A Comparative Analysis of Modern Farming and Traditional Farming:(Unveiling the impact on yield and expenses)

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ARTICLE INFO	ABSTRACT
	This research dives into the heart of how we grow our food, exploring the age-old traditions of farming alongside the cutting-edge technologies of today. As the world grapples with feeding a growing population and protecting our environment, understanding the choices farmers face is more critical than ever. Our journey begins by unpacking the tools of the trade – the tractors versus the plows, the sprinklers versus the hand-dug wells. We'll explore how these tools, along with crop management and pest control methods, define both modern and traditional farming. We'll also investigate why farmers choose one way over the other, and how these choices have evolved over time. But a good harvest is just part of the story. We'll delve into the bounty of each method, asking: does modern farming truly yield more food? We'll analyze the numbers, but that's not all. We'll also consider the costs – from the initial investment in machinery to the everyday expenses of running a farm. Does modern farming make financial sense for the people who put food on our tables? Our exploration extends beyond the farm itself. We'll examine the environmental impact of these contrasting styles. Does high-tech agriculture leave a bigger footprint than traditional methods? Or could it surprisingly offer some benefits for our planet? Farming isn't just about crops and money; it's about people and communities. We'll talk to farmers and those who live around them to understand how different methods impact their lives and traditions. Does modern farming disrupt the way of life in rural areas? What about the valuable knowledge passed down through generations? By weaving these threads together, we aim to paint a clear picture of both modern and traditional farming. This knowledge can empower farmers, policymakers, and scientists to make informed decisions about the future of agriculture. Our ultimate goal: a sustainable and productive farming system that respects both the environment and the people who grow our food. This research isn't a sterile analysis of data. It's about the real choices faced by farmers who are feeding a growing world in a constantly changing environment. We believe our findings can help create a future where farming thrives for both humanity and our planet. **Keywords:**Modern farming, traditional farming, crop yield, agricultural economics, sustainable agriculture, farming practices, environmental impact, socio-cultural implications, cost-benefit analysis, agricultural technology, rural development, food security.

INTRODUCTION

Imagine a weathered hand, gently planting a seed, a practice honed over generations. Now, picture a high-tech drone buzzing across a field, its whirring blades a sign of a new age in agriculture. This research delves into the world of farming, where tradition meets innovation, to explore how these contrasting approaches impact our plates and the lives of those who grow our food.

Feeding a growing world is a complex challenge. Our grandparents might have relied on calloused hands and the wisdom of the seasons. Today, farmers grapple with sophisticated equipment and the promise of science. We're on a quest to understand: which method yields a more bountiful harvest?

Traditional farming feels almost poetic. It's a deep connection to the earth, a rhythm as old as time itself. But can it keep pace with a hungry planet? Modern farming, on the other hand, boasts efficiency and abundance. Robots and satellites promise to coax more food from the land. Yet, is this progress truly sustainable?

Beyond the harvest, there's the farmer's livelihood. Traditional methods might seem cost-effective at first glance. But backbreaking labor and unpredictable yields can take their toll. Modern tools and technology come at a hefty price tag, one that can burden even the most determined farmer.

This research isn't a sterile analysis of numbers. It's about the human stories woven into the fabric of agriculture. We'll explore the challenges faced by farmers who choose tradition, those who embrace technology, and those who navigate a blend of both. Do these new methods translate to more food on the table? Do they empower farmers to make a living from their land? Ultimately, we seek a future where farming is not just productive, but also rewarding and sustainable.

By understanding the trade-offs between tradition and technology, we hope to empower farmers, policymakers, and everyday citizens to make informed choices about how we grow the food that nourishes us all. Perhaps the answer doesn't lie in choosing one path over the other, but in finding a harmonious balance. After all, a secure future for our food system relies on both the wisdom of the past and the potential of the future.

Worlds best wheat producer countries

Top-10 Wheat Producing Countries in the World 2024		
Rank	Country	Production (in million tonnes)
1	China	134.792
2	India	104.983
3	Russia	79.56
4	United States	48.67
5	France	33.7
6	Canada	31.34
7	Australia	27.98
8	Ukraine	26.83
9	Pakistan	25.7
10	Germany	22.31
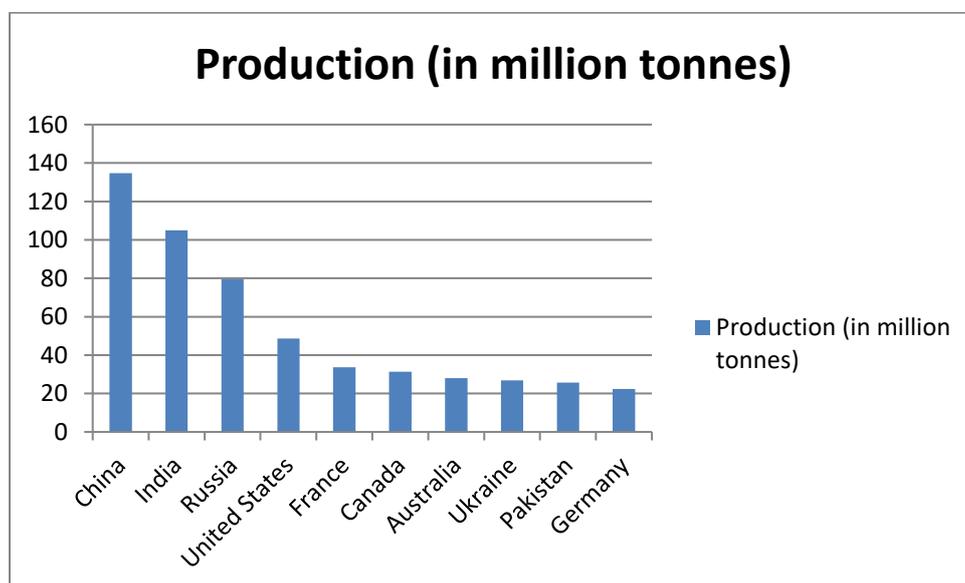
China leads global wheat production with an annual output of 137.7 million tons
The United States ranks fourth, producing 44.9 million tons of wheat annually.
There are several factors that contribute to China's higher agricultural production compared to India, despite India having a larger sown area and population involved in agriculture. Some of the key reasons include:

