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Assessing the Contribution of ZTBL Dairy Value Chain Financing to Rural Economic Empowerment in Northwestern Pakistan

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Abstract

This study investigates the effects of credit provided by Zarai Taraqiati Bank Limited (ZTBL) on livestock outcomes among farmers in the districts of Peshawar, Mardan, Swat, and Dera Ismail Khan in Khyber Pakhtunkhwa (KP), Pakistan. Despite the recognized importance of institutional credit in enhancing rural livelihoods, limited empirical evidence exists on the specific impacts of ZTBL financing on livestock-related indicators in these regions. To address this gap, the study employed a combination of simple random and purposive sampling techniques to collect primary data from livestock farmers through structured interviews. The data were analyzed using a paired sample t-test to evaluate changes before and after credit utilization. The findings reveal that ZTBL credit has had a statistically significant and positive effect on key livestock outcomes, including the number of animals owned, milk productivity per animal, milk used for self-consumption, volume of milk sold, and overall annual income of farmers. These outcomes underscore the transformative potential of agricultural credit in improving both food security and economic well-being in rural KP. Based on these findings, the study recommends that ZTBL introduce interest-free loans based on Islamic partnership models, such as Musharaka and Mudaraba, to increase accessibility for faith-conscious farmers. In addition, it is advised that ZTBL adopt a more flexible collateral policy, simplify credit procedures, and ensure the availability of sufficient credit amounts tailored to the needs of livestock farmers. Expanding branch coverage in rural and underserved areas is also essential to enhance service delivery. This research offers a novel and data-driven perspective on the role of institutional credit in the livestock sector in KP, contributing valuable insights that have been largely overlooked in existing literature.

Keywords: ZTBL credit, livestock outcomes, milk productivity, farmer income, dairy value chain, rural development, Islamic finance, Khyber Pakhtunkhwa.

INTRODUCTION

Livestock is a critical and the largest sub-sector of Pakistan's agricultural economy. It contributes 62.68% to agricultural value addition and 14.36% to the national GDP, with a steady growth rate of 3.78%, as reported in the Pakistan Economic Survey 2023. The sector serves as a cornerstone of rural livelihoods, with over 8 million rural families depending on livestock for 35% to 40% of their income. Additionally, it contributes nearly 2% to total national exports, underscoring its importance in both domestic and international markets. The livestock population in Pakistan is estimated at 225 million animals, including 82.5 million goats, 55.5 million cattle, 45 million buffaloes, and 32.3 million sheep, among others. This extensive livestock base annually produces 67.87 million tons of milk, 5.50 million tons of meat, and a wide range of by-products such as wool, dung, bones, hides, skins, and materials essential to industries like leather, pharmaceuticals, and textiles. Livestock not only ensures food and nutritional security through products like milk, butter, and meat but also contributes to health and well-being, particularly for rural populations. Furthermore, it serves as a form of capital, acting as collateral for credit or as a financial buffer in times of distress (Afzal & Naqvi, 2004). Zooming into the province of Khyber Pakhtunkhwa (KPK), the significance of livestock becomes even more evident. In the given circumstances es when the province's rugged terrain and limited scope for large-scale crop cultivation, livestock emerges as a vital livelihood for local economy and localities in particular for rural communities. KP beings' home to millions of cattle, buffaloes, goats, and sheep, coupled with strong cultural and economic dependency on dairy and meat production share a signficnat portion of national dairy economy and industry. Livestock in KPK is not just a source of income but also a reliable and sustainable source of wealth which not only offer, insurance against crop failure, but also a means of daily sustenance. Despite its economic, social and cultural significance, livestock development in KPK faces several systemic challenges, which include limited access to institutional credit, inadequate and poor-quality veterinary services, low productivity, low quality feed and grazing resources, and weak and loose integration into commercial value chains.

Around the world financing for livestock value chains with the aid of institutional financial support—such as subsidized credit facilities offered by government owned banks Zarai Taraqiati Bank Limited (ZTBL) in Pakistan becomes crucial for livestock development in Pakistan. The current study broached an argument that by providing targeted financing along the dairy value chain, ZTBL due to its nationwide established network and roots in agriculture industry has capacity to empower smallholder farmers, improve livestock productivity, and stimulate broader rural development in KPK. Thus, this research seeks to examine the effects of such niche financing on livestock-related outcomes, with a focus on rural areas of KPK where the need for credit-driven growth is particularly acute. The value chain financing by ZTBL is shown in the figure 1 below.

