The Adequacy of Off-Farm Coping Strategies in Reducing Livelihood Risks Associated With Climate Variability in Dry-Land Farming Areas

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Abstract

The impacts of climate variability and change on the agricultural sector are projected to steadily manifest through changes in land and water regimes. All together affects crop production eventually affects livelihoods. There are varieties of measures that have been taken so far to cope with the situation, off-farm activities being one of the strategies. Therefore, this paper assess as the adequacy of off-farm coping strategies in reducing livelihood risks associated with climate variability. Data were collected from a sample of 150 farming households via questionnaire survey, in five villages located in the upland, midland and lowland areas of Same district of Northern Tanzania along the Pangani river basin. Multistage analysis was used for descriptive and quantitative data analyses. Findings revealed that crop production was low compared to household food needs during 2008/2009 agricultural season. None of the zones managed to produce enough food to sustain entire household for the whole season. Therefore, evidently findings had shown the importance of off-farm activities in rescuing farmers during various shocks, especially when there is crop failure. Sell of livestock and livestock products; small businesses; labour intensive activities; as well as transfer payments were the major off-farm activities used by farmers to supplement the household food and income due to crop failure in the 2008/2009 agricultural season. However, farmers were advised to do most of the off-farm activities which have comparatively high returns with fewer risks.

Key words:
Off-farm Coping Strategies, Adequacy, Climate Variability, Livelihood Risks

1.0 INTRODUCTION

Agriculture is inherently sensitive to climate conditions, and is among the most vulnerable sectors to the risks and impacts of global climate change and variability (Parry and Carter, 1989; Reilly, 1995). Impacts of climate variability and change on the agricultural sector are projected to steadily manifest through changes in land and water regimes. These include changes in the frequency and intensity of droughts, flooding, storm damage, long-term shortages of water and other resources, worsening soil conditions, desertification, and disease and pest outbreaks on crops and livestock. Vulnerable areas are expected to experience losses in agricultural productivity, primarily due to reductions in crop yields (Rosenzweig et al., 2002). Furthermore, increasing use of marginal land for agriculture especially among smallholder farms is anticipated as the availability and productivity potential of land begin to decline.

Consequently people who rely completely on rainwater for survival over the centuries have developed indigenous knowledge and techniques to adapt to those changes (Mbilinyi et al., 2005). Literally there is a variety of documentation about adaptation measures to climate change and variability in the dryland tropics (Pender et al., 2004; Chhibber and Laajaj, 2007), which include on-farm and off-farm management activities. Therefore, the objective of this paper is to assess the adequacy of off-farm coping strategies in reducing livelihood risks associated with climate variability.

2.0 STUDY AREA AND METHODOLOGY

This study of off-farm coping strategies in reducing livelihood risks associated with climate variability in dry-land farming areas was conducted in Same, one of the six districts of the Kilimanjaro region in Tanzania. The district is bordered to the north by the Mwanga district, to the northeast by the republic of Kenya, to the south and southeast by the Tanga region, and to the west by the Manyara region. It is located between Longitude 37o55' E and 4o15' S. The district covers an area of approximately 5730 square kilometres. According to the 2002 Tanzania National Census, the population of Same district was 212 235 (URT, 2002).

Same district is a plain area with an altitude between 600 m and 1000 m above the mean sea level. The lower areas are dry semi-arid whose people deal with mixed

farming systems entailing grazing, rain-fed, and irrigated agriculture along the strip of the Pangani River. The rainfall pattern is bimodal, with mean annual total of 400 to 600 mm in the lowland to midland and around 800 to 1200 mm in the upland. Of the total rainfall, about 200 mm are received in the short rainy season which starts in November and extends to January (locally called 'Vuli') and 400mm in the long rainy season which starts in March and extends to May (locally called 'Masika') . This rainfall pattern distinguishes the district into semi-arid mid to lowland and sub-humid upland dry-lands. Evaporation in the semi-arid dry-lands varies between 3.0 – 5.4 mm per day with an annual long-term average of 1575 mm per year (URT, 2002). With such excessive potential evapo-transpiration compared to cumulative seasonal rainfall the farming system especially in the semi-arid part suffers from agricultural water stress.

