Research Article

# Exploring the Impact of Rural Transformation on Food Security in Pakistan

**Abid Hussain[1]*, Bilal Khan Yousafzai[1] and Muhammad Ishaq[2]**

*[1]Social Sciences Research Institute, PARC-National Agricultural Research Centre, Islamabad, Pakistan; [2]Social Sciences Division, Pakistan Agricultural Research Council, Islamabad, Pakistan.*

**Abstract** | This study is rooted in the analysis of Household Integrated Economic Surveys (HIES) to assess food security across administrative divisions, including provinces and the national scale, while exploring household characteristics. Utilizing data from two HIES rounds conducted in year 2013-14 and 2018-19, the research examines the proportions of high-value crops in total crop production, and non-farm employment in total employment in rural areas at the administrative division level. Employing Logistic regression analysis on the 2018-19 HIES data, the study gauges the impact of high-value crop production, non-farm employment, and farming household characteristics on rural food security. Notably, the analysis reveals an increase in nominal income and food availability in rural areas from year 2013-14 to 2018-19, with a substantial rise in the food-secure population from 76.31% to 90.31%. In this reference, Balochistan province exhibited noteworthy improvements, followed by Punjab and other provinces. In year 2018-19, Sibbi in Baluchistan was identified as the least food-secure administrative division, while Hazara in Khyber Pakhtunkhwa emerged as the most food-secure division in the country. The study highlights the positive influence of the mean age of the household, mean monthly income, and off-farm employment on rural food security. These findings offer valuable insights into the intricate dynamics of rural food security and contribute to a comprehensive understanding of regional factors at play. Hence, it is imperative to control the population growth rate in order to elevate the average household age, as to raise earning hands per household and attain rural food security. Likewise, there is a need for the creation of off-farm employment opportunities and an increase in household income to bolster food security and reshape the rural landscape of the country.

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***Correspondence** | Abid Hussain, Social Sciences Research Institute, PARC-National Agricultural Research Centre, Islamabad, Pakistan; **Email:** abid.parc@gmail.com
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## Introduction

Pakistan is ranked fifth in most populous countries of the world, after India, China, United State and Indonesia. Population of the country was 229.22 million in year 2022, out of which 144.53 million people (63.05%) were residing in rural areas. Population density in the country is moderate i.e.,

287.93 persons per $Km^2$. The country is at third stage of population growth i.e., increase in it has slowed down due to fall in birth rate. Still, population of the country is growing at a high annual growth rate of 2.55 percent. Country's rapidly growing population means ever increasing demand for food and other amenities of life. Pakistan is predominantly an agrarian economy. As the agriculture sector contributes 22.9 percent in the GDP and is source of employment for 37.4 percent of the labour force. The sector ensures food security and also provides raw material to the industrial sector (GoP, 2023).

Food is basic human need and right to gain passable living standard. Food security means that all the people have the capacity to feed themselves in dignity. Food secure people have a consistent, perpetual and unrestricted access to food in accordance with local cultural traditions either through financial purchases or through public/private sector support. Food security ensures physical and mental well-being of the people. It ensures healthy and active life (United Nations, 2022). According to FAO (1996) food security is a situation in which all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life.

In this perspective, few studies have been undertaken up till now to find out food security level of the people in Pakistan. However, all of these studies are confined to national or provincial levels. According to a most recent available regional level study that was conducted by Ishaq *et al*. (2018), based on five rounds of HIES data 2004-2016, food insecurity showed increasing trends during 2004-08 and 2011-14, with decreasing trend in 2009-10 and 2014-16. They reported that the incidence of food insecurity was the highest in Sindh, followed by Balochistan and Punjab with the lowest in KP. They insisted on sustainable solution to improve physical and financial access of the people to food to reduce food insecurity. They reported that food insecurity level is usually high in all the provinces (40 to 75% at 2350 kcal per person per day and 10 to 52% at 1910 kcal per person per day, minimum dietary requirement).

Rural transformation is intricately linked to food security, with various dimensions contributing to this relationship. The economic diversification inherent in rural transformation, specifically the adoption of high-value crop production (RT1), significantly influences food security outcomes. Research by Barrett *et al*. (2001) emphasizes the transformative potential of high-value crops, elucidating how their cultivation positively impacts income levels and, consequently, dietary diversity. This diversification not only ensures economic stability for rural households but also enhances their ability to access a varied and nutritious diet, essential components of sustained food security.