1. **Agricultural Practices and Technology**: China has made significant investments in agricultural research, technology, and infrastructure. The adoption of modern agricultural practices, machinery, high-yielding crop varieties, and efficient irrigation systems has helped increase productivity in Chinese agriculture.
2. **Land Quality and Irrigation**: China has better land quality in many regions compared to India. Additionally, China has made substantial investments in irrigation infrastructure, which has helped in increasing agricultural productivity by ensuring that crops have access to sufficient water.
3. **Government Policies and Support**: China has implemented policies that support agriculture, such as subsidies, price supports, and investments in rural infrastructure. These policies have helped boost agricultural productivity and ensure food security.
4. **Market Reforms**: China has undertaken market reforms that have improved efficiency in the agricultural sector. These reforms have facilitated better distribution of inputs, improved access to credit, and increased market competitiveness.
5. **Crop Diversification**: China has a more diverse range of crops grown, including high-value crops such as fruits and vegetables, which contribute significantly to agricultural output. This diversification has helped in increasing overall agricultural productivity.
6. **Scale of Operations**: China has larger average farm sizes compared to India, which can lead to economies of scale and higher productivity per unit of land.
7. **Infrastructure Development**: China has invested heavily in rural infrastructure, such as roads, storage facilities, and market linkages, which has helped in reducing post-harvest losses and improving market access for farmers.

India is 2nd largest producer of wheat in the world. State wise production is shown by table.

S.No.	State/ UT	Wheat (Th. tonnes)
1	Uttar Pradesh	33949.7
2	Madhya Pradesh	22418.5
3	Punjab	14821.9
4	Haryana	10447.2
5	Rajasthan	9484.08
6	Bihar	6223.76
7	Gujarat	3334.24
8	Maharashtra	2473.71
9	Uttarakhand	863.6
10	West Bengal	661.52

Wheat (Th. tonnes)

https://testbook.com/static-gk/largest-wheat-producing-state-in-india
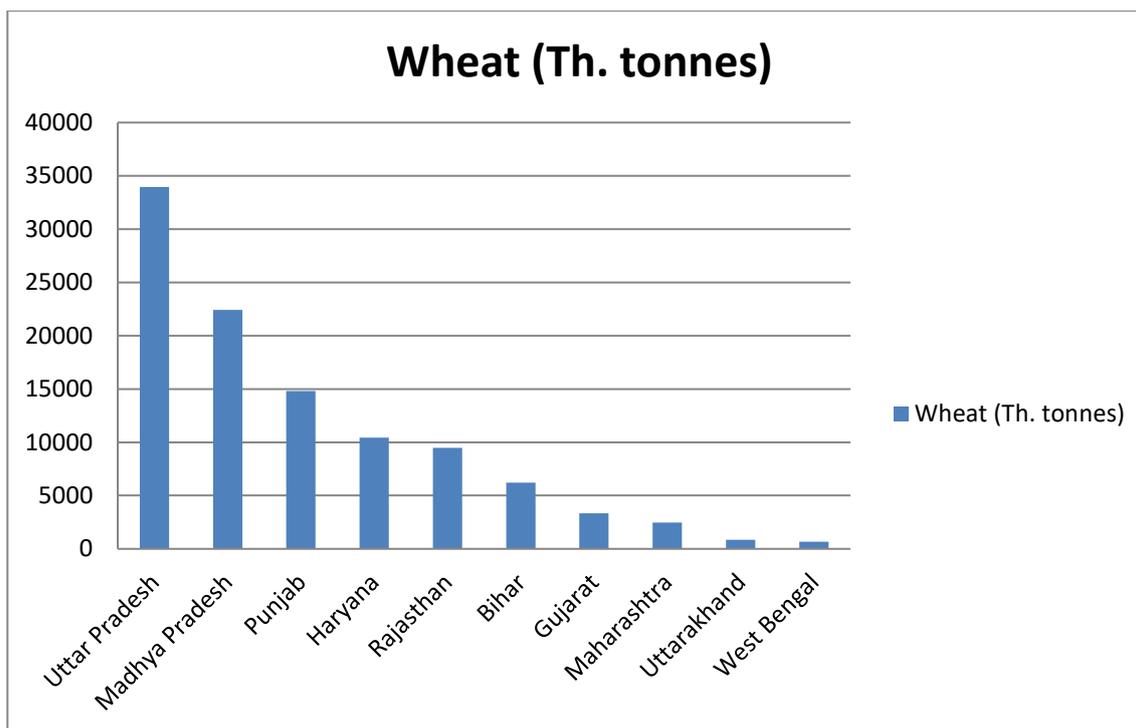
UP is the largest producer of wheat and then MP. Rising temperature is the most prominent reason of less production of wheat. There are some methods of modern technique for wheat production.