Source: Created by the Author Using ChatGPT

According to Zada et al. (2022), the livestock industry is the backbone of agricultural economy of KPK, with the latter playing a pivotal role in sustaining rural livelihoods and provincial economy. In many districts, where soil is not supportive for agriculture particularly in mountainous and less mechanized regions, livestock serves not only as a primary source of food and income but also as a critical asset for labor, transport, and organic fertilization in regions. Animals such as goats, cattle, buffaloes, and sheep are major sources of KPK livestock industry that help the locals to meet both food and milk needs and generate income through the sale of surplus produce and animals. However, the sector faces persistent challenges— which include limited access to institutional credit, inadequate and poor-quality veterinary services, low productivity, low quality feed and grazing resources, and weak and loose integration into commercial value chains. The research gap along with relevant scholarly work receives analysis in this section before the current study defines its focus. The development of livestock-based enterprises through microcredit with institutional financing represents a subject that several scholars studied in Pakistan. The study conducted by Khan et al. (2007) analyzed how the microcredit program of SRSP influenced livestock activities in District Abbottabad. Research data was obtained from sixty microcredit-receiving households that wanted to develop their livestock enterprises. Research results showed that a minority proportion of 33% actually used the provided funds specifically for livestock purposes. The respondents noted societal and economic advancement although acknowledging income growth together with enhanced diet selection and educational progress for their children. The objective is to understand how access to targeted agricultural credit influences livestock productivity, income levels, and the overall sustainability of the livestock sector in the region.

HYPOTHESIS

To empirically assess the impact of ZTBL value chain financing on livestock outcomes, the study formulated the following hypotheses:

Null Hypothesis (H_0):

ZTBL value chain financing has no significant effect on the livestock outcomes of farmers, including productivity, income, and market access.
Symbolically: $H_0: \mu_1 - \mu_2 = 0$

Alternative Hypothesis (H_1):

ZTBL value chain financing has a significant positive effect on the livestock outcomes of farmers, leading to improved productivity, higher income, and enhanced market access.
Symbolically: $H_1: \mu_1 - \mu_2 \neq 0$
Where:
μ_1 and μ_2 represent the mean values of livestock outcomes before and after availing ZTBL value chain financing, respectively.

LITERATURE REVIEW

The subsequent part of this study reviews established scholarly research before describing its intended contribution to address specific research gaps. Studies of microcredit together with institutional financing have been analyzed by multiple investigators regarding their impact on livestock-based enterprise growth in Pakistan. Khan et al. (2007) studied how microcredit provided by the Sarhad Rural Support Program (SRSP) affected the livestock activities in District Abbottabad. Research data was collected from 60 households that obtained microcredit specifically for livestock advancement purposes. The research discovered that out of all households which received funding only thirty-three percent allocated their funds toward livestock operations. The survey participants reported better socio-economic progress although they demonstrated improved household income levels together with increased dietary variety and enhanced educational opportunities for their children. Javed et al. (2023) conducted an investigation to assess agricultural credit effects on livestock expansion within District Faisalabad. The researchers obtained data through stratified random sampling of 50 livestock farming households. The research applied multiple linear regression which established that receiving credit from institutions led to major growth in livestock numbers and animal income levels. Institutional credit resulted in a 160 percent increase in livestock holdings and caused household income to grow by 181 percent thus proving credit's powerful impact on the region.

The research by Javed et al. (2023) evaluated how supervised institutionally provided credit helps boost rural household incomes in Punjab. A structured interview approach was used by researchers to understand credit impact on 80 farming families. Their research results showed formal credit availability to create statistical links between livestock ownership and productivity in addition to agricultural income. The researched population exhibited a 20 percent rise in livestock numbers while production numbers rose by 78 percent leading to a 79 percent income growth. These research reports show agricultural credit's beneficial effects on livestock development together with rural economic welfare through focus on central and northern Punjab or selective districts and intervention programs. Research about the effects of structured dairy value chain financing undertaken by Zarai Taraqiati Bank Limited (ZTBL) and its influence on livestock performance remains insufficient in the Khyber Pakhtunkhwa (KPK) region. This study will analyze ZTBL's particular financial products to evaluate their effects on livestock farmer productivity as well as asset ownership and income generation within KP.