Moreover, the expansion of off-farm employment opportunities (RT2) during rural transformation is a crucial factor in addressing food security challenges. Findings from studies such as Gollin and Udry (2000) underscore the significance of non-agricultural employment in rural economies. Off-farm income not only provides an alternative revenue stream but also contributes to the overall economic resilience of rural communities. This economic resilience, fostered by the diversification of livelihoods, is integral to ensuring consistent access to diet and, consequently, enhancing food security in the evolving rural landscape.

Thus, there is gap in literature, as no study has reported rural food security situation at administrative division level in the country. Moreover, limited regional level studies in the country reveal varying food security situation. Therefore, a sustainable solution is essential. The research study has been undertaken to fill the research gap. In this reference, it is an established fact that production of high value crops and non-farm employment help in ensuring rural food security. The study findings will be useful for designing policy/programs aimed at achieving rural transformation in the country. Keeping all this in view the study has be designed with following specific objectives.

- To determine rural food security levels by administrative divisions in the country for the year 2013-14 and 2018-19
- To assess socioeconomic and farm attributes of rural households at administrative divisions
- To find out impact of high value crop production, non-farm employment and farming household characteristics on food security in the country.

## Materials and Methods

### *Data sources*

The data for this study were sourced from secondary

data sets of Household Income and Expenditure Survey (HIES) for the year 2013-14 and year 2018-19. The rural household samples for these surveys were 11,755 and 15,936, respectively. Socioeconomic and farm attributes of rural households at administrative divisions, province and national level have determined viz. household size in adult equivalence (No.), household head's qualification (Years) monthly income of the household (Rs.), land holding (acre) and livestock holding (No.).

Data for per capita monthly consumption of all commodity groups of rural households was analyzed to determine food insecurity situation at administrative divisions, province and country levels. These were converted in to Calories per day per adult equivalent at household level. Food security status has been determined on the basis of dietary energy consumption (DEC), measured as kcal/day/adult equivalent at household level. Caloric values of food items are obtained from the Food Composition **Table** of Pakistan (FCT) AIOU (2001).

### *Estimation of food and nutrient consumption and adult equivalency*

HIES food consumption data recorded on fortnightly basis was converted to monthly consumption. In HIES, consumption quantities or money values of a large number of food items (>69) is recorded as per their sources e.g. own produce, purchased, and received in kind as gift or charity. As the diet requirements of individuals depends on their age and sex, thus to account for household level differences, initially adult equivalence for each household is calculated as proposed by (Smith and Subandoro, 2007) and by using expression 1.

$$AE_h = \sum_{i=1.0}^{hhsize} AE_i \quad (1)$$

Wherein, each household member's adult equivalent size ($AE_i$) is taken from equivalence scale given in Poverty reduction strategy paper Pakistan (PRSP-I, 2003). Thereafter, total dietary energy consumption per adult equivalent and food security status of households was estimated.

The following phase of our analytical approach involves the application of Logistic regression analysis. The employment of Ordinary Least Squares (OLS) in our analysis facilitates the examination of relationships between the dependent variable, rural food security, and a diverse set of independent variables, encompassing aspects of rural transformation, socioeconomic factors, and farm-related attributes. This analytical framework aims to uncover the complex dynamics shaping food security in rural areas, providing a thorough understanding of contributing factors. Subsequent sections detail the included variables, model specifications, and the interpretation of regression results, illuminating nuanced interactions that underpin the complex landscape of rural food security in the country. Logistic regression analysis has been used to find out impact of rural transformation, socioeconomic characteristics and farm attributes on

**Table 1:** *Household socioeconomic characteristics/attributes.*

| Characteristics/ Attributes | Units | Mean | Standard deviation | Range | Observations |
|---|---|---|---|---|---|
| **2013-14** | | | | | |
| Household size | No. | 6.74 | 3.31 | 1- 47 | 11,755 |
| Mean age of household | Year | 24.25 | 10.08 | 6 - 90 | 11,755 |
| Household head's qualification | Year | 7.95 | 3.43 | 0 - 20 | 5,412 |
| Monthly income | Rs. | 35,882.94 | 38,081.20 | 0 – 1241083 | 11,057 |
| Land holding | Acre | 5.42 | 13.10 | 0.12 - 400 | 2,948 |
| Livestock holding | No. | 1.68 | 0.75 | 1 - 5 | 4,243 |
| **2018-19** | | | | | |
| Household size | No. | 6.54 | 3.24 | 1 - 31 | 15,936 |
| Mean age of household | Year | 24.97 | 10.26 | 6.25 - 84 | 15,936 |
| Household head's qualification | Year | 8.17 | 3.49 | 1-28 | 7,685 |
| Monthly income | Rs. | 46375.89 | 48341.88 | 0 – 2065200 | 15,936 |
| Land holding | Acre | 5.32 | 24.82 | 0 - 875 | 1,533 |
| Livestock holding | No. | 1.71 | 0.75 | 1 - 5 | 5,382 |

