.57	Two Crop Combination
6	Lakhefal	0.22	14.06	21.62	0.01	0	24	0.06	7.09	0.61	2.95	70.62	Two Crop Combination
7	Dahifal	2.73	22.21	35.76	0.03	0.02	22.7	10.7	4.33	1.96	3.29	99.64	Two Crop Combination
8	Vijaypur	47.94	0.92	5.26	22.84	8.41	9	22.9	0.54	0.57	82.89	201.15	Four Crop Combination
9	Dahigaon She.	36.62	0.94	4.41	23.14	8.08	5.48	20.8	0.14	0	112.3	212.73	Four Crop Combination
10	Ranjani	6.92	13.22	20.02	0.06	4.23	6.56	1.15	0.41	1.46	17.25	71.24	Three Crop Combination
11	Bodkhe	9.25	20.97	45.26	2.44	0.05	16.5	0.55	2.43	0.23	34.7	132.36	Three Crop Combination
12	Tajnapur	6.66	19.46	48.85	1.66	1.19	31.3	5.59	0.2	0.01	25.92	140.82	Two Crop Combination
13	Khuntefal	4.67	0.02	22	12.83	7.34	30	5.67	0.69	0.88	13.68	97.9	Three Crop Combination
14	Dadegaon	8.89	13.24	33.37	0.1	1.02	188	0.35	10.4	16.6	10.34	283.26	Four Crop Combination
15	Joharapur	30.41	8.72	28.02	0.8	5.38	10	9.12	2.43	2.43	2.24	99.58	Four Crop Combination
16	Khamgaon	9.55	9.84	21.65	1.53	0.27	15.5	9.55	0.02	0.09	16.57	84.59	Four Crop Combination

17	Hingangaon Ne.	36.6	15.66	28.56	0.04	4.99	72	11.76	0.75	0.74	1.21	194.11	Four Crop Combination
18	Deotakli	26.55	18.32	30.78	0.19	8.17	109	9.17	0.81	1.23	8.27	236.42	Four Crop Combination
19	Dhorsade	19.18	33.98	45.15	1.14	11.37	139	7.4	0.76	1.42	11.65	271.42	Four Crop Combination
20	Antre	16	27.04	36	0	19.36	100	23.04	13	8.04	51.84	294.08	Three Crop Combination
21	Shahar Takali	7.85	23.94	39.69	25.5	0.04	73.8	4.24	0.69	1.54	38.28	217.48	Four Crop Combination
22	Bhavinimgaon	18.88	0.07	0.49	0.12	5.46	39.1	0.08	0.04	0.49	16.83	81.46	Two Crop Combination
23	Dahigaon Ne	57.64	12.06	15.36	12.06	6.57	78.3	23.83	0.04	12.3	10.89	228.98	Four Crop Combination
24	Khamgaon	22.92	8.33	50.82	43.42	18.62	104	8.64	0	3.45	0.31	261.25	Four Crop Combination
25	Gopalpur	18.69	7.87	24.75	14.19	9.33	49.6	1.69	0.01	3.76	4.71	134.56	Four Crop Combination
26	Ramdoh	8.95	2.9	15.99	0.27	11.06	24.6	1.68	0.19	3.06	10.5	79.24	Three Crop Combination
27	Warkhed	9.5	21.41	42.25	27.15	0.08	167	9.5	1.14	0.43	21.8	300.56	Four Crop Combination
28	Suregaon Gangapur	27.24	0.05	9.84	0.05	0	68.5	1.77	0.45	8.59	15.15	131.62	Two Crop Combination
29	Galnimb	0.01	0.04	25.17	0.06	0.5	52.4	0.49	0.34	0.72	41.42	121.18	Two Crop Combination
30	Manglapur	0.54	27.56	47.15	0.14	4.12	40.5	0.54	7.34	5.76	2.11	153.78	Three Crop Combination
31	Khedle Kajali	16.16	11.56	0.02	68.36	29.3	23.6	0.26	18.5	32.1	609.5	827.47	Monoculture
32	Pravara Sangam	5.97	6.56	9.67	1.75	4.59	14.86	11.59	5.68	4.33	35.00	289.75	Four Crop Combination

1. Crop Diversity and Total Deviation:

The analysis of crop combination types in the Nathsagar dam backwater area of Ahmednagar District provides critical insights into the agricultural patterns and the adaptation strategies of farmers in response to environmental conditions. The classification of villages into different crop combination types helps understand the diversity or specialization in crop production, influenced by factors such as water availability, soil fertility, market demand, and climatic conditions.

2 Crop Combination Types

The villages in the study area exhibit a range of crop combination types from monoculture to four-crop combinations, indicating varying levels of crop diversity. Here's a detailed interpretation:

1. **Monoculture (Khedle Kajali)**

The monoculture practice in Khedle Kajali suggests a high dependence on a single crop, which is often influenced by factors like market demand, soil suitability, and possibly irrigation facilities that favor the cultivation of that particular crop. Monoculture can lead to higher economic returns if the crop is high-value, but it also poses risks like vulnerability to pests, diseases, and market price fluctuations.

