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ASSESSING VULNERABILITY TO POVERTY FOR HOUSEHOLDS IN WEST AFRICA: EVIDENCE FROM RURAL GAMBIA

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Abstract

This study assesses household vulnerability to poverty in rural Gambia using the Vulnerability as Expected Poverty (VEP) approach, based on cross-sectional data. Income and consumption were used interchangeably to estimate the probability that a household currently above the poverty line may fall below it in the future. A three-step Feasible Generalized Least Squares (FGLS) method was applied: first, estimating the ex-ante mean using OLS; second, modeling variance from squared residuals; and third, correcting for heteroskedasticity to predict vulnerability. Findings show that household size has a positive and significant effect on expected log income, while its squared term is negative and significant, indicating diminishing returns. Age of the household head has a slightly positive but statistically insignificant effect on income, with the squared term weakening this impact. Employment status is positively associated with income, where a one-unit increase leads to a 2.9% rise in expected log income and reduced vulnerability. Educational attainment also shows a positive, though insignificant, effect. Non-land production assets significantly reduce vulnerability, with a one-unit increase lowering it by 18.8%. The share of irrigated land contributes to a 4.4% reduction in vulnerability. To reduce vulnerability in rural Gambia, government efforts should focus on expanding access to irrigation and productive assets, especially for smallholder farmers. Employment programs targeting rural youth and women can enhance income stability. Strengthening vocational education and improving access to agricultural extension services will also help households build resilience and reduce future poverty risks.

Keywords: Vulnerability, Poverty line, Income, Consumption, Econometrics analysis, Rural Gambia

Abstrak

Studi ini menilai kerentanan rumah tangga terhadap kemiskinan di pedesaan Gambia menggunakan pendekatan Kerentanan sebagai Kemiskinan yang Diharapkan (VEP), berdasarkan data lintas sektoral. Pendapatan dan konsumsi digunakan secara bergantian untuk memperkirakan probabilitas bahwa rumah tangga yang saat ini berada di atas garis kemiskinan dapat jatuh di bawahnya di masa depan. Metode Kuadrat Terkecil Umum yang Layak (FGLS) tiga langkah diterapkan: pertama, memperkirakan rata-rata ex-ante menggunakan OLS; kedua, memodelkan varians dari residual kuadrat; dan ketiga, mengoreksi heteroskedastisitas untuk memprediksi kerentanan. Temuan menunjukkan bahwa ukuran rumah tangga memiliki efek positif dan signifikan pada log pendapatan yang diharapkan, sementara suku kuadratnya negatif dan signifikan, menunjukkan pengembalian yang semakin berkurang. Usia kepala rumah tangga memiliki efek yang sedikit positif tetapi secara statistik tidak signifikan pada pendapatan, dengan suku kuadrat melemahkan dampak ini. Status pekerjaan berhubungan positif dengan pendapatan, di mana peningkatan satu unit menyebabkan peningkatan 2,9% pada log pendapatan yang diharapkan dan mengurangi kerentanan. Pencapaian pendidikan juga menunjukkan efek positif, meskipun tidak signifikan. Aset produksi non-lahan secara signifikan mengurangi kerentanan, dengan peningkatan satu unit menurunkan kerentanan sebesar 18,8%. Proporsi lahan irigasi berkontribusi pada pengurangan kerentanan sebesar 4,4%. Untuk mengurangi kerentanan di pedesaan Gambia, upaya pemerintah harus difokuskan pada perluasan akses terhadap irigasi dan aset produktif, terutama bagi petani kecil. Program-program ketenagakerjaan yang menargetkan pemuda dan perempuan di pedesaan dapat meningkatkan stabilitas pendapatan. Penguatan pendidikan kejuruan dan peningkatan akses terhadap layanan penyuluhan pertanian juga akan membantu rumah tangga membangun ketahanan dan mengurangi risiko kemiskinan di masa depan.

Kata kunci : Kerentanan, Garis kemiskinan, Pendapatan, Konsumsi, Analisis ekonometrika, Gambia pedesaan

Introduction

Vulnerability to poverty remains a multidimensional challenge across West Africa, particularly in The Gambia, where rural households face intersecting risks that undermine their socioeconomic resilience. This study investigates five key dimensions of vulnerability, social, economic, political, technological, and climate-related, each contributing to the persistence of poverty and exclusion.

Social vulnerability refers to the susceptibility of individuals or communities to harm due to entrenched inequalities, limited access to resources, and marginalization. In The Gambia, factors such as youth unemployment, gender disparities, low literacy rates, and restricted mobility, especially among rural women, exacerbate social vulnerability. These groups are disproportionately affected during climate-related shocks, such as droughts, due to their limited adaptive capacity.

Economic vulnerability reflects exposure to adverse economic shocks, including inflation, unemployment, and market volatility. The Gambian economy's dependence on agriculture and tourism renders it highly sensitive to external disruptions. Informal labor and seasonal farming dominate rural livelihoods, offering limited financial security. The COVID-19 pandemic further intensified economic fragility by disrupting remittance flows and tourism revenues.

Political vulnerability arises from weak governance, limited civic participation, and institutional exclusion. Despite democratic reforms since 2017, marginalized groups, including youth and ethnic minorities, continue to face barriers to meaningful engagement in policy processes. The absence of inclusive reconciliation mechanisms has eroded trust in institutions.

Technological vulnerability is driven by limited access to digital infrastructure and low digital literacy. In rural areas, poor connectivity and lack of devices hinder access to education, financial services, and employment opportunities, deepening existing inequalities.

Climate change vulnerability compounds[1] these risks through droughts, floods, and shifting rainfall patterns that threaten agricultural productivity and water security. Countries such as Niger, Mali, and Mauritania exhibit high climate vulnerability due to low adaptive capacity and high exposure to environmental stressors. In The Gambia, climate shocks, like salt intrusion, temperature rise, and erratic rainfall, pose significant threats to rural households, particularly subsistence farmers.

This study adopts the Vulnerability as Expected Poverty (VEP) framework, applying a three-step Feasible Generalized Least Squares (FGLS) estimation to cross-sectional household data. The model estimates the ex-ante mean, ex-ante variance[2], and heteroskedasticity associated with vulnerability to poverty, using income and consumption interchangeably. Climate change variables are included as controls to assess their impact on expected vulnerability levels. The analysis seeks to determine whether exposure to climate extremes or slow-onset changes results in high, medium, or low vulnerability among rural households.

[1] Climate change vulnerability mean- Climate change vulnerability refers to the degree to which a system, be it ecological, social, or economic, is susceptible to and unable to cope with adverse effects of climate change, including variability and extremes

[2] Ex-ante means - Represents the expected level of consumption or income for a household at time t+1, based on current observable characteristics, While ex-ante variances- Captures the uncertainty or volatility around the expected income or consumption.

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To our knowledge, this is the first empirical study to apply the VEP approach in the Gambian context using econometric modeling. The findings offer quantitative tools for practitioners and policymakers aiming to assess household-level risk and design targeted interventions. The paper is structured as follows: Section 2 reviews the literature linking risk, risk management, and vulnerability; Section 3 outlines the methodology; Section 4 presents econometric results and discussion; and Section 5 concludes with policy recommendations.

Research question is: How to measure household's vulnerability to poverty in the rural Gambia

Theoretical model

There are numerous model on how to theorize the vulnerability for climate change ((Change, 2001, Pandey et al., 2014, Intergovernmental Panel on Climate Change, 2014 and Pacifici et al., 2015) and migration as an adaptation strategies(Aitken et al., 2008, Black et al., 2011 and Vinke et al., 2020) and coping mechanism for climate change / environmental respectively. Refugees or climate migrants' are discussed in the following authors' (Reidsma, 2008, Hoddinott and Quisumbing, 2003)**.**

Measuring vulnerability and adaptation to climate change

There are numerous methods in measuring vulnerability to climate change (Gunther &Harttgen, 2006,W. Naude´ et al., 2009, Malone & Engle, 2011 , Nelson et al., 2010 , Adger, 2006 ,Deressa et al., 2008 ,Chang & Huang, 2015, Hoddinott & Quisumbing ,2003, Pandey et al., 2014 ,Ligon & Schechter,2003, Dercon 2005, Gu¨nther & Harttgen 2006 and Zhang et al., 2019 ,) and adaptation to climate change (Dinar et al., 1998, Andersson-Sköld et al., 2015, Morecroft et al., 2019, and Zhang et al., 2019). These methods are in different fields such as social science, geographic, humanity, social-economic situation and so on. In this present study, we want to use vulnerability measures as part of statistical model and econometrics method to study vulnerability of the households as it roots started way back in different literature that study households food security, households hunger status, poverty condition of the households, inequality condition, and households social, economic, occupation, employment, education, migration and development perspective(Ligon& Schechter, 2003, Morduch & Kamanou, 2005, Adger, 2006, Deressa et al., 2008 and Dutta et al., 2011).Likewise we want to use some methods to study adaptation strategies of the households or individual at the time of migration (Gioli et al., 2014), which is climate shocks is the key driver.

Econometric and statistical method for measuring vulnerability and adaptation to climate change

By definition econometric method uses households level survey data such as social economic survey, integrated household survey, in order to analysis and interpret the different levels of households vulnerability conditions, that comprises economic, [3]psychology, social, culture, tradition as well as the demographic status of the individual or household. In this method of vulnerability study, it is classified into 3 kinds and they are; Vulnerability as low expected utility, Vulnerability as uninsured exposure to risk and finally, Vulnerability as expected poverty. In additional to this, the theoretical model combined econometrics methods for measuring vulnerability(Deressa et al., 2008), statistical approaches for vulnerability to climate change(Schlenker&

[3]Psychological vulnerability refers to a state in which individuals are more susceptible to emotional distress, mental health challenges, and maladaptive responses to stressors.

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Lobell, 2010, Lobell & Burke, 2010, and Lobell et al., 2011 with Ricardian model for adaptation strategies (Seo et al., 2005:Gemenne & Blocher, 2017)) to adjust climate change to solve the problems of climate change vulnerability.

Vulnerability as low expected utility

In this context vulnerability was way back in 1987. According to Kanbur 1987[a], Adger, 2006, and Günther & Maier, 2014, vulnerability is defined as a households as the different between expected utility level of consumption and the utility derived from some level of equal consumption at household level and above household utility level of consumption, which household would not be considered vulnerable because of their high consumption.

As they studied panel data model of vulnerability, they applied the method in the data set used in Bulgaria, Vietnam respectively and confirmed that risk and poverty play a crucial roles in the households welfare losses attributed to shock(. Ligonand Schechter 2003, and Magrini et al., 2018).