rural food security in the country as given by expression 2.

$$logit(FS) = \beta^0 + \beta^1*lage + \beta^2*ledu + \beta^3*linc + \beta^4*lhh_{adeqsize} + \beta^5*lagland + \beta^6*rt1 + \beta^7*rt2 \quad ...(2)$$

Where; FS= Food Security Level of $i^{th}$ Administrative Division (Percent); lage = Mean age of the household head (Years); ledu= Education level of the household head (Years); linc = Log of monthly income (PKR); lhh_adeqsize = Log of the household's size adequacy (no.); lagland = Log of land holding. (acre); RT1 = Share of high-value crops (RT1). (Percent); RT2 = Share of off-farm employment (RT2) (Percent).

In logistic regression, the Odds ratio (OR) and Margins are important concepts that help in the interpretation and comprehension of the relationship between independent variables and the likelihood of an event occurring. The Odds ratio (OR) serves as a measure of association between an independent variable and the probability of a specific outcome. When the Odds Ratio (OR) is larger than one, it signifies that the chances of the event happening increase with an increase in the predictor variable. In contrast to this, if the Odds Ratio (OR) is less than one, it indicates that the chances of the event happening decrease as the predictor variable increases. Similarly, in logistic regression, Margins represent the change in the predicted probability of the event occurring associated with a one-unit change in the predictor variable, providing insight into the change in the probability for a one-unit change in the predictor variable.

### *Data limitations*

The reported food quantities in HIES encompass both edible and non-edible components. However, the proportion of the non-edible portion, such as bones, peels, seeds, etc., is not specified, making it challenging to ascertain the edible portion exclusively. Secondly, computing nutrient values for local food items that are not well defined e.g., like other cereals, other meat, others fruits or vegetables etc. was not possible.

## Results and Discussion

### *Socioeconomic and household attributes of rural population in Pakistan*

Mean household size of the sampled rural household as per HIES 2013-14 and 2018-19 were 6.74 and 6.54, respectively (Table 1). Mean age of household members were 24.85 and 25.97 years in year 2013-14 and 2018-19, respectively. Household heads' mean qualification level were 7.95 and 8.17 educational years as per HIES 2013-14 and 2018-19, respectively. Similarly, monthly income of sampled households in year 2013-14 and 2018-19 were Rs.35,882 and 46,376, respectively. Mean land holding of sample households were 5.42 and 5.32 per family in year 2013-14 and 2018-19, respectively. Out of the sampled household, one-fourth (25%) reported to own livestock, with mean animal number of 1.68 per household in the year 2013-14. Similarly, about one-third of the sampled households (34%) reported to own livestock, with mean animal number of 1.71 per household in year 2018-19.

### *Food security situation in Pakistan*

An improvement in the food security situation has occurred overtime both in rural and urban areas. Major improvement in the situation has occurred in rural as well as urban areas of Baluchistan province followed by Punjab and other provinces. Country level as well as province wise details are given in the Table 2. In rural areas of the country, food secure population increased from 76.31 to 90.31 percent from 2013-14 to 2018-19. Thus, fourteen percent of the rural people came out from food insecure status to food secure section of the population.

