

## Original Research Article

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# Effect of Farmer FIRST on Enhancing Food and Livelihood Security of Tribal Farmers in Jharkhand



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## ABSTRACT

The research was undertaken within the framework of the Farmer FIRST Programme (FFP) in designated villages, with a primary focus on evaluating the efficacy of selected technologies and enhancing farmers' livelihood security. Notably, the study incorporated the modified Livelihood Security Index (LSI) developed and introduced six modules to showcase improved agricultural technologies. For this study, a purposive sampling approach was employed, selecting all four FFP villages. The sample comprised 200 beneficiary farmers, randomly chosen for livelihood security assessment. Structured interviews were conducted with farmers, and statistical analyses, including mean, standard deviation, livelihood security index, paired t-test, and correlation coefficient, were applied to the collected data. The findings revealed significant positive impacts of technology adoption, leading to additional net profits and increased man-days in the project villages during the 2022-23 period. Diversification in farm enterprises was evident, contributing to an upward trend in the socioeconomic status of marginal, small, and medium farmers from 2016-17 to 2022-23. Livelihood options expanded during this time, with statistically significant positive changes observed in farmers' livelihood security. The observed positive changes in livelihood security underscore the success of the FFP in promoting sustainable agricultural practices and improving the overall well-being of farmers. The diversification in farm enterprises and the increase in net profits indicate the program's positive influence on farmers' economic outcomes. The noteworthy expansion of livelihood options aligns with the broader goals of FFP, emphasizing holistic rural development. The study's implications suggest that the Farmer FIRST Programme (FFP) has significantly enhanced farmers' livelihood security and fostered sustainable agricultural practices. The positive outcomes, including increased net profits, diversified enterprises, and expanded livelihood options, underscore the program's effectiveness in promoting rural development. These findings advocate for continued support and scaling of FFP initiatives, emphasizing the potential for similar agricultural programs to bring about positive socioeconomic changes and contribute to the overall well-being of farming communities.

**Keywords:** Livelihood security index, Farmer FIRST Programme, Modules

## INTRODUCTION

In the ever-evolving landscape of rural development, the traditional focus on economic growth has given way to a more nuanced understanding that economic progress alone does not necessarily elevate the standard of living for the masses [1]. This realization has spurred a paradigm shift towards a sustainable livelihood approach, one that centers on eradicating poverty, empowering communities, and fortifying the security of livelihoods for those in rural areas. Recognizing this evolution, the World Bank's World Development Report [2] emphasized that the true challenge of development lies in

improving the quality of life. This quality extends beyond economic prosperity to encompass vital elements such as education, health, poverty reduction, environmental cleanliness, equality of opportunity, and individual freedom. Acknowledging the limitations of traditional notions of food and nutritional security, research in the late 1980s and 1990s called for a broader perspective. It became apparent that focusing solely on food security was insufficient to address the wider livelihood considerations of rural communities [3]. This led to the emergence of a livelihood security approach, advocating a shift from narrow food security concerns to a holistic perspective that encompassed the food and nutritional security of households. This approach not only prioritized food production but also emphasized a household's capacity to procure sufficient food for a balanced diet [4]. The Department for International Development [5] further refined the concept of livelihood, defining it as comprising capabilities, assets, and means of living.

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In tribal livelihoods, the natural environment plays a pivotal role in providing goods, services, and resources essential for sustaining their way of life [6]. Operationalizing livelihood security within this framework involves ensuring adequate access to income and resources to meet basic needs such as food, nutrition, health facilities, a clean environment, habitat facilities, educational opportunities, community participation, and social integration.

Jharkhand, a state with a significant tribal farming community, faces challenges related to low production and productivity of horticultural crops. Traditional cultivation practices contribute to below-average yields in various horticultural crops. Agriculture is a crucial income source for tribal farmers, constituting approximately 66% of Jharkhand's total population. Despite having a substantial cultivable area (52%), only 22% is currently under cultivation, falling below the national average of 47 percent. The agriculture landscape in Jharkhand is predominantly rain-fed and monotonously mono-cropped. Horticulture has seen limited development in tribal regions, with fruits, vegetables, and spices accounting for only around 2.5% of the cultivated area. The area's challenges include steep slopes, undulating topography, severe water erosion, and low soil water-holding capacity. Factors like erratic rainfall, inadequate irrigation facilities, poor water retention, and high soil permeability contribute to significant constraints, hindering the successful implementation of double-cropping practices. Addressing these challenges is essential for improving agricultural productivity and enhancing the livelihoods of the tribal farming community in Jharkhand.

The ICAR-initiated Farmer FIRST (Farm, Innovations, Resources, Science, and Technology) Programme, designed to address the evolving challenges encountered by farmers across the nation, is driven by a vision to empower them through research-backed, innovative solutions. The project aims to bridge the gap between scientific knowledge and practical on-field agricultural applications. Specifically, this study focuses on the Farmer FIRST Programme (FFP) villages—Malti, Tetri, Pindarkom, and Kutiyatu—in Kutiyatu Panchayat, Namkum block, Ranchi district, Jharkhand. These villages, with 955 households, have a significant population of scheduled caste and scheduled tribe families, constituting 63.4% of the total. Encompassing a geographical area of 1246.68 hectares, with 45.25% under cultivation and merely 13.8% under irrigation, the region features undulating terrain comprising uplands, medium lands, and lowlands. This intricate understanding of challenges sets the stage for exploring the impact of Farmer FIRST Programme interventions on the livelihood security of these communities.