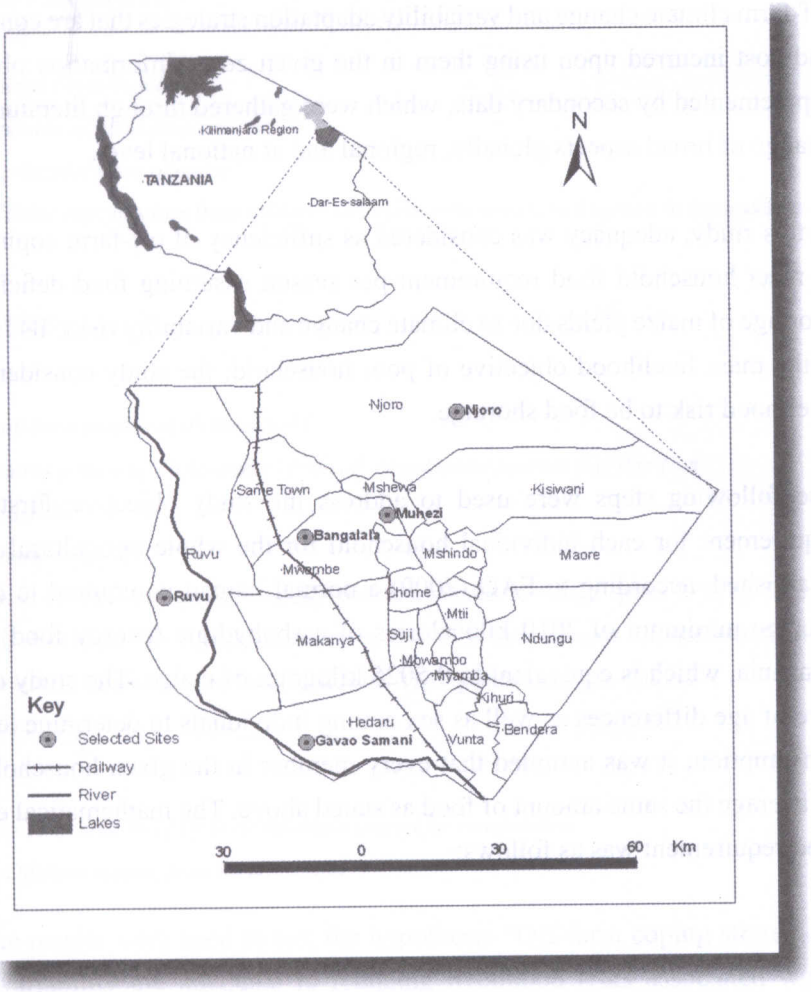

Figure 1: Map of the study area

The study involved five villages, purposively selected based on rainfall pattern and topography. Based on the theory of central limit, sub-humid upland dry-land was represented by 50 farmers from Mhezi and upper part of Gavao-saweni villages of which 25 farmers were from each village, mid-land semi arid was represented by another 50 farmers from lower part of Gavao-saweni and Bangalala villages also 25 from each village, while other 50 farmers from Njoro and Ruvu-mferejini villages with the ratio of 25 from each village were representing lowland semi-arid, all making a total sample of 150 farmers randomly selected.

Data were collected using questionnaire and checklist for Focus Group Discussion (FDG). The information collected included types of crops grown, livestock kept, off-farm climate change and variability adaptation strategies that are commonly used and cost incurred upon using them in the given zone. Information obtained were supplemented by secondary data, which were gathered through literature review on a range of broad aspects globally, regional and at national level.

In this study, adequacy was considered as sufficiency of off-farm coping strategies to meet household food requirement per season assuming food deficit caused by shortage of maize yields due to climate change and variability risks. Its food security is the main livelihood objective of poor household; the study considers the major livelihood risk to be food shortage.