Administrative division wise rural food secure population statistics in percentage terms revealed that in the Khyber Paktunkhwa province of the country in year 2018-19, Hazara division was the most food secure, with 99.42 percent food secure population (Table 3). While, Dera Ismail Khan was the least food secure administrative division of the province with 81.08 percent food secure population. As far as, change in the situation is concerned, it improved the most in Peshawar division i.e., by 18.38 percent and the least in Hazara division i.e., by 1.71 percent. In the Punjab province, Lahore and Bahawalpur were most food secure and insecure administrative divisions in year 2018-19, with 96.76 and 74.95 percent food secure population, respectively. Major improvement in food security situation occurred in rural areas of Sahiwal division i.e., 30.90 percent increase in food secure population was occurred. Whereas, the least increase in food secure population was observed in rural areas of Dera Ghazi Khan division (8.43%). In Sindh Province, the highest and least food secure

**Table 2:** *Food secure population in Pakistan (Percent).*

| Regions/Provinces | 2013-14 | | | 2018-19 | | | Change | | |
|---|---|---|---|---|---|---|---|---|---|
| | Rural | Urban | Over All | Rural | Urban | Over All | Rural | Urban | Over All |
| Pakistan | 76.31 | 77.88 | 76.85 | 90.31 | 93.13 | 91.32 | 14.00 | 15.25 | 14.47 |
| Khyber Pakhtunkhwa Province | 86.90 | 87.16 | 87.00 | 94.04 | 94.41 | 94.16 | 7.14 | 7.25 | 7.16 |
| Punjab Province | 74.12 | 74.00 | 74.07 | 91.81 | 93.00 | 92.21 | 17.69 | 19.00 | 18.14 |
| Sindh Province | 77.20 | 82.10 | 78.49 | 86.22 | 94.01 | 89.62 | 9.02 | 11.91 | 11.13 |
| Baluchistan Province | 62.56 | 64.06 | 62.93 | 84.76 | 88.14 | 85.86 | 22.20 | 24.08 | 22.93 |

**Table 3:** *Food secure population in rural areas by administrative divisions (Percent).*

| Administrative divisions | 2013-14 | 2018-19 | Change (% change) |
|---|---|---|---|
| **Khyber Pakhtunkhwa Province** | | | |
| Malakand | 89.31 | 95.18 | 5.87 |
| Hazara | 97.71 | 99.42 | 1.71 |
| Mardan | 77.38 | 93.65 | 16.27 |
| Peshawar | 74.66 | 93.04 | 18.38 |
| Kohat | 78.99 | 92.48 | 13.49 |
| Bannu | 84.85 | 91.36 | 6.51 |
| Dera Ismail Khan | 76.77 | 81.08 | 4.31 |
| Punjab | | | |
| Islamabad | 76.92 | 93.68 | 16.76 |
| Rawalpindi | 81.41 | 93.68 | 12.27 |
| Sargodha | 82.40 | 93.84 | 11.44 |
| Faisalabad | 79.19 | 95.17 | 15.98 |
| Gujranwala | 63.78 | 93.72 | 29.94 |
| Lahore | 66.13 | 96.76 | 30.63 |
| Sahiwal | 64.29 | 95.19 | 30.90 |
| Multan | 84.08 | 93.24 | 9.16 |
| Dera Ghazi Khan | 84.52 | 92.95 | 8.43 |
| Bahawalpur | 66.31 | 74.95 | 8.64 |
| **Sindh** | | | |
| Larkana | 76.67 | 81.68 | 5.01 |
| Sukkur | 82.65 | 83.82 | 1.17 |
| Hyderabad | 72.54 | 86.78 | 14.24 |
| Mirpur Khas | 77.83 | 87.70 | 9.87 |
| Karachi | 78.15 | 92.63 | 14.48 |
| Shaheed Benazirabad | - | 89.27 | - |
| **Baluchistan** | | | |
| Quetta | 53.67 | 91.44 | 37.77 |
| Zhob | 76.25 | 87.50 | 11.25 |
| Sibbi | 67.86 | 71.70 | 3.84 |
| Nasirabad | 58.39 | 75.69 | 17.3 |
| Kalat | 63.54 | 87.29 | 23.75 |
| Mekran | - | 89.87 | - |

population percentage were in Karachi and Larkana divisions, respectively. As far as, improvement in food security situation is concerned, it improved the most in Karachi division (14.48%) and the least in Sukkur division (1.17%). Similar to Punjab and Sindh province, provincial header quarter/ division of Baluchistan was the most food secure and Sibbi division was the most food insecure. Similarly, from 2013-14 to 2018-19 improvement in food security situation in the province occurred by the highest percentage in Quetta division and the least in Sibbi division.