According to Kanbur, 1987[b], the shortcoming of this method of vulnerability study is that, it does not account for individual in the household risk preferences levels and therefore those individual are not well informed about their level of preferences especially events that are uncertainity.

Vulnerability as uninsured exposure to risk

According to Hoddinott and Quisumbing 2003 and Cardona et al., 2012, the vulnerability as uninsured exposure to risk as one of the econometric method to measure vulnerability of the households is defined as an ex post for the assessment of the extent in which negative shocks causes welfare loss.Thus, in this method the impact of shocks is assessed by using panel data econometric technique to quantified the change induced consumption. In their part Skoufias 2003, Geffersa et al., 2019, and Pham et al., 2021, employed panel data approach in there study to comprehend the impact of shocks have at the time of vulnerability in Russia and found out that shocks impose a households welfare loss that reduces consumption at the time of absence of risk management tools. Population to be total poor is there but the shocks or effects the households faces at the time of disasters can make that households or individual to be vulnerable to poverty. The vulnerability may be current and expect to be in the future unless policy actions are intervene.

Households poverty does determine the vulnerability of the households but what determine it most is the shocks households are facing at the time of crises such as income crises, climate change crises, environmental disasters, households food insecurity, house fire, conflict among family members and so on. If households is more poor, may be likely to be severe poor in the future and that households will be vulnerable to poverty. The more poor households, the more vulnerable they become. Therefore there is level to calculate the vulnerability status of the households at certain thresholds-minimum level, medium level and maximum thresholds.

Further, as the name implied uninsured(not insured ether any of the assets including peoples) associated with insurance and therefore the insurance and the amount of looses incurred during the household vulnerability disaster such as the loss of social economic situation of the households properties are equal.

As in contrast to the other econometric method of vulnerability, the disadvantages is that, vulnerability uninsured exposure to risk in case of absence of panel data sets, cross-sectional data set, to estimates the impacts or effects of vulnerability, the results are inconclusive, inconsistences, unbiased and insignificant.

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Vulnerability as expected poverty

The vulnerability as expected poverty defined vulnerability as a dynamic of poverty-a person can be prospect to be poor in the future if not poor at the moments and is expected to be poor, if poor at the moments. This method contains two things; either chronic poverty or transient poverty. Can be poor now and continue to be poor in the future, is not poor now but may be poor in the future.

Therefore, this vulnerability is view as consumption or income is used as a good proxy for welfare and vulnerability is used as expected poverty.This method coupon with statistical method and with ricardian approach of adaptation will be used in this study.

Thus, this method is based on the probability of the households that are vulnerable at the time of climate change shocks as 1 and 0 otherwise. We will estimating the probability based on consumption or income shocks of the households at certain thresholds levels, below the given minimum requirement if it is already below that level (Deressa et al., 2008).

Using cross-sectional[4] survey data set of 1998, Chaudhuriet al., 2002[5],found out that 45 percent of the population expected to be vulnerable to poverty in the near future whereas the population actual poor stand at 22 percent in Indonesia.Another study also applied cross-sectional data set in Guatemala and confirmed that ¾ of the population has vulnerability index at 0.67 or 67%.

One of the drawback of this method compared to the others is that, estimation are using a single cross-sectional, and numerous cross sectional assumption or simple cross sectional assumption is missing(Hoddinott and Quisumbing 2003 and Deressa et al., 2008)

Table xxx: Summary of approaches to vulnerability to poverty: Three main methods of measuring vulnerability to poverty.

Method	Authors'	Advantages	Disadvantage	Model	Why or why not I choice this method
Vulnerability as low expected utility		-It uses to measure the household utility level of consumption -It also measure household risk and poverty as proxy for welfare losses	-Households are not inform about the risk preferences levels -As in case of shocks or hazard as they are uncertain individuals are not well inform about the risk preferences level.	It uses panel data	I did not used this method because individual and household were not well inform the risk preference level and therefore consumption or income or poverty dynamic cannot be a good proxy to measure welfare losses associated with shocks or hazard at the time of climate crises.
Vulnerability as uninsured exposure to risk		-It is a good measure of households shocks at the time of crises-food crises, income crises, environment disasters, education crises, employment, conflict in the household, household fire and so on, -It is an ex post measurement of vulnerability in which to assess the extend in which negative shocks causes welfare losses such as household faces food insecurity, poor education, lower income, poverty, hunger, high migration, dimate crises like floods, drought, salt intrusion, land degradation and so on.	The disadvantages are: If only cross section data is used than the panel data the results are biased, inconclusive, insignificant and inconsistent. This is due to the fact that the estimate values lack specific fixed effect and in that we will not be able to understand how the error terms behavior is –whether correlated with the explanatory variables or not.	Cross section data	I did not choice this method because of the results will be inconclusive and the measurement of welfare losses such as income or consumption to represent the household poverty level will not be the same assumption as if it is panel data.In panel data I will understand whether to select fixed or random effect based on the hausman test and that assumption takes into account unobserved factors.
Vulnerability as expected poverty		**-The advantages of this method is that it uses probability to define vulnerability of the households at the time of climate crises .So consumption or income will be a good proxy for dynamic of poverty of the households.** **-It is also able to use cross-sectional data for the standard year. Let said one year period because users of single cross sectional data can use cross sectional variability as proxy for inter-temporal variability(data for more than one point in time or one year)** **-Another advantage the availability of data and it advantages of captures different living condition of the household in the study areas, country and so on** **-It is easier to measure living standard using single cross section survey because they provides information of household wellbeing, demographic characteristic, consumption, coping mechanism and livelihoods standard of the households.**	**-It is sometime problematic to measure vulnerability because of the absence of data for more than one point in time or year-temporal variability** **-To capture the aggregate shocks they are less suited until the sample size becomes larger.**	**Cross sectional data/panel data**	**I choice this method because due to the small sample size of the surveyed data collected in the single point in time. It is the best method for small sample size since we can interchanged the log consumption with log income because time series variation can be interchange with cross sectional variation with similar household characteristics. Henceforth, cross sectional variation can be a proxy for intertemporal variation due to cross sectional mean can explain intermporal mean and cross sectional variance can explain intertemporalvariance too.**

Material and Method

Vulnerability as expected poverty Framework

The vulnerability to poverty is one of the method to measure households vulnerability status. Hence, the study is households survey, the paper adopted expected

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vulnerability poverty approach. This is because in this method, we want to understand the probability of households that are poor or non-poor during climate shocks such as flooding, drought, variability in precipitation pattern, frequency of temperature, and migration dynamics indicators such as perception, and food security indicators such as consumption levels, households size etc. and that leads to those household to have below a given level of a households consumption poverty line or the shocks especially the climate shocks force the consumption to stay below the minimum levels, if it is already below this level and this is the baseline((Chaudhuri et al 2002).

VEP is an ex ante vulnerability measure, proposed by Chaudhuri, Jalan and Suryahadi (2002,TemesgenDeressa, Rashid M. Hassan and Claudia Ringler (2008))[6] who apply it to the Indonesian household data.

Consider first an example of VEP. This is the case of vulnerability defined as the probability that a household will fall into poverty in the future.

$$\boldsymbol{eq1} \ \ldots\ldots\ldots \boldsymbol{VEP_{it} = Prob(c_{i,t+1} \leq A)}$$

Where vulnerability of households(or individual i) at time t, $\boldsymbol{V_{it}}$ is the probability that individual i-th household's level of consumption or income at time $\boldsymbol{t+1}$, $\boldsymbol{c_{i,t+1}}$ will be below the poverty line, A (Gaiha and Imai 2004)[7]

In a variant that allows for the degree of vulnerability to rise with the length of the time horizon, vulnerability of the households h for n-periods, denoted as R(.) for risk, is the probability of observing, at least one spell of poverty for n-periods, which is as shown below is one minus the probability of no episodes of poverty:

$$eq2 \ldots\ldots\ldots R_i(n,A) = 1 - [\left(1 - \left(Prob\left(c_{i,t+1}\right) < A\right)\right), \ldots., \ldots, \left(1 - \left(Prob\left(c_{i,t+n}\right) < A\right)\right)]$$

Following this definition and using I(.) as an indicator equally 1 if the condition is true and zero or 0 otherwise if the condition is not true, an alternative measure of vulnerability is that a household is vulnerable if the risk in n-periods is greater than a threshold probability, P (Pritchett, Suryahadi and Sumarto ,2000).

$$\boldsymbol{eq3} \ldots\ldots\ldots \boldsymbol{V_i(p,n,A) = I\{R_{it}(n,A) > p\}}$$

Neither 1 nor 3 take into account other dimension of poverty. The limitation can be overcome by rewriting equation 1 as below;

$$\boldsymbol{eq1(a)} \ldots\ldots\ldots\ldots\ldots\ldots \boldsymbol{V_{it} = \sum_s {}^sP_s} * Prob(\boldsymbol{c_{i,t+1}, A}) = \boldsymbol{\sum_s {}^sP_s * I\left[c_{i,t+1} \leq A\right] * \left[\frac{(A - c_{i,t+1})}{z}\right]^{\beta}}$$

Where $\boldsymbol{\sum_s {}^sP_s}$ is the sum of the probability of all possible state of nature/world's, s in period $\boldsymbol{t+1}$ and $\boldsymbol{\beta}$ is the welfare weight attached to the gap between the benchmark and the welfare measure(see Foster-Greer-Thorbecke poverty measure 1984).In principle, this welfare this welfare weight could take values 0, 1, 2(). Aggregating into N households (Kamanou and Morduch 2002) as given below;

$$eq4 \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1/N) \sum_i^N \sum_s {}^sP_s * I\left[c_{i,t+1} \leq A\right] * \left[\frac{(A - c_{h,t+1})}{z}\right]^{\beta}$$

A vulnerability measure such as (4) has considerable relevance. In Indonesia, for example, the headcount index of poverty was low before the financial crisis but rose sharply in its wake. This implies that a large proportion of those above the poverty line were vulnerable to shocks. There are two risks in such a context. If the headcount index is low, governments/donors might become complacent. If negative shocks are frequent and severe, such complacency would be misplaced. Besides, if the characteristics of those above the poverty line but vulnerable to shocks differ from those of the poor, targeting the latter may miss a significant proportion of those who's living

We begin the analysis from a method by (Chaudhuri et al 2002), Assessing Household Vulnerability to Poverty from Cross-sectional Data in which they assumed that

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consumption/Income of a household h is a stochastic process with mean, $\boldsymbol{\mu}$ and standard deviation of the household, $\boldsymbol{\sigma}$. And normally distributed and is given by;

$$\mathbf{logC_h} = \boldsymbol{\gamma}\mathbf{X_h} + \boldsymbol{\varepsilon_h} \ldots\ldots\ldots (5)$$

Where; log is the natural logarithm, $\mathbf{C_h}$ is per capital consumption expenditure of the household/per capital income of the household, $\mathbf{X_h}$ comprises a bundle of observable household characteristics such as the household size, location, educational level of household heads, climate crises such as flooding, drought, windstorm, bushfire, variability in temperature and precipitation pattern etc, migration variables, perception etc, , $\boldsymbol{\gamma}$ is a vector of parameters and $\boldsymbol{\varepsilon_h}$ is a mean zero disturbance term and OLS used to estimate the error term.

