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RESEARCH ARTICLE

UNVEILING CONSTRAINTS FACED BY AGRICULTURAL FARMERS: TOTAL SCORING AND PRINCIPAL COMPONENT ANALYSIS (PCA) APPROACH IN BANKURA DISTRICT, WEST BENGAL, INDIA

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ABSTRACT

The study delves into the identification and analysis of constraints faced by workers across diverse enterprises and farmers engaged in agricultural cultivation. Through extensive discussions, a plethora of constraints were discerned, each unique to its respective enterprise. Utilizing a comprehensive methodology, constraints were categorized and evaluated through both Total Scoring Method and Principal Component Analysis (PCA).The Total Scoring Method facilitated the systematic ranking of constraints based on respondents' situational perceptions. This involved assigning scores to each constraint and subsequently calculating their frequency to determine their significance. Concurrently, PCA was employed to extract factors, rotate, and interpret them, unveiling underlying patterns and relationships among constraints.In the realm of agricultural cultivation, discussions with farmers elucidated a myriad of constraints. Notably, lower market value for agricultural products and lack of storage reservoirs emerged as prominent issues. Through PCA, these constraints, along with others, were systematically categorized into distinct factors, shedding light on their interconnectedness and impact.The findings underscore the multifaceted nature of constraints impeding enterprise operations and agricultural productivity. Moreover, the scree plot analysis confirmed the relevance of the first 12 factors, collectively explaining a significant portion of the variability in the data. The research provides valuable insights into the constraints faced by workers across different enterprises and farmers in agricultural cultivation. It emphasizes the importance of addressing these constraints through targeted interventions and strategic initiatives to foster sustainable development and enhance productivity in diverse sectors.

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INTRODUCTION

The identification of constraints faced by farmers engaged in the cultivation of agriculture enterprise reveals a multitude of challenges. These include the lack of access to genetically modified (GM), high-yielding variety (HYV), and good-quality seeds, which hinders optimal crop production. Additionally, farmers often lack awareness of various government schemes designed to support agricultural development. Socio-economic pressures frequently compel farmers to engage in distress sales of their produce, perpetuating a cycle of financial instability. Traditional farming methods persist due to insufficient understanding of sustainable agricultural practices, compounded by the absence of proper training programs. Debt traps further exacerbate financial woes, with farmers struggling to repay loans amidst lower productivity and yields per capita labor force. Energy scarcity, manifested in electricity shortages and inadequate mechanization, hampers efficient farming operations. Pest infestations, diseases, and weed proliferation pose significant threats to crop yields, while high input costs and capital scarcity limit farmers' ability to invest in modern agricultural techniques and equipment. Challenges extend to transportation and storage facilities, exacerbating post-harvest losses. Water scarcity, soil erosion, and improper irrigation management further compound agricultural challenges. Despite the availability of subsidies, their allocation often fails to address farmers' needs effectively. Illiteracy and lack of scientific knowledge impede the adoption of best practices, leading to excessive use of inputs and diminished market value for agricultural products. Moreover, disguised unemployment persists in the agricultural sector, highlighting systemic inefficiencies that hinder sustainable development.

METERIALS AND METHODS

Constraint analysis has been measured with the help of Total Ranking Method and Principal Component Analysis Method. After discussion with the workers of different enterprise, a large number of constraints have been identified. Different constraints relating to different enterprise have been selected for data collection. Its statements (constraints) have been presented to the respondents in a 4-point continuum like very much, much, not so much, not at all, with weightage 4, 3, 2, 1 respectively.

Total Scoring Method: After collection of data, total scoring was done for each of constraints and these constraints have been ranked on the basis of **total scoring**. Each respondent give score against each statement according to their situational perception. Then by calculating the frequency against each constraint the scoring has been done.

Principal Component Analysis Method: In order to identify the important constraints, factor analysis is done with Principal Component Analysis (PCA) which involves extraction of factors, rotation and interpretation of factors. For interpretation of factors, variables, with factor loadings, were taken into consideration. Constraints were named on the basis of the similarity of the variables representing the factors. The items were arranged on thebasis of high factor loading. All factors have been identified relating to the constraints of households of different unorganised sectors separately.

Each respondent give score against each statement according to their situational perception. The scoring has been done by calculating the frequency against each constraint.

Different constraints are categorized on the basis of degree with ranking such as

a) **Very much, b) Much, c) Not so much, d) Not at all**

The scoring has been done by calculating the frequency against each constraint.

RESULTS AND DISCUSSION

After discussion with the farmers, a large number of constraints relating to the enterprise – cultivation of agriculture has been identified.