1. Rotary tillageCrop rotations are planned sequences of crops over time on the same field. Rotating crops provides productivity benefits by improving soil nutrient levels and breaking crop pest cycles
2. Raised bed planting involves planting crops on ridges and applying irrigation water to the bottom of furrows.
3. Drip Irrigation: drip irrigation systems, especially in water-scarce regions. Drip irrigation involves slowly and precisely delivering water and nutrients directly to the plant's roots, reducing water waste and increasing efficiency.
4. Sprinkler Irrigation: sprinkler irrigation systems, which use a network of pipes and sprinklers to distribute water over the crop area. This method helps in better water coverage and distribution.
5. Precision Irrigation: precision irrigation technologies, which utilize sensors, GPS, and computer-controlled systems to precisely manage water application based on real-time data and crop needs.
6. Centre Pivot Irrigation: which use a rotating sprinkler mechanism to cover a circular area of cropland. This system is particularly useful for large-scale farming operations
7. **Zero tillage technique**: It is a new method used in the Rice-Wheat cropping system. In this method, the sowing of wheat is delayed beyond 25 November because of multiple reasons, viz. preparation of field, uncertain rainfall, and rice harvesting with the traditional method.

REVIEW OF LITERATURE

Dr.D.Princy (2022) Recentlyanalyzed A Comparative Study Modern And Traditional Farming In India and concluded that Modern agriculture uses advanced technology, it is less labor intensive than traditional agriculture, and the yield quantity is larger because there is a focus on maximizing production and maintaining a consistent quality.

Sofia et al (2006) Traditional agriculture is nearly 4000 years old. Indian agriculture comprises a mosaic of diverse TAPs which is the result of its various agro-climatic conditions, soil type and vegetation resulting in heterogamous farming. Apart from ecological adaptation, the source of economy, survival capability, religious and cultural aspect also plays a significant role in traditional crop diversification. Agriculture is the cornerstone of the Indian economy, which contributed about 50% of the workforce and 17–18% of gross domestic product (GDP) as reported in the economic survey report of India for the year 2017–2018. Presently, two-thirds of Indian agriculture is rained which produces almost half of the total production of the country. This rained farming has remained unaffected to the detrimental effect of the green revolution. Indian agriculture is based on the monsoon cycle where variable climatic conditions make it more diverse in the different parts of the country.

Garcia and Wang (2019)investigates the quantitative dimensions of crop yield, considering factors such as crop varieties, soil health, and climate. This body of work reveals nuanced insights into how technological

interventions in modern farming contribute to increased yields, but it also acknowledges the adaptive resilience exhibited by traditional farming systems in certain contexts (Morton, 2021).

Research gap
Identifying research gaps and problems in the context of yield and expenses in modern and traditional farming methods involves exploring several dimensions. Here are key areas to consider:

Research Gaps
1. **Comparative Yield Data**: There is often insufficient comparative data on yields from modern versus traditional farming methods across various crops and regions. This gap hinders the ability to make general conclusions about the efficacy of different farming practices.
2. **Cost-Benefit Analysis**: Detailed cost-benefit analyses that account for both direct and indirect costs (e.g., labour, equipment, environmental impact) are often lacking. More comprehensive economic assessments are needed to evaluate the true costs of modern and traditional farming.
3. **Long-term Sustainability**: Research often focuses on short-term yield and expenses, neglecting long-term sustainability issues such as soil health, water usage, and ecosystem impacts. There is a need for longitudinal studies that track these factors over extended periods.
4. **Adaptation to Climate Change**: How different farming methods adapt to and mitigate the effects of climate change is an underexplored area. This includes understanding the resilience of various methods under changing climate conditions.
5. **Socio-economic Impacts**: The socio-economic impacts of adopting modern versus traditional farming methods on rural communities, including effects on livelihoods, cultural practices, and social structures, are not well-documented.
6. **Technological Adoption Barriers**: Understanding the barriers to adopting modern farming technologies, particularly in developing regions, is crucial. This includes factors such as cost, knowledge, infrastructure, and cultural resistance.

Research Problems
1. **Yield Variability**: Investigating the factors that contribute to yield variability between modern and traditional farming methods. This includes understanding the role of inputs such as fertilizers, pesticides, and genetically modified seeds in modern farming compared to natural or organic practices in traditional farming.
2. **Expense Analysis**: A detailed breakdown of expenses associated with each farming method, including both initial setup costs and ongoing operational costs. This should include labor, machinery, inputs (seeds, fertilizers, pesticides), and any hidden costs like environmental degradation.
3. **Environmental Impact**: Assessing the environmental impact of modern versus traditional farming practices, including soil health, water usage, carbon footprint, and biodiversity. This involves comparing the sustainability of different practices and their long-term ecological consequences.
4. **Productivity vs. Quality**: Examining the trade-offs between productivity (yield) and quality of produce in modern and traditional farming methods. This includes nutritional content, taste, and market value of crops.
5. **Resource Efficiency**: Studying the efficiency of resource use (water, energy, land) in modern and traditional farming methods. This includes analyzing how each method optimizes the use of natural resources.
6. **Economic Viability**: Investigating the economic viability of small-scale traditional farming versus large-scale modern farming. This includes assessing the potential for profitability, market access, and financial sustainability.
7. **Farmer Livelihoods**: Understanding the impact of different farming methods on farmer livelihoods, including income stability, health, and overall quality of life. This also includes exploring how changes in farming practices affect rural economies and communities.
8. **Policy and Support Systems**: Evaluating the role of government policies, subsidies, and support systems in promoting or hindering different farming methods. This involves understanding how policy frameworks influence the adoption of modern or traditional practices.

