ISSN 2189-9126

国際開発研究フォーラム
FORUM OF INTERNATIONAL DEVELOPMENT STUDIES

研究論文
ARTICLE

Factors Affecting Farmers' Resilience to Food Insecurity in the Peanut Belt of Senegal

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Maouloud Talla FALL*

Abstract

The paper examines determinants that influence resilience to food security using a survey of 140 rural farm households in the Peanut Belt of Senegal. I analysed the data using principal component analysis and regression model.

The results show income diversification, targeted relief, the number of people employed in the family, organic fertiliser and age of household head which affect resilience. Income diversification provides farmers new sources of revenues. Facing land degradation and the decrease in yields, a shift to organic fertiliser (manure and compost) as agricultural technology and practice helped farmers spend less money on farm materials and soil revitalisation. Targeted aid from the local nongovernmental organisation and partners provided care and food to vulnerable households.

Considering the feebleness of farm production in the Peanut Belt, an increase of off-farm active household members improves resilience. Households that solely rely on agricultural production to survive face severe risks of food insecurity.

Besides, homes with aged household head face with food insecurity. Elderly family heads struggle to keep up with farms and need more labour force.

My findings also suggest the village Keur Bamba holds the highest resilience index and female household heads have higher resilience index than male-led households.

Keywords: Agriculture, Farmers, Food Insecurity, Resilience, Senegal

1. Introduction

This study identifies factors affecting farmers' resilience in the Peanut Belt of Senegal. Crops and plants producers in the Peanut Belt continuously experience food shocks.

Measuring resilience index becomes critical for researchers and local projects interested in analysing micro sample populations. Despite policies, food access in rural Senegal has become drastic.

The Peanut Belt represents the backbone (McClintock and Diop 2005: 2). Cereals are the first food speculation and resources. Over the years, the region confronted droughts and floods.

The agricultural system in Senegal in 2015 accounted for almost 34 percent of GDP growth (World Bank 2016). The peanut supply represents 70 percent of the agrarian employment and 60 percent of farm households' revenue (Thuo, Ureta, Hathie, Asiedu 2010: 2).

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I measured the resilience index using a principal component analysis (PCA). Researchers pursue measuring resilience lately, adopting quantitative and qualitative methods (FAO 2016). FAO remains the first to study resilience and food security (Pingali et al., 2005). It proposed an econometric approach (Alinovi et al. 2008). Other studies suggested alternative methods (Frankenberger et al. 2012, Vaitlia et al. 2012).

I used micro-level metrics such as food expenditure, the number of farms exploited, and income, food shocks, and livestock size.

Vaitlia et al. (2012) used a "livelihood change approach", which models components of livelihood strategies framework. Boukary et al. (2016) created a resilience index in Niger adopting the following variables: stock, tropical livestock unit, income, food expenditure and farm.

Second, I determined the factors affecting resilience to food insecurity using a multiple regression analysis. The variables are agricultural practices and technologies (organic fertilizer, inorganic fertilizer, pesticides, veterinary services, value of input); assets (radio, phone); social safety nets (assistance received, the amount of the aid, and targeting assistance); adaptive capacity (number of people employed, other sources of income); age of the household head, gender of the household head, and household head education.

The remainder of this paper unfolds as follows: next section discusses the written knowledge about food security/insecurity, resilience in development studies. Section 3 describes the research area. Section 4 presents the material and methods. Section 5 concerns the result of resilience measurement. Section 6 analyses the determinants of resilience. Section 7 displays the results and discussion. Section 8 has the conclusion and recommendation.

2. Literature Review

2.1. Food Security and Food Insecurity: Definition of Concepts

In 1996, the World Food Summit admitted food security is the state "when persons continuously have total access to sufficient and nutritious food for an active and healthy life."

In the Third World, food security defines as access to dietary, safe, and individually tolerated foods, and fitted to local customs (Parnell and Smith 2008).