The Farmer FIRST Program unfolds as a transformative initiative, drawing inspiration from successful poverty alleviation programs and sustainable development strategies. The program's overarching goal is to enhance the overall well-being and livelihood security of farmers through a strategic integration of various modules. Embracing a multi-dimensional approach, FFP implements distinct modules to address key aspects of agricultural and rural development. These modules include Crop-based, Horticulture-based, Livestock-based, Natural Resource Management (NRM)-based, Enterprise-based, and Integrated Farming System (IFS)-based initiatives. Each module is meticulously designed to optimize agricultural practices, diversify income sources, and foster sustainable farming. At the core of the conceptual framework lies the Livelihood Security Index (LSI), a comprehensive metric adapted from successful models in the literature [7,8].

The LSI comprises seven vital components—Food Security, Occupational/Financial Security, Habitat Security, Educational Security, Health Security, Social Security, and Environmental Security. This tailored index serves as a robust tool to assess the holistic impact of FFP interventions on farmers' livelihoods.

Rigorous impact assessments are essential to gauge the efficacy of FFP interventions. Variables and indicators, aligned with each module and LSI component, are meticulously tracked and analyzed. This includes changes in production levels, income patterns, housing conditions, educational attainment, health metrics, social participation, and environmental sustainability.

### Conceptual Framework and Hypothesis Formulation:

In alignment with the Farmer FIRST Program's comprehensive approach, the availability of capital emerges as a pivotal factor with the potential to alleviate poverty and enhance household well-being [8]. Recognizing this, FFP strategically integrates financial assistance, capital provision, and bank linkages into its framework. This dual approach, combining financial support with self-employment training, empowers beneficiaries to either establish their own businesses or make investments in agriculture, thereby elevating their income levels and ensuring economic security.

The symbiotic impact of training and capital infusion not only opens avenues for entrepreneurial endeavors but also creates a positive ripple effect across various dimensions of livelihood security (Fig. 1). The increased income levels generated through FFP participation enable families to access quality food, addressing the crucial aspect of food security. Moreover, economic security, coupled with the cultivation of social capital within the community, raises awareness and aspirations. As a result, beneficiaries may seek improved living conditions (habitat security), emphasizing the program's broader impact on the overall well-being of participating households.

In rural India, where financial constraints often hinder educational opportunities, the augmented income levels post-FFP participation can mitigate these constraints. Parents, empowered by increased income, are better positioned to prioritize the education of their children, thereby contributing to educational security. Drawing inspiration from existing literature, we posit a comprehensive hypothesis: that participation in the Farmer FIRST Program enhances livelihood security across multiple dimensions, including educational security, economic security, health security, empowerment, and food security. This hypothesis underscores the program's potential to catalyze positive transformations in the lives of the rural populace, aligning with FFP's overarching goal of holistic rural development. The Farmer FIRST Program stands on a robust conceptual foundation, synthesizing learnings from successful poverty alleviation models. By aligning with key dimensions of livelihood security and implementing a diverse set of modules, the program aims not only to improve agricultural practices but also to elevate the economic, social, and environmental well-being of participating farmers. The integration of a comprehensive Livelihood Security Index and hypothesis testing adds methodological rigor to the evaluation process, ensuring a thorough understanding of the program's impact on farmers' lives.

To quantify the impact of FFP, hypotheses are formulated and tested. The null hypothesis ( $H_0$ ) posits that there is no difference in the livelihood security index score of farmers between the pre-FFP period (2016) and the FFP implementation period (2023).

Conversely, the alternate hypothesis ( $H_1$ ) suggests a difference in the livelihood security index score during these periods. This hypothesis testing serves as a critical element in objectively assessing the effectiveness of the FFP interventions.

## Materials and Methods

### Locale of study:

The study was conducted in Ranchi District of Jharkhand. All four villages (Malti, Tetri, Pindarkom and Kutiyatu) of the Farmer FIRST Programme were purposively selected. All households of FFP villages was benefited with one or more need-based technologies. 200 beneficiary farmers were randomly selected for data collection on livelihood security. There are 955 beneficiaries of Farmer FIRST among them 200 beneficiary farmers were randomly selected to assess performance of technologies (Fig. 2).

**Implementation of different modules:** Participatory Rural Appraisal (PRA) techniques were used for assessing available resources in the selected villages. Resource profile of villages, land use pattern, soil types, available enterprises, crops and cropping season, animal husbandry and dairy, micro-farming situation and participation of rural women in decision-making in selected villages were analyzed. Agricultural problems were prioritized by farmers on the basis of severity of the problems. Different modules were developed for solving prioritized problems. Implementing/ demonstrating farmers were selected by villagers. Trainings were provided to the selected farmers about details of technology. Demonstrations were conducted by farmers on their land in guidance of project team. Field Days were organized at successful demonstration sites. Different modules undertaken and technical interventions are mentioned in Table 1

**Selection and measurement of variables:** Keeping in view the objectives of the study and the variables to be measured, an interview schedule was developed. Apart from information on the socio-personal characteristics, various information with regard to the different dimensions of livelihood security, their livelihood options, etc. were collected from 200 beneficiary farmers of FFP villages.

**Food Frequency Questionnaire (FFQ):** The study employed a Food Frequency Questionnaire (FFQ) and a 24-hour recall method to assess dietary patterns. The FFQ provided information on the frequency of food consumption over a specified period, capturing habitual intake, while the 24-hour recall method focused on detailed dietary recall for the preceding day. This combined approach aimed to gather comprehensive data on participants' food consumption habits, enabling a nuanced understanding of their dietary patterns. The FFQ offered insights into long-term dietary behaviors, while the 24-hour recall method allowed for a more immediate and detailed examination of daily food intake, enhancing the robustness of the dietary assessment in the study. For livelihood security measurement Livelihood Security Index (LSI) was used.

**Livelihood Security Index (LSI):** The assessment of livelihood security among farmers was conducted using the Livelihood Security Index (LSI), originally developed by [9] and modified for the present study. The LSI comprises seven components, each operationalized as follows:

(a) *Food Security:* Defined as the availability and access to balanced food at the household level.