Sulemana et al. (2023) conducted research in Ghana to determine the effects of Livestock Development Project microcredit on small-scale livestock farmers' productivity. This research used purposive along with simple random sampling alongside stratified sampling to choose its subject participants and it collected data by combining structured questionnaires with field observations. The research analysis which incorporated descriptive statistics together with inferential statistics showed that smallholder farmers experienced increased livestock output after receiving microcredit. The research demonstrates that properly timed and directed credit services function as important elements to boost livestock production in areas where resources are limited.

In a more recent effort, Ahmad (2019) focused on the impact of ZTBL credit on income generation in the livestock sector within District Dir Lower. Using a multistage sampling strategy and semi-structured questionnaires to collect data from 298 respondents, the study combined descriptive and inferential analyses to explore credit outcomes. The findings confirmed a statistically significant and positive association between ZTBL financing and increased income levels among livestock farmers. Collectively, these studies highlight the consistently positive impact of institutional credit on livestock productivity and farmer income across various regions of Pakistan. They affirm the role of ZTBL and other credit institutions in enabling rural households to invest in better livestock practices, improve productivity, and enhance their economic standing. However, despite the growing body of literature, there remains a critical gap in the empirical assessment of ZTBL's credit impact in District Dir Upper—a region where livestock serves as a key livelihood source, yet limited research exists on credit effectiveness. To the best of our knowledge, no quantitative study has been conducted to evaluate how ZTBL dairy value chain financing specifically influences livestock-related outcomes in this district. This study, therefore, aims to address this gap by offering robust, local-level evidence on the relationship between ZTBL credit and livestock productivity, herd size, and farmer income in District Dir Upper.

MATERIALS AND METHODS

This section describes the research methods, including the materials and techniques used to conduct the research in the study area and the details are as under.

Study Area

The current study was conducted in Khyber Pakhtunkhwa (KP) province, located in the northwestern region of Pakistan. KP is known for its diverse geography, including mountainous terrains, fertile valleys, and river systems, which contribute to both agricultural and livestock-based livelihoods. The province shares borders with Gilgit-Baltistan to the northeast, Azad Jammu and Kashmir to the east, Punjab to the southeast, Balochistan to the southwest, and Afghanistan to the west and northwest. KP has a rich historical and cultural heritage and has been a significant region in both ancient and modern South Asian geopolitics. As per the 2023 population census, KP spans an area of approximately 101,741 square kilometers and houses a population of over 40 million people, with an estimated population density of around 393 persons per square kilometer. The annual population growth rate is reported at 2.27 percent (Government of Pakistan, 2023). The province is administratively divided into several divisions and districts, with a substantial portion of the population residing in rural areas. The majority of residents are engaged in agriculture, livestock rearing, and small-scale trade, with livestock forming a vital part of the rural economy, particularly in the less mechanized and hilly regions of the province.

Sampling Technique and Sample Size

The present study was conducted across major livestock-rearing districts of Khyber Pakhtunkhwa (KP) to assess the impact of ZTBL dairy value chain financing on farmers' livestock outcomes. A stratified multistage sampling technique was adopted to ensure representative coverage of various agro-ecological zones and farming communities in the province. In the first stage, four districts—Peshawar, Mardan, Swat, and Dera Ismail Khan—were selected based on the prevalence of livestock activities and the operational presence of ZTBL. These districts represent both northern and southern regions of KP and cover a diverse range of climatic and socio-economic conditions.

In the second stage, two tehsils were selected from each district based on the consultation with ZTBL regional managers and the availability of active credit programs related to livestock. The study population included ZTBL credit beneficiaries who had received loans specifically for livestock and dairy-related purposes. According to records obtained from relevant ZTBL branches, a total of 1,400 farmers had availed agricultural loans across the selected districts, out of which 525 farmers had utilized the credit specifically for livestock and dairy activities.

A screening process was conducted through initial farmer meetings and branch-level validation to confirm credit usage. Farmers who had used the loans exclusively for livestock purposes were included in the final sample. After exclusions, a total of 400 valid respondents were selected proportionally from the participating districts for structured interviews. The district-wise distribution of respondents is shown in Table 1 below.

