**Variations in agriculture credit allocation: Evidence from Mann Whitney U test**

**Abstract**

CONTEXT

Farmers need credit to meet the production costs and invest in agriculture activities, and with rising input costs, the situation becomes increasingly challenging, necessitating more accessible and adequate financial support. However, the untested notions of farmers' misutilization of agriculture credit restrict the banks and government from increasing the credit limit for farmers.

OBJECTIVE

This study was formulated to understand credit allocation purposes and their extent and to test any difference in allocation for agricultural and non-agricultural purposes.

METHODS

An ex-post facto study was conducted in the two districts of Gujarat state of India, where more acreage was under rice cultivation. With a purposive selection of talukas and villages, a sample size of 230 was finalized and contacted randomly using an interview schedule. The Mann-Whitney U test was performed to know any significant difference between the allocation scores for agricultural and non-agricultural purposes.

RESULTS AND CONCLUSIONS

Descriptive statistics as frequency and percentages showed credit allocation for short-term agricultural activities such as procuring seeds (69.20%) and fertilizers (66.50%). Conversely, a notably lower credit allocation towards long-term investments like purchasing livestock and machinery (74.73%, 54.30% opted never) indicates a preference for immediate over long-term agricultural needs. The Mann-Whitney U test results reveal a significant difference (Z = 14.711, p < .001) between the allocation scores for agricultural and non-agricultural purposes, with a higher mean rank for agricultural activities. Though there was a reduction in the diversion of agricultural credit to non-agricultural purposes, the potential for optimal credit utilization has not been fully realized.

SIGNIFICANCE

The study suggests increasing loan amounts, simplifying application procedures, strengthening extension services, expanding Direct Benefit Transfer schemes, conducting financial literacy programs, and implementing robust monitoring and awareness campaigns to enhance efficient and ethical loan use, thereby fostering sustainable agricultural development.

**Keywords** - *Agriculture credit, Credit allocation, Loan diversion, Mann Whitney U test.*

**Introduction**

Agriculture as an economic activity requires investment in money and time. Seasonality of agriculture income demanding expenses throughout the growing season and generating revenue after the harvest mandates the credit for smooth cash flow. Additionally, associated risks and vulnerabilities of agriculture activities require investment in risk management strategies such as crop insurance, diversification, and adoption of new technologies that can be enabled by credit accessibility.

The credit issued by the banks under the Kisan Credit Card (KCC) - a short-term crop loan with interest subvention, considers all the production expenses such as meeting the short-term credit requirements for the cultivation of the crop, post-harvest expenses, marketing loan for produce, consumption requirements of farmer household, working capital for maintenance of farm assets and activities allied to agriculture and investment credit requirement for agriculture and allied activities.

**Agriculture credit allocation**

Earlier studies (Oboh & Douglas, 2011; Rizwan *et al*., 2019; Singh *et al*., 2020) majorly reported a severe loan diversion towards non-agriculture activities, resulting in a non-efficient loan utilization, thereby not witnessing the apparent impacts of agriculture credit. Nakashe (2017) reported about one-fourth of credit borrower farmers have only partially utilized the agriculture credit and diverted money to other businesses (34.31%), social ceremonies (25.49%), and house construction (24.50%). Ray and Das (2023) studied the magnitude of beneficiaries' utilization and diversion of loans. They found that of total crop loans availed, 83.69 per cent was properly utilized, whereas 16.31 per cent was diverted to other activities. However, a breakdown of this based on the landholding shows that the extent of diversion was greater across marginal farmers (21.99%) than large farmers (12.25%). Similar to these results, Oboh and Douglas (2011) observed that with increased land size, the allocation of agriculture credit to farm activities increases, inferring that diversions are more across small and marginal farmers. Sharma and Kumawat (2014) reported that in Rajasthan, 70.59 per cent of the farmer borrowers had completely utilized the credit for the stipulated purposes. About 23.98 per cent had partially utilized it, and the remaining 5.43 per cent of the farmer borrowers had completely diverted the loan for other purposes. However, Siddayya *et al.* (2016) found that credit allocation varies between normal and crisis situations.

 The common reasons regarded for this behaviour are farmers' lack of education and lower farm income, which is insufficient to cover family expenses (Rizwan et al., 2019). In such mixed notions, it becomes crucial to understand the agriculture credit allocations of the farmers in these current agrarian situations.

