



# Household Food Security under Social Forestry: Evidence from a Forest Farmer Group in the Drylands of East Nusa Tenggara, Indonesia

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## ABSTRACT

Forest farmer households in tropical dryland areas represent a vulnerable group whose livelihoods depend heavily on forest resources and rain-fed agriculture, making their food security critical for rural resilience and sustainable development. This study analyzes the food security of forest farmer households who are members of the Fetomnasi Forest Farmers Group in Sillu Village, Fatuleu District, Kupang Regency, East Nusa Tenggara. The research examines the relationship between socioeconomic characteristics, the utilization of non-timber forest products, agroforestry practices, and household food security levels. Data were collected from 24 households through structured interviews and analyzed using descriptive statistics, the Household Food Security Index, and Pearson's correlation test. The results indicate an average food security index score of 0.65, classified as adequate food security. Variations in food security status among households are influenced by income, education, access to information, and the capacity to utilize non-timber forest products. The Fetomnasi Forest Farmers Group plays a strategic role in strengthening household food security through the coordination of agricultural and forestry activities, technical training, facilitation of government assistance, and the development of social capital such as trust and cooperation among members. However, institutional performance remains constrained by limited capital, infrastructure, and management capacity. Strengthening institutional governance, improving access to financial resources, and promoting agroforestry diversification are essential to enhance food security resilience and ensure the sustainability of forest-based livelihoods in tropical drylands. Future research should examine longitudinal changes in household food security and evaluate the long-term effectiveness of institutional interventions in dryland social forestry systems.

**Keyword:** Agroforestry, Household Food Security, Institutions, Non-Timber Forest Products, Socioeconomic Factors, Sustainability

## 1. Introduction

Food security is an important aspect of sustainable development, especially in rural areas that depend on forest resources as a primary livelihood source. In tropical dryland forest areas, forests serve as ecological systems and livelihood assets that support food availability, income diversification, and household resilience [1], [2]. Through social forestry schemes, communities gain legal access to forest land, enabling integration of food crops, forestry crops, and non-timber forest products (NTFPs) into diversified livelihood systems. At the household level, this integration is reflected in agroforestry practices that combine food crops, perennials, and NTFPs. The agroforestry system contributes to production stability, diversification of consumption, and

increased family income, especially in areas with limited natural resources. Semi-commercial agroforestry practices contribute to balancing economic and ecological objectives while supporting long-term food security [2], [3]. The application of this concept has expanded in various regions of Indonesia, including South Sulawesi and East Nusa Tenggara, and has contributed to increasing land productivity and community welfare [4], [5].

However, food security in the eastern region of Indonesia, especially East Nusa Tenggara (NTT), still faces structural challenges in the form of long dry seasons, limited water availability, land degradation, and low production capacity and infrastructure [6]. The conditions increase household vulnerability to food insecurity, especially in dryland areas of NTT [7]. Research on social forestry has predominantly focused on ecological dimensions, while quantitative empirical evidence linking participation in social forestry to household food security is limited. The integration of socioeconomic characteristics, NTFP utilization, and agroforestry practices in measuring the food security of household members of Forest Farmers Groups (Kelompok Tani Hutan, hereafter KTH Fetomnasi) has not been widely developed, indicating conceptual and methodological gaps in assessing household food security within social forestry contexts in tropical dryland areas.