Table 1.
Distribution of Respondents by Districts in the Research Area

District	Total Credit Beneficiaries	Livestock Credit Beneficiaries	Targeted Respondents
Peshawar	350	128	95
Mardan	320	112	85
Swat	360	142	110
Dera Ismail Khan	370	143	110
Total	1,400	525	400

Source: ZTBL Regional Offices, Khyber Pakhtunkhwa (2023)

Data Collection Source and Tool

This study is primarily based on firsthand data collected from ZTBL credit recipients (loanees) involved in livestock farming across selected districts in Khyber Pakhtunkhwa. A total of 400 respondents within the study were selected through face-to-face interviews for their use of ZTBL credit in livestock and dairy-related activities. The study collected data during three consecutive years from 2021 to 2024 to match credit patterns with natural seasonal patterns in livestock operations. The survey instrument incorporated various metrics that covered loan size as well as problems with credit accessibility together with livestock ownership types and animal milk outputs and market destination of milk and farmer incomes preceding and subsequent to ZTBL lending. The designed questionnaire enabled extensive comparison among performance metrics that came from the utilization of credit facilities.

Data Analysis

The researchers evaluated their data through Statistical Package for the Social Sciences (SPSS) software. Analyzing the ZTBL financing effects on livestock outcomes required using both descriptive and inferential statistical methods.The analysis computed descriptive metrics for both credit size and loan processing difficulties together with livestock stock numbers and milk output measures using frequencies, means, percentages and standard deviations.

Inferential Statistics

To assess the statistical significance of changes in livestock indicators before and after the utilization of ZTBL credit, a paired sample t-test was employed. This method is particularly suitable for comparing two related samples — in this case, the same farmers' performance pre- and post-credit access.

The paired t-test formula used in the analysis is as follows:
$t = (\bar{X}_{before} - \bar{X}_{after}) / \sqrt{(s^2_{before} / n) + (s^2_{after} / n)}$
Where:
- $\bar{X}_{before}$ and $\bar{X}_{after}$ are the means of livestock outcomes before and after credit
- s^2_{before} and s^2_{after} are the variances
- n is the sample size

For specific outcomes:
$t_Y = (\bar{Y}_{post} - \bar{Y}_{pre}) / SE_Y$

$t_M = (\bar{M}_{post} - \bar{M}_{pre}) / SE_M$
$t_L = (\bar{L}_{post} - \bar{L}_{pre}) / SE_L$

Where:
- SE_Y, SE_M, SE_L are the standard errors for income, milk productivity, and livestock count respectively

RESULTS AND DISCUSSION

This section discusses the amount of credit borrowed, the challenges farmers encounter while receiving credit from ZTBL, and the impact of credit on livestock outcomes. The details are as follows. In the selected research districts of Khyber Pakhtunkhwa (Peshawar, Mardan, Swat, and Dera Ismail Khan), the majority of respondents reported encountering significant difficulties in accessing credit from Zarai Taraqiati Bank Limited (ZTBL). Only a small proportion of farmers stated they faced no problems during the credit application process. The detailed distribution of these challenges is presented in Table 2.

Table 2.
Distribution of Respondents by Problems Faced in Receiving Credit

District	No problem Freq.	No problem Percent	High collateral Freq.	High collateral Percent	Remote bank Freq.	Remote bank Percent	Complex procedure Freq.	Complex procedure Percent
Peshawar	22	10	40	18	28	13	20	9
Mardan	18	8	35	16	30	14	25	11
Swat	20	9	38	17	27	12	23	10
D.I. Khan	21	10	36	16	26	11	22	10
Total	81	37	149	67	111	50	90	40

Source: Authors' Estimation

As seen in Table 2, high collateral requirements emerged as the most common barrier, reported by 67 percent of respondents, followed by remote bank access (50%) and complex credit procedures (40%). Only 37 percent of participants indicated that they faced no challenges in obtaining credit. The district-wise data reflect a consistent trend, with collateral demands and procedural complexity forming key constraints across all surveyed areas. The research shows it is essential to revamp the credit distribution structure. Farmers who belong to marginalized or asset-poor communities cannot obtain institutional finance because they do not fulfill the collateral requirements. Barki et al. (2024) detailed collateral as a main factor making rural areas unattainable for credit access while farmers in the study area stopped using formal credit due to their religious concern about interest-based credit agreements. The behavior prevents livestock producers from obtaining necessary funds which they need to grow their operations. ZTBL needs to develop Shariah-compliant financial products that exclude interest payments through Musharaka and Mudaraba agreements. The authors Raimi et al. (2007) highlight how Islamic finance operations can support agricultural sustainability while broadening its accessibility to various stakeholders.