 OBJECTIVE
1. To compare and contrast the crop yields of modern and traditional farming methods.
2. To analyse the operational expenses associated with both modern and traditional farming practices.
3. To assess the appropriate method for increasing yield.
4. The study is effective for the wheat producers, government and other related stake holders.

RESEARCH METHODLOGY

The study**:** the study is descriptive. A structured questionnaire with open and close ended questions is used to collect responses.

Sampling type**:** Simple random sampling was used to collect the Primary data.

Hypotheses:-
1) For expenditure analysis
Hypothesis (H$_O$): There is no difference in cost of production in modern and traditional farming method.
Hypothesis (H$_1$): The cost of production is higher in modern farming compared to traditional farming.
2) For yield analysis
Hypothesis (H$_O$): There is no difference in yield in modern and traditional farming method
Hypothesis (H$_1$): Modern farming methods result in higher crop yields than traditional methods.
Sample size**:** The sample consists of 104 respondents from various villages of Ujjain districts of Madhya Pradesh.
Tools used**: Mean,**ANOVAs, T-test, Z-test, F-test.
Limitations:-
* Result could not apply outside Ujjain region.
* The study has 2 to 3 month duration; the acquired data is partially reliable.
* Self reported questioner circulated through Google form so it may response biased.
* All the statistical tools are applied through Excel.
* Data collected was only 104 respondent which may not represent the whole.

FINDINGS OF THE STUDY

Analyse the operational expenses associated with both modern and traditional farming practices
OPERATING EXPENSES in MODERN FARMING

Table 1: Modern Farming	
Expense Range	**Frequency**
1000-5000	4
5001-10000	3
10001-15000	37
15001-20000	18

(source- primary data)
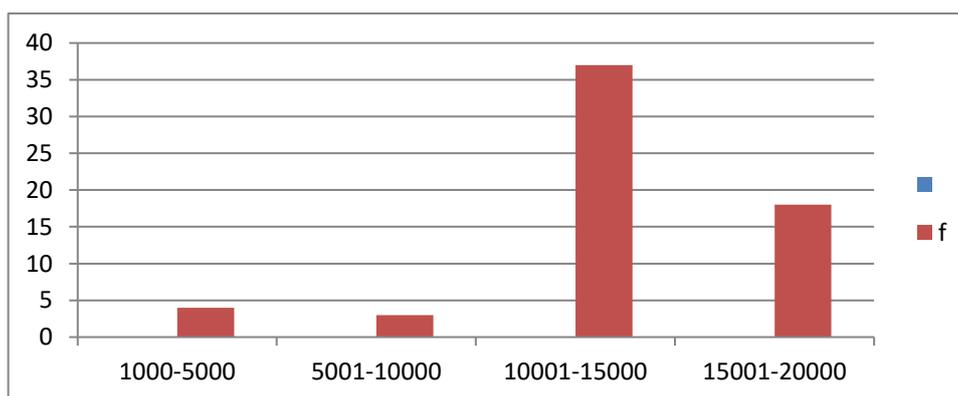
Table represents operating expenses in traditional farming

Table 2: Traditional Farming	
Expense Range	**Frequency**
1000-5000	3
5001-6500	13
6501-7500	24
7501-8500	20
8501-9000	2

(Source- primary data)
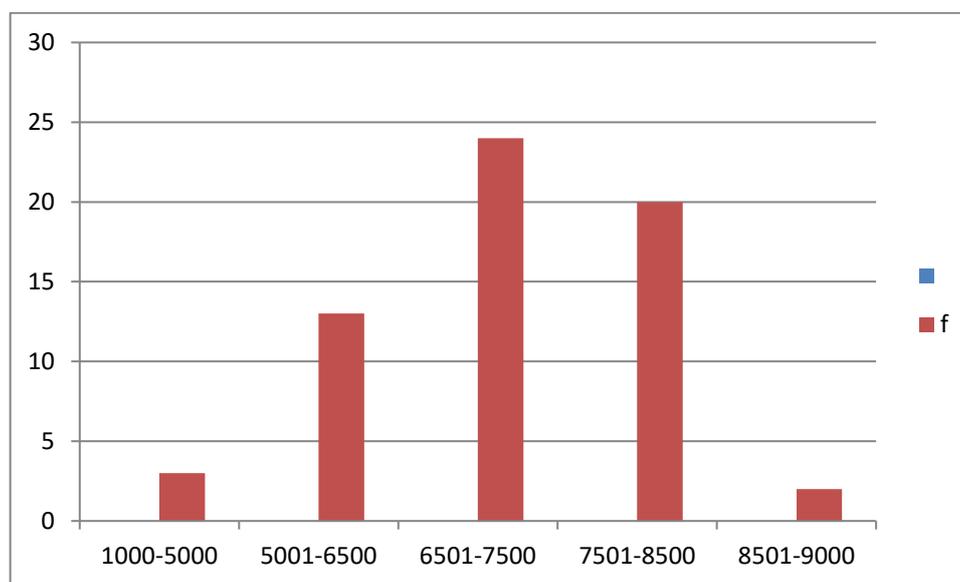
Anova (one way)

Step 1: Calculate the means for each group Modern Farming mean: 12903.23 Traditional Farming mean: 7103.23

Step 2: Calculate the overall mean Overall mean: 10003.23

Step 3: Calculate the Sum of Squares Between groups (SSB) SSB = 1,016,774,193.55

Step 4: Calculate the Sum of Squares Within groups (SSW) SSW = 1,374,516,129.03

Step 5: Calculate the degrees of freedom df between = 1 (number of groups - 1) df within = 122 (total number of observations - number of groups)

Step 6: Calculate Mean Square Between (MSB) and Mean Square Within (MSW) MSB = SSB / df between = 1,016,774,193.55 MSW = SSW / df within = 11,266,525.65

Step 7: Calculate the F-statistic F = MSB / MSW = 90.25

Step 8: Determine the critical F-value For a significance level of 0.05, with df between = 1 and df within = 122, the critical F-value is approximately 3.92.