### *Rural transformation in the country by province and administrative division levels*

Both RT1 and RT2 have improved at province level in the country (Table 4). RT1 situation improved the most in Baluchistan Province followed by Punjab and other provinces. RT2 situation improved the most in Punjab Province followed by Khyber Pakhtunkhwa and other provinces. Change in RT2 in Punjab and Khyber Pakhtunkhwa was much higher than in Sindh and Baluchistan province. Administrative Division level results revealed that in Khyber Pakhtunkhwa province RT1 and RT2 improved the most in Kohat and Dera Ismail Khan divisions, respectively. In Punjab province, Gujranwala division gained the most in RT1 and Multan division achieved the most in RT2. Similarly, in Sindh province, Mirpur Khas division achieved the highest positive change both in RT1 and RT2. Likewise, in Baluchistan province, highest positive changes in both RT1 and RT2 were observed in Sibi division.

### *Impact of rural transformation, socioeconomic characteristics and household attributes on food security (2018-19)*

The outcomes of the Logistic regression analysis indicate that the majority of independent variables exhibit anticipated positive signs and achieve statistical significance (refer to Table 5). Specifically, the coefficients for age, income, household size adjusted for adult equivalent, and RT2 are found to

be statistically significant. The signs of the coefficients for the mean household size, mean household income, and off-farm employment (RT2) are positive. Consequently, the mean household age, mean household income, and off-farm employment (RT2) are shown to positively influence rural household food security. While, coefficient of the mean household size as per adult equivalent is statistically significant and has an expected negative sign, which implies that the increase in household size as per adult equivalent adversely affects the rural household food security.

**Table 4:** *Province and divisional level RT1 and RT2 scores (Percent).*

| Division | RT1 | | | RT2 | | |
|---|---|---|---|---|---|---|
| | 2014 | 2019 | Change | 2014 | 2019 | Change |
| Malakand | 84.62 | 87.91 | 3.29 | 59.49 | 68.15 | 8.66 |
| Hazara | 88.70 | 91.64 | 2.94 | 45.15 | 52.96 | 7.81 |
| Mardan | 88.51 | 90.62 | 2.11 | 66.89 | 72.14 | 5.25 |
| Peshawar | 91.46 | 93.6 | 2.14 | 78.34 | 83.99 | 5.65 |
| Kohat | 87.89 | 93.35 | 5.46 | 75.51 | 82.11 | 6.6 |
| Bannu | 87.27 | 87.57 | 0.30 | 76.3 | 84.58 | 8.28 |
| D. I. Khan | 92.18 | 93.99 | 1.81 | 69.96 | 80.44 | 10.48 |
| Khyber Pak-tunkhwa | 88.66 | 91.24 | 2.58 | 67.38 | 74.91 | 7.53 |
| Rawalpindi | 82.87 | 86.40 | 3.53 | 56.11 | 59.92 | 3.81 |
| Sargodha | 72.12 | 75.01 | 2.89 | 44.16 | 54.2 | 10.04 |
| Faisalabad | 79.87 | 82.89 | 3.02 | 43.79 | 55.86 | 12.07 |
| Gujranwala | 64.03 | 71.67 | 7.64 | 58.49 | 66.02 | 7.53 |
| Lahore | 66.86 | 71.29 | 4.43 | 54.35 | 70.41 | 16.06 |
| Sahiwal | 64.40 | 70.59 | 6.19 | 31.66 | 44.38 | 12.72 |
| Multan | 73.73 | 75.26 | 1.53 | 38.51 | 52.99 | 14.48 |
| D. G. Khan | 75.59 | 80.03 | 4.44 | 29.59 | 39.2 | 9.61 |
| Bahawalpur | 79.79 | 81.13 | 1.34 | 28.66 | 38.5 | 9.84 |
| Punjab | 73.25 | 77.14 | 3.89 | 42.81 | 53.5 | 10.69 |
| Larkana | 88.93 | 90.66 | 1.73 | 30.76 | 19.05 | -11.71 |
| Sukkar | 82.39 | 86.32 | 3.93 | 37.77 | 44.2 | 6.43 |
| Hyderabad | 88.35 | 89.27 | 0.92 | 37.88 | 39.55 | 1.67 |
| Mirpur Khas | 92.95 | 96.21 | 3.26 | 29.42 | 39.84 | 10.42 |
| Sindh | 88.16 | 90.61 | 2.45 | 33.96 | 35.66 | 1.70 |
| Sibbi | 77.41 | 90.80 | 13.39 | 35.30 | 39.88 | 4.58 |
| NasirAbad | 55.56 | 58.96 | 3.40 | 9.78 | 13.93 | 4.15 |
| Kalat | 94.47 | 93.58 | -0.89 | 48.54 | 42.81 | -5.73 |
| Baluchistan | 75.81 | 81.11 | 5.3 | 31.21 | 32.21 | 1.00 |