2. **Two Crop Combination (Khanapur, Ghotan, Erandgaon, Lakhefal, Dahifal, Tajnapur, Bhavinimgaon, Suregaon Gangapur, Galnimb)**

Villages with two crop combinations indicate a moderate level of diversification. This strategy can mitigate risks associated with monoculture while still allowing farmers to focus on a limited number of crops that suit the local agro-climatic conditions. The presence of two dominant crops suggests that these villages may have adapted to growing crops that require similar management practices or that complement each other in terms of soil nutrient usage.

3. **Three Crop Combination (Antarwali Bk., Ranjani, Bodkhe, Khuntefal, Antre, Ramdoh, Manglapur)**

A three crop combination reflects a higher level of diversification. This could be a strategy to spread economic risk and ensure food security by producing a variety of crops. Such a pattern might be indicative of mixed farming systems where different crops are grown in different seasons or in rotation to maintain soil health and reduce pest pressures. These villages are likely benefiting from a balanced approach to farming that maximizes resource use efficiency.

4. **Four Crop Combination (Karhetakali, Vijaypur, Dahigaon She., Dadegaon, Joharapur, Khamgaon, Hingangaon Ne., Deotakli, Dhorsade, Shahar Takali, Dahigaon Ne, Gopalpur, Warkhed, Pravara Sangam)**

Villages with four crop combinations show the highest level of crop diversity in this study. This indicates a robust and resilient agricultural system that can adapt to various environmental and economic conditions. Such diversity helps in maintaining ecological balance, enhancing soil fertility through crop rotation, and reducing dependency on a single crop. It also suggests that these areas might have better access to diverse markets or more favorable environmental conditions that allow for the cultivation of multiple crops.

Implications of Crop Combination Diversity:

1. **Risk Management**: Higher crop diversity, as seen in villages with three or four crop combinations, implies better risk management strategies. Diverse cropping systems are less susceptible to complete failure due to pests, diseases, or adverse weather conditions.
2. **Economic Stability**: Crop diversity can lead to economic stability for farmers. By cultivating multiple crops, farmers can balance their incomes and reduce the impact of market price fluctuations for any single crop.

3. **Environmental Sustainability**: Villages with diverse cropping patterns contribute to environmental sustainability. Crop rotation and diversification help maintain soil health, reduce soil erosion, and improve water use efficiency. These practices are essential for long-term agricultural productivity.
4. **Adaptation to Climate Change**: Diverse cropping systems are more resilient to climate change. They can better withstand extreme weather events and changing climatic conditions, ensuring food security for the local population.

The assessment of crop combination types in the Nathsagar dam backwater area reveals significant variability in cropping patterns across different villages. This variability reflects the adaptive strategies of farmers to local environmental and socio-economic conditions. Promoting crop diversity can enhance resilience, sustainability, and economic stability in the region's agriculture. Policymakers and agricultural extension services should support practices that encourage diversification to ensure the long-term sustainability of farming in this area.

3 Factors of Crop Combination Types:

3.1 Climatic Conditions:

The climate of Shevgaon tehsil plays a significant role in determining the types of crops grown. Villages with reliable rainfall patterns or access to irrigation are able to diversify their crops more effectively, resulting in nine-crop combinations. For example, Karhetakali and Khedle Kajali have access to adequate water resources, allowing them to cultivate a wide variety of crops, including cereals, pulses, and sugarcane.

3.2 Soil Fertility:

Soil type and fertility also dictate crop selection. Villages with fertile soil can support a greater diversity of crops. Vijaypur and Dadegaon benefit from nutrient-rich soils, which support the growth of cereals, fruits, and vegetables. In contrast, villages with less fertile soil, like Ghotan and Erandgaon, tend to focus on a narrower range of crops that are more resilient to soil limitations.

3.3 Water Availability:

Access to water sources, such as rivers, canals, or wells, influences crop diversity. Villages with ample water supply, such as Khanapur and Hingangaon Ne., can sustain water-intensive crops like sugarcane and vegetables, leading to more diverse crop combinations. Conversely, villages with limited water access, like Antarwali Bk. and Ghotan, often rely on drought-resistant crops, resulting in six-crop combinations.

3.4 Market Demand:

Market demand and economic considerations drive crop choices. Villages near markets or with better transportation facilities tend to grow a variety of high-value crops. For instance, Dahigaon Ne. and Pravara Sangam diversify their crops to meet market demand, including cereals, pulses, and commercial crops like sugarcane.

3.5 Traditional Practices:

Traditional agricultural practices and cultural preferences also shape crop combinations. Some villages follow age-old farming methods that favor certain crops over others. This is evident in villages like Lakhefal and Dahifal, where traditional crops such as Jawar and Bajara dominate due to historical precedence and community preference.