Result: The calculated F-value (90.25) is much larger than the critical F-value (3.92), which suggests that there is a statistically significant difference between the means of Modern Farming and Traditional Farming expenses.

Interpretation: Based on this ANOVA test, we can conclude that there is a significant difference in the expenses per acre between Modern Farming and Traditional Farming methods. The p-value for this test would be very small ($p < 0.001$), indicating strong evidence against the null hypothesis of no difference between the groups.

This analysis suggests that the choice of farming method (Modern vs Traditional) has a significant impact on the expenses per acre. Specifically, Modern Farming appears to have significantly higher expenses per acre compared to Traditional Farming.

F-Test Two-Sample for Variances

State the hypotheses H0: $\mu_1 = \mu_2$ (The mean expenses of Modern Farming and Traditional Farming are equal) Ha: $\mu_1 \neq \mu_2$ (The mean expenses of Modern Farming and Traditional Farming are not equal)

Step 1: Calculate the variances for each group

Modern Farming variance: 17,845,161.29 Traditional Farming variance: 2,687,903.23

Step 2: Calculate the F-statistic F = Larger variance / Smaller variance F = 17,845,161.29 / 2,687,903.23 = 6.64

Step 3: Determine the degrees of freedom df numerator (Modern Farming) = 61 df denominator (Traditional Farming) = 61

Step 4: Determine the critical F-value For a two-tailed test at a significance level of 0.05, with df numerator = 61 and df denominator = 61, the critical F-values are approximately: Lower critical value: 0.63 Upper critical value: 1.59

Step 5: Compare the calculated F-value with the critical F-values

Result: The calculated F-value (6.64) is greater than the upper critical F-value (1.59).

Interpretation: Since the calculated F-value falls outside the range of the critical F-values, we reject the null hypothesis that the variances are equal. This means there is strong evidence to suggest that the variances of the expenses for Modern Farming and Traditional Farming are significantly different.

Specifically, the variance of Modern Farming expenses is significantly larger than the variance of Traditional Farming expenses. This indicates that Modern Farming expenses are more spread out or variable compared to Traditional Farming expenses.

T-TEST

State the hypotheses H0: $\mu_1 = \mu_2$ (The mean expenses of Modern Farming and Traditional Farming are equal) Ha: $\mu_1 \neq \mu_2$ (The mean expenses of Modern Farming and Traditional Farming are not equal)

Step 1: Calculate the means and standard deviations for each group

Modern Farming: Mean ($\bar{x}_1$) = 12903.23 Standard Deviation (s_1) = 4223.17

Traditional Farming: Mean ($\bar{x}_2$) = 7103.23 Standard Deviation (s_2) = 1639.48

Step 2: Calculate the pooled standard deviation $s_p = \sqrt{[(s_1^2(n_1-1) + s_2^2(n_2-1)) / (n_1+n_2-2)]}$ s_p = 3235.75

Step 3: Calculate the t-statistic $t = (\bar{x}_1 - \bar{x}_2) / (s_p * \sqrt{(2/n)})$ t = 9.50

Step 4: Determine the degrees of freedom df = $n_1 + n_2 - 2$ = 122

Step 5: Determine the critical t-value For a two-tailed test at a significance level of 0.05 and df = 122, the critical t-value is approximately ±1.98.

Result: The calculated t-value (9.50) is greater than the critical t-value (1.98).

Interpretation:

- We reject the null hypothesis that there is no difference between the mean expenses of Modern Farming and Traditional Farming.
- There is a statistically significant difference between the mean expenses of Modern Farming and Traditional Farming (t(122) = 9.50, p < 0.001).
- The positive t-value indicates that the mean expense for Modern Farming is significantly higher than that of Traditional Farming.

Z-TEST

Step 1: State the hypotheses H0: $\mu_1 = \mu_2$ (The mean expenses of Modern Farming and Traditional Farming are equal) Ha: $\mu_1 \neq \mu_2$ (The mean expenses of Modern Farming and Traditional Farming are not equal)

Step 2: Calculate the means and standard deviations for each group

Modern Farming (Group 1): Mean ($\bar{x}_1$) = 12903.23 Standard Deviation (s_1) = 4223.17 n_1 = 62

Traditional Farming (Group 2): Mean ($\bar{x}_2$) = 7103.23 Standard Deviation (s_2) = 1639.48 n_2 = 62

Step 3: Calculate the z-statistic $z = (\bar{x}_1 - \bar{x}_2) / \sqrt{((s_1^2/n_1) + (s_2^2/n_2))}$ z = 10.18

Step 4: Determine the critical z-value For a two-tailed test at a significance level of 0.05, the critical z-value is ±1.96.

Step 5: Calculate the p-value the p-value for a z-score of 10.18 is extremely small (p < 0.00001).

Result: The calculated z-value (10.18) is much greater than the critical z-value (1.96).