The outreach program of ZTBL should advance its mission by simplifying loan applications alongside removal of bureaucracy and expanded presence in rural and mountainous districts where service is currently inadequate. According to Balana and Oyeyemi (2022) rural farmers tend to avoid seeking credit due to complicated procedures and insufficient institutional reach. The essential role ZTBL provides to finance the livestock sector needs evolution of its products and processes to fit the rural Pakistani reality. ZTBL's implementation of interest-free financing combined with simplified collateral requirements and enhanced accessibility will enhance its contributions to rural economic growth through institutional credit services. The rural economy benefits from multiple loan offerings through fifty financial institutions operating in Pakistan. Zarai Taraqiati Bank Limited (ZTBL) operates with central importance by providing specific financial services to the farming population throughout Pakistan while sustaining the Khyber Pakhtunkhwa province. In the context of this study, respondents from Peshawar, Mardan, Swat, and Dera Ismail Khan reported receiving credit of varying sizes for their livestock and dairy-related needs. The distribution of credit sizes among these respondents is summarized in Table 3 below.

Table 3.
Distribution of Respondents by Credit Size (PKR in Thousand)

District	Up to 300 Freq.	Up to 300 Percent	301-500 Freq.	301-500 Percent	501 & Above Freq.	501 & Above Percent
Peshawar	30	13	50	21	20	8
Mardan	28	12	48	20	19	8
Swat	27	12	46	19	22	9
D.I. Khan	26	11	49	21	21	9
Total	111	48	193	81	82	34

Source: Authors' Estimation

The data in Table 3 show that a majority of farmers (81%) obtained loans in the range of PKR 301,000 to 500,000, while 48% secured loans up to PKR 300,000. A smaller group (34%) received loans exceeding PKR 500,000. Among those in the PKR 301,000–500,000 range, the highest number of beneficiaries were from Peshawar (21%) and D.I. Khan (21%), followed closely by Mardan (20%) and Swat (19%). For the lower tier (up to PKR 300,000), proportions were relatively balanced across districts, ranging from 11% to 13%. In the highest tier (PKR 501,000 and above), Swat and D.I. Khan recorded the highest share at 9% each. These findings reveal that while most farmers have access to mid-range credit packages, a significant number expressed dissatisfaction with the adequacy of the loan amounts. Many respondents reported that the funds they received were insufficient to meet the growing demands of livestock operations, including costs related to animal purchase, feed, healthcare, and infrastructure. This concern points to a critical need for ZTBL to revisit and revise its credit ceilings, particularly for livestock-oriented farmers. Providing larger and more flexible financing options will not only enhance productivity but also empower farmers to sustainably grow their businesses and improve rural livelihoods. In Pakistan, the average rural household typically owns 2 to 3 cattle or buffaloes and 3 to 4 goats or sheep (GOP, 2007). To assess the impact of institutional credit on livestock ownership, farmers from the four selected districts—Peshawar, Mardan, Swat, and Dera Ismail Khan—were interviewed about their livestock holdings before and after receiving credit from ZTBL. Their responses are summarized in Table 4 below.

Table 4.
Effect of Credit on the Number of Animals per Farmer

District	Before Credit	After Credit	Percentage Change (%)	t-value	p-value
Peshawar	3	5	67	11.45	0.000
Mardan	4	6	50	11.12	0.000
Swat	5	7	40	13.30	0.000
D.I. Khan	4	6	50	12.20	0.000
Average	4	6	52		

Source: Authors' Estimation

The results presented in Table 4 demonstrate a statistically significant increase in livestock numbers across all four districts after credit utilization. On average, the number of animals increased from 4 to 6 per farmer, reflecting a 52 percent overall change. The number of livestock holdings in Peshawar increased by 67 percent while

Mardan and D.I. Khan achieved a 50 percent rise and Swat saw a 40 percent increase. The p-values showed results below 0.01 throughout all cases which established the statistical significance of the revealed changes. The availability of ZTBL credit services let farmers increase their livestock portfolio by either strengthening existing herd management or adding new animals to their assets. The results of Khan et al. (2007) in District Karak supported the findings that formal credit led to a 76% growth in goat population and 33% growth in cattle and 26% growth in buffalo population.

The milk production output of domestic animals receives direct benefits from structured financial institutions. The milk production industry in Pakistan places the country as the fourth-ranking nation in global milk production statistics. Milk production in Pakistan derives approximately 80 percent of its output from rural small-holder farms and receives an additional 15 percent from peri-urban producers in addition to 5 percent from urban dairy farms. Milk production in Pakistan mainly stems from buffaloes (60%) and cows (36%) and goats and sheep and camels (4% together) (Sattar, 2020). Dairy farming sustains millions of rural households economically and provides them with essential nutrition benefits both for household use and commercial trading purposes.