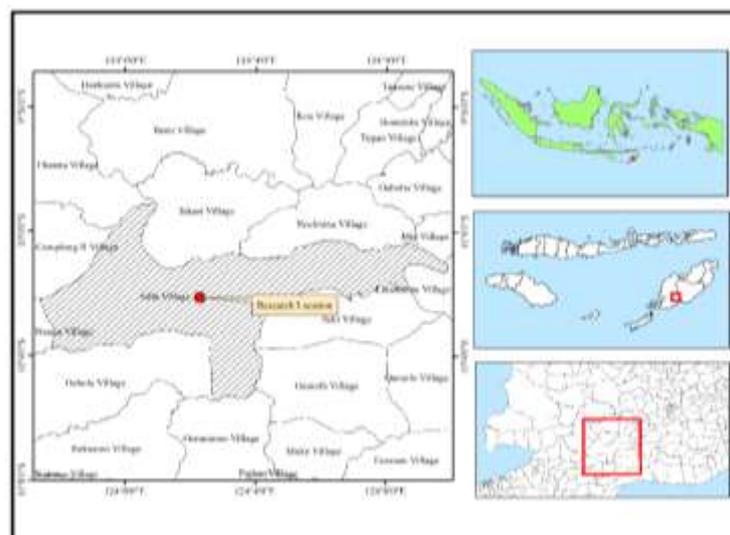
Sillu Village, Fatuleu District, Kupang Regency, represents the conditions of forest farmer households in dry forest areas in NTT. In this area, KTH Fetomnasi manages approximately 100 ha of state forests under a social forestry scheme and implements a livelihood system that combines dryland agriculture, livestock, and NTFP utilization. As a local institution within social forestry, KTH Fetomnasi plays a role in coordinating land management, facilitating access to government support, and strengthening social capital among its members. Dependence on rainfall, low income levels, and limited access to agricultural technology and extension services continue to increase the risk of household food insecurity.

Based on the background, the study analyzes household food security within a social forestry context using the Food and Agriculture Organization [8] framework, which includes availability, access, utilization, and stability. Food security is positioned as an outcome of participation in social forestry by examining the relationship between socioeconomic characteristics, NTFP utilization, agroforestry practices, and the level of household food security. The findings are expected to provide empirical contributions to strengthening food security-based social forestry policies in the tropical dry forest regions of eastern Indonesia. This study addresses existing empirical gaps in understanding household food security within dryland social forestry systems.

## 2. Method

### 2.1 Study Area and Period

The research was conducted from May to July 2025 in the Fetomnasi Forest Farmers Group (Kelompok Tani Hutan, hereafter KTH Fetomnasi), Sillu Village, Fatuleu Subdistrict, Kupang Regency, East Nusa Tenggara Province. The study area covers approximately 100 ha of state forest managed by the community under a social forestry scheme, characterized by dry agroecological conditions at an altitude of 200-600 meters above sea level (Figure 1).



**Figure 1.** Research Location

## 2.2. Research Design

The study population consisted of 24 households who were members of KTH Fetomnasi. A census approach was applied, whereby all households were included as respondents. The inclusion criteria comprised households that had been members of KTH Fetomnasi for at least one year, actively participated in group activities, and engaged in dryland farming or non-timber forest product (NTFP)-based activities. All members met these criteria; therefore, no households were excluded from the study.

## 2.3. Data Collection

Primary data were obtained through structured interviews using questionnaires that covered household socioeconomic characteristics, income, food expenditure, and access to forest resources. The validity of the questionnaire was assessed through a pre-test involving five households outside the study sample, and its reliability was evaluated using Cronbach's alpha coefficient ( $\alpha = 0.78$ ), indicating acceptable internal consistency. Secondary data were collected from the Statistics Indonesia (*Badan Pusat Statistik/BPS*) of Kupang Regency, the East Nusa Tenggara Provincial Environment and Forestry Agencies, and previous studies related to forest-based food security [5], [8], [9].

## 2.4. Data Analysis

Data were analyzed using descriptive and quantitative approaches to describe the socioeconomic conditions and levels of household food security. The analysis included calculations of household income and food expenditure, the proportion of food expenditure as a welfare indicator, and food security scores based on the four FAO pillars: availability, access, utilization, and stability [8]: Food security levels were measured using the Household Food Security Index (*Indeks Ketahanan Pangan Rumah Tangga/IKPR*), calculated as:

$$IKPR = \frac{\text{Availability} + \text{Access} + \text{Utilization} + \text{Stability}}{4} \quad (1)$$

Each indicator was assessed on a scale of 1-5 and normalized to a 0-1 range. IKPR values were categorized into four levels of food security as shown in Table 1. In addition to descriptive analysis, Pearson correlation tests were conducted to examine the relationship between education level, household income, and IKPR scores.