We now assume that the variance of $\boldsymbol{\varepsilon_h}$ is given by;

$$\boldsymbol{\sigma}_{\varepsilon,h}{}^2 = \mathbf{X_h}\boldsymbol{\vartheta} \ldots\ldots\ldots (6)$$

We will estimate the parameters $\boldsymbol{\gamma}$ and $\boldsymbol{\vartheta}$ using a three-step feasible generalised least squares (FGLS) procedure suggested by Amemiya (1977). Using the estimates $\boldsymbol{\gamma}$and , the expected logarithm of consumption and variance of log consumption for each households h are, estimated as follows;

$$\hat{\mathbf{E}}[\mathbf{logC_h}/\mathbf{X_h}] = \mathbf{X_h}\hat{\boldsymbol{\gamma}} \ldots\ldots\ldots (7)$$

$$\hat{\mathbf{V}}[\mathbf{logC_h}/\mathbf{X_h}] = \hat{\boldsymbol{\sigma}}_{\varepsilon,h}{}^2 = \mathbf{X_h}\hat{\boldsymbol{\vartheta}} \ldots\ldots\ldots (8)$$

By assuming that log consumption is normally distributed (i.e. that $\mathbf{logC_h}$ is normally distributed), the above enables the estimation of the probability that a household with the characteristics $\mathbf{X_h}$ will be the household's vulnerability level i.e. poor. Letting $\aleph(.)$ denote the cumulative density of the standard normal, the estimated probability is given by:

$$\hat{\mathbf{V}}_\mathbf{h} = \hat{\mathbf{P}}\ (\mathbf{logC_h} < \mathbf{logZ}\ /\mathbf{X_h}) = \aleph\left(\frac{\mathbf{logZ} - \mathbf{X_h}\hat{\boldsymbol{\gamma}}}{\sqrt{\mathbf{X_h}\hat{\boldsymbol{\vartheta}}}}\right)$$

……(9)

Where $\mathbf{logZ}$ is the log of the minimum consumption/income level beyond which a household would be called vulnerable or poor.

This is an ex-ante vulnerability measure that can be estimated by cross-sectional data. Equation (9) will deliver the likelihood of a household at time t flattering poor at t + 1 given the dissemination of consumption at time t. A value of this vulnerability measure is that it can be estimated by cross-sectional data set. Nonetheless, the amount properly reproduces a household's vulnerability only if the distribution of consumption across all households, given the household given characteristics at one time, which characterizes the time-series difference of consumption of the household. Henceforth, this measure necessitates a large sample in which some households experience a decent period and others hurt from bad shocks. Correspondingly, the degree is improbable to reproduce unforeseen large negative shocks (e.g., American financial crises, Asian financial crisis e.t.c), if we use the cross-sectional data for a standard year.

So we have included all households in the 3 rural areas of the Gambia due to the small sample size. Similarly, to mark our outcomes similar with some previous studies on vulnerability as expected poverty (e.g., Gaiha and Deolalikar 1993; Gaiha and Imai 2004)[8], we interchangeable the log consumption with log income per capita vice versa in the above specification since the time-series variation of log income per capita with particular household characteristics can be approximated by the cross-sectional variation of the households with similar characteristics. The vulnerability as expected poverty, which simply take on that consumption vulnerability arises from the stochastic property of the inter-temporal consumption stream (Chaudhuri, Jalan and Suryahadi 2002)[9]. Our specification of VEP can be written as follows, based on two of the

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earlier studies (Gaiha and Deolalikar 1993; Gaiha and Imai 2004, Gaihaand Imai 2014).

$$eq10 \ldots\ldots\ldots\ldots\ldots\ldots\ldots lnY_i = x'_i\delta_1 + L'_i\delta_2 + H'_i\delta_3 + \epsilon_i$$

$$eq11 \ldots\ldots\ldots\ldots\ldots\ldots \sigma^2_{\epsilon_i} = x'_i \quad \beta_1 + L'_i \quad \beta_2 + H'_i \quad \beta_3$$

where i indexes the household. Yi is per capita annual household income from all sources (in constant prices) in a particular crop year. Xi is a vector of household characteristics (e.g., age of household head and its square, household size and its square, caste and household size, gender, and location/regions). Li is a vector of owned land area and its square, the share of irrigated land in the total, and non-land assets and its square, climate crises such as flooding, drought, windstorm, bushfire, variability in temperature and precipitation pattern. Hi is a vector of human capital formation, such as schooling years of household head or educational level of household heads and it squared, employment level and it squared. The $\sigma^2_{\epsilon,i}$ is the variance of the disturbance term which is pretentious by numerous household features. This can be assessed by a three-step FGLS(see for details Chaudhuri, Jalan and Suryahadi (2002), and Hoddinott and Quisumbing (2003b)[10].

Table xxx: Explanatory variables that are used in the study while the dependent variable is vulnerability as expected poverty-log of hh consumption or log of hh income or log of hh food cosunmption(interchangeable) hh-households.

Variables Name	Description of the Variable	Expected Sign(+/-)
Household income/consumption is the dept var.	log of hh consumption or log of hh income(interchangeable) Continuous	
Age of household head-xi	Age of the households	-/+
Age of household head squared-xi	Age squared of the household head	-
Household size-xi	Size of the household	-/+
Household size squared-xi	Size square of the household	-
Owned area of land-li	Area of land owned by the households	+
Owned area squared-li	Squared of the land area	-
Caste system(noble or slave)-xi	Caste system affect vulnerability	+/-
Share of irrigated land-li	Irrigated land-dummy	+/-
Non-land production assets-li	Non-land production assets of the households-dummy	+/-
Non-land production assets squared-li	The square of it	+/-
Education status of the responded -hi	Measure human capita	_
Education status of the responded squared -hi	Square of it	+
Educational attainment	level	
Educational attainment squared	Square of it	
Households' food security consumption level	Level of food security of the household	+/-
Gender	dummies	
Locations/regions	dummies	
Climate variabilities	dummies	

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Employment of the hh heads		
Employment of the hh heads squared		

Source author's own evaluation from household survey

Results and Discussion

Selected socio-economic and climate change in the study region

Household characteristic

In this study 13, 14, and 13 villages were randomly selected with replacement in North Bank Region (NBR), Central River Region (CRR) and Upper River Region (URR) respectively. 10 households were surveyed in each village. In total, 400 households were surveyed in this study.

Table xxx: Distribution of sampled villages and regions

No. of Villages	*No. of households*	*No. of sample*	*Regions*
13	*10*	*130*	*NBR*
14	*10*	*140*	*CRR*
13	*10*	*130*	*URR*

Own Evaluation

The size of the household in the study is generally high with an average of 21 persons per household. Furthermore, in the rural Gambia; 77% are able to read and write, 69% are farmers, 55% believe the existence of caste system, 92% are married, 74% are food secure and finally, average income is $160 respectively.

Table xxx: Basic household characteristics of the surveyed farmers

Variable	Average($)	Percentage
Household size	21	
Education		77
Gender		67
Age	47	
Employment		69
Caste System		55
income	160	
Marital status		92
Food secure		74

The surveyed households were generally poor in terms of total consumption per capital per month, food consumption per capital per month, income per capital per month and food security consumption level per day. The total household's income per capital per month stand at $169, food consumption per capital per month stand at $159, income per capital per month stand at $159.6, and food security consumption level stand at $1.969 respectively.

Tablexxx: Basic Assets of the respondents or Welfare Measures

Variable	Average($)
Total household consumption per capita per month	169
Total household food consumption per capita per month	159
Total household income per capita per	159.6

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month	
Food Security Consumption Level	1.969

Climatic conditions, and shocks

As described earlier in this study, the survey regionsare in the rural Gambia, which differ in many ways in term of changing in rainfall and temperature. As expected, average change in temperature in NBR and URR are higher than CRR. In CRR, both average change in temperature and rainfall are lower compared to the other regions.

Tablexxx : Climate condition in the study area

Regions	Average change in Temperature	Average change in rainfall
CRR	.8928571	.9357143
NBR	1	1
URR	.9692308	.9923077

Own evaluation using stata 16

In general, most of the surveyed farmers who reported to have experienced shocks over the past 10 to 20 years.According to surveyed farmers, 70.74 percent encounter floods as major shocks; 73% encounter drought; 40 percent encountersalinization; 79 percent experienced changing in rainfall; 95 percent experienced changing in temperature; 64 percent has access to water during drought.Animals that are decline is 1.4 on average during climate shocks with standard deviation of 0.898.

Table : Major shocks encountered by surveyed farmers

Shock	Number of farmers	Percentage of farmers	Descriptive	
Floods	278	70.74	Average	Std
Drought	288	73.28		
Salinization	149	40.05		
Shifting pattern of rainfall	315	79.35		
Shifting pattern of temperature	381	95.25		
Access to water at the time of drought	232	64.80		
Animals/livestock decline			1.40069	.8985611

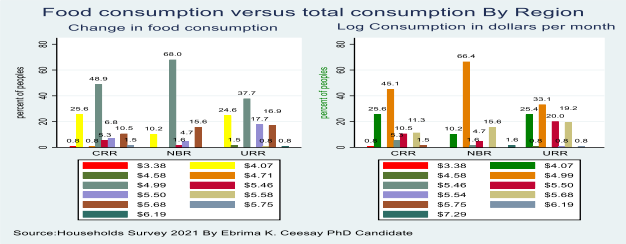

Figure xxx:

In the figure above, 68% experience change in food consumption at $4.99 and 66.4% experience log consumption at $4.99. More peoples that only 4.99 dollars used it to consume as food consumption and total consumption and that happened in NBR.In addition, 10.2 percent of the peoples consume $4.07 per month. The compared to poverty line of 1.90 per day, most of the peoples in all the three regions haveethe income to spend on food and total consumption per capital per months are lower than poverty line per capita per month. Meaning in these three regions in the rural Gambia, vulnerability to poverty is very higher based on certain households' characteristics and climate shocks. That causes lower livelihood and from poor agriculture. Note 1.90 dollars per day is equivalent to 57 dollars per months

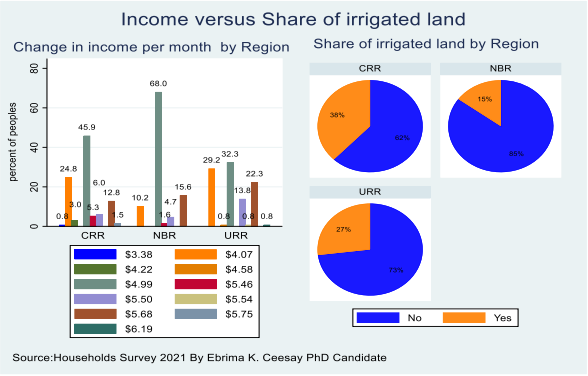

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Figure xxx:

In the figure above for food consumption and total consumption, change in income per month occurred more in the rural Gambia, 68 percent followed by CRR 46 percent approximately, and follow by URR a 32 percent respectively. For the share of irrigated land by region, the pie chart indicated CRR has 38 percent of the share of irrigated land, while NBR and URR has smallest share of irrigated land about 15 percent and 27 percent respectively. Thus, in the Gambiathe food backet is the irrigated land at CRR and that will reduce helps us to be more food self-sufficiency the study noted.