(b) *Occupational/Financial Security:* Operationalized as access to regular and satisfactory employment and the financial condition of the respondent.

(c) *Habitat Security:* Encompassing housing with basic amenities.

(d) *Educational Security:* Involving the educational level of the family and access to educational facilities, including higher education.

(e) *Health Security:* Encompassing the health status of the family and access to healthcare facilities.

(f) *Social Security:* Involving social participation and the social status of the family.

(g) *Environmental Security:* Encompassing a pollution-free environment, access to water resources, eco-friendly farm management practices, and protection from flood or drought conditions.

Each component was attributed a scale value by [9] as outlined below: Food Security (11.53), Occupational/Financial Security (9.56), Habitat Security (8.78), Health Security (7.91), Environmental Security (6.66), Social Security (5.18), and Educational Security (5.01). Subsequently, to calculate the Livelihood Security Index (LSI) for each respondent, unit scores for each component were computed utilizing the prescribed formula:

### Computing the livelihood security index

Each component of livelihood security consisted of a different number of items/indicators and hence their range of scores was different. Therefore, the scores of all the seven components were converted into unit scores by using simple range and variance as given underneath.

$$U_{ij} = \frac{Y_{ij} - \text{Min } y_j}{\text{Max. } y_j - \text{Min } y_j}$$

Where,

$U_{ij}$  = Unit score of the  $i^{\text{th}}$  respondent on  $j^{\text{th}}$  component

$Y_{ij}$  = Value of the  $i^{\text{th}}$  respondent on the  $j^{\text{th}}$  component

$\text{Max } y_j$  = Maximum score on the  $j^{\text{th}}$  component

$\text{Min } y_j$  = Minimum score on the  $j^{\text{th}}$  component

The score of each component ranged from 0 to 1 i.e. when  $y_{ij}$  is minimum, the score is 0 and when  $y_{ij}$  is maximum the score is 1.

The unit scores of each respondent were multiplied by respective component scale values and summed up. The scores thus obtained were divided by the total scale value and multiplied by 100 to get the Livelihood Security Index for each respondent.

$i = 1-200, j = 1-7$

$$LSI_i = \frac{\sum U_{ij} S_j}{\sum S_j} \times 100$$

Where,

$LSI_i$  = Livelihood Security Index of  $i^{\text{th}}$  respondent

$U_{ij}$  = Unit score of the  $i^{\text{th}}$  respondent on  $j^{\text{th}}$  component

$S_j$  = Scale value of the  $j^{\text{th}}$  component

Subsequently, mean LSI was calculated.

### Survey Instrument and Reliability Assessment and Data Collection:

To facilitate comprehensive data collection, an interview schedule was meticulously developed for this study.



The survey instrument incorporated a spectrum of socio-personal variables and management practices associated with various modules under consideration. In addition, Participatory Rural Appraisal (PRA) and Focused Group (FG) techniques were employed to assess available resources within the targeted villages.

The interview schedule underwent a pretest with a sample group of non-beneficiaries (n=30) to ensure its appropriateness and effectiveness. Subsequently, the reliability and validity of the schedule were rigorously evaluated. The Frequentist Scale Reliability Statistics, as indicated in the table below, provide key metrics for assessing the reliability of the instrument.

Cronbach's  $\alpha$ , is a widely utilized measure of internal consistency, and yields a value of 0.727. This coefficient reflects the extent to which the items within the interview schedule consistently measure the intended constructs. A higher Cronbach's  $\alpha$  suggests increased reliability in the measurement tool. The Average Interitem Correlation, a vital indicator of item homogeneity, is computed at 0.213. This metric assesses the degree of correlation between individual items within the survey instrument. A higher average interitem correlation signifies greater consistency in responses across different items.

**Research Design:** In this study, a longitudinal before-and-after research design was employed to assess the impacts of enrolling as a Farmer FIRST beneficiary on the enhancement of livelihood security. The quasi-experimental framework was chosen to meticulously account for and control potential confounding variables, recognizing their significance in the research setting. The utilization of a quasi-experimental approach allows for the examination of changes in livelihood security outcomes over time, drawing comparisons between conditions before and after becoming a Farmer FIRST beneficiary.

The emphasis on controlling confounding variables within the quasi-experimental setting is imperative. This entails the strategic consideration and management of factors external to the Farmer FIRST intervention that could potentially influence the observed changes in livelihood security. By systematically addressing and mitigating the impact of these confounding variables, the study aims to establish a more robust and internally valid association between Farmer FIRST beneficiary status and enhanced livelihood security. This meticulous approach ensures that the observed effects can be confidently attributed to the participation in the Farmer FIRST program, contributing to the reliability and validity of the study's findings.

## Results and Discussion

Over the course of the Farmer FIRST Program, the year-wise changes in each module underscore significant advancements and growing adoption of agricultural technologies (Table 1). In the Crop Based Module, the cultivation area and participating households notably expanded from 12.4 hectares with 102 households in 2017-18 to 49.47 hectares involving 300 households in 2022-23. Horticulture activities witnessed consistent growth, with the area increasing from 0.12 hectares and 24 households in 2017-18 to 27.08 hectares and 152 households in 2022-23. The Livestock Based Module exhibited fluctuations but overall growth, with an increase in the pond area and the number of animals receiving vaccinations and other treatments, reaching 1337 animals and 177 households in 2022-23.

The Enterprise-Based Module showcased a significant surge in entrepreneurial activities, expanding from 40 households and 0.04 hectares in 2017-18 to 83 households and 83 mushroom units in 2022-23. Natural Resource Management practices demonstrated increased adoption, with 366 households engaging in activities like rice-fallow, drip irrigation, mulching, and homestead garden development in 2022-23.