The researchers examined how institutional funding from ZTBL affected dairy animal milk output by studying milk production changes among animal herds in Peshawar, Mardan, Swat, and Dera Ismail Khan districts. The farmers reported their milk productivity to ZTBL both before and after receiving agricultural loans. The research results appear as shown in Table 5.

Table 5.
Effect of Credit on Milk Productivity of Livestock (Kg)

District	Before Credit	After Credit	Percentage Change (%)	t-value	p-value
Peshawar	4002.3	6083.5	52	12.60	0.000
Mardan	3690.2	5461.5	48	11.25	0.000
Swat	3417.5	4955.4	45	9.76	0.000
D.I. Khan	3595.4	5572.9	55	13.15	0.000
Average	3676.3	5518.3	50		

Source: Authors' Estimation

All surveyed districts exhibited a major boost in milk yield after ZTBL provided credit resources according to Table 5. After receiving ZTBL credit the average milk production per animal rose from 3676.3 to 5518.3 kg yearly showing half the initial figure increase. The district that showed the highest dairy productivity growth was D.I. Khan (55%) followed by Peshawar (52%), Mardan (48%), while Swat experienced (45%) percent rise. The results demonstrated that credit utilization produced highly significant impacts on milk production because all t-values reached statistical significance at $p < 0.01$. Farmed animals received improved feeding habits and better veterinary services and better breeds which led to greater milk output because farmers obtained access to credit. A 40% rise in milk production coincides with the research findings presented by Ahmad (2019) in his study measuring effects of ZTBL lending on District Dir Lower Pakistan. The evidence demonstrates that institutional loans play an essential part in enhancing dairy productivity for smallholders which demonstrates the need to expand these financing approaches throughout rural Pakistan.
Households throughout Peshawar and Mardan and Swat and Dera Ismail Khan tend to hold livestock for two main purposes that include financial and nutritional benefits

to support their food needs. People in these areas keep most of their dairy products as self-use to meet their everyday dietary requirements. The survey documented the changes in household milk utilization by recipients of ZTBL credit between prior to their engagement with the program and the current period. Access to ZTBL credit has led to the changes in milk usage documented in Table 6.

Table 6.
Effect of Credit on Self-Consumption of Milk per Farmers (Kg)

District	Before Credit	After Credit	Percentage Change (%)	t-value	p-value
Peshawar	1180.5	1887.2	60	5.85	0.000
Mardan	1094.3	1725.1	58	4.97	0.000
Swat	1122.6	1783.9	59	5.66	0.000
D.I. Khan	1164.8	1856.7	59	6.12	0.000
Average	1140.6	1813.2	59		

Source: Authors' Estimation

ZTBL credit implementation resulted in a 59 percent yearly enhancement of milk self-consumption among farmers throughout all districts studied according to Table 6. The population of Peshawar witnessed the greatest rise in milk self-consumption at 60% along with similar increases of 59% for Swat and D.I. Khan and Mardan (58%). All improvements were statistically significant at $p < 0.01$, indicating a reliable positive impact of credit support on milk self-consumption.This notable rise in self-consumption suggests that credit-facilitated investments—such as the purchase of improved livestock, enhanced feeding practices, and better animal health services—have translated into higher milk yields, enabling households to allocate more for personal use. These findings are in line with the conclusions drawn by Ravindredran et al. (2007), who identified a strong positive correlation between total milk production and household consumption. The increase in self-consumed milk indicates not only improved nutritional outcomes for rural families but also enhanced resilience against food insecurity. The milk market provides essential income opportunities along with domestic milk needs to rural farmers across Peshawar, Mardan, Swat, and Dera Ismail Khan districts. The surplus milk exceeding household requirements leads farmers to sell it in local markets where it supports their financial stability. The evaluation of ZTBL institutional loan effects on commercial milk sales required respondents to share their milk volumes in the local market before loan acquisition and post-loan acquisition. The summarized information about their responses appears in Table 7.**Table 7.**

Effect of Credit on Milk Sale (Kg)