Pair wisecorrelation analysis: The pearson correlation matrix is used to determine the relationship between two variables (see Table below). The Pearson correlation coefficient is used to represent this relationship which ranges from -1.00 to +1.00. The results of the test of correlation show the relationship between the growth of log income in the rural Gambia and age of the household head GDP is slightly positive (a correlation coefficient of 0.0562). Thus, if age increase by 1 year, the log income increase by 0.06 percent closely.The result from the below table found that education status and log income, log consumption and log food consumption is negative and with correlation coefficient are -0.1049, -0.0583 and -0.0695 respectively. Size of the household has positive correlation with income and consumptions. Larger households, food consumption, income and total consumptions becomes higher compare to smaller households. Employment as positive or direct relationship with income in the rural Gambia while employment status and consumption are negative relationship. Increases in employment, food consumption and total consumption decreases.

Tablexxxx:Pairwise correlation analysis of explanatory variables included in the analysis

Variables	LnIncome	LnConsumption total	LnConsumption (Food)
Age of the households' head	0.0562	0.1054	0.1130
Size of the households	0.1729	0.1856	0.1984
Education status	-0.1049	-0.0583	-0.0695
Gender	0.0962	0.0812	0.1270
Employment	0.0658	-0.0119	-0.0178
Caste system	0.1232	0.0610	0.0266

Own computation

Multicollinearity test

In the VEP analysis, it is important to test multicollinearity among the independent variables to know which variables to be include in the model. Due to multicollinearity issues, education status squared of the households were removed. Conditions: If the tolerance value i.e. 1/VIF is below 0.20 and the Variance Inflation Factor (VIF) is greater than 5, multicollinearity is present. Though, it is suitable for the VIF to lie between 1–10. As shown in Table x, apart from education status squared, none of variables showed any multicollinearity signs. Subsequently, the expectations of non-collinearity were content, and the model was then estimated

Table xxx; Variance inflation factor (VIF) test for multicollinearity among variables included in the analysis

Variable	VIF	1/VIF
Sizeofthehouseholds	4.23	0.236557
Householdsizesquared	4.06	0.246017
Ownland	1.22	0.818357
Educationalattainment	2.30	0.435072
Educationstatusofthe responded	2.17	0.461151

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Employmentofhouseholdheadcategory	1.16	0.864579
Nonlandproductionassets	1.45	0.687906
Shareofirrigatedland	1.13	0.887841
Gender	1.17	0.855463
Castesystem	1.40	0.715774
Flood	1.28	0.782142
Changesinrainfall	2.52	0.396688
Drought	1.53	0.652666
Changesintemperature	2.32	0.431281
Salinizationandsaltwaterintrusion	1.41	0.708020

Results for VEP

We carried out econometric estimation on the VEP(vulnerability as expected poverty) measure based on the specification in the earlier sectionand obtained vulnerability measures. In this part of the thesis, we will first briefly discuss theestimation results for the VEP when we interchangeable different dependent variables such as log. Income, log.Consumption and log.Food consumption respectively.In that, the study employs a three step Feasible Generalized Least Squares (FGLS) estimation procedure. In the first step, we calculated ex ante mean by using OLS and we predict the residual and in the second step we generate residual squared as variance and we calculated the variance by OLS and in the final steps, we estimate the structure of heteroskedasticity from OLS to estimate vulnerability to poverty and to predict which households are more likely to be poor or non-poor looking at their current income, total consumption, or food consumption.

The three important things for vulnerability as expected poverty is looking at the poverty line, ex-ante mean or expected future consumption/income/food consumption, and finally, ex-ante variance to see the variation in future income or total consumption or food consumption based on households characteristics such as households size, age, education, gender, caste system, employment, climate shocks and so on.Climate shocks is an important determinants to find out the which households likely to the poor or none-poor looking at their current situations.

Model results and Discussion

As in our methodology, we applied Equations (10) and (11) uses a single cross-sectional household survey data set carry out in the year 2021 to looking at the income/total consumption/food consumption as a proxy for the welfare of each household and results based on FGLS in the line ofGaiha and Deolalikar (1993),Chaudhuri, Jalan and Suryahadi (2002), Gaiha and Imai (2004) and Gaiha and Imai, (2008).The results are given in Tables below and the final result for FGLS is given in the final table, where we corrected the mean regression for heteroskedasticity. This is the first of it kind as we uses three variables as our dependent variable and interchangeable them like log Income, log Total consumption and log Food consumption respectively as a measure of welfare.To measure our household welfare, the three variables are interchangeable and the results for the VEP study for each variable differ.

First log Income, the results for log income per capital per month are generally plausible as in Chaudhuri, Jalan and Suryahadi (2002) and Gaihaand Imai, (2008).The results revealed that size of the households in the rural Gambia has positive and significant impacts on the expected log income at 1 percent significance level but it squared has negative and significant. 1 unit increase in household size, the vulnerability to poverty is expected to be lower in the future.Study confirmed the result is Deressa(2013).As households size squared has negative sign and therefore 1 unit increase will lead to household to be highly vulnerable in the future.As households sized becomes squared, the negative relationship exist between change in income and household size. It means that as more mouth to feed the likelihood to be vulnerability to poverty is high keeping other explanatory variables constant. In

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contrast to Gaihaand Imai, (2008) in which they found household size negative and its squared positive. The coefficient for age is positive and insignificant effect on log income and it squared becomes negative and insignificant.1 additional year add to your age increases the log income by 0.02% and vulnerability to poverty decreases, reflecting the households with more elderly heads to have higher income but as the age squared becomes negative then the positive effect on log income weakens with age.The same results found in the following study Gaihaand Imai, (2008),

The coefficient for educational attainment and education of the household head all has positive and insignificant impacts on log income and lower vulnerability to poverty in the future. 1 unit increase in household educational level, the expected log income for households increases by 12.89% and 2.8% respectively. This mean that households with higher members have education, the vulnerability to poverty decreases.

The coefficients for employment status of the household heads categoryare positive, reflecting that 1 unit rise in employment status, the expected log income increases by 2.9% and vulnerability to poverty become lower in the future.

Nonland production assets has positive and significant impacts on expected log income. 1 unit increase in nonland production assets, the vulnerability to poverty become lower by 18.8%.The share of irrigated land has expected sign and the vulnerability to poverty decreases by 4.4%.

Table x. Results for VEP(vulnerability as expected poverty) measure- ex ante mean, when log.income is the dependent variable

LnIncome	Coef.	Std. Err.	t	P>|t|	[95% Interval]	Conf.
sizeofthehouseholds	.0105743	.0032005	3.30	0.001	.0042772	.0168714
Householdsizesquared	-.0000523	.0000217	-2.41	0.016	-.000095	-9.62e-06
Ageofthehouseholdshead	.0196958	.0133245	1.48	0.140	-.0065208	.0459125
Ageofhhheadsquared	-.0001896	.000136	-1.39	0.164	-.0004572	.0000779
Ownland	-.1252873	.097928	-1.28	0.202	-.3179653	.0673907
Educationalattainment	.1288901	.0797817	1.62	0.107	-.0280842	.2858645
Educationalattainmentsquared	-.012793	.0098721	-1.30	0.196	-.0322168	.0066307
educationstatusoftheresponde	.0281975	.10029	0.28	0.779	-.1691278	.2255228
Employmentofhouseholdsheadca	.0289317	.0657187	0.44	0.660	-.100373	.1582363
Nonlandproductionassets	.1878028	.0700278	2.68	0.008	.0500198	.3255859
Shareofirrigatedland	.0440948	.0671456	0.66	0.512	-.0880174	.1762071
1.Gender	.0358608	.0683907	0.52	0.600	-.0987011	.1704228
1.castesystem	.1219634	.0677496	1.80	0.073	-.0113372	.255264
Flood	-.1358694	.0699807	-1.94	0.053	-.2735598	.0018209
changesinrainfall	-.3409313	.2954591	-1.15	0.249	-.9222611	.2403985

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Drought	-.2687456	.079089	-3.40	0.001	-.4243569	-.1131343
changesintemperature	-.0907112	.2077437	-0.44	0.663	-.4994569	.3180344
Salinizationandsaltwaterintr	.111415	.06968	1.60	0.111	-.0256838	.2485138
_cons	4.614707	.3874377	11.91	0.000	3.852405	5.377009
No of obs.=333						
F(18,314)=4.01						
Prob>F=0.0000***						
R-squ.=18.69%						
Adj.R-squ=14.01%						

Notes: *** indicates the coefficient is significant at 1% level; ** = significant at 5% level; *= significant at

10% level of significance.

To input i.x for dummy variables reflecting one in the gender are those that are male. So the coefficient for male headed household is positive and insignificant impact on expected log income. 1 unit increase in male headed household, the expected future income increases by 3.6%, reflecting that male headed household to be less vulnerability to poverty.This is confirmed by Muleta and Deressa(2014)

Caste system in the rural Gambia were coded as dummy variables 1 if the individual is a noble and 0 if slave. The coefficient for those that are noble are more likely to have higher expected log income.1 unit increase in household that are noble, the expected log income rises by 12.2%. It means that in the rural Gambia, those that are noble to be less vulnerable to poverty than their counterparts.

