



Assessing Climate Risk to Improve Incomes of Rural Farming Households in the Caprivi Region, Namibia

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Assessing Climate Risk to Improve Incomes of Rural Farming Households in the Caprivi Region, Namibia

J.M. Nyambe ^α & A. Belete ^σ

Abstract - While the scientific world blames the severity of climate risk factors on climate change, the assessment of its effects on a rural household remains understudied. The objective of this study is to assess climate risk factors on rural households that practices small-scale agriculture with the aim of improving the incomes of farming households. The paper used cross-sectional data from a sample of 253 respondents who represented households that were based in the flood prone areas of the Caprivi region. Invoking a multivariate regression model revealed that climate risk factors especially flood exacerbates the opportunity cost for obtaining a good harvest and thus exposed farming households to income risk and food insecurity. In view of these findings, old age pension and retirement annuities, the value of livestock and that of food aid proved vital to the income and food security needs of rural households in the study area. Investing in early warning systems and publicizing likely climate risk scenarios may be helpful to rural households in preparing to secure their income sources and thus reducing chances of hunger.

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1. INTRODUCTION

Globally, climate variability has become common. In Namibia in general and in the Caprivi region in particular, climate risk factors especially flood is problematic. Although flood and drought are the usual climate risk factors that often affect the Caprivi region, flood is frequent than drought. The frequency and the degree to which flood affects rural households in the Caprivi region reflects how critical it has become on the incomes of those who rely on agriculture for food and income generation. Other regions of Namibia such as Kavango, Ohangwena, Omusati, Oshana and Oshikoto also suffer from annual flood and sporadic droughts but the frequency and the severity of flood as dating back to long historical times shows how serious flood can be in the Caprivi region. This makes the Caprivi region the most historically prone region to flood risk.

Elsewhere, climate change has been recorded as a serious concern in the human security stream. This has to do with the added effect of conflicts arising from disputes over natural resources that are depleting across Africa (Carius, 2009). It further presents a dire to

the agricultural sector and the natural environment with regards to long term consequences. Since Africa is known for high poverty incidents, Hansen et al. (2007) suggest that while seeking to address persistent poverty, there is a need to adopt effective and innovative management practices to deal with climate risk. Innovative ways includes sharing climate information and introducing technology and policies that reduces risks. Climate shocks have both ex ante and post ante consequences. Ex ante ones includes losses and damages to agricultural enterprises and infrastructure while post ante refers to the opportunity cost that is associated with conservation strategies. The absence of insurance policies for rural agricultural enterprises is also a drawback to protecting rural livelihoods. Without insurance against losses to rural agricultural enterprises, rural communities would easily face long-term consequences to their livelihoods (Hansen et al., 2007). Taking up insurance is in line with concave utility and risk aversion principles (Kent, 2004). Risk in agriculture can reduce both farm yield and efficiency with a resultant effect of lowering incomes of farming rural households and exposing them to food insecurity. Low farm commodity prices also cause income risk (Macdonal, 2006).

In seeking to improve rural household incomes from a process of managing climate risks, it should be understood that it can be cumbersome. There are complexities as well to the process given the severe variability of climate risk. As a result George et al. (2005) suggests the need for understanding the extent to which climate risk varies, accuracy of climate forecasting, characterising events of dry periods, and understanding issues surrounding climate change. Characterising climate risk factors and offering reliable advice can benefit farmers (George, et al., 2005). So far, very little is reported on climate forecasting in Africa as compared to early warnings in developed countries. Although climate forecasting is imperative in the assessment of economic consequences, it remains an unpopular undertaking with regards to its use in African countries (Arndt and Bacou, 2000).

For the rural setup, formal jobs are scarce and as it is the case in the Caprivi region, formal jobs are confined to the urban centre at Katima Mulilo. This leaves rural job hunters to search for informal jobs,

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which in most cases offers less income benefits compared to in-kind food rewards. By default, this creates sectoral labour-attachment in favouring agriculture as the most attractive sector in the rural areas when it comes to providing employment opportunities. Similarly to this view there is confirmation in a study that was conducted in Slovenia by Bojnec and Dries (2005) in which they found that market liberalization ushered in the opportunity for agriculture to become the mainstay of employment creation in rural areas compared to other sectors.