Food insecurity in developing countries shows limited food availability at national stage affecting households, inadequate and inequitable access to food (Abdu-Raheem and Worth 2011).

Food insecurity concerns mainly households, not individuals. Homes are food secure when they can access to the healthy food needed for all their members and when it is not at undue risk of losing such access (Bajagai 2013). They incline to food insecurity when they are impotent to mitigate shocks, or erosion of, food availability, access, and utilisation (Webb et al., 2006).

2.2. Resilience, Development and Food Security

The growing interest in resilience as a new model stems from gaps in current development science and practice.

"Resilience is prominent in academia and serves as a central framework" (Béné et al., 2014: 1). We can understand "resilience as the ability of individuals, systems, and communities to anticipate, absorb, adapt to, and recover from disruptions" (Ross Peizer 2014: 4).

Resilience approach gives materials to study and analyse development questions holistically and adopt cross-sectoral and interdisciplinary techniques. "Resilience stands as a narrative to bring together different actors and different disciplines under one single approach" (Béné et al., 2013: 6).

Household resilience to food security is the ability to withstand or recover from recurrent food shocks at household level.

2.3. Food Security Measurement and Indicators

Despite apparent empirical strength, the operationalisation of food security still presents many challenges. The lack of consensus installs an inefficient amassment of data collection methods on multiple dimensions of food security.

Food security analysts candidly acknowledge "there is a need to diversify techniques and institutions engaged in analyzing food security" (Carletto and al. 2013).

2.3.1. Methods of Measuring Food Security

The FAO Method

The FAO proposal focuses on calorie and energy absorption. It requires information regarding the amount of calories people consumed in a period of time. They also need "the coefficient of variation of caloric intake to generate the energy distribution curve, cut-off point to estimate the range of people under the minimum caloric requirement" (Perez-Camilla and Segall-Correa 2008).

Household Income and Expenditure Surveys

It hinges on household interviews. Indicators are the "quantity of food bought and cost associated with different foods consumed within and outside the compound, foods the household got as either gift or as payment for work, foods cultivated for household consumption" (Perez-Camilla and Segall-Correa 2008).

Personal Dietary Intake

The methods include "24–hour recall", "food frequency questionnaires", "food records" gathered reports. This process has the advantage to measure food consumption and food availability directly and gives intra-household food consumption report.

Food Insecurity Experience Scales

Cornell University researchers developed the use of scales from respondents' attitudes. It provides information on the level of harshness of food insecurity. This method is fit to diverse sociocultural settings and provides a comprehensive analysis of reasons and effects of food insecurity.

Anthropometry

Anthropometry refers to the study of the measurement of human body. It measures how the lack of food and healthy diet influence individuals. They are more often experimented in national surveys using height and weight, or length of the child.

3. Description of the Research Area

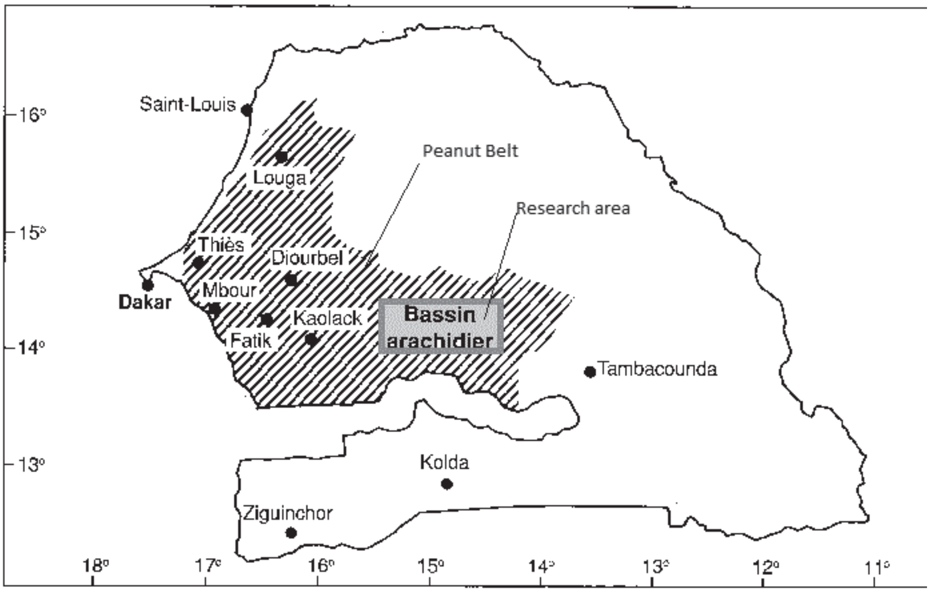
Senegal is both a coastal and desert located in West Africa. Food insecurity in the country mainly concerns the rural area (WFP 2016).