Identification of Constraints of farmers of Enterprise – Cultivation of Agriculture

1	Lack of GM, HYV and good quality seeds
2	Lack of awareness on different Govt. schemes among farmers
3	Farmers are forced, under socio-economic conditions to carry on distress sale of their produce
4	Traditional method of farming
5	Natural disasters (flood, drought, monsoon failure etc.)
6	Lack of proper understanding of the need to grow crops sustainably
7	Lack of proper training programme
8	Debt trap: Unable to repay loans
9	Lower productivity and low yields per capita labour force
10	Energy scarcity like electricity, mechanization
11	Pest, germs and weed cause heavy loss to crops
12	High cost of inputs
13	Scarcity of capital
14	Lack of transport facilities
15	Small farm size
16	Unawareness to use bio-fertilizers, biocides
17	Soil erosion
18	Improper management of water through irrigation
19	Allocation of subsidies is not appropriate
20	Illiteracy
21	Excess use of manures, fertilizers and pesticides
22	Lack of storage reservoirs
23	Water scarcity
24	Lack of modern agricultural implements and machinery
25	Lower market value to the agricultural products
26	Lack of knowledge over scientific method

Constraints Analysis of Farmers of the Enterprise – Cultivation of Agriculture on the Basis of Total Scoring: Each respondent give score against each statement according to their situational perception. Then by calculating the frequency against each constraint the scoring has been done.

Table 1. Constraints Analysis of Farmers of the Enterprise – Cultivation of Agriculture on the Basis of Total Scoring

Statement	Score	Ranking
X1	139	11
X2	135	15
X3	122	17
X4	113	20
X5	105	23
X6	138	13
X7	120	18
X8	151	8
X9	129	16
X10	110	22
X11	120	19
X12	161	4
X13	157	6
X14	160	5
X15	113	21
X16	157	7
X17	137	14
X18	83	26
X19	90	25
X20	90	24
X21	139	12
X22	83	27**
X23	165	3
X24	166	2
X25	168	1*
X26	144	10
X27	150	9

* Highest rank
** Lowest rank

The study reveals that according to respondent's perception. In total scoring method, the constraint number (X_{25}), designated as lower market value to the agricultural products and the constraint number X_{22}, designated as lack of storage reservoirs is found to be the highest and the lowest among all the constraints respectively. The perceived sequences of different constraints faced by the farmers are represented below.

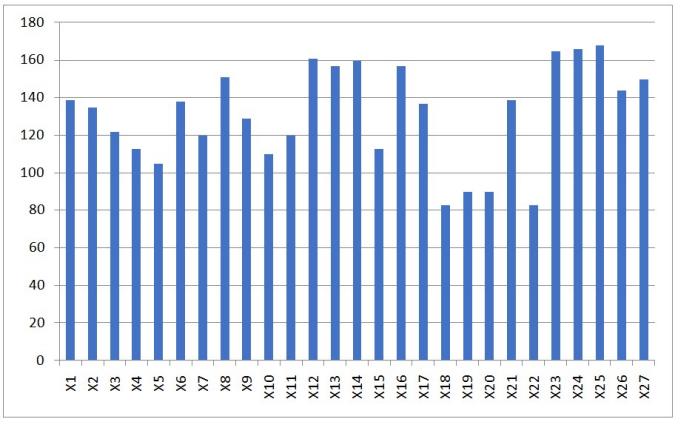

Fig. 2. Graphical Representation of Constraints Analysis of Farmers of the Enterprise – Cultivation of Agriculture on the Basis of Total Scoring

Constraints Analysis of Farmers of the Enterprise – Cultivation of Agriculture on the Basis of Principal Component Analysis (PCA): In order to identify the important constraints, factor analysis is done with Principal Component Analysis (PCA) which involves extraction of factors, rotation and interpretation of factors. For interpretation of factors, variables, with factor loadings, were taken into consideration. Constraints were named on the basis of similarity of the variables representing the factors. It was observed from the above table that the different constraints are divided into 12 component matrix or factors with the help of Principal Component Analysis (PCA) matrix.