The Integrated Farming System Module displayed a gradual rise in both area and households, emphasizing an increasing integration of diverse farming activities, reaching 7 households and 2.5 hectares in 2022-23. These consistent positive trends across modules signify the program's success and its impactful contributions to agricultural development and livelihood improvement over the years.

## Changing dynamics of prevailing farming systems from 2016-17 to 2022-23

The changing dynamics of prevailing farming systems from 2016-17 to 2022-23 are illustrated in Figures 2 and 3, depicting a notable shift in the livelihood options of farmers in the selected villages. A discernible increase in livelihood options is evident during 2022-23 compared to 2016-17. Prior to the introduction of the Farmer FIRST Programme (FFP) in 2016-17, mushroom cultivation was not a prevalent choice among farmers. However, by 2022-23, it had become an integral part of 33.4% of all farming systems, with female farmers actively cultivating oyster mushrooms at home during the leisure months of September to April. Additionally, some farmers extended their cultivation to milky mushrooms from May to August. A significant transformation was observed as many farmers replaced local varieties of field crops, vegetables, and indigenous breeds of goats and pigs with improved varieties. This shift was attributed to impactful demonstrations, training sessions, field days, and exhibitions conducted by the FFP team. The adoption of vaccination, deworming practices, and the provision of chelated, area-specific mineral mixtures for their animals became widespread among the majority of farmers. Furthermore, some farmers integrated dairy animals, such as cows and buffaloes, into their farming systems, showcasing a diversified and modernized approach in response to the interventions and guidance provided by the Farmer FIRST Programme.

Fig. 3-5 indicated that net agricultural income, non-farm income and gross family income of marginal (having less than 1 ha land), small (having 1-2 ha land), and medium (having 2-3 ha land) farmers increased during 2016-17 to 2022-23. It highlights the positive trajectory in net agricultural income, non-farm income, and gross family income for marginal, small, and medium farmers from 2016-17 to 2022-23. This improvement can be attributed to advancements in livelihood options across all farmer categories. Given the peri-urban context, many marginal farmers engage in labor during lean periods, while small and medium farmers participate in land sale and purchase activities, contributing to increased non-farm income and gross family income. Specifically, the annual net agricultural income of marginal farmers surged from Rs. 20,000/- in 2016-17 to Rs. 1,20,000/- in 2022-23, driven by the adoption of lucrative ventures like mushroom cultivation, goatry, and piggery. This economic upturn has translated into tangible improvements in living conditions, as evidenced by the transition from makeshift to permanent housing and the shift of children from government to private schools.

Furthermore, the increased participation of women in decision-making activities underscores the broader positive socio-economic impact of the implemented modules.

### Food security of the farmers

To measure the Impact of the Farmers First Program on Food security Wilcoxon Sign Rank Test was conducted after getting confirmation through Shapiro-Wilk Test for Normality. It was found that all the food Items were taken significantly more before and after the FFP. The table provides a detailed examination of the consumption patterns of various food items in 2016 and 2023, accompanied by statistical analyses using the Shapiro-Wilk test for normality and the Wilcoxon Sign Rank Test. These tests aim to assess the normal distribution of differences between paired observations and determine whether there is a significant discrepancy from a symmetric distribution centered around zero. The findings reveal substantial insights into the changes in food consumption between the two-time points. The results indicate that several food items experienced significant alterations in consumption. Roti witnessed a substantial decrease ( $z = 11.200$ ,  $p < .001$ ), along with Dal ( $z = 9.436$ ,  $p < .001$ ), Leafy Vegetables ( $z = 5.185$ ,  $p < .001$ ), Seasonal Vegetables ( $z = 5.183$ ,  $p < .001$ ), Milk ( $z = 8.484$ ,  $p < .001$ ), Paneer ( $z = 10.675$ ,  $p < .001$ ), Mushroom ( $z = 11.763$ ,  $p < .001$ ), Egg ( $z = 11.139$ ,  $p < .001$ ), Fish ( $z = 9.777$ ,  $p < .001$ ), and Chicken ( $z = 11.354$ ,  $p < .001$ ). Interestingly, Off-Sea Vegetables displayed a notable increase in consumption ( $z = -6.763$ ,  $p < .001$ ). Moreover, the Shapiro-Wilk tests demonstrated that the differences in consumption for each food item were significantly non-normally distributed (all  $p < .001$ ). These findings collectively suggest a substantial shift in dietary preferences and consumption habits over the years, reflecting evolving socio-economic and lifestyle factors. The Hodges-Lehmann Estimate and Rank-Biserial Correlation are statistical measures used in the Wilcoxon Sign Rank Test to provide additional insights into the central tendency and effect size of the observed differences between paired observations. These measures help to understand not only the significance of the observed changes (as indicated by the p-values) but also provide insights into the direction, magnitude, and strength of these changes. In our case Positive changes in food consumption was recorded in each items except Off season Vegetables. They contribute to a more comprehensive interpretation of the impact of interventions or changes over time on food consumption patterns.

### Livelihood security of farmers

Table 3 illustrates the mean values of various components of the Livelihood Security Index over the years 2016 and 2023, accompanied by the outcomes of the t-test for each component. Notably, the Food Security Index demonstrated a remarkable surge from 0.35 in 2016 to 0.74 in 2023 (t-test = 14.95), indicating a substantial improvement in ensuring access to balanced food at the household level. In contrast, the Occupational Security Index displayed a marginal change from 0.57 in 2016 to 0.58 in 2023, with a non-significant t-test result (0.24), suggesting stability in terms of regular and satisfactory employment. The Habitat Security Index witnessed a significant enhancement, soaring from 0.35 in 2016 to 0.94 in 2023 (t-test = 28.46), signifying improved housing conditions with basic amenities. Similarly, the Educational Security Index exhibited noteworthy progress, escalating from 0.26 in 2016 to 0.60 in 2023 (t-test = 7.12), indicative of an improved educational landscape.