4 Suggestions for Crop Rotation for Risk Mitigation:

4.1 Diversify Crop Selection: Integrate a mix of cereals (e.g., Bajara, Jawar), pulses, and cash crops (e.g., sugarcane, vegetables) to enhance resilience. Villages like Karhetakali can benefit from expanding their crop diversity to reduce dependency on any single crop.

1. **Implement Drought-Resistant Crops**: In areas with limited water availability, such as Ghotan and Antarwali Bk., prioritize drought-resistant crops like Bajara and pulses. Rotate with less water-intensive crops to maintain soil fertility.
2. **Utilize Leguminous Crops**: Include pulses in rotation cycles to improve soil nitrogen content, benefiting subsequent cereal crops. This practice is particularly beneficial for villages like Dahigaon She. and Vijaypur, which already have diversified cropping systems.
3. **Maximize Off-Season Crops**: Introduce off-season vegetables and short-duration crops in regions with reliable irrigation, like Khanapur and Hingangaon Ne., to maximize land use and income.
4. **Adopt Improved Varieties**: Use high-yield, disease-resistant crop varieties to enhance productivity and reduce vulnerability to pests and diseases.

By implementing these strategies, farmers can optimize crop rotation, mitigate risks, and sustain agricultural productivity in the Nathsagar Dam backwater region.

CONCLUSION:

The crop patterns in the Nathsagar Dam backwater region of Shevgaon and Nevasa tehsils exhibit a diverse agricultural landscape driven by various factors, including climatic conditions, soil fertility, water availability, market demand, and traditional practices. Villages with nine-crop combinations, such as Karhetakali and Khedle Kajali, demonstrate extensive diversification, ensuring resilience against climatic and market fluctuations. These villages leverage fertile soils and reliable water sources to cultivate a broad range of crops, enhancing food security and economic stability. Conversely, six-crop combination villages like Antarwali Bk. and Ghotan focus on fewer, drought-resistant crops, reflecting their adaptation to limited water availability and soil constraints. The strategic crop choices in these villages highlight the importance of optimizing crop rotation to mitigate risks associated with environmental variability.

Overall, the identification of crop patterns in this region underscores the necessity of tailored agricultural strategies that consider local conditions. By optimizing crop rotation and diversifying crop selection, farmers can enhance productivity, manage risks effectively, and sustain agricultural livelihoods in the Nathsagar Dam backwater region. This approach promotes sustainable farming practices, contributing to the long-term stability and prosperity of the agrarian community in Ahmednagar District.

REFERENCES:

1. Bhosale, V. P., & Patil, S. R. (2016). Hydrological study of Nathsagar Dam and its effect on surrounding agriculture. *Journal of Water Resources Planning and Management*, 142(8), 05016005.
2. Dadhwal, S. S., & Navalgund, R. R. (2009). Agricultural crop mapping using remote sensing and GIS: A case study in Kharif season of Maharashtra, India. *Journal of Remote Sensing Technology*, 23(4), 567-582.
3. Desai, R. T., & Pawar, S. D. (2018). Adoption of sustainable agricultural practices in Maharashtra: A case study. *International Journal of Agricultural Sustainability*, 16(2), 148-160.
4. Deshmukh, A. B., & Karle, K. R. (2015). Impact of climate change on water resources in Nathsagar Dam region, Maharashtra. *Journal of Hydrology*, 530, 548-556.
5. Gaikwad, M. V., & Jadhav, S. A. (2019). Case study on crop pattern diversification in Ahmednagar District, Maharashtra. *Journal of Agricultural Economics and Development*, 7(3), 45-56.
6. Hooda, R. S., Bhatt, B., & Singh, R. (2010). Spatio-temporal analysis of agricultural crop pattern changes in central India. *Indian Journal of Agricultural Sciences*, 80(8), 687-692.
7. Kulkarni, N. S., & Rao, P. R. (2017). Socio-economic analysis of agricultural practices in Maharashtra: Challenges and opportunities. *Journal of Rural Development*, 36(1), 25-38.
8. Mulla, D. J., & Toth, B. T. (2013). Optimizing crop rotations to improve soil health and mitigate risks. *Soil Science Society of America Journal*, 77(6), 2133-2142.
9. Sharma, P. P., & Singh, M. B. (2012). Crop rotation and its impact on agricultural sustainability: A review. *Agricultural Research Journal*, 29(3), 234-245.
10. Shinde, A. H., & Kadam, R. B. (2020). Local farmers' adaptation strategies to climatic variations in Ahmednagar. *Climate Risk Management*, 27, 100209.
11. Singh, R., & Bhatt, B. (2015). Climate change and its impact on agriculture in Maharashtra. *Agricultural Research*, 4(2), 123-135.
12. Tripathi, R. K., & Pandey, V. (2011). Assessment of crop yield variability in response to climate change in Maharashtra. *Journal of Climate Change Research*, 10(3), 245-257.
13. Vyas, S., & Mishra, A. (2014). Role of water management in sustainable agriculture: A case study from Maharashtra. *Water Resources Management*, 28(6), 1703-1715.