Table 3. Constraints Analysis of Farmers of the Enterprise – Cultivation of Agricultureon the Basis of Principal Component Analysis (PCA)

Factor No.	Factor Name	Factor Loading %	% of Variation	Cumulative %	Rename Factors
Factor-1	• Lack of GM, HYV and good quality seeds • Lack of modern agricultural implements and machinery • Lack of transport facilities	0.709 0.629 0.556	11.59	11.59	Unavailability of inputs
Factor-2	• Lower market value to the agricultural products • Lower productivity and low yields per capita labour force • Pest, germs and weed cause heavy loss to crops	0.488 0.474 0.470	9.03	20.61	Crop loss
Factor-3	• Energy scarcity like electricity, mechanization • Water scarcity • Scarcity of capital	0.573 0.523 0.513	8.04	28.65	Scarcity of Resources
Factor-4	• Farmers are forced, under socio-economic conditions to carry on distress sale of their produce • Disguised unemployment in Agricultural sector	0.506 0.499	7.31	35.96	Low marginal productivity
Factor-5	• Lack of proper training programme • Illiteracy • Lack of awareness on different Govt. schemes among farmers • Lack of knowledge over scientific method	0.583 0.575 0.539 0.429	7.04	43.00	Skill and Knowledge development
Factor-6	• Small farm size • High cost of inputs • Improper management of water through irrigation	0.681 0.560 0.467	6.29	49.29	Scattered Production
Factor-7	• Debt trap: Unable to repay loans • Allocation of subsidies is not appropriate	0.542 0.538	5.66	54.94	Debt Servicing
Factor-8	• Excess use of manures, fertilizers and pesticides • Traditional method of farming	0.572 0.505	4.78	59.73	Indigenous farming
Factor-9	• Lack of storage reservoirs	0.664	4.31	64.04	Storage Problem
Factor-10	• Lack of proper understanding of the need to grow crops sustainably	0.433	4.22	68.26	Lack of Sustainability
Factor-11	• Unawareness to use bio-fertilizers, biocides	0.515	3.93	72.18	Introduction Organic farming
Factor-12	• Natural disasters (flood, drought, monsoon failure etc.) • Soil erosion	0.454 0.442	3.75	75.93	Natural Barriers

It is observed from the above table that the different constraint factors are divided into 12 component matrix or factors with the help of Principal Component Analysis (PCA) matrix.

- **Factor-1** includes constraints like unavailability of GM, HYV and good quality seeds, lack of modern agricultural implements and machinery and lack of transport facilities, which have contributed of 11.59 per cent variance and has been renamed as unavailability of inputs.
- **Factor-2** includes constraints like lower market value to the agricultural products, lower productivity and low yields per capita labour force andpest, germs and weed cause heavy loss to crops, which have contributed of 9.03 per cent variance and has been renamed as crop loss.
- Factor-3 includes constraints like energy scarcity like electricity, mechanization, water scarcity and scarcity of capital, which have contributed of 8.04 per cent variance and has been renamed as scarcity of resources.
- Factor-4 includes constraints like farmers are forced, under socio-economic conditions to carry on distress sale of their produce and disguised unemployment in agricultural sector, which have contributed of 7.31 per cent variance and has been renamed as low marginal productivity.
- Factor-5 includes constraints like lack of proper training programme, illiteracy, lack of awareness on different Govt.
- schemes among farmers and lack of knowledge over scientific methods, which have contributed of 7.04 per cent variance and has been renamed as **skill and knowledge development.**
- Factor-6 includes constraints like small farm size, high cost of inputs and improper management of water through irrigation, which have contributed of 6.29 per cent variance and has been renamed as **scattered production**
- Factor-7 includes constraints like debt trap: unable to repay loans and allocation of subsidies is not appropriate, which have contributed of 5.66 per cent variance and has been renamed as **debt servicing.**
- Factor-8 includes constraints like excess use of manures, fertilizers and pesticides and traditional method of farming, which have contributed of 4.78 per cent variance and has been renamed as **indigenous farming.**
- Factor-9 includes constraints like Lack of storage reservoirs, which have contributed of 4.31 per cent variance and has been renamed as **storage problem.**
- Factor-10 includes constraints like Lack of proper understanding of the need to grow crops sustainably, which have contributed of 4.22 per cent variance and has been renamed as **lack of sustainability.**
- Factor-11 includes constraints like Unawareness to use bio-fertilizers, biocides, which have contributed of 3.93 per cent variance and has been renamed as **introductionorganic farming.**

- Factor-12 includes constraints like Natural disasters (flood, drought, monsoon failure etc.) and soil erosion, which have contributed of 3.75 per cent variance and has been renamed as **natural barriers.**
- In Principal Component Analysis (PCA) method, the scree plot displays the number of the factors versus its corresponding eigenvalue. Here, the scree plot shows that the first 12 factors account for most of the total variability in the data (given by the eigen values). The eigen values for the first 12 factors are all greater than 1. The remaining factors account for a very small proportion of the variability and are likely unimportant. It is understood that the first 12 factors have eigenvalues over 1.00, and together these explain over 75.93 per cent of the total variability in the data. This leads us to the conclusion that a 12-factor solution will probably be adequate. The**scree** plot of different constraints faced by the farmers of the enterprise – cultivation of agriculture is represented below.