Only 1.3 percent of agricultural lands are equipped for irrigation, and vulnerability to climate shocks, with high risks of drought and regular, severe flooding affecting urban areas (FAO 2013: 1).

A significant portion of the population relies on traditional agriculture. The centrally harvested grains are millet, maize, and rice.

The study area is the Peanut Belt located in the region of Kaoloack. Among the eco-geographic

Figure 1 Study Area



Source: Adapted from Google Map

zones, the Peanut Belt is the most exposed to environmental issues, land degradation, the recession of soils (erosion, high salinity), land grabbing, etc. The various projects and national projects have not yet enough results to overcome the constant challenges. The Peanut Belt generates about three-quarters of the food crop (cereals) and peanut production (cash crop).

Farmers in the Peanut Belt derive most of their resources from cereals crops such as millet, maize, rice.

4. Materials and Methods

4.1. Data Collection

I administrated structured questionnaires to household heads within seven villages in *Djiguimar*, *Djiguimar II*, *Keur Ardo*, *Keur Bamba*, *Koupakh*, *Payoma*, *Payoma II*.

Households were randomly selected and replaced in case of absence of respondents. I collected data from 140 households. The questionnaire detailed as follow: households' demographic characteristics (Table 2), educational status and production activity (Table 2), shocks, livestock, assets, safety nets (Table 4), farm characteristics and technology (Table 6).

To gather households' characteristics information, I used variables such as number of people in the household, farm ownership, farming other farms (some farmers help their neighbors in exchange for grains or other in-kinds), age of the household head (the age of the head affects the household dynamics and capacity to withstand hazards such as floods, drought, disease, etc.), household education level (literacy and schooling are crucial determinants of quality of life and key indicators of unprivileged people's ability to take advantage of income-generating opportunities), experience of shocks (farmers tell whether or not they have experienced internal or external shocks susceptible to influence their food security), staple food (this variable informs on farm household food habits), second activity (the diversification of income source activities is key to income improvement, and plays a vital role in leveraging resources when the primary production activity inches back), household head gender (female vs. male).

Table 1 shows the distribution of population among villages. Djiguimar concentrates a large part of the people in the Peanut Belt with 98 households counting for 1180 people.

Table 2 explains the descriptive of the sample households. Most of the houses have on average 11 people. They mainly have one household head and practice farming on the family farm. The variable farming other farms are very relevant to food security studies because farmers with more lands and farming opportunities can diversify their income sources and improve production. Most of the household head has achieved an insufficient level of education with a mean 8.54 equivalent to junior high school.