The Health Security Index demonstrated an increase from 0.19 in 2016 to 0.45 in 2023 (t-test = 4.92), portraying an enhanced health status and access to healthcare facilities. A positive shift in the Social Security Index was evident, with the mean value ascending from 0.48 in 2016 to 0.73 in 2023 (t-test = 5.29), highlighting increased social participation and status. Lastly, the Environmental Security Index experienced a notable rise from 0.27 in 2016 to 0.55 in 2023 (t-test = 8.29), pointing towards an improved ecological setting, free from pollution, with better access to water resources, eco-friendly farm practices, and protection from environmental challenges. Fig.6 substantiated those tremendous positive changes that took place in most of the components of the livelihood security index, viz. food security, environmental security, social security, health security, educational security and habitat security. Whereas, occupational security showed less positive changes. These improvements may be attributed to the interventions and strategies implemented by the Farmer FIRST Programme, emphasizing diverse aspects of livelihood security for the farmers.

The observed improvements in the Livelihood Security Index components during 2016-2023 can be attributed to the multifaceted interventions and initiatives implemented by the Farmer FIRST Programme (FFP) in the selected villages. The FFP team actively promoted and facilitated various livelihood options, such as mushroom cultivation, adopting scientific methods for crop cultivation, engaging in vegetable cultivation, fishery, goatry, piggery, poultry, duckery, and dairy farming. Additionally, the introduction of drought-tolerant paddy variety SwarnShreya, the Black Bengal breed of goats, and the TxD breed of pigs played a pivotal role in diversifying and enhancing agricultural practices.

Furthermore, strategic interventions such as fencing of crops, effective rice fallow management, vermicomposting, drip irrigation, value addition to produce, and the adoption of sustainable farming practices contributed significantly to the positive changes in livelihood security. The emphasis on strengthening Self Help Groups (SHGs), cultivating in groups, and establishing marketing linkages with Farmer Producer Organizations (FPOs) further empowered farmers economically.

The introduction and adoption of innovative agricultural practices not only enhanced agricultural productivity but also improved the socio-economic status of farmers. The promotion of cleanliness and environmental sustainability contributed to the overall well-being of the farming communities. The FFP team's efforts in promoting these interventions played a crucial role in the observed positive changes.

However, it is noteworthy that there were limited changes observed in the occupation of the farmers, suggesting that while the FFP interventions contributed significantly to enhancing the socio-economic status and livelihood security, there was relative stability in the occupational aspects of the farmers' lives during the study period.

Table 4 provides a comprehensive socio-personal profile of the 200 farmers under consideration in the study. The mean age of the farmers is 40.5 years, with a breakdown into three age categories: Young (< 30 years) comprising 16% of the population, Middle (30-50 years) representing 66%, and Old (> 50 years) accounting for 18%. The gender distribution reveals that 36% are male, and 64% are female. Educational levels vary, with 4% being illiterate, 2% able to read and write only, 24% having passed below the 10th grade, 26% completing the 10th

grade, 26% having completed 10+2, and 18% holding a graduation degree. Marital status indicates that 80% of the farmers are married, while 20% are unmarried. Family types include 60% nuclear families and 40% joint families. The majority of families fall into the medium family size category (4-7 members), constituting 74%, while small families (< 4 members) make up 6%, and large families (> 7 members) constitute 20%. Occupation-wise, 84% are engaged in farming, and 16% work as laborers. The gross annual income ranges from low (< 151999) for 12% of the farmers, medium (151999-324021) for 76%, to high (>324021) for another 12%. The landholding is distributed among marginal (54%), small (28%), medium (8%), and large (10%) categories. Decision-making patterns reveal that 2% of farmers are guided by males, 16% by females, and 82% make decisions collectively. In terms of innovativeness, 16% brought innovations to their knowledge, 54% adopted innovations introduced by other family members, and 30% prefer to wait and take time before embracing innovations. This socio-personal profile serves as a valuable foundation for understanding the diverse characteristics of the farmers involved in the study.

Table 5 illustrates the Livelihood Security Index (LSI) scores of farmers in two distinct periods: before the initiation of the Farmer FIRST Programme (FFP) in 2016 and during FFP in 2023. The mean LSI values are categorized into Low, Medium, and High, accompanied by the respective frequency percentages. In 2016, the mean LSI was 35.92, with 12% classified as Low, 72% as Medium, and 16% as High. In 2023, the mean LSI significantly increased to 66.50, with 20% in the Low category, 72% in the medium category, and 8% in the High category. A paired t-test was conducted to compare the mean LSI values between the two periods, revealing a significant positive change at a 5% significance level. This indicates a noteworthy enhancement in the livelihood security of farmers, suggesting that the interventions introduced by the FFP have positively influenced various dimensions of livelihood. The shift towards higher mean LSI scores in 2023 underscores the effectiveness of the program in improving the overall well-being and security of the farming community.

Table 6 provides insights into the correlation between independent variables and the livelihood security of farmers. Notably, a positive and significant association was identified between landholding and livelihood security, underscoring the pivotal role of land in farming activities. The positive correlation of age with livelihood suggests that the livelihood of elderly villagers is predominantly dependent on agricultural endeavors. Annual family income exhibited a positive and significant association with livelihood, indicating that higher incomes contribute to increased savings and broader livelihood options. This finding aligns with previous studies by [11&12]. Family size demonstrated a significant correlation with livelihood, highlighting how the division of labor among family members positively influences livelihood security.

In contrast, gender and education were found to be non-significantly associated with the livelihood security of farmers. Both male and female members play crucial roles in enhancing family livelihood, and the non-significant association may suggest a balanced contribution from both genders. The non-significant association with education could be attributed to the majority of farmers having completed only school-level education, limiting its impact on livelihood improvement.

