**Global Crop Analysis: Unveiling Insights for Sustainable Agriculture and Food Security**

**Submitted for**

**DATA VISULIZATION AND DASHBOARD**

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| 1. **INTRODUCTION**   In the face of a rapidly growing global population and the escalating challenges posed by climate change, the imperative to ensure food security and promote sustainable farming practices has never been more critical. Agriculture, as the primary source of sustenance for humanity, stands at the nexus of these challenges and opportunities. To address this complex and urgent issue, this study embarks on a comprehensive analysis of global crops data. Theoverarching goal is to unravel the intricate web of variables influencing agriculture productivity on a global scale. The focus extends beyond merely identifying crops and their scientific nomenclature; weightage considerations, and the prevalence of dryness. By delving into the depths of these multifaceted aspects, the study aims to provide insights that can inform sustainable farming practices, foster resilience against environmental uncertainties, and ultimately contribute to the enhancement of worldwide food security. The synergy of data-driven analysis and agricultural science forms the backbone of this endeavor, underlining its potential to shape the future trajectory of global agriculture.  **Problem Statement:** Conduct a comprehensive analysis of global crops data to identify crops, its scientific name, symbol and factors influencing agriculture productivity, considering variables such as moistures, crop category, weightage, dryness, with the aim of informing sustainable farming practices and improving food security worldwide.  **Related Work:**  The Quest for understanding global crops and enhancing agricultural productivity has spurred extensive research across various domains[1]. Numerous studies have explored the identification and categorization of crops, shedding light on their scientific names and symbols. The study of this report delves into the taxonomy classification of crops, providing a foundational understanding of the botanical diversity within global agriculture[2]. Additionally, this research extends beyond taxonomy to investigate the impact of moisture levels on crop yield, offering valuable insights into the intricate relationship between environment conditions and agriculture outcomes[3].  In **Table. 2.1,** it shows the total coarse grain area, yield and production all over the world.  **Table No. 2.1, Total Coarse grain, Yield and Production**    In the realm of sustainable farming practices, we explored the implications of different crop categories on soil health and long-term agricultural viability[4]. Their findings underscore the importance of crop rotation and diversification for mitigating the depletion of soil nutrients[5]. Furthermore, On the basis of this study we have conducted seminal work on the weightage assigned to various crops in different regions, contributing to our understanding of the economic and nutritional significance of specific agriculture products[6]. In **Table No. 1,** we analyze data regarding soil conditions, including moisture level, temperature, and chemical makeup, all of which have an impact upon crop growth and livestock well-being. Using this implementation, develop means to predict harvest yields and evaluate crop quality for individual plant species and enabling farmers to treat plants significantly to the growth of much higher precision.  **Table No. 2.2 , Evaluation of Implemented Crop Dataset**     1. **SOFTWARE USED**  * **Jupiter Notebook** * **Python** * **Power BI** * **Anaconda Navigator** * **Microsoft Office** * **Canva**  1. **METHODOLOGY ---**   To undertake a comprehensive analysis of global crops data and address the multifaceted dimensions outlined in the problem statement, a structured and systematic methodology is crucial. The proposed methodology encompasses the following key steps:   1. **Data Collection-**  * Collect a diverse and extensive dataset comprising global crops information, including scientific names, symbols, moisture levels, crop categories, and weightage. * Leverage reputable agricultural databases, satellite imagery, and open-access repositories to ensure the breadth and depth of the dataset.  1. **Data Cleaning and Preprocessing –**  * Thoroughly clean and preprocess the collected data to ensure consistency, accuracy, and compatibility across diverse sources. * Address missing or erroneous values and standardize units for relevant variables.  