The following steps were used to address the study objective:-First step; food requirement for each individual household for the whole agricultural season was established, according to FAO (2009) a normal human is required to consume an average minimum of 2010 kilocalories of carbohydrate (energy food) per day in Tanzania, which is equivalent to 0.5025 kilogram of maize. The study did not take care of age differences as well as sex among individuals to determine level of food consumption; it was assumed that every member in the given household consume on average the same amount of food as stated above. The mathematical equation for food requirement was as follows:-

$$QFR_i = HS_i \, X \, APC'_i \quad \ldots\ldots(1)$$

$$APC'_i = 0.5025 \text{ kg of maize } X \text{ 365 days} \quad \ldots\ldots(2)$$

Where:

QFR= Quantity of Food Required by the household

HS= Household size

APC' = Average Personal Consumption per year

i= ith household

Second step; the food requirements were converted into cash value by multiplying with market price for maize to have a valued food required. The equation for that is as follows.

$$VFR_i = QFR_i \, X \, Mrkt\,\mathrm{Pr}_{mz} \quad \ldots\ldots(3)$$

Where:

VFR=Valued Food Required

QFR=Quantity of Food Required

$MrktPr_{mz}$=Market price of maize

i=ith householdThird step; incomes from off-farm strategies were established as seen in the equation 4 bellow:-

$$Offinc_i = \sum_{j=1}^{n} rtns_j \quad \ldots\ldots(4)$$

Where:

$Offinc_i$=off-farm income of ith household

$Rtns_j$=returns gained by ith household from off-farm income sources (i.e. jth=1...n)

i=ith household

$\sum$=summation sign

Fourth step; based on the valid assumption that poor households in Africa spend 75% on food products and only 25% on non-food products, therefore 75% of off-farm incomes was deducted from off-farm income and the result was used for computation. The equation used is as follows

$$Toffinc_i = 0.75 X \, Offinc_i \quad \ldots\ldots(5)$$

Where:

$TOffinc_i$= Total amount of off-farm income required for computation

$Offinc_i$=Off-farm income from ith household

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Therefore, the results were used to test the hypothesis "Off-farm coping strategies for climate variability are adequate in reducing livelihood risks associated with climate variability"

3.0 RESULTS AND DISCUSSION

In this study, food shortage was considered as the major livelihood risk faced by different households. Therefore, this section presents the findings on the ability of off-farm coping strategies through the money value they can raise to cover the cost of purchasing food in case of yield risk resulting from low production or crop failure due to climate change and variability

3.1 Off-farm Coping Strategies

It was observed that major off-farm activities that were used to cope with yield risk caused by climate change for the agricultural season of 2008/2009 were selling of crops, selling of livestock, selling of livestock products, small business, labour intensive activities (i.e. brick layering, hired labour in farm activities), income received by households as social transfers (i.e., remittances), food aid and reduction in the number and size of the meals taken per day.

Results in Figure 2, show that midland villages had the highest proportion of those used these strategies across all the strategies, followed by upland and lastly lowland. This is evidence that the midland zone was highly affected with the climate changes and variability compared to other remaining zones.

Figure 2 also shows that, in lowland villages food aid was not wide spread compared to upland and midlands (48% and 100%, respectively), this is due to advancement of small business activities conducted in this zone which is favoured by location and transportation facilities available in lowland zone. Moreover, results in Figure 2, indicate that selling of livestock was not very important in upland villages (40%) compared to the other zones (i.e. 84% mid-land and low-land). Small number of animals kept, the high cost of production being the reason behind this circumstance. Therefore, people might not rely much in such business compared to crop business which is more important as it seen in Figure 2.

Moreover, upland villages appeared to command little social transfers (24%) compared to other zones (i.e. Midland and lowland villages, 42% and 44%, respectively). In African context, source of most of social transfers are basing on

remittances received from children and close relatives who are well-off; in this study upland villages appeared to have little households' heads aging more that 55 years, which is an age for one to have children able to support their parents through remittances. Therefore, the return from such activity would be small.