Climate shocks is an important determinant for households that are likely to be vulnerability to poverty considering their income for now. The coefficient for flood is negative. The results confirmed that flood has negative and significant impact on log income at 5% level of significance. Climate shocks increases the vulnerability to poverty and therefore 1 unit increase in flood, the vulnerability to poverty increase by 13.6% considering the log income as the dependent variable. As flood happen, your income decline and vulnerability to poverty increase. Change in rainfall and change in temperature has negative relationship with household income, reflecting that those household affected by shift in these extreme climate events are more likely to be vulnerable to poverty. This is confirmed in the study done by Christiaensen and Subbarao (2004)On the other hand agriculture will decline with change in rainfall and temperature. 1 unit increase in shift in rainfall and temperature, the log income for the household decrease by 34% and 9% respectively and vulnerability to poverty rises.Only salt intrusion has expected sign reflecting that positive and insignificant relationship exist between salt intrusion and vulnerability to poverty. 1 unit increase salt intrusion, the log income increase by 11% keeping all other variables constant. Finally, if we make all explanatory variables constant, log income becomes autonomous and constant at 4.6%.

Table y. Results for VEP(vulnerability as expected poverty) measure- ex ante variance, when log.income is the dependent variable-step 1

Ex ante Variance	*Coef.*	*Std. Err.*	*t*	*P>|t|*	*[95% Conf. Interval]*	
sizeofthehouseholds	*.0057796*	*.0140544*	*0.41*	*0.681*	*-.0218731*	*.0334322*
Householdsizesquared	*.0000346*	*.0000953*	*0.36*	*0.717*	*-.0001528*	*.0002221*
Ageofthehousehol	*-.035*	*.058*	*-0.*	*0.54*	*-.150*	*.079*

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dshead	*6043*	*5125*	*6*	*3*	*7305*	*5219*
			1			
Ageofhhheadsquared	*.000*	*.000*	*0.*	*0.67*	*-*	*.001*
	2504	*5971*	*42*	*5*	*.000*	*4253*
					9245	
Ownland	*.489*	*.430*	*1.*	*0.25*	*-*	*1.33*
	0136	*0349*	*14*	*6*	*.357*	*5128*
					1005	
Educationalattainment	*-*	*.350*	*-*	*0.17*	*-*	*.211*
	.477	*3484*	*1.*	*4*	*1.16*	*8866*
	4406		*36*		*6768*	
Educationalattainmentsquared	*.070*	*.043*	*1.*	*0.10*	*-*	*.155*
	0133	*3516*	*62*	*7*	*.015*	*3097*
					2831	
educationstatusoftheresponde	*-*	*.440*	*-*	*0.49*	*-*	*.568*
	.298	*4071*	*0.*	*8*	*1.16*	*0462*
	4758		*68*		*4998*	
Employmentofhouseholdsheadca	*-*	*.288*	*-*	*0.01*	*-*	*-*
	.741	*5929*	*2.*	*1****	*1.30*	*.174*
	9107		*57*		*9731*	*0903*
Nonlandproductionassets	*-*	*.307*	*-*	*0.00*	*-*	*-*
	.957	*5157*	*3.*	*2****	*1.56*	*.352*
	4453		*11*		*2497*	*3935*
Shareofirrigatedland	*.211*	*.294*	*0.*	*0.47*	*-*	*.791*
	1431	*8592*	*72*	*4*	*.369*	*2926*
					0064	
1.Gender	*-*	*.300*	*-*	*0.27*	*-*	*.260*
	.330	*3266*	*1.*	*2*	*.921*	*7342*
	1727		*10*		*0796*	
1.castesystem	*-*	*.297*	*-*	*0.00*	*-*	*-*
	1.01	*5114*	*3.*	*1****	*1.59*	*.427*
	3359		*41*		*8727*	*9911*
Flood	*-*	*.307*	*-*	*0.27*	*-*	*.267*
	.336	*3088*	*1.*	*4*	*.941*	*8726*
	7722		*10*		*417*	
changesinrainfall	*.925*	*1.29*	*0.*	*0.47*	*-*	*3.47*
	2092	*7461*	*71*	*6*	*1.62*	*8025*
					7606	
Drought	*-*	*.347*	*-*	*0.06*	*-*	*.028*
	.654		*1.*		*1.33*	
	4562	*3063*	*88*	*0*	*7798*	*8856*
changesintemperature	*.527*	*.912*	*0.*	*0.56*	*-*	*2.32*
	7365	*2728*	*58*	*3*	*1.26*	*2677*
					7204	
Salinizationandsaltwaterintr	*-*	*.305*	*-*	*0.22*	*-*	*.230*
	.371	*9885*	*1.*	*6*	*.973*	*8464*
	2005		*21*		*2474*	
_cons	*-*	*1.70*	*-*	*0.81*	*-*	*2.94*
	.399	*137*	*0.*	*4*	*3.74*	*7634*
	8921		*24*		*7418*	
No of obs.= 333						
F(18,314)= 4.14						
*Prob>F=0.0000****						
R-squ.= 19.19%						
Adj.R-squ=14.56%						

Notes: *** indicates the coefficient is significant at 1% level; ** = significant at 5% level; *= significant at

10% level of significance.

The regression results on variance of log income per capita per monthfluctuate over time.

However, it is noted that variance is influenced by some household characteristics. Both the size and it squared are positive and insignificant impact on the variation of household log income in the rural Gambia.

Age of the household head has negative variation of the household income in the rural Gambia.The result is insignificant. The age squared becomes positive meaning age squared increases the variation of log income.

Education attainment has negative and insignificant coefficients while it squared has positive and insignificant coefficient.1 I unit increase in education attainment, the variation of log income decline and vulnerability to poverty rises but education attainment squared increase, vulnerability to poverty in the future increases.

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Employment/occupation is an important determinant of whether households will be vulnerable or not if consider their current log income. So, the results revealed that employment status has significant and negative coefficient on the variation of log income at 1 percent level of significance, but employment has positive coefficient on the expected mean or ex-ante mean of log income. 1 unit increase in employment status of the household, variation in log income decline by 74%. This attributed to that in the rural Gambia, dependency ratios is much higher and that influence the fluctuation of income as employment rise.

Nonland production assets has significant and negative influence on the variation of log income. 1 unit increase in nonland production assets, household log income decreases by 95.7%. Moreover, share of irrigated land has positive coefficient. 1 unit increase in the share of irrigated land, the variation of log income increases by 21.1 percent and vulnerability to poverty decline in the future. Share of irrigated land increases with log income, the study noted.

Those that are male headed household are more likely to have variation in their log income. The coefficient for male headed household, the variation of log income decline by 33 percent and vulnerability to poverty increases. This may be due to the fact that male headed household has many mouth to feed and may increase the number of children or illness or instability in comecan all lead to reduction in future log income and vulnerability to poverty rises.

The ex-ante mean,some of the variables are positive while ex-ante variance most of variables turn out to have negative coefficient.

For caste system, the coefficient is negative and significant impact on the variation of future income at 1 percent level of significance.1 unit rise in those who say noble exist as caste system, the variation of log income decline by 10 percent. Due to conflict may rises, caste system has negative variation with income.

Climate variability such as flood, drought and salt intrusion has negative influence with the variation of household income.Change in rainfall and change in temperature has positive and insignificant impact on log income variation in the rural Gambia.Due to certain climate change condition, poor agriculture and livelihood influences this negative sign.

Table y…Results for VEP(vulnerability as expected poverty) measure- ex ante mean, when log.total consumption is the dependent variable-step 3

LnConsumptiontotal	Coef.	Std. Err.	t	P>|t|	[95% Interval]	Conf.
sizeofthehouseholds	.0117922	.0032149	3.67	0.000	.0054667	.0181177
Householdsizesquared	-.0000624	.0000218	-2.87	0.004	-.0001053	-.0000196
Ageofthehouseholdshead	.0099869	.0133846	0.75	0.456	-.0163479	.0363218
Ageofhhheadsquared	-.0000577	.0001366	-0.42	0.673	-.0003265	.000211
Ownland	-.16954	.0983694	-1.72	0.086	-.3630865	.0240065
Educationalattainment	.1471401	.0801413	1.84	0.067	-.0105418	.304822
Educationalattainmentsquared	-.0139495	.0099166	-1.41	0.161	-.0334608	.0055618
educationstatusoftheresponde	.1046176	.100742	1.04	0.300	-.0935971	.3028324
Employmentofhouseholdsheadca	-.0908362	.0660149	-1.38	0.170	-.2207237	.0390513
Nonlandproductionassets	.2530437	.0703435	3.60	0.000	.1146396	.3914478

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Shareofirrigatedland	.0064428	.0674483	0.10	0.924	-.126265	.1391505
1.Gender	.048106	.068699	0.70	0.484	-.0870625	.1832745
1.castesystem	.0183454	.068055	0.27	0.788	-.1155561	.1522468
Flood	-.138002	.0702961	-1.96	0.051	-.276313	.000309
changesinrainfall	-.7077915	.2967909	-2.38	0.018	-1.291742	-.1238412
Drought	-.2331265	.0794455	-2.93	0.004	-.3894392	-.0768137
changesintemperature	.0992536	.2086802	0.48	0.635	-.3113345	.5098418
Salinizationandsaltwaterintr	.1256132	.0699941	1.79	0.074	-.0121035	.26333
_cons	4.983335	.3891841	12.80	0.000	4.217597	5.749073
No of obs.= 333						
F(18,314)= 4.03						
Prob>F=0.0000***						
R-squ.= 18.78%						
Adj.R-squ=14.13%						

Notes: *** indicates the coefficient is significant at 1% level; ** = significant at 5% level; and *= significant at

10% level of significance.

For the total consumption as the dependent variable, the results revealed that size of the household has positive and significant coefficient. 1 unit increase in the size of the household, log total consumption rises by 1.79 percent. Then, vulnerability to poverty decrease in the future.Confirmed by Chaudhuri (2003).The squared of the household size becomes negative and significant. 1 unit increase in household size squared, the log total consumption decrease by 0.006 percent and vulnerability to poverty increase because size of the household double.

Age of the household has positive and significant coefficient on the log of total consumption but age squared is negative impact on household total consumptionat 10 percent level of alpha.The vulnerability to poverty decline when age is the explanatory variable and vulnerability to poverty increase when age-squared is the exogenous variable.

Educational attainment has positive and significant effect on log total consumption.In additional, 1 year add to your year of schooling, total consumption increase by 14.71 percent. Surprisingly, the coefficient for education squared is negative and insignificant impact on log of total consumption. 1 more year add to your higher education, then likely there is 1.4 percent decrease in log total consumption.Furthermore, the coefficient for education status of the household head category is positive. 1 year increase in educationstatus , log total consumptionrises by 10.46 percent.

Employment status is important determinant to understand which household is likely to be vulnerable in the future. Therefore, employment status in the rural Gambia has negative impact on household log total consumption. Employment status increase by 1 unit, log total consumption decrease by 9.08 percent.