Occupation of the head of the family and innovativeness exhibited negative non-significant associations with livelihood security. In most cases, where the occupation of the head of the family is farming, its non-significant association with livelihood underscores the predominant role of agriculture in determining livelihood outcomes. The negative non-significant association with innovativeness may suggest that innovative practices are not significantly influencing overall livelihood security.

The Farmer FIRST Programme, implemented in selected tribal villages of Jharkhand, has remarkably transformed the livelihood security of marginalized farmers from 2016 to 2023. Livelihood security index encompassing Food, Habitat, Educational, Health, Social, and Environmental Security showed significant improvement during the period. Factors such as landholding, age, and annual family income had the pivotal role in influencing the livelihood security of tribal farmers. The socio-economic impact demonstrated substantial growth in net agricultural income, non-farm income, and gross family income, thus reflecting the program's holistic success. While gender, education, occupation, and innovativeness exhibited non-significant associations with livelihood security and these findings underscore the need for tailored strategies in considering the predominant occupation in farming and the prevailing educational levels. The study recognizes the program's commendable impact while acknowledging the less observed changes in occupation, thus signaling the areas for further exploration. The Farmer FIRST Programme's multifaceted approach, with the integration of modules like Crop-based, Horticulture-based, Livestock-based, NRM-based, Enterprise-based, and IFS-based, ensures a comprehensive upliftment of farmers' livelihoods. The continuity of these interventions contributes valuable insights to rural development, emphasizing the importance of adaptability and ongoing research to sustain positive impacts on livelihoods amidst evolving challenges.

The multifaceted approach of the Farmer FIRST Programme, integrating modules such as crop-based, horticulture-based, livestock-based, natural resource management (NRM)-based, enterprise-based, and integrated farming system (IFS)-based interventions, underscores the importance of comprehensive strategies in uplifting farmers' livelihoods. Policymakers can draw valuable insights from the success of this program in rural development and emphasize the importance of adaptability and ongoing research to sustain positive impacts amidst evolving challenges.

Furthermore, the findings from this investigation can inform policymakers in designing technology modules tailored to the specific needs of tribal farmers to enhance food and livelihood security effectively. By leveraging the successes and lessons learned from the Farmer FIRST Programme, policymakers can develop targeted interventions that address the unique challenges faced by marginalized farmers, thereby promoting inclusive and sustainable rural development in similar contexts. Additionally, continued investment in research and development to refine and innovate agricultural practices and interventions will be essential in ensuring the long-term success and impact of such programs on livelihoods and food security in tribal communities.

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**Table 1: Annual Progression of Technology and Module Adoption in the Farmers FIRST Program**

Modules	Year-wise coverage of technologies											
	2017-18		2018-19		2019-20		2020-21		2021-22		2022-23	
	Area (ha)/ No. of animals/pl ants/ Units	Househ olds	Area (ha)/ No. of animals/plants / Units	Househ olds	Area (ha)/ No. of animals/pl ants/ Units	Househ olds	Area (ha)/ No. of animals/pl ants/ Units	Househ olds	Area (ha)/ No. of animals/pl ants/ Units	Househ olds	Area (ha)/ No. of animals/plant s/Units	Househ olds
<b>Crop based</b>	12.4 ha	102	54 ha	86	2 ha	102	16 ha	740	6.15 ha	61	49.47 ha	300
<b>Horticulture based</b>	0.12 ha	24	2.3 ha	72	2.5 ha	64	2.7 ha	68	11.29 ha	120	27.08 ha	152
<b>Livestock based</b>	0.8 ha pond	4	Vaccination deworming & M. mixture to 1250 animals	750	500 animals	150	600 animals	175	1250 animals	350	1337 animals	177
<b>Enterprise based</b>	0.04 ha seed production, Lac cultivation and mushroom	40	0.25 ha Seed, Mushroom, vermicompost, value addition	264	92 mushroom units	92	41 mushroom units	41	45 mushroom units	45	83 mushroom units	83
<b>NRM</b>	-	-	11.1 ha Rice-fallow, drip & mulching homestead garden	210	2 ha	10	2.1 ha	11	4.96 ha	366	2.94 ha	53
<b>IFS</b>	0.21 ha	1	1.5 ha	2	1 ha	1	1 ha	2	2.18 ha	6	2.5 ha	7

**Table 2: Impact of Farmers First Program on Food security**

Food items in 2016	Food items in 2023	Test for Normality		Wilcoxon Sign Rank Test				
		Shapiro-Wilk W	P	W	z	p	Hodges-Lehmann Estimate	Rank-Biserial Correlation
Roti 2016	Roti 2023	0.843	< .001	26.000	11.200	< .001	2.000	0.996
Dal 2016	Dal 2023	0.786	< .001	1140.000	9.436	< .001	1.000	0.839
L veg 2016	L Veg 2023	0.762	< .001	390.000	5.185	< .001	1.000	0.703
Sea Veg 2016	Sea Veg 2023	0.727	< .001	462.000	5.183	< .001	1.000	0.684
Off sea Veg 2016	off sea veg 2023	0.811	< .001	4492.000	-6.763	< .001	-1.000	-0.779
Milk 2016	Milk 2023	0.924	< .001	1202.000	8.484	< .001	3.500	0.793
Paneer 2016	Paneer 2023	0.917	< .001	90.000	10.675	< .001	2.000	0.985
Mushroom 2016	Mushroom 2023	0.842	< .001	0.000	11.763	< .001	3.000	1.000
Egg 2016	Egg 2023	0.873	< .001	154.000	11.139	< .001	1.500	0.979
Fish 2016	Fish 2023	0.872	< .001	1170.000	9.777	< .001	1.000	0.850
Chicken 2016	Chicken 2023	0.884	< .001	510.000	11.354	< .001	1.500	0.945

Note-L veg- Leafy vegetable, Sea Veg- Seasonal vegetable, Offsea- Offseason vegetable