Interpretation:

- We reject the null hypothesis that there is no difference between the mean expenses of Modern Farming and Traditional Farming.
- There is a statistically significant difference between the mean expenses of Modern Farming and Traditional Farming (z = 10.18, p < 0.00001).

- The positive z-value indicates that the mean expense for Modern Farming is significantly higher than that of Traditional Farming.

Z-TEST
Step 1: State the hypotheses H0: $\mu_1 = \mu_2$ (The mean expenses of Modern Farming and Traditional Farming are equal) Ha: $\mu_1 \neq \mu_2$ (The mean expenses of Modern Farming and Traditional Farming are not equal)
Step 2: Calculate the means and standard deviations for each group
Modern Farming (Group 1): Mean ($\bar{x}_1$) = 12903.23 Standard Deviation (s1) = 4223.17 n1 = 62
Traditional Farming (Group 2): Mean ($\bar{x}_2$) = 7103.23 Standard Deviation (s2) = 1639.48 n2 = 62
Step 3: Calculate the z-statistic z = ($\bar{x}_1$ - $\bar{x}_2$) / $\sqrt{(s_1^2/n_1) + (s_2^2/n_2)}$ z = 10.18
Step 4: Determine the critical z-value For a two-tailed test at a significance level of 0.05, the critical z-value is ±1.96.
Step 5: Calculate the p-value The p-value for a z-score of 10.18 is extremely small (p < 0.00001).

Result: The calculated z-value (10.18) is much greater than the critical z-value (1.96).
Interpretation:
Null hypotheses arerejected and alternative hypotheses are accepted.
- We reject the null hypothesis that there is no difference between the mean expenses of Modern Farming and Traditional Farming.
- There is a statistically significant difference between the mean expenses of Modern Farming and Traditional Farming (z = 10.18, p < 0.00001).
- The positive z-value indicates that the mean expense for Modern Farming is significantly higher than that of Traditional Farming.
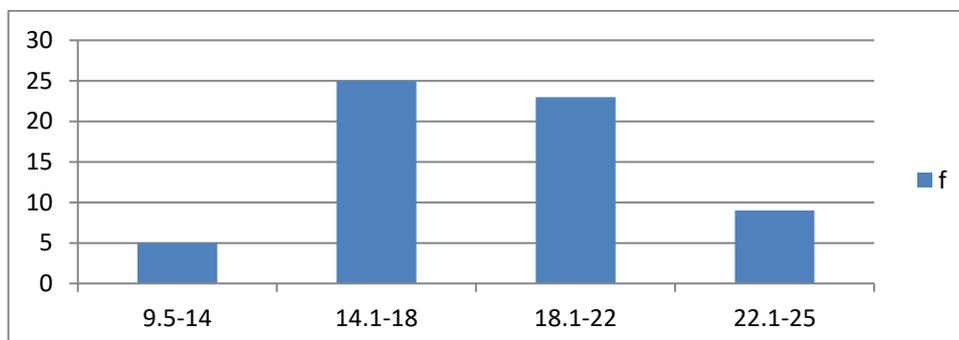
Compare and contrast the crop yields of modern and traditional farming methods quintal per acre

Table and graph represents yield per acre in modern farming method

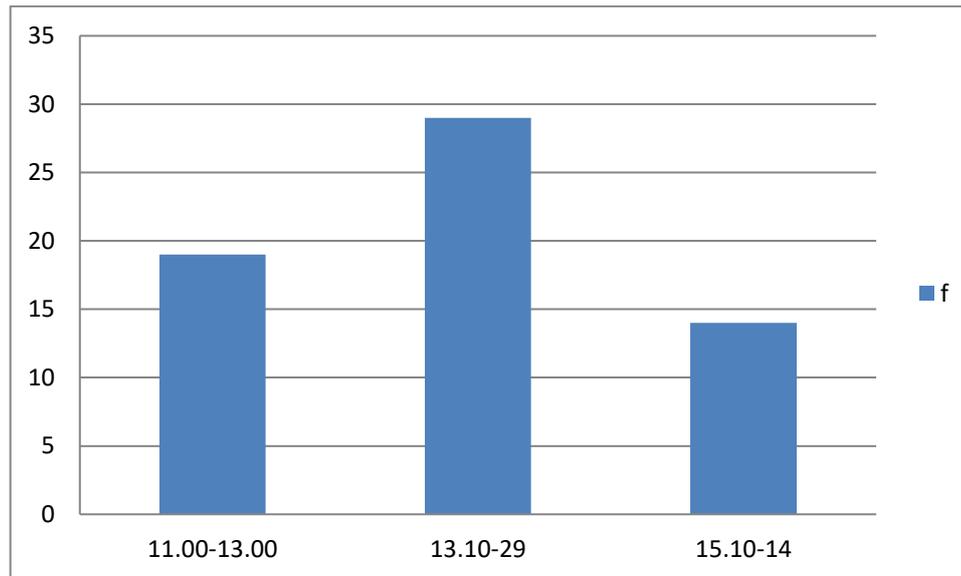| Table 1: Modern Farming Yield	
Yield Range (quintals)	**Frequency**
9.5-14	5
14.1-18	25
18.1-22	23
22.1-25	9

(source-primary data)

Graph shows yield quintal per acre of land

Table and graph represents yield per acre in traditional farming method

Traditional Farming Yield	
Yield Range (quintals)	Frequency
11.00-13.00	19
13.1-15	29
15.1-17	14

(source-primary data)

ANOVA (Analysis of Variance)