Nonland production assets has positive and significant impact on log total consumption.The result is highly significant and positive at 1 percent level of significance.Then, the vulnerable for poverty decrease.Thus, share of irrigated land has positive and insignificant effect on log total consumption.1 unit increase in the share of irrigated land, the log total consumption reduce by 0.64 percent.The, vulnerability to poverty reduces as share of irrigated land is the explanatory variable.

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Gender is coded as 1 if household is male and 0 if female. Therefore, household with male headed has positive and insignificant impact on total consumption. This translated to that male headed household are more like to provide consumption and therefore vulnerability to poverty reduces.Thus, female headed household does not influence the total consumption in the compound and vulnerability to poverty increases.

Caste system is important determinant in the rural Gambia or Gambia as a whole when individual or households are more likely to be vulnerable to poverty by considering the mean consumption, poverty line and variation in log total consumption. The caste system has positive and insignificant impact on household log total consumption. 1 unit increase in caste system, the log total consumption increases by 1.8 percent. The vulnerability to poverty decline with positive coefficient for caste system.

Climate shocks causes agriculture to decline and can lead to poor livelihoods in the rural Gambia. Therefore, flood has negative and significant impacts on log total consumption and vulnerability to poverty increase due to climate flood as a proxy for climate shocks.1 unit increase in flood, log total consumption decline by 13.8 percent. Salt intrusion has positive and significant coefficient on log total consumption and vulnerability to poverty lessen. Further, change in rainfall and change in temperature has negative and positive impact on log total consumption and vulnerability to poverty increase and decrease respectively. Finally, drought has negative and significant impact on vulnerability to poverty. Rough increase the vulnerability for households like to be poor considering the drought as a proxy for climate change.Confirmed in the study done by (Adger 1999a; Bohle et al. 1994; Downing 1991; Liverman 1990).

Table Results for VEP(vulnerability as expected poverty) measure- ex ante variance, when log.total consumption is the dependent variable.

Ex ante variance	Coef.	Std. Err.	t	P>|t|	[95% Interval]	Conf.
sizeofthehouseholds	.0018976	.0133495	0.14	0.887	-.0243682	.0281634
Householdsizesquared	.0000684	.0000905	0.76	0.451	-.0001097	.0002464
Ageofthehouseholdshead	-.0734234	.0555779	-1.32	0.187	-.1827755	.0359288
Ageofhhheadsquared	.0006286	.0005672	1.11	0.269	-.0004873	.0017446
Ownland	.646157	.4084668	1.58	0.115	-.157521	1.449835
Educationalattainment	-.4872674	.332777	-1.46	0.144	-1.142022	.1674872
Educationalattainmentsquared	.0559818	.0411774	1.36	0.175	-.0250366	.1370003
educationstatusoftheresponde	-.4214592	.4183189	-1.01	0.314	-1.244521	.4016031
Employmentofhouseholdsheadca	-.1915238	.2741188	-0.70	0.485	-.7308656	.347818
Nonlandproductionassets	-.8793616	.2920925	-3.01	0.003	-1.454068	-.3046557
Shareofirrigatedland	.1704965	.2800708	0.61	0.543	-.3805561	.7215491
1.Gender	-.1276682	.285264	-0.45	0.655	-.6889387	.4336023
1.castesystem	-.4594565	.28259	-1.63	0.105	-1.015466	.0965528
Flood	-.1431678	.291896	-0.49	0.624	-.7174872	.4311515
changesinrainfall	3.01	1.23	2.	0.0	.589	5.43

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	4647	2388	45	15	8657	9428
Drought	-.2130934	.3298875	-0.65	0.519	-.8621627	.4359759
changesintemperature	-1.089586	.8665185	-1.26	0.210	-2.794503	.6153301
Salinizationandsaltwaterintr	-.4795197	.2906419	-1.65	0.100	-1.051371	.0923321
_cons	-1.090006	1.616039	-0.67	0.500	-4.26964	2.089627
No of obs.= 333						
F(18,314)= 2.09						
Prob>F=0.0061***						
R-squ.=10.72%						
Adj.R-squ=5.60%						

Notes: *** indicates the coefficient is significant at 1% level; ** = significant at 5% level; *= significant at

10% level of significance.

Both the size of the household and it squared has positive and insignificant impact on the variation of log consumption.1 unit increase in the size of the household and it squared, the variance of log consumption increase by 0.19 and 0.068 percent respectively.The vulnerability to poverty decrease.Age of the households has negative and insignificant impact on the log of total consumption and age squared becomes positive and insignificant. Own land is positive and insignificant impact on the variance of the log of total consumption.Education attainment is negative and it squared become positive which education status become negative. It means that variation of log of total consumption is not stable over time.Further employment of the household head is negative and variation of vulnerability to poverty becomes higher.nonlandprdocution assets becomes has negative sign.share of irrigated land has positive variation of log consumption and vulnerability to poverty decrease. The household head that are male has negative effect on the vulnerability to poverty.Likewise caste system has negative variation on the vulnerability to polverty.Climate shocks such as flood, change in temperature, salt intrusion and drought causes higher variation of vulnerability to poverty. This may be the influence they have on agriculture yields both production and productivity and livelihood.In additional, change in rainfall has positive variation with vulnerability to poverty. Change in rainfall decrease the variation of vulnerability to poverty.Finally, If we make all variables constant, the variation of log consumption becomes negative.

Food consumption

Table ..Results for VEP(vulnerability as expected poverty) measure- ex ante mean, when log.food consumption is the dependent variable.

LnConsumptionFood	Coef.	Std. Err.	t	P>|t|	[95% Interval]	Conf.
sizeofthehouseholds	.0104817	.0030592	3.43	0.001	.0044626	.0165007
Householdsizesquared	-.0000536	.0000207	-2.59	0.010	-.0000944	-.0000128
Ageofthehouseholdshead	.0056182	.0127361	0.44	0.659	-.0194407	.0306772
Ageofhhheadsquared	-.0000155	.00013	-0.12	0.905	-.0002712	.0002403
Ownland	-.0333105	.0936037	-0.36	0.722	-.2174802	.1508592
Educationalattainment	.1030423	.0762587	1.35	0.178	-.0470003	.2530849
Educationalattainmentsquared	-.0083138	.0094361	-0.88	0.379	-.0268799	.0102522
educationstatusoftheresponde	.0699365	.0958613	0.73	0.466	-.1186753	.2585482

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Employmentofhouseholdsheadca	-.0810396	.0628167	-1.29	0.198	-.2046344	.0425552
Nonlandproductionassets	.2319206	.0669355	3.46	0.001	.1002218	.3636194
Shareofirrigatedland	.0316527	.0641806	0.49	0.622	-.0946257	.1579312
1.Gender	.0485711	.0653707	0.74	0.458	-.0800488	.177191
1.castesystem	-.0103282	.0647579	-0.16	0.873	-.1377425	.1170861
Flood	-.1524541	.0668905	-2.28	0.023	-.2840643	-.0208439
changesinrainfall	-.4625214	.2824121	-1.64	0.102	-1.018181	.093138
Drought	-.208525	.0755965	-2.76	0.006	-.3572648	-.0597852
changesintemperature	-.0531104	.1985701	-0.27	0.789	-.4438066	.3375858
Salinizationandsaltwaterintr	.0757081	.0666031	1.14	0.257	-.0553367	.2067528
_cons	4.988639	.3703291	13.47	0.000	4.259999	5.71728
No of obs.= 333						
F(18,314)= 4.21						
Prob>F=0.0000***						
R-squ.= 19.43%						
Adj.R-squ=14.81%						

Notes: *** indicates the coefficient is significant at 1% level; ** = significant at 5% level; *= significant at

10% level of significance.

Food consumption is another important measure of welfare. Household size is positive and significant coefficient impact on the growth of food consumption. The results is highly significant at 1 percent level of alpha.Therefore, household size increase with change in food consumption and vulnerability to poverty decrease.As maximum household size in the summary equation is too large, the squared of the household ahs negative effect on household food consumption and vulnerability to poverty increases due to many mouth to feed. For instance, age has positive and insignificant impact on food consumption and that lead to decrease in vulnerability poverty as age increases.In additional, age squared has negative influence on log food consumption and reflecting that age double vulnerability to food consumption become increase.Own land has negative influence on food consumption.Education attainment has positive and insignificant impact on thehousehold food consumption and vulnerability to poverty decrease.The squared of education attainment has negative and insignificant impact on log food consumption of the households.Education status of the respondent has positive and insignificant impact on food consumption of the households and vulnerability to poverty decline. Education influence positively the vulnerability to poverty.In contrast, employment status has negative impact on household log food consumption and vulnerability to poverty becomes higher.This may be attributed to less salary or other negative determinant that affect employment, the study noted.Nonland production assets has positive and significant coefficient on household food consumption per capita per month and therefore vulnerability to poverty decrease.Share of irrigated land has alsopositive sign and therefore vulnerability to poverty decline as share of irrigated land increase.Those male headed household are more likely to have food consumption and the results is expected. Therefore, male headed household has positive and insignificant impact on household food consumption per capita per month and vulnerability to poverty decline.Caste system vulnerability to poverty increase. For Flood, change in rainfall,drought and change in temperature vulnerability to

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poverty increase while salt intrusion vulnerability to povertydecrease.Finally, if all the variables remain constant, log food consumption become positive and significant coefficient and constant.

Tablexx:Results for VEP(vulnerability as expected poverty) measure - ex ante variance, when log.food consumption is the dependent variable.

Ex ante Variance	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
sizeofthehouseholds	.012912	.0128389	1.01	0.315	-.0123491	.0381731
Householdsizesquared	-.0000119	.000087	-0.14	0.892	-.0001831	.0001594
Ageofthehouseholdshead	-.068977	.053452	-1.29	0.198	-.1741463	.0361924
Ageofhhheadsquared	.0005767	.0005455	1.06	0.291	-.0004966	.0016499
Ownland	-.0972478	.3928428	-0.25	0.805	-.8701847	.6756892
Educationalattainment	-.2063256	.3200481	-0.64	0.520	-.8360355	.4233844
Educationalattainmentsquared	.012934	.0396023	0.33	0.744	-.0649855	.0908534
educationstatusoftheresponde	-.2580253	.402318	-0.64	0.522	-1.049605	.5335545
Employmentofhouseholdsheadca	.1838244	.2636336	0.70	0.486	-.3348874	.7025361
Nonlandproductionassets	-.7533369	.2809198	-2.68	0.008	-1.30606	-.2006138
Shareofirrigatedland	.0360316	.2693579	0.13	0.894	-.493943	.5660061
1.Gender	-.4290662	.3525	-1.56	19	.9688679	7355
1.castesystem	-.170744	.2717808	-0.63	0.530	-.7054857	.3639977
Flood	-.146305	.2807309	-0.52	0.603	-.6986564	.4060463
changesinrainfall	.8981577	1.185248	0.76	0.449	-1.433874	3.23019
Drought	-.16668	.3172691	-0.53	0.600	-.7909221	.4575622
changesintemperature	-.0495959	.8333738	-0.06	0.953	-1.689299	1.590107
Salinizationandsaltwaterintr	-.1767016	.2795247	-0.63	0.528	-.7266798	.3732766
_cons	-.4885142	1.554225	-0.31	0.753	-3.546525	2.569497
No of obs.= 333						
F(18,314)= 1.64						
Prob>F=0.05***						
R-squ.=8.58%						
Adj.R-squ=3.34%						

Notes: *** indicates the coefficient is significant at 1% level; ** = significant at 5% level; *= significant at

10% level of significance.