The Odds ratios (OR) presented in Table 5 indicate that for the variables age, income, and RT2, the odds ratios are greater than 1. This suggests that an increase in these variables is associated with an increased likelihood of ensuring rural household food security. In contrast, the odds ratio for household size adjusted for adult equivalent is less than 1, indicating that a one-unit increase in this variable is linked to a reduced likelihood of rural household food security. Specifically, the odds ratio for the age variable is 2.98, signifying that for each additional year of mean household age, the likelihood of household to be food secure increases by a factor of 2.98.

**Table 5:** *Results of logistic regression analysis.*

| FS | Coefficient | Z | P>z | Odds ratio | Margins |
|---|---|---|---|---|---|
| lage | 1.092847 | 2.31 | 0.02 | 2.9828 | 0.0536 |
| ledu | 0.32932 | 1.04 | 0.30 | 1.3900 | 0.0162 |
| linc | 0.4452428 | 2.38 | 0.02 | 1.5609 | 0.0218 |
| lhh-adeqsize | -0.8662438 | -2.18 | 0.03 | 0.4205 | -0.0425 |
| lagland | 0.1126053 | 0.83 | 0.41 | 1.1192 | 0.0055 |
| rt1 | -0.0077685 | -0.79 | 0.43 | 0.9923 | -0.0004 |
| rt2 | 0.0177239 | 1.83 | 0.07 | 1.0179 | 0.0009 |
| _cons | -5.096743 | -2.2 | 0.03 | 0.0061 | |

Log likelihood = -177.38523; Number of obs = 791; LR chi2(7) = 23.5; Prob > chi2 = 0.0014; Pseudo R2= 0.0621.

Likewise, the odds ratio for the income variable is 1.56, suggesting that with one unit increase in household income, the probability of achieving food security by a household increases by a factor of 1.56. The odds ratio for the off-farm employment variable (RT2) is 1.01, indicating that an one unit (percent) increase in the variable can elevate the chances of a household being food secure by a factor of 1.01.

The margins in Table 5 represent the change in the predicted probability of attaining rural household food security. Specifically, the margins value for the age variable is 0.05, suggesting that for each extra year of mean household age, the predicted probability of achieving food security by the household increases by five percent. For the income variable, the associated margins are 0.02, signifying a 2% increase in the predicted probability with each additional unit. Similarly, the margins value for the variable RT2 is 0.0009, indicating a 0.09% increase in the probability of achieving rural food security.

## Conclusions and Recommendations

It is concluded that rural food security situation has improved over time in all the administrative units, provinces and on the country level. RT1, i.e., share of high value crops in total agricultural production

has become better in all the administrative divisions, except Kalat division in Balochistan. Similarly, RT2, i.e. share of off-farm employment in total rural employment has improved in all the administrivia divisions, except Larkana division in Sindh and Kalat division in Balochistan. Contribution of mean household age, mean income of the household and off-farm employment (RT2) in ensuring food security are positive and statistically significant. Therefore, population growth rate needs to be checked to increase mean household age to achieve rural food security. Similarly, off-farm employment generation and increase in household earnings are required to enhance the food security and transform rural landscape of the country.

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## Novelty Statement

It is an established fact that cultivating high-value crops and engaging in non-farm employment contribute to rural food security. However, there is a gap in the literature, as no study has examined rural food security at the administrative division level within the country. Likewise, the impact of high-value crop production, non-farm employment, and farming household characteristics on food security remains unreported. In this context, this study aims to establish a connection between rural transformation and food security in the country. The findings will be valuable for developing policies and programs focused on achieving rural transformation.

## Author's Contribution

**Abid Hussain:** Refined the study design based on expert guidance, oversaw data analysis, reviewed relevant literature, drafted the article, and integrated feedback from anonymous reviewers to finalize it.

**Bilal Khan Yousafzai:** Retrieved and analyzed the data, presenting the results according to the table format proposed by the first author.

**Muhammad Ishaq:** Provided technical input at every stage of the research process.

### *Conflict of interest*

The authors have declared no conflict of interest.

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