District	Before Credit	After Credit	Percentage Change (%)	t-value	p-value
Peshawar	2895.2	4402.6	52	9.65	0.000
Mardan	2702.1	4013.4	49	7.23	0.000
Swat	2765.9	4060.8	47	7.66	0.000
D.I. Khan	2700.7	4059.3	50	8.15	0.000
Average	2765.9	4134.0	49		

Source: Authors' Estimation

According to Table 7 the annual average milk sales per farmer rose from 2765.9 kg to 4134.0 kg as a result of a 49 percent increase in four districts. In Peshawar milk sales expanded by 52 percent while D.I. Khan along with Mardan and Swat registered similar increases of 50 percent and 49 percent and 47 percent respectively. The statistical evaluation at $p < 0.01$ level showed significant increases in milk commercialization rates because of ZTBL credit programs. This rise in milk sales highlights the role of institutional credit in expanding market-oriented dairy production. Access to credit likely enabled farmers to invest in better feed, animal healthcare, and improved dairy breeds, which in turn enhanced milk yields and created surplus for sale. These findings are in line with the results of Ahmad (2019), who reported a similar positive relationship between ZTBL financing and increased milk sales in District Dir Lower, Pakistan. The ability to convert surplus milk into market revenue not only strengthens household income but also reinforces the sustainability of smallholder dairy operations. In the research districts of Peshawar, Mardan, Swat, and Dera Ismail Khan, farmers derive their annual income primarily through the sale of milk, livestock, and related products. To evaluate the economic benefits of institutional financing, respondents were asked to report their annual income before and after receiving ZTBL credit. Their responses are presented in Table 8.

Table 8.
Effect of Credit on Farmers' Income (PKR in 000)

District	Before Credit	After Credit	Percentage Change (%)	t-value	p-value
Peshawar	458.7	695.6	52	4.12	0.000
Mardan	429.4	621.7	45	3.44	0.001
Swat	417.2	614.3	47	3.39	0.001
D.I. Khan	434.5	641.9	48	3.61	0.001
Average	435.0	643.4	48		

Source: Authors' Estimation

Table 8 reveals a statistically significant increase in annual income following the utilization of ZTBL credit. On average, farmers' income rose from PKR 435,000 to PKR 643,400, reflecting a 48 percent increase across the four districts. The highest increase was observed in Peshawar (52%), followed by D.I. Khan (48%), Swat (47%), and Mardan (45%). All improvements were statistically significant at $p < 0.01$. These results clearly show that access to credit enables farmers to invest in productive livestock assets, which subsequently enhances their income streams. The findings are consistent with the study by Khan et al. (2019), who observed a 56 percent rise in farmer income following institutional credit access in rural Pakistan.

CONCLUSIONS

The livestock sector stands as the biggest and most indispensable agricultural sub-sector in Pakistan because it produces vital economic value and job opportunities for thousands of rural families. The area that encompasses these districts depends heavily on livestock to keep both food reserves for household use and to create a financial growth platform. Rural farmers who operate livestock appear unable to grow and modernize their operations because they continually face monetary limitations. Zarai Taraqiati Bank Limited (ZTBL) provides essential credit to many farmers who utilize this funding to enhance their dairy farming operations and to improve livestock health and breeding standards as well as feed quality. A quantitative evaluation within selected districts demonstrated that ZTBL institutional financing produces statistically meaningful positive outcomes for different livestock indicators. Provision of ZTBL credit results in greater animal ownership combined with better milk production per animal and increased household milk consumption followed by increased milk market sales that generate substantial growth in annual farmer earnings. Institutional credit access improves both the productive capability of smallholders and their economic standing and food security outcomes. Interest-free credit programs need expansion throughout underserved rural regions of Pakistan because they offer flexibility and easy accessibility which would drive sustainable rural advancement and agricultural resilience.

RECOMMENDATIONS

The following policy recommendations derive from this research to boost institutional credit impact on the livestock sector. The first requirement is that ZTBL must provide sizable loan quantities to agricultural producers who can then perform investments in their livestock operations leading to better productivity alongside enhanced earnings. The provision of interest-free loans through Islamic partnership models Musharaka and Mudaraba should be introduced by ZTBL to attract and serve rural farmers who have religious sensitivities. The bank should amend its collateral standards to let smallholder farmers without formal assets obtain credit. The bank requires changes to its credit approval procedures since they need streamlining and speedier decision-making to deliver credit services promptly to farmers. ZTBL should develop new branches in rural regions without adequate services to expand livestock farmer access to credit and create economic empowerment through agricultural investments.

DECLARATIONS

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