1. **Taxonomic Analysis:**  * Utilize taxonomic databases and botanical references to identify and classify crops based on their scientific names and symbols.  1. **Moisture and Dryness Analysis:**  * Employ statistical and geospatial analysis techniques to investigate the distribution of moisture levels globally. * Examine the prevalence of dryness in different regions and assess its impact on crop productivity.  1. **Crop Categorization and Weightage Assessment:**  * Apply clustering algorithm to categorize crops based on shared characteristics. * Evaluate the economic and nutritional weightage of each crop in diverse geographical contexts.  1. **Integrated Analysis:**  * Integrate the findings from taxonomic, moisture, and categorization analyses to unveil comprehensive insights into the factors influencing global agriculture productivity.  1. **Information Visualization:**  * Develop visually engaging and informative representation of the data analysis results to facilitate comprehension and knowledge dissemination.   This rigorous methodology, combining data-driven approach with established agriculture science principles, aims to uncover nuanced relationships and contribute substantively to the promotion of sustainable farming practices and global food security.[7]   1. **Flowchart Diagram:**  * In the evaluation, the main issues and main concerns that need to be considered to address the complexity of agricultural sustainability assessment. These issues and concerns can be categorized in seven broad groups:  1. Integration of climate changes. 2. Maintaining resources, farming and agro environment. 3. Ensuring system performance. 4. Involving stakeholders. 5. Maintaining food production views. 6. Integration of food security 7. Practicing distinct consumption pattern.     **Fig. 4.8.1, Flow Chart Diagram**  The flowchart begins with climate change which improves in yields simulation categorized in three groups as resource, farming & agro environment. The process goes for scenario analysis for informative visualization of food production which gives the conclusion of the effective communication of food security.   1. **EXPERIMENTAL RESULTS**   A comprehensive study of global crop data has shed light on the intricate workings of agriculture worldwide. This meticulous investigation has identified the key crops cultivated across the globe, providing insights into their geographical distribution and significance.[8] A thorough taxonomic examination has provided a deep understanding of each crop, including their precise scientific names and symbols.  By analyzing moisture patterns, the study has uncovered global trends, identified regions optimally suited for specific crops, and assessed potential linkages with productivity. Organizing crops based on shared characteristics has established a systematic framework for overseeing diverse farming environments. Additionally, an economic and nutritional weightage assessment has provided a methodical approach to prioritizing crops for further research and development. In **Fig 1.,** the dataset gives the distribution of Temperature and ph. level which gives the result of fascinating on how these two really resemble each other.    **Fig. 5.1 Distribution of Temperature and ph**  In **Fig 2.,** we visualize the diagonal distribution between two features for all the combinations. This can allow crops to be grown at much higher precision, enabling farmers to treat plants individually, which in turn significantly increases the effectiveness of farmer’s decision.    **Fig. 5.2 Visualization of the diagonal distribution b/w all combinations.**  In **Fig. 3,** as the rain affects soil moisture which affect ph. of the soil. Here, we correlate the average humidity over the temperature for the production of crops during the rainfall. Here are the crops which are likely to be planted during the rainfall season. [9]   * Since, rice needs heavy rainfall (>200 mm) and a humidity above 80%. There will be no doubt that rice production from East Coasts which has average of 220 mm rainfall every year. * Coconut is a tropical crop and needs high humidity therefore explaining massive exports from coastal areas around the country.     **Fig. 5.3, Joint plot b/w rainfall and humidity**  In **Fig. 4,** we correlate the visualization between two features, to see how phosphorus levels and potassium levels are highly correlated.    **Fig. 5.4, Corr. Visualize b/w p levels and K levels.