Also, households experience different shocks such as late rainfall, flood, drought, late harvest,

Table 1　Village, Sample, and Population

Village	Sample households	Total number of households (N)	Total number of population
Djiguimar	20	98	1180
Djiguimar II	20	92	1056
Keur Ardo	20	84	756
Keur Bamba	20	62	660
Koupakh	20	43	456
Payoma	20	63	641
Payoma II	20	68	684

Source: Author Survey, 2015

Table 2　Descriptive Statistics of the Sample: Households Information

	N	Minimum	Maximum	Mean	Std. Deviation
Number of People in the household (count)	140	4	27	11.07	4.158
Farming (1＝Yes, 0＝otherwise)	140	1	1	1.00	.000
Own a farm (1＝Yes, 0＝otherwise)	140	1	1	1.00	.000
Farming other farms (1＝Yes, 0＝otherwise)	140	0	1	.36	.483
H-Head age (count)	140	20	78	52.96	11.352
Experience shocks (1＝Yes, 0＝otherwise)	140	1	1	1.00	.000
H-Head gender (1＝Male, 0＝otherwise)	140	0	1	.80	.401
Valid N (listwise)	140				

Source: Author's calculation

cricket invasion, etc. Most of household heads are males.

Table 3 shows that 92.1% of households have primary education level. Most families keep children on the farms after elementary school. Villages do not have secondary schools and parents refuse to send their children to urban areas.

Rice represents the primary staple food. With the country not being able to produce enough rice, a large part of the budget goes to rice importation.

Table 5 shows most households (65%) do not have a second income-generating activity. Many do gardening. They are essentially women. Livestock helps for transport in exchange for cash.

Most farmers in the Peanut Belt own 1 or 2 ha farm. The production quantity is less than 1 ton.

Table 3　Household Head Education level

		Frequency	Percent	Valid Percent
Valid	0 < 7 (Primary)	129	92.1	92.1
	8 < 11 (Junior High)	11	7.9	7.9
	Total	140	100.0	100.0

Source: Author's calculation

Table 4　Household Staple Food

		Frequency	Percent	Valid Percent
Valid	Rice	80	57.1	57.1
	Millet	45	32.1	32.1
	Corn	15	10.7	10.7
	Total	140	100.0	100.0

Source: Author's calculation

Table 5　Household Second Activity

		Frequency	Percent	Valid Percent
Valid	None	91	65.0	65.0
	Gardening	45	32.1	32.1
	Transport	2	1.4	1.4
	Others	2	1.4	1.4
	Total	140	100.0	100.0

Source: Author's calculation

Table 6　Descriptive Statistics of the Sample: Farms Information

	N	Minimum	Maximum	Mean	Std. Deviation
Number of farms (count)	140	1	2	1.01	.085
Farm size (ha)	140	1.0	7.0	1.996	1.3604
Production quantity (count/tons)	140	.00	6.00	.7057	.78704
Valid N (listwise)	140				

Source: Author's calculation

Table 7　Type of Soil

Type of Soil		Frequency	Percent	Valid Percent
Valid	Joor	101	72.1	72.1
	Daak	31	22.1	22.1
	Daak-Joor	8	5.7	5.7
	Total	140	100.0	100.0

Source: Author's calculation

Table 8 Soil Quality

		Frequency	Percent	Valid Percent
Valid	Rich	46	32.9	32.9
	Somewhat rich	11	7.9	7.9
	Poor	83	59.3	59.3
	Total	140	100.0	100.0

Source: Author's calculation

Joor, Daak, and Daak-Joor are main types of soils in rural Senegal. 72.1 of farms in the Peanut Belt are of Joor soil. Joor soils constitute the wealth of the country. They are ochre-coloured and light, consisting of sands mixed with iron oxide.

They form dunes and are immensely suitable to peanut cultivation. Joor soils respond very well to food crops such as sorghum, millet, and corn. Most farmers describe Joor soils as fertile and soft. Daak soils have a hard texture and are black coloured.

Daak-Joor soils have a mix of both textures. These are soils with sandy loam composed of 15% clay and slit. The depth of the composition can vary from sandy loam to clay.

Table 8 explains that most lands in the Peanut Belt have poor quality. This impacts farmers' production yield considering soils fertility goes hand-in-hand with food security.

4.2. Empirical Model

Resilience's not observable *per se*. Alinovi et al. (2008) advise using "assets, income-generating activities", "social safety nets", "adaptive capacity".