**Mann Whitney U test**

It is a non-parametric statistical test that compares two independent groups when the dependent variable is ordinal or continuous but not normally distributed. It is used to determine whether there is a significant difference between the medians of the two groups. Agussabti *et al.* (2022) utilized the U test to understand whether there is any difference in perception about smart technologies among farmers who have and do not have access to credit. The results contradicted the notion that credit access means a high preference for using new technology. The mean rank for non-access to credit (108.48) was higher compared to having access to credit (87.63) with a significant Z value (Z = 0.081, p = .010). Factors influencing the climate adaptation decision of farmers were even tested by Nyong and Martin (2018), and personal and economic factors like age, household, farm size, number of farms, annual income, and farm experience had significant U value. Padaria *et al.* (2009) performed farmers' training needs assessments in two different regions, and by performing the U test, they identified certain training requirements were significantly different. Therefore, decisions that were not significantly different can be made uniformly across regions for training (weed management, seed rate, etc). In contrast, customization will be needed for training (sowing, fertilizer usage) with a significant U-value.

As established, agriculture credit could be utilized for agricultural and non-agricultural purposes. When studying respondents' extent of allocation in these two categories, a score could be obtained for each individual, which can then be compared to determine whether there is any difference in allocation between the two stated purposes. If yes, which one is favoured over the other? To answer this statistically, the Whitney U test can be used when the data does not conform to the normal distribution (Sundjaja *et al.*, 2023).

**Need for the study**

Increasing input costs for most marginal and small farmers creates a credit crunch. To address this, banking institutions have to increase the loan amount. The lending institution's responsibility does not end with issuing the loan but only after ensuring its proper utilization. Also, the government, through Direct Benefit Transfer (DBT), wanted to increase the farmer's purchasing power. When untested and generalized notions of misutilization of agriculture credit prevail, it hinders taking necessary actions (further credit and capital enhancement) that could amputate the farmer's affordability. Therefore, it becomes imperative to understand the purposes for which agriculture credit is allocated. The following study was drafted with the researchable questions as
1. How is the agriculture credit allocated to different purposes, and to what extent?

2. Is there any difference in farmers' allocation of agriculture credit towards agricultural and non-agricultural purposes?

**Methodology**

**Locale**

In Gujarat state of India, two districts were conveniently selected: Anand and Kheda. These districts were predominant in rice cultivation (Directorate of Agriculture, Gujarat (2023) report), and rice farmers were included in the study to obtain a sampling frame. From each district, two blocks were selected (a total of 4), and from each block, 4 villages (a total of 16). The sample size (n) was finalized using the formula

**n = [z2 \* p (1-p)] / e2**

|  |  |
| --- | --- |
| The **Z-score** is a constant value automatically set based on your confidence level. It indicates the "standard normal score," or the number of standard deviations between any selected value and the average/mean of the population. With 90 per cent of confidence level, the Z-score will be 1.65. | **Population proportion**: It is assumed that there is a population of individuals where some proportion, p, of the population, is distinguishable from the other 1-p in some way. As the study areas were dominant rice growing areas, approximately 70 per cent (p= 0.7) of the population could be considered rice farmers. |
| The margin of error, or **"confidence interval**," refers to the error one wishes to allow in their results. A standard of 5 per cent is set in this study. | **Confidence level** is closely related to confidence interval (margin of error). This value measures one's certainty regarding how well a sample represents the overall population within your chosen margin of error. Since it is a social science study, a confidence level of 90 per cent was finalized. |

The calculation of sample size (n)

n = [(1.65)2 \* 0.7(1-0.7)] / (0.05)2

= [(2.7225\* 0.7 \*(0.3)] / (0.05) 2

= [(0.571725] / (0.0025)

n = 228.69 ~ 229 (rounded off to 230)

Therefore, a sample size of 230 rice farmers were contacted with a structured, pre-tested interview schedule to obtain responses for their preferred source to obtain credit and extent of contact.

**Instrument:**

A list of agricultural and non-agricultural purposes has been curated from several articles for which agriculture credit could be used. The response was collected in a 4-point continuum ranging from regular to never, with a scoring procedure of 4 to 1, respectively. Since the allocation of agriculture credit to non-agriculture activities affects credit utilization negatively, a reverse scoring was followed where the response in regular marks a score of 1 and 4 for never. Therefore, the maximum and minimum scores that could be obtained were 15 and 60. The total score of the respondents was obtained by summation of the responses recorded at each activity.

**Statistical analysis**

The obtained response was tabulated using frequency and percentage. The class interval method (using range) was used to categorize the respondents into poor, moderate, and optimal credit allocations. Using these credit allocation scores, Mann Whitney U test was conducted.

The Mann-Whitney U test compares the values' ranks in the two groups. Here's the general formula:



Where:

n1 is the number of observations in group 1

n2 is the number of observations in group 2

∑ R1is the sum of ranks in group 1

∑ R2 is the sum of ranks in group 2

The hypothesis (Ho) formulated was there is no significant difference between the credit allocation scores of respondents for agricultural and non-agricultural purposes.