State the hypotheses H0: μ1 = μ2 (The mean Yield of Modern Farming and Traditional Farming are equal)
Ha: μ1 ≠ μ2 (The mean Yield of Modern Farming and Traditional Farming are not equal)
Step 1: Calculate the means for each group Modern Farming mean: 18.95 Traditional Farming mean: 14.31
Step 2: Calculate the overall mean Overall mean: 16.63
Step 3: Calculate the Sum of Squares Between groups (SSB) SSB = 660.06
Step 4: Calculate the Sum of Squares Within groups (SSW) SSW = 932.94
Step 5: Calculate the degrees of freedom df between = 1 df within = 122
Step 6: Calculate Mean Square between (MSB) and Mean Square within (MSW) MSB = 660.06 MSW = 7.65
Step 7: Calculate the F-statistic F = 86.28
Step 8: Determine the critical F-value For a significance level of 0.05, with df between = 1 and df within = 122, the critical F-value is approximately 3.92.
Result: The calculated F-value (86.28) is much larger than the critical F-value (3.92), indicating a statistically significant difference between the means of Modern Farming and Traditional Farming yields.
Null hypotheses is rejected and alternative hypotheses is accepted.
Interpretation:
- There is a statistically significant difference in the mean yields between Modern Farming and Traditional Farming methods (F(1, 122) = 86.28, p < 0.001).
- This suggests that the choice of farming method (Modern vs Traditional) has a significant impact on crop yield.
- We can confidently reject the null hypothesis that the mean yields are the same for both farming methods.

F-test
State the hypotheses H0: μ1 = μ2 (The mean Yield of Modern Farming and Traditional Farming are equal)
Ha: μ1 ≠ μ2 (The mean Yield of Modern Farming and Traditional Farming are not equal)
Step 1: Calculate the variances for each group Modern Farming variance: 11.84 Traditional Farming variance: 1.94
Step 2: Calculate the F-statistic F = 11.84 / 1.94 = 6.10
Step 3: Determine the degrees of freedom df numerator (Modern Farming) = 61 df denominator (Traditional Farming) = 61

Step 4: Determine the critical F-values (at 0.05 significance level) Lower critical value: 0.63 Upper critical value: 1.59

Result: The calculated F-value (6.10) is greater than the upper critical F-value (1.59), indicating significantly different variances between Modern and Traditional Farming yields.

F-test Interpretation:

Null hypotheses arerejected and alternative hypotheses are accepted.

- There is a statistically significant difference in the variances of yields between Modern Farming and Traditional Farming methods.
- Modern Farming shows significantly more variability in yield compared to Traditional Farming.

T-test

State the hypotheses H0: $\mu_1 = \mu_2$ (The mean Yield of Modern Farming and Traditional Farming are equal)
Ha: $\mu_1 \neq \mu_2$ (The mean Yield of Modern Farming and Traditional Farming are not equal)
Step 1: Calculate means and standard deviations Modern Farming: Mean = 18.95, SD = 3.44 Traditional Farming: Mean = 14.31, SD = 1.39
Step 2: Calculate the pooled standard deviation sp = 2.59
Step 3: Calculate the t-statistic t = 9.29
Step 4: Determine the degrees of freedom df = 122
Step 5: Determine the critical t-value Critical t-value (two-tailed, 0.05 significance) $\approx \pm 1.98$

Result: The calculated t-value (9.29) is greater than the critical t-value (1.98), indicating a statistically significant difference between the mean yields of Modern and Traditional Farming.

T-test Interpretation:

Null hypotheses is rejected and alternative hypotheses is accepted.

- There is a statistically significant difference between the mean yields of Modern Farming and Traditional Farming ($t(122) = 9.29$, $p < 0.001$).
- Modern Farming produces significantly higher yields on average compared to Traditional Farming.

Findings

- Modern farming techniques generally result in higher wheat yields due to the use of high-yield variety seeds, synthetic fertilizers, and advanced irrigation systems.
- Traditional farming techniques typically produce lower yields due to reliance on local seed varieties and organic fertilizers, which may not be as potent as synthetic ones.
- The use of advanced technology, synthetic fertilizers, pesticides, and irrigation systems increases the cost of inputs.
- Larger-scale operations can reduce per-unit costs, but initial investments are high.
- Traditional methods generally involve lower input costs due to the use of locally sourced seeds, organic fertilizers, and natural pest control methods.
- In traditional method manual labour can increase costs, but labour is often cheaper in rural regions.
- Organic fertilizers and natural pest control methods are less harmful to the environment.
- Efficiency is often technology-dependent, requiring consistent maintenance and updates.
- Advanced irrigation systems (like drip or sprinkler irrigation) and precision farming techniques optimize water and nutrient use.
- Higher yields and efficiency can lead to greater profitability for farmers with access to capital and technology.
- Requires training and knowledge, which can be a barrier for some farmers.
- India has a system of Minimum Support Prices (MSPs) for various agricultural commodities, which aims to provide a guaranteed price floor for farmers.
- India provides subsidies on inputs like fertilizers, seeds, and electricity for irrigation, which helps reduce the cost of production for farmers.
- India has implemented several crop insurance schemes, such as the Pradhan Mantri Fasal Bima Yojana, to provide farmers with protection against crop losses due to natural calamities.
- India has been investing in rural infrastructure, such as irrigation systems, rural roads, and storage facilities, but the pace of development has been relatively slower

Suggestions

- Provide training and support to farmers to help them adopt suitable modern technologies while preserving beneficial traditional practices.
- Indian government have to put more emphasis on technological innovation and has made substantial investments in agricultural research, leading to the development of high-yielding crop varieties and advanced farming techniques.
- Indian government has to make advanced control systems that integrate weather data, soil moisture sensors, and real-time monitoring to optimize irrigation schedules and water usage.