Other recommend using an observable variable as resilience proxy. There are not yet firmly defined variables prone to measure resilience (Gallopin 2006). Also, the process to quantify resilience remains controversial (Chan et al., 2007).

In this study, resilience score is a composite index from the aggregation of five variables: food expenditure, farm, income, food shocks, tropical livestock units (TLU). The variables explain in Table 9.

Analytically, the resilience index for a household *i* formulates as follows:

$$R_i = f(foodexp_i, farm_i, income_i, shocks_i, TLU_i) \quad (1)$$

Where R is a latent variable that refers to household resilience index. Food expenditure is the amount of money the household spends on buying food; the farm is whether the household exploits different farms, income is the sum of money the household earns in a year, shocks is whether the household has experienced food shocks, tropical livestock unit counts the livestock holdings. For the TLU, the coefficients applicable to sub-Saharan Africa (HarvestChoice 2011 are: cattle = 0.7, sheep = 0.1, goats = 0.1, pigs = 0.2, chicken = 0.01, dairy cow = 0.5.

Alinovi et al. (2008) developed the resilience index through multivariate stages and methods.

Table 9 Resilience Variables, Unit of Measurement and Hypothesized Relationship

Variables	Unit of measurement	Hypothesized relationship
Food Expenditure	Amount of money spent on purchasing food	The capacity of food consumption shows the household's wealth.
Farm	Number of exploitation	Having several farms can improve a family's food and income.
Income	Revenue gained	Higher income creates sustainable resilience.
Food shocks	Has experienced food shocks or not	Households experiencing food shocks are more likely to be food insecure.
Tropical Livestock Units	Livestock size	Having more TLU may increase resilience to food insecurity.

Similarly, Kei et al. (2008) applied the degree of drought-induced expenditure reductions for necessities and the absolute differences in the consumption of selected food items between the standard and the drought situation as a basic indicator for resilience".

To derive the uni-dimensional and the weight of resilience indicators, and finally the resilience index, I applied a multivariate analysis using principal component analysis (PCA).

In mathematical denomination, PCA generates uncorrelated indices or components whereby each component is a linear weighted combination of the variables as follows:

$$pc_m = a_{m1}X_1 + a_{m2}X_2 + a_{m3}X_3 + \ldots + a_{mn}X_n \quad (2)$$

Where a_{mn} represents the weights for the m^{th} components and the n^{th} variable. The first component explains the most substantial amount of variable contingent on the constraint that the sum of the squared weight ($a_{m1}^2 + a_{m2}^2 + a_{m3}^2 + \ldots + a_{mn}^2$) is equal to one.

Once the factors identified, the resilience index shows as follows:

$$R_i = w_{F_1}F_{1_i} + w_{F_2}F_{2_i} + w_{F_3}F_{3_i} + \cdots \quad (3)$$

Where R is resilience; i is household; w is the weight; F represents factors.

With the components estimated in the first stage having a normal distribution (mean 0, variance 1), PCA created scores and weights for resilience (R). The variance of each factor score represents the weighting, and the sum of weighted factors produces the resilience index of each household in the Peanut Belt.

Finally, the PCA is estimated for the pooled data and households re-classify into resilient and less resilient groups based on the mean value of the resilience score. Households with a factor score ≥ 0 categorise as resilient to food insecurity and less resilient, otherwise.

Furthermore, regression analysis helped find factors affecting resilience to food security.

$$R_i = f(A_i, SNN_i, APT_i, AC_i, HHeduc_i, HHage_i, HHsex_i) \quad (4)$$

Households' alternatives hold variables assets (A), social safety nets (SNN), agriculture practices and technologies (APT), income-generating activities, adaptive capacity (AC), household head age, household head gender, household head education.

Details of the explanatory variables appear below:

Assets (A): assets represent a valuable coping resource during hazards. The study uses radio and telephone.