In the milieu of frequent annual floods, rural farmers in the Caprivi region continue to record poor harvests. This scenario imbeds a negative prospect on the income generating opportunities. Intriguing to the conundrum of declining agricultural output and livelihoods in general is that no empirical study has so far attempted to assess the effects of climate risk in the context of seeking to improve incomes of rural farming households in the study area.

II. MATERIALS AND METHODS

a) The study site

The Caprivi region is situated in the eastern part of Namibia. Namibia has a human population size of 2 104 900 million. Out of this, the population the Caprivi

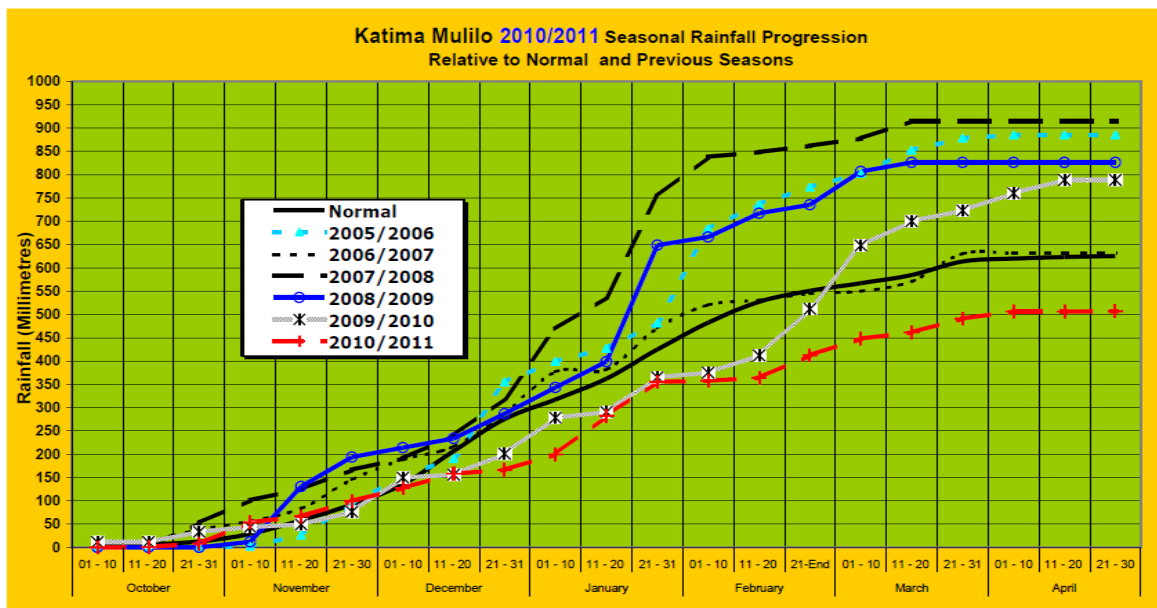
region accounts for is 90 100 (National Planning Commission, 2011). On climatological metrics, the Caprivi region receives an average annual rainfall of 653 mm (Ministry of Works and Transport, 2011; Samsamwater, 2011).

b) Data gathering process

The period which this paper focuses on is the 2002/3 to 2007/8 cultivation and harvesting seasons. As the time series data is scanty and at times non-existent, cross sectional data was gathered using a structured questionnaire. The population is that of rural dwellers in the flood plains from which a sample of 253 respondents was drawn from. The respondents were randomly sampled using multi-stage cluster sampling approach. Three constituencies from where the randomly selected households were obtained are: Kabbe, Katima Rural and Linyanti.

c) Conceptual framework

Before going deeper into methodological technicalities, the environment in which rural farming households exist first needs to be reflected here. The reflection will take the form of presenting the context of a conceptual framework.



Source : Ministry of Works and Transport (2011)

Figure 1 : Rainfall records for Katima Mulilo for the period 2005 to 2011

For the planting seasons of 2002 to 2007, the rainfall pattern escalated above the average annual record notwithstanding the recorded figures below the average.