**Results and Discussion**

Credit allocation addresses the ‘what’ component as it records the responses for all activities the availed loan was used for and to what extent. The results obtained are displayed in Table 1.

**Table 1: Distribution of respondents according to their credit allocation for agricultural purposes**

(n=230)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Agricultural Purposes** | **Regularly** **No. (%)** | **Often****No. (%)** | **Rarely****No. (%)** | **Never** **No. (%)** |
| Field preparation |  135 (58.70) | 75 (32.60)  | 17 (7.40)  | 03 (1.30) |
| Procurement of seeds |  **159 (69.20)** | 56 (24.40)  | 13 (5.70)  | 02 (0.90)  |
| Buying fertilizers |  **153 (66.50)** | 61 (26.50)  |  14 (6.10)  |  02 (0.90)  |
| Pesticides/weedicides |  129 (56.20)  | 64 (27.80)  | 30 (13.00)  | 07 (3.00)  |
| Payment for labors |  126 (54.80)  | 66 (28.70)  | 23 (10.00)  | 15 (6.40)  |
| Hired harvesting machinery |  84 (36.50)  | 82 (35.70)  | 36 (15.70)  |  28 (12.10)  |
| Transportation of harvest |  50 (21.70) | 56 (24.40) | 53 (23.00)  | 71 (30.90)  |
| Purchase of livestock |  05 (2.17) | 16 (7.00)  | 37 (16.10) | **172 (74.73)**  |
| Purchase of machinery |  20 (8.70) | 40 (17.40)  | 45 (19.60)  | 125 (54.30)  |

Table 1 speaks about agricultural purposes only, and the results show that two-thirds of respondents regularly use agriculture credit to procure seeds (69.20%) and buy fertilizers (66.50%). More than half of respondents were noted for regular use for activities like field preparation (58.70%), pesticides or weedicides (56.20%), and payment of labours (54.80%).

A higher proportion, close to three-fourths, was recorded in the non-utilization of agriculture loans to purchase livestock (74.73%), and more than half (54.30%) for purchasing machinery instead relied on hiring machinery (36.50%). The results are in line with those of Nakashe (2017).

The loan amount can be put unethically into use for several non-agricultural purposes. Farmers with limited capital availability and lower incomes might direct the loans disproportionately towards other purposes over the intended agriculture activity. Such behaviour was studied to know for what purposes and the extent to which credit was allocated to non-agricultural purposes.

**Table 2: Distribution of respondents according to their credit allocation for non-agriculture purposes**

(n=230)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Non-agricultural purposes** | **Regularly** **No. (%)** | **Often****No. (%)** | **Rarely****No. (%)** | **Never** **No. (%)** |
| Children's education |  09 (3.90) | 15 (6.60)  | 41 (17.80)  | 165 (71.70)  |
| Marriage and Funerals(Social ceremonies) |  06 (2.60) | 35 (15.20)  | 66 (28.70)  | 123 (53.50)  |
| Medical expenses |  08 (3.50) | 30 (13.00)  | 56 (24.30)  | 136 (59.20)  |
| House construction |  03 (1.30) | 23 (10.00)  | 48 (20.90)  | 156 (67.80)  |
| Settling old debts | 14 (6.10) | 57 (24.80) | 97 (42.20) | 62 (27.00) |
| Daily expenses | 19 (8.30) | 80 (34.80) | 101 (43.90) | 30 (13.00) |

The results from Table 2 give a refreshing view on the ethical use of agriculture loans by farmers of developing countries like India, where meager percentages were recorded in regular usage for non-agriculture purposes and higher amounts in the never category. These results contradict those of Singh *et al.* (2020), who observed greater misutilization of agricultural credit.

Table 3: **Distribution of respondents according to their purposes of credit allocation**

(n=230)

|  |  |  |  |
| --- | --- | --- | --- |
| **Categories** | **Range** | **Number** | **Per cent** |
| Poor credit allocations | 31 to 40.3 | 41 | 17.80 |
| Moderate credit allocations | 40.4 to 49.6 | 142 | 61.70 |
| Optimal credit allocations | 49.7 to 59 | 47 | 20.40 |
| **Total** | 230 | 100.00 |

The total credit allocation score of the respondents was obtained by summating the responses recorded at each activity. Table 3 mentions that slightly more than three-fifths (61.70%) of respondents fall in moderate credit allocation, followed by 20.40 per cent in optimal and 17.80 per cent in the poor category.

Upon extracting the allocation score for agriculture and non-agriculture purposes, a hypothesis was formulated to test whether there was any significant difference in the scores. Since the data was ordinal and did not conform to the normal distribution (confirmed by the Shapiro-Wilk test of normality), the Mann-Whitney U test was conducted to test the hypothesis, and the results are as follows in Table 4.