Social safety nets (SSN): they play a crucial role in mitigating crises. Many rural households around the globe rely on assistance and government projects. I analyse the variable SNN using indicators such as assistance received, the value of assistance, and assistance targets.

Agricultural practices and technologies (APT): this dimension captures the variety of techniques in farming activities. The indicators include the use of fertiliser (organic and non-organic), pesticide, veterinary, the value of inputs.

Adaptive capacity (AC): this variable demonstrates the ability to accustom to shocks and recover. The leading indicators are other sources of income, the number of persons employed in the household.

Household head gender (sexofHH), age of household head (HHage), and household head education (HHeduc) are also explanatory variables.

5. Results of Resilience Measurement

The measurement relies on household food expenditure, farming in other farms, the value of income, food shocks experience, the total TLU of the household. Table 3 provides information on the sample households.

Table 10 shows that households experience shocks at least once in a year. The highest average income is $1440. Houses in Keur Bamba have higher food spending, TLU average 4.7 and also exploit more lands compared to other villages.

PCA allows selecting the factors with an eigenvalue greater or equal to 1. The two first factors

Table 10 Variables of Household Resilience to Food Insecurity (Mean)

Villages	Food expenditure in a year ($)	Farming in other lands 1 yes, 0 otherwise	Value of income in a year ($)	Experience of shocks 1 yes, 0 otherwise	Total TLU per household
Djiguimar	1746	0.3	967	1	2.5
Djiguimar II	2124	0.2	1018	0.8	2.5
Keur Ardo	1242	0.4	790.5	0.8	3.2
Keur Bamba	3420	0.7	557	0.8	4.7
Koupakh	1206	0.2	572.5	0.4	3.4
Payoma	2088	0.3	1107	1	3.0
Payoma II	1548	0.6	1440	0.6	1.8

Source: Author's calculation

explain 80% of the total variation in the dataset.

Table 12 implies the variable with the most influential association to the underlying latent variable. Factor 1, is TLU, with a factor loading of 0.75. Since factor loadings can relate to standardised regression coefficients, the analysis shows that the variable TLU has a correlation of 0.75 with Factor 1. Two other variables, food expenditure, and farming other lands also associate with Factor 1.

Uniqueness implies the variance that is unique to the variable and not shared with the other variables. It is equal to 1. The Table shows 40.94% of the shared variance in "Food expenditure" is not shared with other variables in the overall model.

To estimate resilience, I retained the two first factors. Since two scored factors are orthogonal to each other, I can weight their sum.

Table 11 Eigenvalue of the Correlation Matrix

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	1.45331	0.35843	0.2907	0.2907
Factor2	1.09488	0.12379	0.2190	0.5096
Factor3	0.97109	0.18072	0.1942	0.7039
Factor4	0.79037	0.10001	0.1581	0.8619
Factor5	0.69035	.	0.1381	1.0000

Source: Author's calculation

Table 12 Principal Components Factor Loadings and Unique Variances of the Resilience Variables

Variable	Factor1	Factor2	Uniqueness
Food expenditure	0.6103	0.4670	0.4094
Farming other lands	0.6861	−0.1468	0.5078
Value of income	−0.0397	−0.5956	0.6437
Experience of shocks	−0.1580	0.7132	0.4664
Total TLU per household	0.7572	−0.0469	0.4245

Source: Author's calculation

Table 13 Factors and Variance

Factor	Variance	Difference	Proportion	Cumulative
Factor1	1.44303	0.33788	0.2886	0.2886
Factor2	1.10516	.	0.2210	0.5096