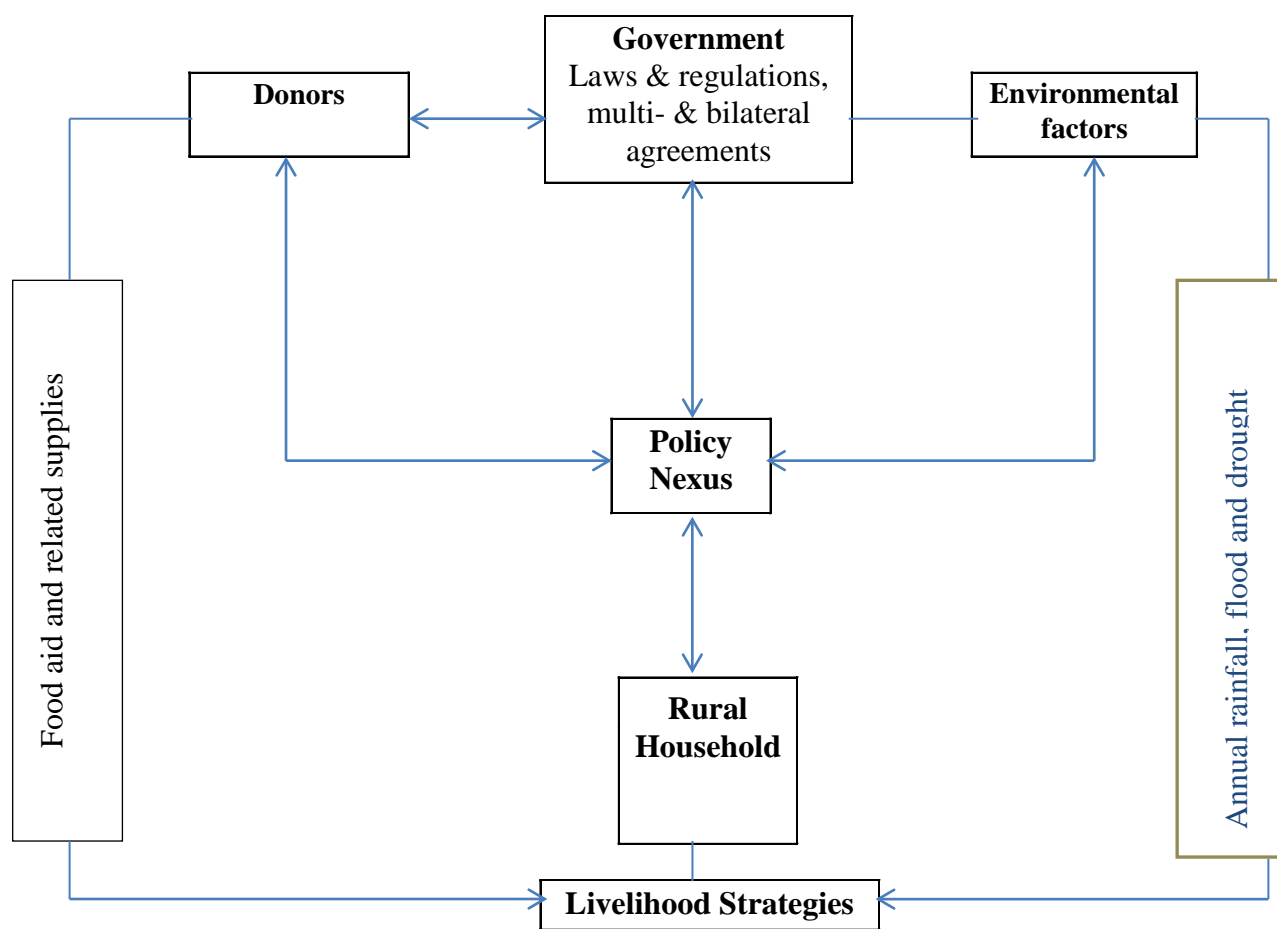


Figure 2 : Conceptual framework for rural farming households in the Caprivi

Figure 2 presents the relationship between a rural household and its supportive structures. The government and donor agencies have for decades been offering material support to needy households when climate risk factors strikes. Climate risk factors are nested under environmental factor category. Existing laws and regulations includes domestic and international legal instruments that seek to advance human welfare. Among such pertinent instruments are the United Nations General Assembly resolution 2200A (XXI) of 16 December 1966 on the International Convention of Economic, Social and Cultural Rights, Part III, Article 11 (United Nations, 1966); the Namibian Constitution, the Rural Development Strategy, and the Agricultural Policy.