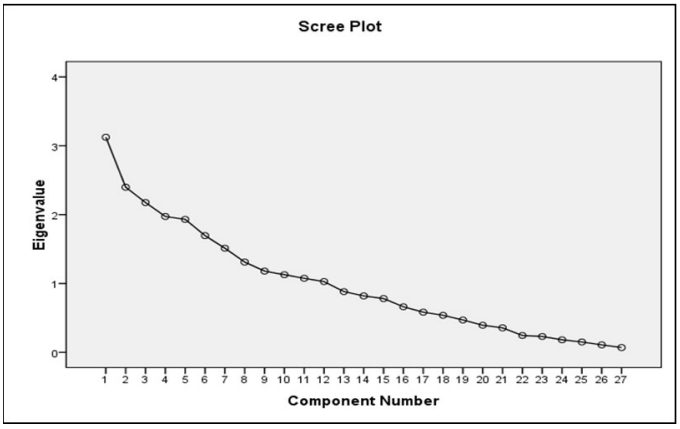

Fig. 3. Graphical Representation of Constraints Analysis of Farmers of the Enterprise – Cultivation of Agriculture on the Basis of Principal Component Analysis (PCA)

CONCLUSION

The comprehensive analysis conducted through discussions withfarmers involved meticulous methodologies such as Total Scoring Method and Principal Component Analysis (PCA). These methodologies provided invaluable insights into the multitude of constraints faced by different sectors, particularly in agriculture.Through the Total Scoring Method, constraints were systematically ranked based on respondents' perceptions, offering a nuanced understanding of their significance. The Principal Component Analysis (PCA) method further dissected these constraints into distinct factors, unveiling underlying patterns and relationships among them.The findings highlighted a spectrum of challenges encompassing agricultural practices, from input availability to market dynamics, resource scarcity, and socio-economic pressures. Factors such as unavailability of inputs, crop loss, and scarcity of resources emerged as prominent concerns, each contributing significantly to the overall variance in the data. Furthermore, the scree plot analysis affirmed the relevance of the first 12 factors, which collectively explained a substantial portion of the total variability. This underscores the robustness of the analytical approach employed, indicating that a 12-factor solution adequately captures the complexity of the constraints under examination.Overall, the synthesis of findings underscores the multifaceted nature of challenges confronting agricultural enterprises, necessitating holistic strategies for sustainable development. Addressing these constraints requires collaborative efforts across stakeholders, encompassing policy interventions, technological advancements, and capacity-building initiatives to foster resilience and enhance productivity in the agricultural sector.

Future Scope

The comprehensive identification and analysis of constraints faced by farmers in agricultural cultivation lay a robust foundation for future research and action. Looking ahead, various avenues of exploration and intervention emerge. Firstly, further refinement and validation of methodologies such as the Total Scoring Method and Principal Component Analysis (PCA) can enhance their applicability and accuracy in pinpointing and prioritizing constraints. Additionally, exploring alternative analytical frameworks may offer complementary insights into the complexities of these constraints. Comparative studies across diverse sectors and geographical regions can illuminate commonalities and disparities in constraint profiles, guiding targeted interventions and tailored policy frameworks. Longitudinal studies tracking the evolution of constraints over time can unveil dynamic socio-economic and environmental factors influencing enterprise operations and agricultural practices, informing adaptive strategies and resilience-building measures. Continued stakeholder engagement, including workers, farmers, policymakers, and community leaders, remains essential for co-designing and implementing contextually relevant solutions. Capacity-building initiatives aimed at enhancing technological literacy, entrepreneurial skills, and resource access empower stakeholders to effectively address constraints. Embracing holistic approaches to sustainable development, integrating economic, social, and environmental dimensions, can mitigate constraints and foster resilient, inclusive growth. This entails leveraging technological innovations such as precision agriculture and renewable energy solutions to optimize resource utilization while minimizing environmental impact. Advocacy for evidence-based policy reforms and investments in supportive institutional frameworks is crucial for addressing systemic constraints and promoting inclusive economic growth. Collaborative efforts between academia, government agencies, non-governmental organizations, and private sector entities can catalyze transformative change at scale. In conclusion, the identification and analysis of constraints provide a roadmap for future research and action aimed at fostering sustainable development, enhancing livelihoods, and promoting equitable prosperity across diverse sectors and communities. Through interdisciplinary collaboration, innovative approaches, and stakeholder engagement, we can collectively address complex challenges and build a more resilient, inclusive future.

Conflict of Interest Statement: The authors affirm their commitment to conducting research with integrity and transparency, and declare no conflicts of interest that could unduly influence the outcomes or interpretations presented in this study.

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