Source: Author's calculation

5.1. Resilience Index

The resilience index stems as follows:

$$\text{Resilience} = 0.2886 * \text{Factor1} + 0.2210 * \text{Factor2}$$

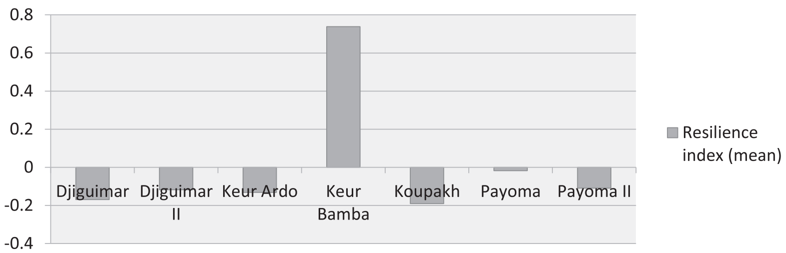
Table 14 shows that the village Keur Bamba is the most resilient (mean resilience 0.7) village in the Peanut Belt.

Table 14 Resilience Mean and Standard Deviation

Village	min	max	mean	sd
Djiguimar	−0.609	0.839	−0.169	0.421
Djiguimar II	−0.676	1.664	−0.118	0.560
Keur Ardo	−0.676	0.774	−0.132	0.489
Keur Bamba	−0.512	3.326	0.738	0.780
Koupakh	−0.674	2.344	−0.191	0.682
Payoma	−0.538	0.816	−0.018	0.396
Payoma II	−0.590	0.446	−0.110	0.320
Total	−0.676	3.326	0.000	0.613

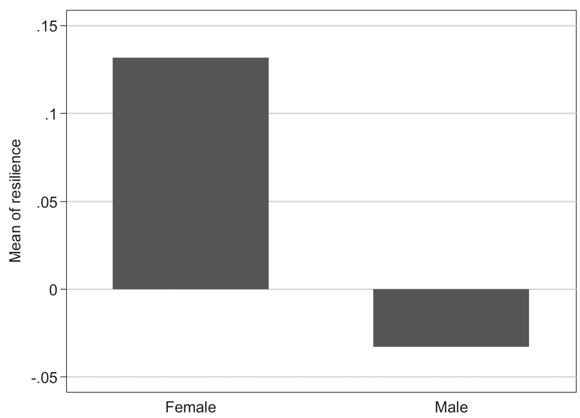
Source: Author's calculation

Figure 2 Resilience Index by Village



Source: Author's calculation

Figure 3 Resilience Index by Gender of Household Head



Source: Author's calculation

6. Determinants of Resilience

6.1. General Model: Multiple Regression Models

To determine how the observed variables influence resilience to food insecurity in farm households, I chose multiple regression model analysis. The main advantages of multiple regression are its much simpler design and adopted in food security studies (Arega Bazezew 2012; Alinovi, Mane, Romano 2010; Pheley, Graham, and Simpson 2002).

6.2. Model Design

For factors affecting resilience, I built a preliminary equation with the 15 observed variables described above.

$$R = \sum b_i * X_i + b_0 \qquad (5)$$

Where R is resilience, X_i the independent variables, b_i, are free parameters associated with each independent variable, and b_0 is the intercept.

6.3. Results Discussion, Model Fitness, Statistical Significance, and Model Coefficients

My goal was to determine which input variables are statistically significant and how their changes affect the dependent variable resilience. Therefore, the value of R^2 is not of grand importance.

The F statistic is equal to 2.42 with a distribution of F (15, 124), and the likeliness of observing a value greater than or equal to 2.42 is less than 0.004. There is evidence, however not keen that coefficients for the independent variables are not equal to zero.

Considering the P-value of the overall F-test is less than our significance level (0.005), I can conclude that changes in the predictor associate with changes in the response values.

In conclusion X_5, X_6, X_{11}, X_{12}, and X_{13} are statistically significant at $P < 0.005$.

7. Results and Discussion

Table 15 displays social safety nets (SNN), adaptive capacity (AC), agricultural practices and technologies (APT), and age of household head have significant influence. They explain 23 percent of the variation that occurs in resilience.

Targeted assistance (X5): assisting farm households has become part of the broader social protection plan. Social safety nets in the area consist mainly of food distribution in kind.