A rural household shares the policy nexus with the government and donor agencies. It is within the policy nexus-platform that ideas on policy instruments are first generated and later crafted with the aim of improving the livelihoods of rural farming households. Amidst possibilities of emergency reliefs when conditions necessitate such, rural households have their own livelihood and coping strategies from the perspectives of farm, non-farm nature, and remittances.

It is the livelihood and coping strategies which rural people have been employing over the years which sustained them in the past. However, the increasing climate risk factors are making it difficult for rural farming households to manage their day to day lives. Even with various coping strategies being brought on board, the way climate risk affects the livelihoods of farming households requires an entire calculus of tested interventions especially when considering the desire to induce the elements of self-sufficiency. In an attempt to find solutions to problems that affect livelihoods Mahul (2001) studied risk analysis using a production function that leaned heavily on the random weather index and also on production shocks that are not insurable.

The complexity of climate risk factors is found in the fact that climate risk issues are exogenously determined outside the realm of a rural household. In the immediate and short-run period, the common interventions have so far been the provision of food aid and other needed supplies. These support actions are temporal and difficult to sustain as they also depend on economic situations in donor countries. With drought, Iglesias et al. (2007) suggests the need to operate irrigation systems with sustained hydrological resources.

They argue that irrigation reservoirs are essential for water consumption smoothing. While many people in the study area are involved in agriculture in one way or the other, their income sources varies. Both non-farm and farm activities remains important income sources. The extent to which an income source can generate the needed income makes it an important source that needs to be secured.

d) Model

A multivariate regression model was constructed for empirical analysis purposes. The truncated yet unconstrained model inculcates among others the un-biasedness element in its construction. In general, multivariate regression models have been used widely in empirical studies and they take various forms depending of the nature of study including the nature of the data that is available. The model developed in this study can be written using natural log format as follows:

$$LnY = \delta + \kappa_1 Ln\psi_1 + \kappa_2 Ln\psi_2 + \dots \kappa_n Ln\psi_n + \kappa\mu$$

Where Y = Rural household income, κ = Parameters for estimation. Other variables including income differential ones are as follows:

- ψ_1 = Pension,
- ψ_2 = value of livestock in the hands of a rural household expressed in Namibia dollars (N\$),
- ψ_3 = Value of food aid received in a year expressed in N\$,
- ψ_4 = Age of the head of the household expressed in years

ψ_5 = Household size expressed in numbers, and
 μ = Error term.
 LN= Natural Log

Variables are statistically accepted at the 95% level of significance. Considering that drought is less frequent in the Caprivi region compared to flood, flood makes crop farming less reliable and riskier compared to livestock farming. Though flood reduces accessibility to pastoral land, livestock enterprises are much more adaptable compared to crop farming in the study area. In the model, effects of climate risk are implicit in the yield. In other words, at the time a yield is obtained, climate risk factors would have already imputed their effect on the total yield. Thus in the model, income is treated as a proxy that captures the effects of climate risk. Climate risk would trigger a yield risk which may also lead to an income risk, holding all other things constant.

III. RESULTS AND DISCUSSION

a) Socio-economic Features of the Respondents

The respondents who were interviewed have socio-economic characteristics that are displayed in Table 1. In Table 1, the average labour in numbers available to the household during the cultivation and harvesting season is 3 persons. These are adults who supply needed labour to the household. The average income which the household receives per month from all its sources is US\$76.67 with the average remittance received standing at US\$23 per month.