**Table 3: Breakdown of Farmers' Livelihood Security by Components**

S. No.	Components of livelihood security Index	Mean value during 2016	Mean value during 2023	t-test
1	Food security index	0.35	0.74	14.95*
2	Occupational security index	0.57	0.58	0.24
3	Habitat security index	0.35	0.94	28.46*
4	Educational security index	0.26	0.60	7.12*
5	Health security index	0.19	0.45	4.92*
6	Social security index	0.48	0.73	5.29*
7	Environmental security index	0.27	0.55	8.29*

\*Significant at 5% level of significance

**Table 4: Socio-personal profile of respondents farmers N=200**

S.No.	Variables	Mean value	Category	Frequency (%)
1	Age (yrs)	40.5	Young (< 30)	32 (16)
			Middle (30-50)	132 (66)
			Old (> 50)	36 (18)
2	Gender	-	Male	72 (36)
			Female	128 (64)
3	Education	-	Illiterate	8 (4)
			Can read and write only	4 (2)
			Passed below 10th	48 (24)
			Passed 10th	52 (26)
			Passed 10+2	52 (26)
			Passed graduation	36 (18)
4	Marital status	-	Married	160 (80)
			Unmarried	40 (20)
5	Family Type	-	Nuclear	120 (60)
			Joint	80 (40)



6	Family size	5	Small (< 4)	12 (6)
			Medium (4-7)	148 (74)
			Large (> 7)	40 (20)
7	Occupation		Farming	168 (84)
			Labour	32 (16)
8	Gross annual income (Rs.)	238010	Low (< 151999)	24 (12)
			Medium (151999-324021)	152 (76)
			High (> 324021)	24 (12)
9	Land holding (in acres)	3.89	Marginal (< 2.5)	108 (54)
			Small (2.5-5.0)	56 (28)
			Medium (5-7.5)	16 (8)
			Large (> 7.5)	20 (10)
10	Decision making pattern	-	Decision by male	4 (2)
			Decision by female	32 (16)
			Decision by both	164 (82)
11	Innovativeness	-	Brought to my knowledge	32 (16)
			Adopted by other members	108 (54)
			Prefer to wait & take time	60 (30)

Table 5: Livelihood security Index of farmers during the period 2016 and 2023

Before FFP (2016) (N=200)			During FFP (2023) (N=200)			t-score (between mean score)
Mean score	Category	Frequency (%)	Mean score	Category	Frequency (%)	
35.92	Low (< 27.78)	24 (12)	66.50	Low (< 55.40)	40 (20)	15.71 Significant at p < 0.05
	Medium (27.78- 44.06)	144 (72)		Medium (55.40-77.59)	144 (72)	
	High (> 44.06)	32 (16)		High (> 77.59)	16 (8)	

Table 6 Correlation between independent variables and livelihood security of farmers

S.No.	Independent variables	Correlation coefficient
1	Age	0.290341554*
2	Gender	0.058939117
3	Education	0.130065019
4	Family size	0.178615368*
5	Occupation of head of family	-0.186408243
6	Annual family Income	0.257180258*
7	Land holding	0.313340959*
8	Innovativeness	-0.062138066