Organic fertiliser (X6): the variable organic fertiliser shows a significant relation with resilience (p-value = 0.02). Organic fertiliser designates any fertiliser that originates from a natural source such as manure, compost, animal extracts.

Other sources of income (X11): one of the significant results is that income diversification

Table 15　Regression Analysis Results

Regression Statistics	
Multiple R	0.48
R Square	0.23
Adjusted R Square	0.13
Standard Error	0.59
Observations	140

ANOVA

	df	*ss*	*MS*	*F*	*Significance F*
Regression	15	12.60	0.84	2.42	0.004
Residual	124	42.96	0.35		
Total	139	55.6			

	Coefficients	*Standard Error*	*t Stot*	*P-valve*
Intercept	0.50	0.35	1.44	0.15
Radio (X1)	−0.22	0.12	−0.13	0.90
Phone (X2)	−0.08	0.22	−0.35	0.72
Received assistance (X3)	0.21	0.21	1.00	0.32
Value of assistance (X4)	−0.17	0.44	−0.38	0.70
Assistance targets (X5)	−0.56	0.18	−3.10	0.00
Organic fertilizer (X6)	0.37	0.16	2.30	0.02
Inorganic fertilizer (X7)	−0.16	0.13	−1.19	0.24
Veterinary (X8)	0.09	0.11	0.83	0.41
Pesticides (X9)	−0.33	0.26	−1.29	0.20
Value of input (X10)	−0.52	0.37	−1.40	0.16
Other sources of income (X11)	0.32	0.11	2.88	0.00
Nb. of persons employed (X12)	−0.73	0.38	−1.90	0.06
Age of household head (X13)	−0.75	0.37	−2.05	0.04
Educ. of household head (X14)	−0.23	0.24	−0.97	0.33
Gender of household head (X15)	0.10	0.14	0.68	0.50

Source: Author's calculation

positively and significantly affects household resilience (p-value = 0.00). As the results suggest, for every new source of income, a household has 32% chance to be more resilient.

Number of people with a job (12): household employment ratio is also an essential variable for predictions and has a substantial effect on resilience (p-value = 0.06).

Age of household head (X13): it is a significant factor in determining household resilience (p-value = 0.04). The age of household head varied significantly among villages.

8. Conclusion and Recommendation

The study reveals that targeted assistance as part of social safety nets significantly affects households' resilience. Targeted relief operates from different actors, partners, local council, NGOs, municipalities, local businesses, cooperatives, and local associations. It plays a prominent role as a mechanism to extend assistance to those in greatest need. It helps control the quantity of food or materials distributed, and also it reduces the risk of depressing producer price or displacing traditional local networks. Targeting proves to maximise the impact of aids and assistance.

The study also shows that agricultural practices and technologies especially organic fertilising are positively significant to resilience to food insecurity.

Income diversification has a compelling relationship with resilience. Farm households diversify their income differently. More educated families have a chance to secure better jobs as a school teacher, mailman, council member, partnership facilitator, etc.

The number of employed individuals in the household is also significant to resilience. The negative coefficient informs the difficulty for households to diversify their sources of income. Improving avocation conditions and accessibility would probably empower tenants and balance the production loss.

The age household head reveals relevant to resilience. Many household heads are old which explains the negative coefficient.

Finally, the study allows conceding that resilience is measurable despite the plethoric and dichotomous number of measurement methods and metrics. It elaborates food security metrics are evidence-based. Additionally, with the resilience index, it is possible to investigate factors that affect household food security using a regression analysis.

Initiatives to build or improve resilience imply require satisfactory off-farm jobs, diverse the income sources, more decision power to young people, access to organic fertiliser, and an inclusive and swift targeted assistance plan.

Resilience building supersedes a set of integrated approaches. Counterparts come together for better metrics and strategies. Thus, the urgency to create productive assets and bolster livelihoods.

In perspective, the author intends to develop a theoretical model of household optimisation to predict the behaviour of farmers towards food security.

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