**  The study has also elucidated the diverse factors influencing productivity, encompassing temperature fluctuations, soil quality, and pest prevalence. The convergence of these experimental findings allows for the development of practical suggestions for ecologically responsible and sustainable farming methods, supporting resilient agricultural techniques. Ultimately, these discoveries are pivotal in improving global food security strategies since they maximize crop yield and provide guidance for policies that support a safe and sustainable future for agriculture globally.[10]   1. **DASHBOARD Visualization -**     **Fig No. 6.1 Power BI Dashboard of Crop Data**   1. **CONCLUSION**   A comprehensive analysis of global crop data has yielded illuminating insights into the intricate workings of agriculture across the globe. This meticulous study has identified the predominant crops cultivated worldwide, shedding light on their geographical distribution and significance. A thorough taxonomic examination has provided a deep understanding of each crop, including their precise scientific names and corresponding symbols.  By delving into moisture patterns, the study has unearthed global trends, pinpointed regions optimally suited for specific crops, and assessed potential linkages with productivity. Organizing crops based on shared characteristics has established a systematic framework for overseeing diverse farming environments. Additionally, an economic and nutritional weightage assessment has provided a methodical approach to prioritizing crops for further research and development.  The study has also elucidated the diverse factors influencing productivity, encompassing temperature fluctuations, soil quality, and agronomic practices. It has highlighted the critical role of climate change in shaping crop yields, emphasizing the need for adaptation strategies.  Ultimately, these discoveries are pivotal in improving global food security strategies since they maximize crop yield and provide guidance for policies that support a safe and sustainable future for agriculture globally.   1. **REFERENCES**   [1] M. S. Farooq *et al.*, “Uncovering the Research Gaps to Alleviate the Negative Impacts of Climate Change on Food Security: A Review,” *Frontiers in Plant Science*, vol. 13. Frontiers Media S.A., Jul. 11, 2022. doi: 10.3389/fpls.2022.927535.  [2] L. Benos, A. C. Tagarakis, G. Dolias, R. Berruto, D. Kateris, and D. Bochtis, “Machine learning in agriculture: A comprehensive updated review,” *Sensors*, vol. 21, no. 11. MDPI AG, Jun. 01, 2021. doi: 10.3390/s21113758.  [3] I. K. Nti, A. Zaman, O. Nyarko-Boateng, A. F. Adekoya, and F. Keyeremeh, “A predictive analytics model for crop suitability and productivity with tree-based ensemble learning,” *Decision Analytics Journal*, vol. 8, Sep. 2023, doi: 10.1016/j.dajour.2023.100311.  [4] A. Carlos, X. Salinthone, M. Nguyen, and A. Jacobs, “Sustainable Agriculture through Data Analytics,” *CSU Journal of Sustainability and Climate Change*, vol. 1, no. 1, Jan. 2022, doi: 10.55671/2771-5574.1009.  [5] A. Karnwal, A. Dohroo, and T. Malik, “Unveiling the Potential of Bioinoculants and Nanoparticles in Sustainable Agriculture for Enhanced Plant Growth and Food Security,” *Biomed Res Int*, vol. 2023, pp. 1–23, Nov. 2023, doi: 10.1155/2023/6911851.  [6] T. O. Lawal, M. Abdulsalam, A. Mohammed, and S. Sundararajan, “Economic and Environmental Implications of Sustainable Agricultural Practices in Arid Regions: A Cross-disciplinary Analysis of Plant Science, Management, and Economics,” *International Journal of Membrane Science and Technology*, vol. 10, no. 3, pp. 3100–3114, Aug. 2023, doi: 10.15379/ijmst.v10i3.3027.  [7] S. Minoli, J. Jägermeyr, S. Asseng, A. Urfels, and C. Müller, “Global crop yields can be lifted by timely adaptation of growing periods to climate change,” *Nat Commun*, vol. 13, no. 1, Dec. 2022, doi: 10.1038/s41467-022-34411-5.  [8] D. Deryng, D. Conway, N. Ramankutty, J. Price, and R. Warren, “Global crop yield response to extreme heat stress under multiple climate change futures,” *Environmental Research Letters*, vol. 9, no. 3, 2014, doi: 10.1088/1748-9326/9/3/034011.  [9] C. Zhao *et al.*, “Temperature increase reduces global yields of major crops in four independent estimates,” *Proc Natl Acad Sci U S A*, vol. 114, no. 35, pp. 9326–9331, Aug. 2017, doi: 10.1073/pnas.1701762114.  [10] D. K. Ray, N. D. Mueller, P. C. West, and J. A. Foley, “Yield Trends Are Insufficient to Double Global Crop Production by 2050,” *PLoS One*, vol. 8, no. 6, Jun. 2013, doi: 10.1371/journal.pone.0066428. |  |
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