Table 1 : Socio-economic characteristics of respondent

Description	Measurement	Statistics
Average available household labour during the cultivation season	In numbers	24
Average monthly income	In US\$	76.67
Average remittance receipts per month	In US\$	23
Average farm size	In hectares	6
Gender orientation	Ratio of male to female	96:157
Average education level	In years	6
Average household size	In numbers of people	5
Average old age pension	In US\$	54

N = 253; US\$1 = N\$8.20

Remittances are included in the actual income received by households. More women were interviewed compared to men. Respondents spent on average 6 years in school and they came from households with an average family size of 5.

b) Model Output

Variables	Coefficients	Std. Error	T	Sig.
(Constant)	5.674	0.051	111.940	0.000
Ψ_1	0.001	0.000	31.364	0.000
Ψ_2	1.720E-5	0.000	2.223	0.027
Ψ_3	0.010	0.004	2.392	0.018
Ψ_4	0.001	0.001	1.781	0.076
Ψ_5	-0.018	0.017	-1.102	0.271
Adjusted R ²	0.808			

Table 2 above shows the model simulation output. Although not presented in Table 2, the simulation yielded an F test of 220.236 which was based on a 5% level of significance. The associated p-value is 0.000, which makes the model tenable. In Table 2, among the explanatory variables that were entered in the model are: pension (old age and retirement annuities) fund, the value of livestock owned by a rural household and the value of food aid received by a rural household. A variable was considered to be statistically significant when its p-value was ≤ 0.005 . By applying these criteria to the model results, it shows that the three variables pension fund, the value of livestock owned by a rural household and the value of food aid received by a rural household are all statistically significant with p-values of 0.000, 0.027 and 0.018 respectively.

On the coefficient side, a variable may have little impact on the dependent variable but remain statistically significant. An extension on this provides that instead of considering coefficients that are too close to zero as zero, the slopes of their t statistics should not be ignored (Ghadim *et al*, 2005; Alemu *et al*, 2003). Following the insightful view of Ghadim *et al* (2005) and Alemu *et al* (2003), in the current model a unit change in the amount of pension fund in the hands of a rural household could lead to an increase in the income of the respective rural household by 0.001, *ceteris paribus*. A unit increase in the value of livestock in the hands of a rural household could potentially increase household income by 0.00001720 while all other explanatory variables are held constant. Again, a unit increase in the value of food aid received by a rural household has an incremental effect of 0.010 on the income of a rural household.

With regard to the t statistics, pension fund (31.364), the value of livestock (2.223) and the value of food aid (2.392) are all statistically significant. The significance of the t values of the three explanatory variables corresponds in acceptance with their p values, which were discussed earlier. As for the other two explanatory variables, age of the head of a household and household size, their t statistics and p values rendered them insignificant. Overall, the adjusted R² of 80.8% is acceptable in that 81% of the variation in rural income is explained by the explanatory variables that were included in the model.

The results obtained from the model indicate how climate risk affects the rural household. High rainfall and drought have an impact on the income of the household in that the value of food at the disposal of the household may be reduced when climate risk factors are at the extreme. This aspect is implicit in the response variable that was tested in the model, since the total harvest is a function of a number of factors, including rainfall. At the time when a harvest is obtained, climate risk factors would have already had their effect

on the crop produce. Another way to look at it is that when severe climate risk factors are experienced, the value of food aid provided may be reduced owing to the value of own produce in the response variable, which in this context would be very low or non-existent. It is by theoretical implication, that when this happens, it would have a reduced influence on the household income. Though both drought and flood affect livestock, drought can cause a more serious set-back to the livestock of a rural household. The effect occurs in terms of reduced value of livestock owned by the household. Should this occur, there will be a transitory effect on the income of the household.

IV. CONCLUSION

Climate risk factors will increasingly continue to affect rural households. Reliable policies are needed in order to assist rural households to secure their livelihoods through improving their income situations. There is a great need for rolling out climate risk awareness campaigns in rural areas where flood is problematic. Those should take into consideration survival options so that any targeted support measure may fit the needs of the affected households. In line with this consideration, suggesting the needed to introduce new crop varieties with a shorter growth cycle would be vital so that at the time when flood is imminent, such crops would have matured and be ready for harvesting.

As a means to secure incomes of rural households, there is a need to explore the possibility of extending production loans to rural farming households so that when an opportune time comes, they may be able to access the needed inputs for production purposes and have to repay after they have marketed their products. Another area of intervention that needs urgent attention is that of extending research to explore the possibility of rolling-out crop insurance for small-scale farmers. This will add value to current unsecured livelihoods and will also play an important role in reducing income losses at the household level. Therefore, improving incomes would most likely to have a positive impact on the food security situation of rural households and thus reduce the threat from hunger in the study area.

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