**Table 1.** Categories of household food security levels based on IKPR

IKPR Score	Food Security Category
0.80-1.00	Food Secure
0.60-0.79	Food Sufficient
0.40-0.59	Food Vulnerable
<0.40	Food Insecure

## 3. Results and Discussion

### 3.1. Socioeconomic Characteristics of KTH Fetomnasi Members

Analysis of the socioeconomic characteristics of respondents is important for understanding the adaptive capacity and vulnerability of forest farmer households to fluctuations in resources and food availability. This study involved 24 households that are members of KTH Fetomnasi in Sillu Village, Fatuleu Subdistrict, Kupang Regency, East Nusa Tenggara Province. Most members are in the productive age group (30-55 years) and have a relatively low level of education. Based on the survey, 16.67% of members have never attended formal education, 58.33% are elementary school graduates, 12.5% are junior high school graduates, and 12.5% are high school graduates (Table 2). This finding suggests structural limitations in access to information, forestry technology, and alternative economic opportunities, which may constrain the implementation of sustainable social forestry practices [5].

**Table 2.** Education Level of KTH Fetomnasi Members, Sillu Village

Education	Number (People)	Percentage (%)
No Schooling	4	16.67
Elementary	14	58.33
Junior High School	3	12.5
High School	3	12.5

The respondents' livelihoods were dominated by dryland farmers (79.2%), while the remainder worked as farm laborers, livestock herders, and small business owners. The average household income was recorded at

IDR 347,916 per month, with food expenditure of IDR 234,375, resulting in food expenditure accounting for 69.81% of total household income. This high proportion indicates that most of the household income is allocated to basic consumption needs, suggesting a high level of vulnerability to food insecurity.

These findings show that most members of KTH Fetomnasi still rely on subsistence agriculture and forest products such as cashews, candlenuts, coconuts, and bananas as primary sources of food and income. Cashews constitute an important source of cash income, while food crops such as corn, cassava, and bananas support daily household consumption. The combination of fast-growing food crops and perennial forestry crops reflects an adaptive livelihood strategy under dryland agroecological conditions.

The share of food expenditure is widely recognized as a key indicator of household food security [10], [11]. A proportion exceeding 60-65% of total income reflects a high level of vulnerability to price fluctuations and food supply disruptions. Households allocating a large share of income to food consumption generally exhibit lower levels of food security compared to those able to allocate resources to savings or productive investments [12], [13].

These socioeconomic conditions are further influenced by environmental constraints. The agroecological conditions of Sillu Village are characterized by hilly topography, rocky soils, average annual rainfall of 800-1,000 mm, and a dry season lasting 6-7 months. Agricultural production remains subsistence-oriented and depends largely on rainfall, with no permanent irrigation systems. The community practices mixed cropping systems that integrate food crops, plantation crops, and forestry species in the form of simple agroforestry to maintain soil fertility and extend food availability throughout the season.

The low carrying capacity of dryland agroecosystems, soil degradation, and the expansion of critical land areas further increase household vulnerability. Therefore, adaptive strategies such as diversification of food sources and strengthening agroforestry systems are essential for enhancing regional food security [3, 14]. Limited access to extension services, agricultural inputs, and post-harvest technology also constrain productivity and food diversification. Nevertheless, local knowledge in integrating perennial crops with seasonal food crops represents a practical expression of socio-ecological adaptation supporting sustainable livelihoods.

### 3.2. Household Food Security Level of KTH Fetomnasi

Based on the Household Food Security Index (Indeks Ketahanan Pangan Rumah Tangga, IKPR) calculation, the average IKPR score in Sillu Village is 0.65, which falls into the "food sufficient" category. This moderate IKPR score reflects the structural socioeconomic constraints described in Section 3.1, particularly the high share of food expenditure and limited household income. At the same time, it suggests that food sufficiency in Sillu Village is structurally sustained by direct access to land and forest-based resources, despite limited monetary income. The distribution of food security shows that 8 households (33.3%) are classified as food secure, 13 households (54.2%) are food sufficient, 1 household (4.2%) is food vulnerable, and 1 household (4.2%) is food insecure (Table 3).