- Implement policies that support sustainable farming practices, offering subsidies for organic inputs and technologies that improve efficiency without harming the environment.
- Small farmers are not capable of using modern technique of farming as its capital cost is high and not suitable for small lands.
- Implement practices like no-till farming, cover cropping, and crop rotation to maintain soil health and reduce erosion.
- Use GPS and remote sensing technologies to optimize water, fertilizer, and pesticide use, reducing waste and environmental impact.
- Utilize solar panels, wind turbines, and biogas plants to power farm operations and reduce carbon footprint.
- Use Internet of Things (IoT) devices and data analytics to monitor crop health, soil conditions, and weather patterns, enabling timely interventions.
- Promote the use of compost, manure, and green manures to improve soil fertility and structure.
- Grow multiple crops together to enhance biodiversity, reduce pest pressure, and improve soil health.
- Develop local markets and community-supported agriculture (CSA) programs to provide farmers with direct access to consumers.
- Develop policies that promote sustainable farming, protect small farmers, and encourage biodiversity conservation.

CONCLUSION

Wheat production in India faces several challenges that hinder its full potential. Climate change-induced variability in weather patterns, including untimely rains, heat stress, and pest infestations, poses a significant risk to crop yields and quality.

o India's wheat production has declined in the **last 3 years** due to unfavourable weather conditions, leading to a sharp drop in wheat output.
o The government estimates this year's wheat crop to be **6.25% lower** than the previous year's (2023) record production of **112 million metric tons.**

https://www.drishtiias.com/daily-updates/daily-news-analysis/india-to-import-wheat-after-6-years

So Indian policy maker follows a balanced approach that integrates modern and traditional farming methods is essential for achieving sustainable agricultural development

The study reveals that the fields of modern and traditional farming have revealed a compelling story. Modern methods, with their high-tech tools and advanced science, have unlocked a cornucopia of food, allowing us to feed more people than ever before. But like any good harvest, there's a price to pay. The sophisticated equipment and fertilizers that fuel this abundance also come with a hefty bill for farmers.

This creates a complex challenge. Modern farming offers a solution to feeding a growing world, but it can strain the wallets of the very people who grow our food. The key to a sustainable future lies in finding a harmonious balance. Farmers need to carefully consider the trade-offs - can the increased harvest outweigh the financial burden of modern methods?

There's no single answer, and the future of farming is likely a blend of old and new. Perhaps the wisdom of traditional practices, passed down through generations, can be combined with the power of modern technology. Research into areas like sustainable intensification, which

Focuses on getting more food from the land without harming the environment, offers a glimmer of hope.

Ultimately, the future of our food system rests on our collective shoulders. Farmers need on-going support and research to navigate these complexities. Policymakers need to create frameworks that encourage sustainable practices. And all of us, as consumers, can play a role by understanding the challenges farmers face and making informed choices about the food we buy.

By acknowledging the trade-offs inherent in modern farming and embracing a spirit of innovation, we can cultivate a future where our food system thrives. Let's work together to ensure that our plates are not only full, but that the bounty we enjoy comes from a source that's both productive and respectful of the planet that sustains us all.

REFERENCES

1. Dweba TP, Mearns MA (2011) Conserving indigenous knowledge as the key to the current and future use of traditional vegetables. IntJInf Manage 31(6):564–571
2. Dwivedi JL (2011) Status paper on rice in Uttar Pradesh. Rice Knowledge Management Portal (RKMP), Directorate of Rice Research, Hyderabad, India. Accessed 7 Sept. https://www.rkmp.co.in
3. FAO (2015) The State of food insecurity in the world. In: Meeting the 2015 international hunger targets: taking stock of uneven progress. FAO, Rome
4. FAO (2016) The State of Food and Agriculture, Climate Change, Agriculture and Food Security. Food and Agriculture Organization of the United Nations Rome, 2016. www.fao.org
5. https://www.drishtiias.com/daily-updates/daily-news-analysis/india-to-import-wheat-after-6-years

6. https://testbook.com/static-gk/largest-wheat-producing-state-in-india
7. https://www.google.com/search?q=wheat+production+in+madhya+pradesh&rlz=1C1JJTC_enIN1078IN1078&oq=wheat+production+in+m&gs_lcrp=EgZjaHJvbWUqBwgCEAAYgAQyBggAEEUYOTIHCAEQABiABDIHCAIQABiABDIHCAMQABiABDIHCAQQABiABDIHCAUQABiABDIGCAYQRRg8MgYIBxBFGDzSAQkxNTYxOGowajeoAgiwAgE&sourceid=chrome&ie=UTF-8
8. https://www.quora.com/Why-is-Chinas-agricultural-production-higher-than-Indias-production-even-though-India-has-a-larger-sown-area-and-population-involved-in-it
9. https://byjusexamprep.com/upsc-exam/what-are-the-methods-of-wheat-cultivation
10. https://www.google.com/search?q=methods+of+modern+agriculture+methods+for+wheat+crop&rlz=1C1JJTC_enIN1078IN1078&oq=methods+of+modern+agriculture+methods+for+wheat+crop&gs_lcrp=EgZjaHJvbWUyBggAEEUYOTIKCAEQABiABBiiBDIKCAIQABiABBiiBDIKCAMQABiABBiiBNIBCDg0NTJqMG03qAIIsAIB&sourceid=chrome&ie=UTF-8