Size of the household has positive variation on log food consumption and it squared has negative effect.Age has negative variation on log food consumptiona and it squared has positive effect. The later has less vulnerability to poverty and the former has more vulnerable to poverty.Own land has negative variation with household log food consumption and likewise educational attainment. The squared of educational attainment has positive and insignificant impact on log food consumption in the rural Gambia.

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Like educational attainment, education status has negative influence on the food consumption and large variation influence that vulnerability to poverty will rises.Further, employment has positive variation on household food consumption and vulnerability to poverty decline. Nonland production assets has negative and in significant variance while share of irrigated land has positive variation and the later vulnerability to poverty decreases and the former the vulnerability to poverty increases.Male headed household has negative variation on food consumption and the vulnerability to poverty increase as household is headed by male.Likewise, caste system vulnerability to poverty increase.Climate chocks causes higher variation to log of food consumption and vulnerability to poverty is very higher.

Limitation of the Study

This study employs the Vulnerability as Expected Poverty (VEP) approach to estimate the probability that a household will fall below the poverty line in the future, based on current income and consumption distributions (Chaudhuri et al., 2002). While the VEP method is appropriate for cross-sectional data, its predictive accuracy and policy relevance would be significantly enhanced through the use of panel data and more disaggregated income sources. Detailed information on income and consumption, such as remittances, agricultural yields, informal earnings, and household expenditure patterns, would enable more precise modeling of vulnerability pathways.

Agricultural shocks, including rainfall variability and pest outbreaks, disproportionately affect rural livelihoods in The Gambia, where over 70% of the labor force is engaged in subsistence farming. Incorporating such shocks into the model would help identify causal mechanisms underlying income volatility and food insecurity (Dercon, 2004). Furthermore, recent data from the Gambia Bureau of Statistics indicate that rural poverty remains substantially higher than urban poverty, with 76% of rural households classified as poor in 2020. This highlights the need for targeted data collection on rural income sources, including non-land assets, irrigation access, and informal labor dynamics.

To enhance policy relevance, future iterations of the study should integrate a framework for institutional accountability, examining the roles of local governance, agricultural extension services, and social protection programs. While kinship networks and community-based savings schemes offer informal insurance, they remain insufficient without formal mechanisms (Morduch, 1995). Additionally, applying a Regression Discontinuity Design (RDD) to border villages between The Gambia and Senegal could exploit geographic and administrative discontinuities to identify causal effects of institutional differences. This approach has proven effective in studies of education, health, and governance (Dell, 2010; Casey et al., 2012), and would allow for a more rigorous assessment of how policy regimes, cultural norms, and institutional capacity shape household vulnerability.

Conclusion and Policy recommendation

Some important findings are summarized from a larger policy perspective for the case of the rural Gambia household vulnerability assessment.An attempt was made to assess the vulnerability of rural households in the Gambia based on household surveyed 2021.Both ex ante mean and ex ante varance measures vulnerability for the rural households were computed.The dependent variables are three; log income, log total consumption and log food consumption were interchangeable.In that we first run log income as the dependent variable on the explanatory variables. The results found that size of the household and size of the household squared has positive and significant and size squared has negative and significant effect on the household vunlnerability to poverty status(see details explanation in the

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above table).Caste system is a dummy variable indicated 1 if the households head is noble and 0 otherwise. Caste system has positive and significant impact on vulnerability to poverty in the rural Gambia.So to be chronic poor, illness or lack of employment can causes it.Age squared, education squared, flood, changing rainfall, drought and changing rainfall more likely to be vulnerable to poverty in the rural Gambia using log income as the dependent variable. Using log food conmption as dependent variable, the results revealed that size squared increases household future vulnerability status to poverty while caste system you are more to be vulnerability to poverty using food consumption as the dependent variable .Ownland you are more likely to vulnerable to poverty. An important conclusion and policy implication come out from the chapter is that vulnerability and poverty are related. If you are vulnerable due to nature disasters, climate shocks, poor agriculture, high price hike, illness, unemployed, slave, larger household size, do not have own land, and poor share of irrigated land using income variation as the dependent variables, you may likely to be vulnerable to poverty. Likewise using total consumption and food consumption, looking at the current food consumption or total consumption for the household in the rural Gambia, climate extreme shocks may increase the probability to be vulnerable to poverty in the near futures. Future income, future total consumption, and future food consumption, variation of income, total consumption and flood consumption are determined by present saving. If present saving is lower the likely for the rural household to deepening into poverty is mostly very higher.Diversification of income, good adaptation practice by farmers, diversification of the production assets, employment diversification, increases in education, nuclear family, noble in the society, good rainfall, and age as proxy for experience, the probability of the household to be vulnerable to poverty is very slim, the author meditated.

In conclusion, so while there is a case for broadening the area of intervention for vulnerability ex ante mean and ex ante variance, it is farfrom obvious what the trade-offs are between income diversification, total consumption diversification, savings, food consumption anddifferent forms of providing insurance. The risks and return are an important determine for household to be poor or non-poor in the future considering their present log income, and log food/total consumption and likewise present saving, the author concluded.

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E-ISSN : 3089-3216

References

Chaudhuri, S., Jalan, J., &Suryahadi, A. (2002). Assessing Household Vulnerability to Poverty from Cross-sectional Data: A Methodology and Estimates from Indonesia. World, 0102–52(April), 36.http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=pubmed&cmd=Retrieve&dopt=AbstractPlus&list_uids=6086807498683160254related:vpYxtyuveFQJ

Hoddinott, J., &Quisumbing, A. (2010).Methods for Microeconometric Risk and Vulnerability Assessment.Risk, Shocks, and Human Development, 0324, 62–100. https://doi.org/10.1057/9780230274129_4

Ofoegbu, C., &Chirwa, P. W. (2019).Analysis of rural people's attitude towards the management of tribal forests in South Africa.Journal of Sustainable Forestry, 38(4), 396–411. https://doi.org/10.1080/10549811.2018.1554495

Bohle, H. G., Downing, T. E., & Watts, M. J. (1994).Climate change and social vulnerability.Global Environmental Change, 4(1), 37–48. https://doi.org/10.1016/0959-3780(94)90020-5

Downing, T. E. (1991). Vulnerability to hunger in Africa. A climate change perspective. Global Environmental Change, 1(5), 365–380. https://doi.org/10.1016/0959-3780(91)90003-C

Nawrotzki, R. J., Riosmena, F., & Hunter, L. M. (2013). Do Rainfall Deficits Predict U.S.-Bound Migration from Rural Mexico? Evidence from the Mexican Census.Population Research and Policy Review. https://doi.org/10.1007/s11113-012-9251-8

Amdu, B., Ayehu, A. and Deressa, A. (2013) Farmers' Perception and Adaptive Capacity to Climate Change and Variability in the Upper Catchment of Blue Nile, Ethiopia. The African Technology Policy Studies Network (ATPS), Nairobi.

Gaiha, R., & Imai, K. (2008).Measuring Vulnerability and Poverty Estimates for Rural India.In Research Paper (Vol. 40, Issue July 2006).

Gaiha, R., & Imai, K. (2014).Measuring Vulnerability and Poverty : Estimates for Rural India Research Paper No . 2008 / 40 Measuring Vulnerability and Poverty Estimates for Rural India RaghavGaiha 1 and Katsushi Imai 2 (Issue January 2008).

Chaudhuri, S., Jalan, J., &Suryahadi, A. (2002). Assessing Household Vulnerability to Poverty from Cross-sectional Data: A Methodology and Estimates from Indonesia. World, 0102–52(April), 36. http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=pubmed&cmd=Retrieve&dopt=AbstractPlus&list_uids=6086807498683160254related:vpYxtyuveFQJ

Gaiha, R., & Imai, K. (2004). Vulnerability, shocks and persistence of poverty: Estimates for semi-arid rural South India. Oxford Development Studies, 32(2), 261–281. https://doi.org/10.1080/1360081041000169998 4

Amemiya, T. (1977). The Maximum Likelihood and the Nonlinear Three-Stage Least Squares Estimator in the General Nonlinear Simultaneous Equation Model. Econometrica, 45(4), 955. https://doi.org/10.2307/1912684

Deressa, T., Hassan, R. M., &Ringler, C. (2008).Measuring Ethiopian farmers' vulnerability to climate change across regional states.In IFPRI Discussion Paper.

Tadesse, T., Hassan, R. M., Ringler, C., Alemu, T., &Yesuf, M. (2009).Determinants of farmers ' choice of adaptation methods to climate change in the Nile Basin of Ethiopia Determinants of farmers ' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. June 2017. https://doi.org/10.1016/j.gloenvcha.2009.01.002

Günther, I., &Harttgen, K. (2009). Estimating Households Vulnerability to Idiosyncratic and

P-ISSN : 2615-5265
E-ISSN : 3089-3216

Covariate Shocks: A Novel Method Applied in Madagascar. World Development, 37(7), 1222–1234. https://doi.org/10.1016/j.worlddev.2008.11.006

Science, E., Bryan, E., Deressa, T., Gbetibouo, G. A., &Ringler, C. (2009).Adaptation to Climate Change in Ethiopia and South Africa : Options and Constraints. October 2017. https://doi.org/10.1016/j.envsci.2008.11.002

Pham, Q. D., Stuart, R. M., Nguyen, T. V., Luong, Q. C., Tran, Q. D., Pham, T. Q., ... & Kerr, C. C. (2021). Estimating and mitigating the risk of COVID-19 epidemic rebound associated with reopening of international borders in Vietnam: a modelling study. The Lancet Global Health.

Mendelsohn, R. (2014). The impact of climate change on livestock management in Africa : a structural Ricardian analysis. July.