**Table 3.** Distribution of Household Food Security in KTH Fetomnasi

Food Security Category	Number (Households)	Percentage (%)
Food Secure (0.80-1.00)	8	33.3
Food Sufficient (0.60-0.79)	13	54.2
Food Vulnerable (0.40-0.59)	1	4.2
Food Insecure (<0.40)	1	4.2
Total	24	100

Analysis of the indicators that make up the IKPR shows the following average values: food availability 3.29, food access 3.21, food utilization 3.21, and food stability 3.25. The dimension of food availability is classified as sufficient because most households are able to meet their consumption needs from their own harvests, such as maize, sweet potatoes, bananas, and legumes, as well as forest products such as candlenuts and coconuts. These findings are consistent with [15], which reports that households in dryland areas of Indonesia still rely on their own production to meet their basic food needs. Although 79.17% of households are classified as income-poor, food sufficiency is maintained thanks to direct access to land and local resources. This indicates that food security in this region is determined more by land availability and crop yields than by cash income alone.

Access to food remains limited due to low incomes, fluctuations in staple food prices in local markets, and limited diversification of income sources. Household income and expenditure significantly influence food security [16]. Food security is also shaped by access to information and technology, as internet use can reduce food insecurity [17]. Environmental factors, including the loss of forest resources and traditional knowledge, also significantly affect household food security [18]. Furthermore, access to information, training, and institutions such as KTH Fetomnasi plays an important role in supporting more stable access to food.

The dimension of food utilization shows that households consume agricultural products and NTFPs, although dietary diversity remains limited. The potential of NTFPs such as candlenuts, areca nuts, and forest honey has not been fully optimized despite their economic and nutritional value. The effective utilization of these resources depends on household knowledge and skills in managing NTFPs and environmentally friendly agricultural practices [19]. Nutritional literacy also influences menu diversity and consumption quality, indicating that education and training interventions could improve food utilization and dietary outcomes.

The dimension of food stability reflects high dependence on rainfall patterns and seasonal production. The practice of combining fast-growing crops with perennial species functions as a local adaptation strategy to maintain food availability between seasons. Farming households in the drylands of East Nusa Tenggara remain highly dependent on the rainy season and their own harvests to meet food needs [20]. Limited water availability and declining soil fertility increase vulnerability to food fluctuations [21]. Further analysis shows heterogeneity among households. Households with higher incomes, better education, and optimal NTFP management capacity tend to be food secure, whereas low-income households with limited knowledge are more likely to fall into vulnerable or food-insecure categories, indicating that education, income diversification, and production capacity significantly influence household food security [22], [23].

The role of local institutions such as KTH Fetomnasi has also been shown to support household food security through training in crop cultivation, NTFP processing, community engagement, and information exchange among members. These activities strengthen social capital, including social networks, trust, and collective values that contribute to long-term food stability [9]. Additionally, KTH administrators serve as role models, increasing member participation in improved agricultural practices and resource management, thereby contributing positively to household welfare and food security [24]. These findings confirm that farmer institutions function as coordination platforms and important instruments in strengthening adaptive capacity and forest-based food sustainability.

### 3.3. Heterogeneity and Factors Supporting Food Security

The analysis shows heterogeneity in food security among KTH Fetomnasi households. These differences are influenced by socioeconomic variables, technical capacity, and utilization of forest resources. Households with higher incomes, better education levels, and optimal utilization of NTFPs tend to be food secure. They are able to meet their food needs from their own harvests, manage dietary diversity, and maintain sufficient food reserves to cope with price fluctuations or supply disruptions. Conversely, households with low incomes, limited education, and restricted access to information and technology tend to fall into the vulnerable or food-insecure category. This finding indicates that food security depends not only on production levels but also on households' capacity to manage resources, capital, and information to ensure food availability, access, and stability [25], [26].

The results of the Pearson correlation test reinforce these findings, showing a significant relationship between socioeconomic indicators and IKPR scores. Household income shows a strong positive correlation with IKPR ( $r = 0.73$ ,  $p < 0.01$ ), indicating that higher income levels contribute to improved food security. Education also demonstrates a moderate positive correlation with IKPR ( $r = 0.61$ ,  $p < 0.05$ ), suggesting that higher education levels enhance households' ability to optimize food utilization, manage NTFPs efficiently, and make economic decisions that support food stability.