**Table 4: Mean Ranks**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Group** | **Number of observations** | **Mean Rank (M)** | **Sum of ranks** |
| Agricultural purpose | 1 | 230 | 321.48 | 73940.50 |
| Non-Agricultural purpose | 2 | 230 | 139.52 | 32089.50 |
|  | **Total** | 460 |  |

Upon examining the ranks in Table 4, it was evident that the mean rank for allocation scores in the agriculture purpose group (M = 321.48) is substantially higher than the non-agriculture purpose group (M = 139.52). This difference in mean ranks suggests that, on average, allocation scores are higher for activities associated with agriculture than those related to non-agriculture purposes.

**Table 5: Test of significance: Mann-Whitney U test**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Mann-Whitney U test** | **Z value** | **Asymp. Sig. (2-tailed)** |
| Values | 5524.500  | 14.711 | .000  |

Table 5 showcases the findings of the Mann-Whitney U test, in which allocation scores for agriculture and non-agriculture purposes were compared. The test resulted in a statistically significant difference between the two groups (Z = 14.711, p < .001).

**Discussion**

It could be interpreted from Table 1 that the credit utilization/ allocation was for immediate short-term agriculture activities, such as procurement of seed, fertilizers, field preparation, and payment for labour. Activities that demand more credit and are considered investments, like purchasing livestock and machinery, were less practiced by the respondents in the study area.

About half of the respondents included in the study were marginal, small to medium farmers whose concern was mainly to fetch remunerative prices for the produce generated rather than having secondary activities and investments on land. It is a good sign that more than half of the respondents were hiring farm machinery. This insight could be used better by increasing Custom Hiring Centres (CHC) near villages, bringing out mechanization and employment in rural areas.

The interaction with farmers showed their interest and capacity to take short-term loans (crop loans), which are the lesser amounts decided based on crop and acreage under cultivation. The purchase of livestock required a heavy documentation process from banks, which inhibited them from approaching formal sources to avail of livestock loans.

The higher percentage of respondents with medium credit utilization scores shows that though diversion for non-agriculture purposes has been reduced, the farmers have not reached their fullest potential in utilizing the credit. It points out that constructive action from formal institutions should be undertaken, such as simplifying loan application procedures and providing assistance while providing better linkage with local extension personnel.

Earlier studies showed that farmers have a common tendency to use agriculture loans for non-agriculture purposes. This was even stated as a major agricultural credit constraint to show its impact on true potential. But this study contradicts and presents that despite diversions, the recorded responses were majorly in often, rare, and never continuum than regular. On investigation, it was stated by the farmers that the issued amount as agriculture credit is low and falls short in these times of rising cost of cultivation. In such cases, they have no option but to use it for their economic activity. The farmers in the study relied on formal banking institutions to avail of loans. This discussion points to banking institutions with congruence with the government to increase the credit issuance limit. If not, the farmers might rely on informal sources and fall into the debt trap, which is not a desired outcome for the sustainability of agriculture in India.

**Conclusion**

The study on agriculture credit allocation and diversion in Gujarat state provides significant insights into the utilization patterns of agricultural loans among rice farmers. The research highlights that most of the credit is directed towards essential short-term agricultural activities such as procuring seeds and fertilizers, field preparation, and labor payments. Conversely, there is a notably lower credit allocation towards long-term investments like purchasing livestock and machinery, indicating a preference for immediate over long-term agricultural needs. The Mann-Whitney U test results reveal a significant difference between the allocation scores for agricultural and non-agricultural purposes, with a higher mean rank for agricultural activities. This suggests that farmers prioritize agricultural purposes when utilizing credit, despite some diversion towards non-agricultural needs. The findings contradict earlier studies that reported extensive agricultural loan misutilization.

The study also uncovers that while there has been a reduction in the diversion of agricultural credit to non-agricultural purposes, the potential for optimal credit utilization has not been fully realized. Factors such as complex loan application procedures and insufficient loan amounts inhibit farmers from fully benefiting from the credit provided. Simplifying these procedures and increasing credit limits could enhance loan utilization and prevent reliance on informal credit sources, often leading to debt traps.

The study suggests several policy implications for enhancing agricultural credit utilization. Increasing loan amounts and simplifying application procedures can address the rising cultivation costs and bureaucratic hurdles. Promoting Custom Hiring Centres and strengthening extension services will facilitate mechanization and effective loan use. Expanding Direct Benefit Transfer schemes and conducting financial literacy programs can ensure ethical loan utilization. Robust monitoring and evaluation frameworks and awareness campaigns about formal credit sources will further support farmers in accessing and efficiently using agricultural loans, thereby fostering sustainable agricultural development in Gujarat and across India.

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