\*P &lt; 0.05

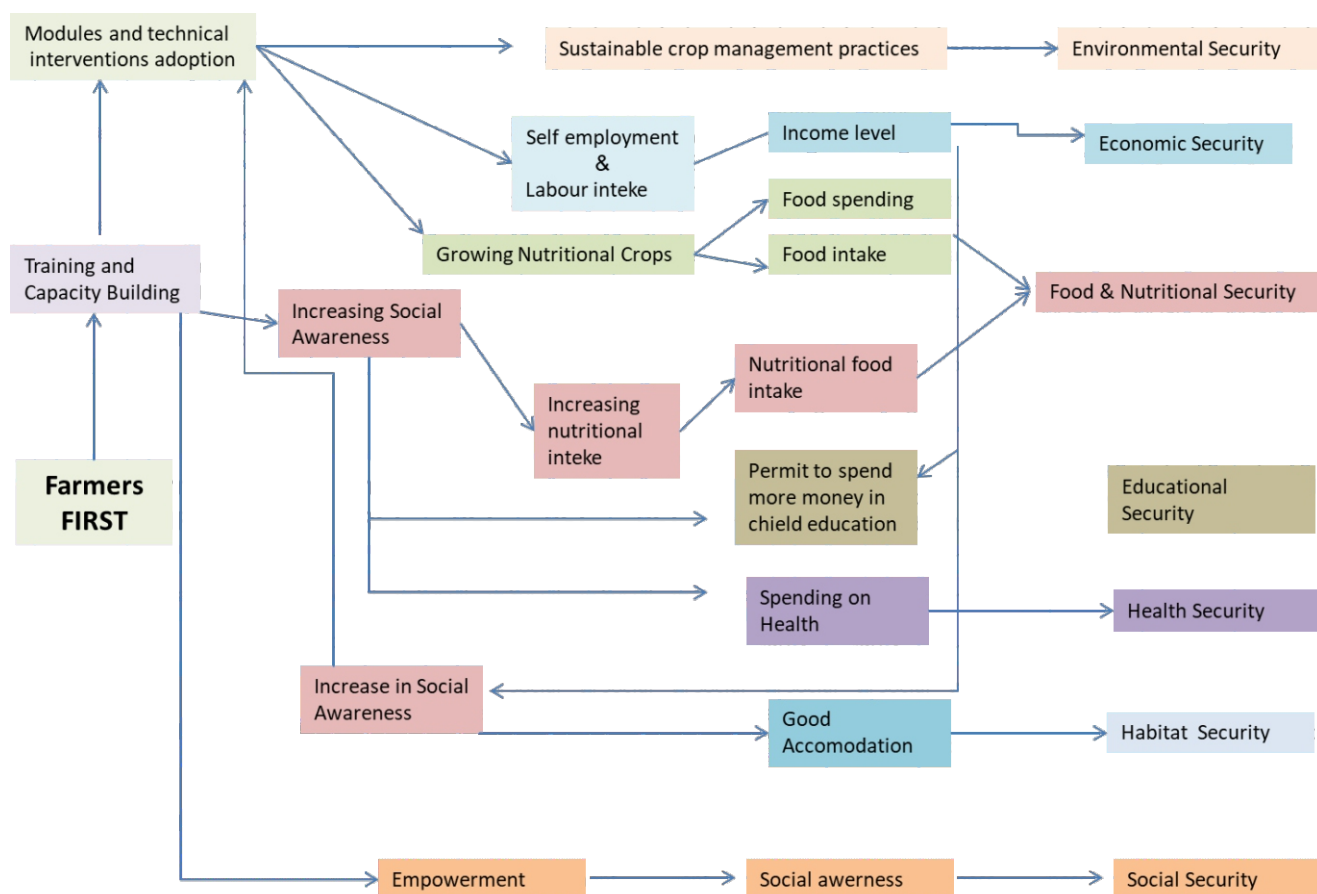


Fig. 1. Conceptual Framework of Farmers FIRST Program





Fig. 2. Selected Village of Ranchi District of Jharkhand

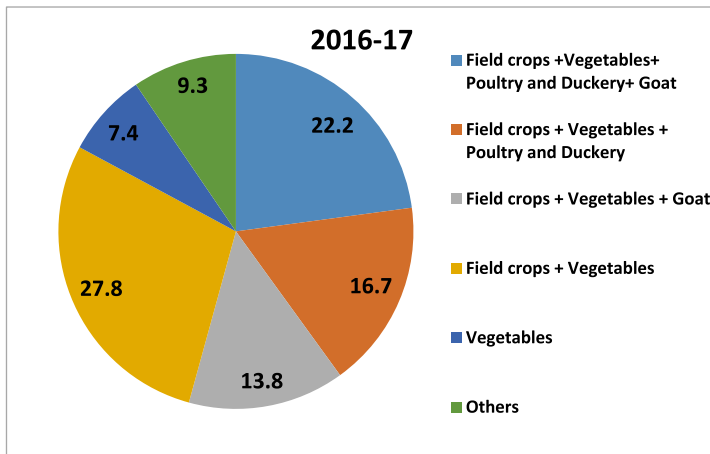


Fig.3. Prevailing farming systems during 2016-17

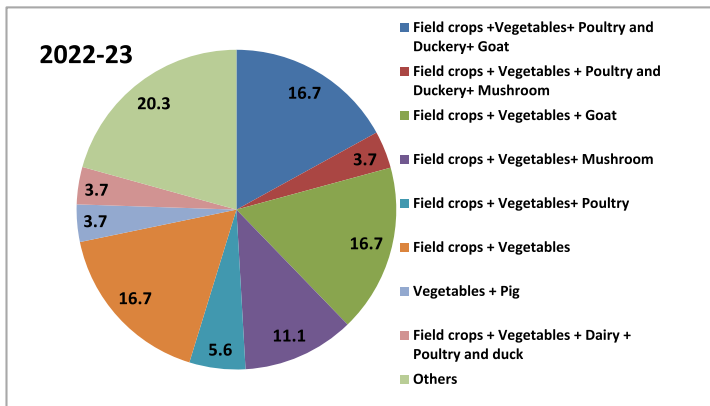


Fig.4. Prevailing farming systems during 2022-23

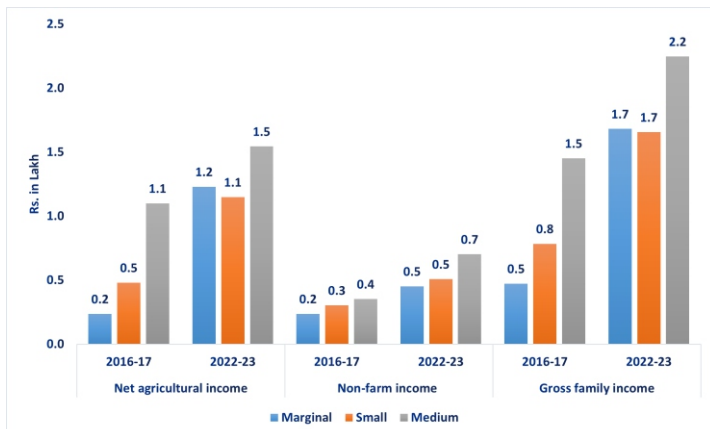


Fig.5. Changes in income pattern of different farmer groups during 2016-17 to 2022-23

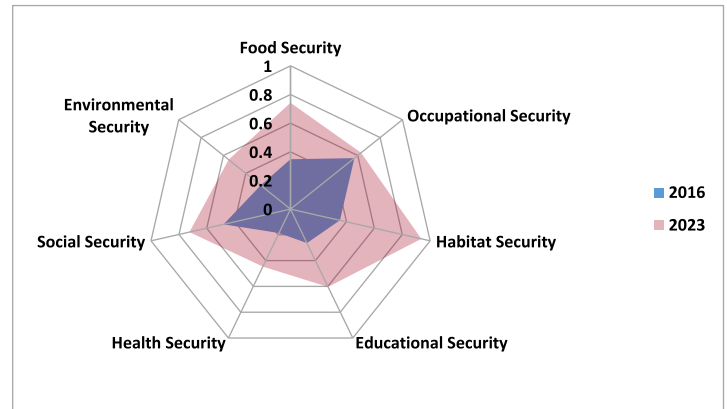


Fig. 6. Changes in components of livelihood security of farmers before and during FFP

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