Other factors influencing food security heterogeneity include access to local markets, diversification of income sources, household management capacity, and institutional support from KTH Fetomnasi. Households actively engaged in institutional activities tend to have better access to information on cultivation techniques, NTFP management, and adaptation strategies to food supply disruptions. Income and livelihood diversification have been shown to enhance food security, welfare, and household adaptive capacity to economic and environmental shocks [27]-[29].

### 3.4. Institutional Role of KTH Fetomnasi

KTH Fetomnasi plays a strategic role in supporting forest-based livelihoods in Sillu Village. KTH Fetomnasi functions not only as a coordination platform for agricultural and forest management activities but also as a facilitator of capacity building through technical assistance, extension services, and training related to agricultural techniques, forest product processing, and household management. In addition, KTH Fetomnasi acts as an intermediary in accessing government assistance programs, including seeds, fertilizers, capital support, and food security-related development initiatives. By strengthening members' social capital, the institution contributes to improving food availability, access, and distribution at the local level, particularly when institutional management and member participation are effectively implemented [30]. Furthermore, empowerment through local resource-based and community-driven institutions strengthens household capacity in managing financial, natural, and social capital to support sustainable food security [31].

The household food security initiatives facilitated by KTH Fetomnasi support the utilization of forest and agricultural products as sources of food and supplementary income. The institution assists members in organizing production schedules, storage, and distribution systems to help ensure year-round food availability. Rural institutions also play an important role in supporting food security policies related to availability, access, and utilization, both through specific institutional functions and through integrated village-level mechanisms [32]. Agroforestry systems contribute positively to household food security on community lands surrounding forest areas through food diversification, increased income, environmental stability, and employment opportunities [2].

Beyond its technical functions, KTH Fetomnasi also plays an important social and economic role by strengthening solidarity and cooperation among members through mutual assistance activities, regular meetings, and participatory decision-making processes. The institution facilitates the marketing of forest products to improve household income and provides targeted support for women and economically vulnerable families through training programs and small-scale business assistance. The role of KTH Fetomnasi within the social forestry scheme contributes not only to member welfare but also to forest sustainability [33].

Despite its strategic role, KTH Fetomnasi faces several challenges, including limited capital, relatively low education levels among some members and inadequate facilities and infrastructure. Strengthening institutional performance requires improved management capacity, increased member participation in decision-making, and enhanced collaboration with government agencies, non-governmental organizations (NGOs), and the private sector. Thus, KTH Fetomnasi functions as an institutional bridge between communities and forest resources, strengthening adaptive capacity and promoting sustainable, forest-based food security in dryland social forestry systems.

## 4. Conclusion

The food security of KTH Fetomnasi member households falls within the adequate food category, with an average IKPR score of 0.65. There is clear heterogeneity in food security among households, influenced by socioeconomic factors such as income, education level, access to information and technology, and the utilization of Non-Timber Forest Products (NTFPs). Households with higher incomes, better education, and optimal NTFP management tend to be food secure, while those with limited capital, knowledge, and access are more likely to be food insecure or vulnerable. The KTH Fetomnasi institution plays a strategic role in strengthening household food security through the coordination of agricultural activities, forest management, technical training, member assistance, food distribution arrangements, and the reinforcement of social capital, including solidarity and cooperation among members. However, its role remains constrained by limited management capacity, capital availability, infrastructure, and relatively low education levels among some members. The policy implications of this study highlight the need to strengthen institutional capacity through targeted training programs, improved access to financial capital, infrastructure development, and enhanced collaboration between KTH, local government, and external stakeholders. Support for NTFP value chain development and livelihood diversification is also essential to increase income resilience and reduce vulnerability to seasonal and market fluctuations. Future research should explore longitudinal assessments of household food security dynamics, evaluate the long-term effectiveness of institutional interventions, and examine the integration of agroforestry-based food systems within broader regional food security policies in dryland social forestry contexts.

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