Lobell, D. B., Hammer, G. L., McLean, G., Messina, C., Roberts, M. J., &Schlenker, W. (2013). The critical role of extreme heat for maize production in the United States.Nature Climate Change, 3(5), 497–501. https://doi.org/10.1038/nclimate1832

Lobell, D. B., Burke, M. B., Tebaldi, C., Mastrandrea, M. D., Falcon, W. P., & Naylor, R. L. (2008). Prioritizing climate change adaptation needs for food security in 2030. Science, 319(5863), 607–610. https://doi.org/10.1126/science.1152339

Lobell, D. B., Hammer, G. L., McLean, G., Messina, C., Roberts, M. J., &Schlenker, W. (2013). The critical role of extreme heat for maize production in the United States.Nature Climate Change, 3(5), 497–501. https://doi.org/10.1038/nclimate1832

Reidsma, P., &Ewert, F. (2008). Regional farm diversity can reduce vulnerability of food production to climate change. Ecology and Society, 13(1). https://doi.org/10.5751/ES-02476-130138

January 2009. (2009). International Journal of Industrial Ergonomics, 39(1), 283–286. https://doi.org/10.1016/s0169-8141(08)00187-x

Adger, W. N., & Kelly, P. M. (1999).Social vulnerability to climate change and the architecture of entitlements.Mitigation and Adaptation Strategies for Global Change, 4(3–4), 253–266. https://doi.org/10.1023/a:1009601904210

Liverman, D. M. (1990). Drought Impacts in Mexico: Climate, Agriculture, Technology, and Land Tenure in Sonora and Puebla. Annals of the Association of American Geographers, 80(1), 49–72. https://doi.org/10.1111/j.1467-8306.1990.tb00003.x

Christiaensen, L. J., &Subbarao, K. (2005).Towards an understanding of household vulnerability in rural Kenya.Journal of African Economies, 14(4), 520–558. https://doi.org/10.1093/jae/eji008

Muleta, A., &Deressa, D. (2014).Female Headed Households and Poverty in Rural Ethiopia.Science, Technology and Arts Research Journal, 3(1), 152. https://doi.org/10.4314/star.v3i1.25

Legesse, D., Legesse, H., &Geleta, N. (2018).Effects of Blended Fertilizer Rate and Time of Application on Growth and Yield of Sugarcane Ratoon Crop at Arjo-Sugar Factory, Western Ethiopia.Science, Technology and Arts Research Journal, 5(1), 1. https://doi.org/10.4314/star.v5i1.1

Gaiha, R., &Deolalikar, A. B. (1993). Persistent, expected and innate poverty: Estimates for semi-arid rural South India, 1975-1984. Cambridge Journal of Economics, 17(4), 409–421. https://doi.org/10.1093/oxfordjournals.cje.a035246

Skoufias, E. (2003). Economic crises and natural disasters: Coping strategies and policy implications. World Development, 31(7), 1087–1102. https://doi.org/10.1016/S0305-750X(03)00069-X

P-ISSN : 2615-5265
E-ISSN : 3089-3216

Society, R. E. (2009).Measuring Vulnerability Author (s): Ethan Ligon and Laura Schechter Source : The Economic Journal , Vol . 113 , No . 486 , Conference Papers (Mar ., 2003), pp . C95-C102 Published by : Blackwell Publishing for the Royal Economic Society Stable URL : h. 113(486).

Magrini, M. B., Anton, M., Chardigny, J. M., Duc, G., Duru, M., Jeuffroy, M. H., Meynard, J. M., Micard, V., &Walrand, S. (2018). Pulses for Sustainability: Breaking Agriculture and Food Sectors Out of Lock-In. Frontiers in Sustainable Food Systems, 2(October), 1–17. https://doi.org/10.3389/fsufs.2018.00064

Ravi Kanbur, S. M. (1987). Structural adjustment, macroeconomic adjustment and poverty: A methodology for analysis. World Development, 15(12), 1515–1526. https://doi.org/10.1016/0305-750X(87)90234-8

Günther, I., & Maier, J. K. (2014).Poverty, vulnerability, and reference-dependent utility.Review of Income and Wealth, 60(1), 155–181. https://doi.org/10.1111/roiw.12081

Authors, C., Klein, R. J. T., Mukhala, E., Stephen, L., Winograd, M., Ziervogel, G., Alam, M., Bhawal, S., Bosch, H., Hyera, T., Jones, R., Lugenja, M., Meena, H. E., Munasinghe, M., Nyong, A., Rahman, A., Safi, S., Solar, J. S., &Smit, B. (n.d.).Climate Adaptation.

Gemenne, F., &Blocher, J. (2017). How can migration serve adaptation to climate change? Challenges to fleshing out a policy ideal.Geographical Journal, 183(4), 336–347. https://doi.org/10.1111/geoj.12205

Gioli, Giovanna ; Khan, Talimand ; Scheffran, J. (2016).Gender and Environmentally-induced Migration in Gilgit-Baltistan , Pakistan Gender and Environmentally-induced Migration in. July. https://www.researchgate.net/publication/274541391_Gender_and_Environmentally-induced_Migration_in_Gilgit-Baltistan_Pakistan

Vörösmarty, C. J., Green, P., Salisbury, J., &Lammers, R. B. (2000). Global water resources: Vulnerability from climate change and population growth. Science, 289(5477), 284–288. https://doi.org/10.1126/science.289.5477.284

- Ayodotun, B., Bamba, S., &Adio, A. (2019). *Vulnerability Assessment of West African Countries to Climate Change and Variability*. *Journal of Geoscience and Environment Protection*, 7(6), 13–15. [Read article](https://www.scirp.org/journal/paperinformation?paperid=93085)

- Ansah, E. W., Amoadu, M., Obeng, P., &Sarfo, J. O. (2024). *Climate change, urban vulnerabilities and adaptation in Africa: a scoping review*. *Climatic Change*, 177(71). [SpringerLink](https://link.springer.com/article/10.1007/s10584-024-03711-8)

- Fernández-López, S., Álvarez-Espiño, M., & Rey-Ares, L. (2023). *Financial Vulnerability of Low-Income Households: Review of Scopus and WoS Journals*. AEID Journal. [Read summary](https://www.usc.es/economet/reviews/aeid2419.pdf)

- Lawal, O., &Arokoyu, S. B. (2015). *Modelling social vulnerability in sub-Saharan West Africa using GIS*. Jàmbá: Journal of Disaster Risk Studies. [Access article](https://jamba.org.za/index.php/jamba/article/view/155)

- United Nations Economic Commission for Africa (2023). *Socioeconomic Profile of West Africa*. [Full report](https://www.uneca.org/eca-events/sites/default/files/resources/documents/sro-na/icsoe-na-wa-2023/socioeconomic-profile-2023-west-africa-english.pdf)

- ECOWAS & UNDP (2024). *Regional Resilience Strategy for West Africa*. [Workshop summary](https://www.undp.org/africa/press-releases/ecowas-undp-technical-consultation-initiates-efforts-develop-west-africa-resilience-strategy)

P-ISSN : 2615-5265
E-ISSN : 3089-3216

Key References:

- Morduch, J. (1995). Income smoothing and consumption smoothing. Journal of Economic Perspectives, 9(3), 103–114.
- Dell, M. (2010). The persistent effects of colonial institutions in Mexico. American Economic Journal: Applied Economics, 2(1), 1–27.
- Casey, K., Glennerster, R., & Miguel, E. (2012). Reshaping institutions: Evidence on aid impacts using a preanalysis plan. Quarterly Journal of Economics, 127(4), 1755–1812.
- World Bank. (2023). Poverty Trends in The Gambia: A Tale of Two Crises. Retrieved from World Bank Blog

- Adger, W. N. (2006). Vulnerability. Global Environmental Change, 16(3), 268–281. https://doi.org/10.1016/j.gloenvcha.2006.02.006
- Brinkerhoff, D. W. (2005). Rebuilding governance in failed states and post-conflict societies: Core concepts and cross-cutting themes. Public Administration and Development, 25(1), 3–14. https://doi.org/10.1002/pad.352
- Briguglio, L., Cordina, G., Farrugia, N., &Vella, S. (2009). Economic vulnerability and resilience: Concepts and measurements. Oxford Development Studies, 37(3), 229–247. https://doi.org/10.1080/13600810903089893
- UNCTAD. (2024). Economic Development in Africa Report 2024: Strengthening resilience to trade shocks. Retrieved from UNCTAD report
- WANEP & UNDP. (2018). Conflict and Development Analysis – The Gambia. Retrieved from CDA report
- World Bank. (2017). The Gambia Fragility Risk and Resilience Assessment. Retrieved from World Bank document
- World Bank. (2023). Poverty Trends in The Gambia: A Tale of Two Crises. Retrieved from World Bank blog

Key References:

- Chaudhuri, S., Jalan, J., &Suryahadi, A. (2002). Assessing household vulnerability to poverty from cross-sectional data: A methodology and estimates from Indonesia. Department of Economics, Columbia University. https://doi.org/10.2139/ssrn.629624
- Dercon, S. (2004). Growth and shocks: Evidence from rural Ethiopia. Journal of Development Economics, 74(2), 309–329.
- Gambia Bureau of Statistics. (2022). Prevalence and Depth of Poverty: Integrated Household Survey 2020. Retrieved from GBoS Poverty Report
- The Standard Newspaper. (2025). Poverty in The Gambia: Localised Dimensions and Realities. Retrieved from The Standard

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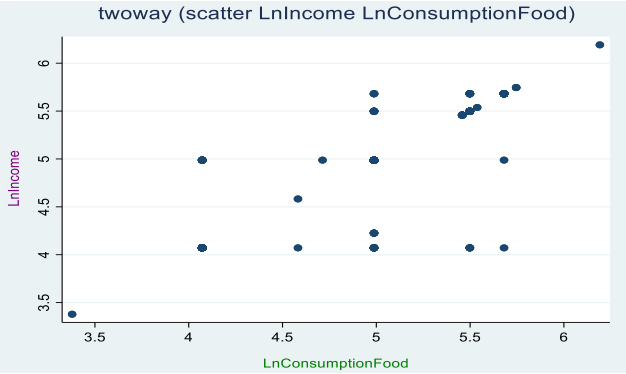

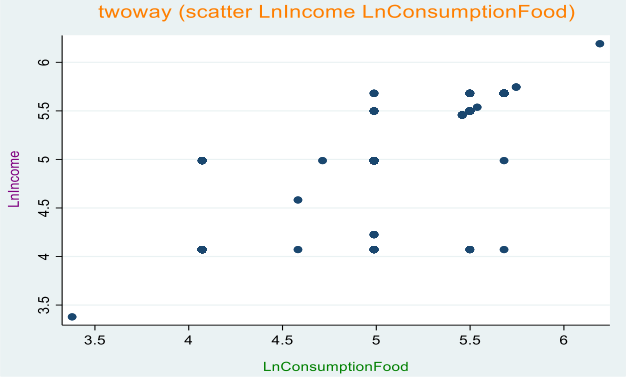

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