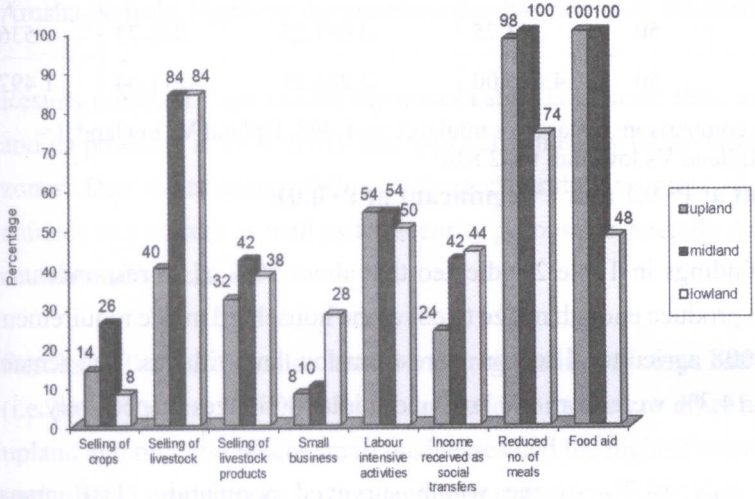

Figure 2: Off-farm Coping Strategies

3.2 Comparison of Maize Produced and Household Food Requirement

Major livelihood risk that was observed in the study area was shortage of food due to climate variability. It was observed that maize produced in the 2007/2008 season did not surpass the need from household consumption. According to FAO (2009), a normal human (i.e., do not account age and type of work) is required to consume an average minimum of 2010 kilocalories of carbohydrate (i.e., energy food) per day in Tanzania, which is equivalent to 0.5025 Kilogram of maize. Results in Table 1 indicate huge difference between maize harvested and household's maize requirement in all three zones in the 2008/2009 season.

However, lowland and upland zones were relatively better in terms of food deficit compared to midland zones (i.e. mean -643.27 and -211.04 for upland and lowland, respectively). This was due to the fact that the production level of midland in that agricultural season was very low to cover the household food demand for the whole season.

Table 1: Comparison of Maize Harvested and Household Maize Requirement in 2007/2008 Agricultural Season [units in Kgs of maize]

Location	n	Max	Min	Mean	Std. Dev
Upland	50	1 587.50	-1 953.13	-643.27	726.702
Midland	50	343.75	-2 081.25	-848.73	536.86
Lowland	50	4 675.00	-2 281.25	-211.04	1 497.00
Difference comparison: Upland Vs midland: t=-1.498, Upland Vs lowland: t = -1.798*, Midland Vs lowland: t= -2.838**					

***Significant at P<0.1 and **Significant at P<0.01**

However, findings in Table 2 indicated that about 50% of 28 respondents who managed to produce enough maize to cover the household maize requirement for the 2007/2008 agricultural season were from lowland villages. The remaining 35.7% and 14.3% were from use land and midland villages respectively.

Generally, only 18.7% of the whole surveyed population (150) managed to produce enough food for the 2007/2008 agricultural season. This level of production made local communities in surveyed area to engage themselves into off-farm activities aiming at supplementing the household income especially for the 81.3% who did not produce enough. It was observed that business became an important activity for coping with the situation whereby selling of crops, livestock and livestock were predominant coping strategies. Others were causal labour based works such as mining, charcoal making, bricks making and fishing.

Table 2: Households Managed to Cover Food Required per Season (N=28)

Location	n	%
Upland	10	35.7
Midland	4	14.3
Lowland	14	50

3.3 Incomes from Off-farm Coping Strategies

Findings in Table 3 indicate that, at least every household in surveyed area had an off-farm activity that supplement household income primarily to buy food and if possible to have surplus for other household expenditures. Table 3

shows that lowland zone had higher average income (i.e. mean income 656 011) compared to other two zones. This means on average lowland zone had higher off-farm incomes than the other two; this is due to many business opportunities available. It should be noted that, the lowland zone is in proximity to the Dar-Arusha-Nairobi Highway the situation that has favoured businesses.

Results obtained from the survey area (Table 3) indicate that, selling livestock and its products is the activity that was performed by many farmers in all three zones. Due to its compatibility with crop production most of them do keep animals as a culture as well as for security purposes especially during social and economical shocks.

Results in Table 3 also show that, on average selling of crops had highest returns (i.e. mean income 945 000) in the lowland compared to other activities unlike upland and midland where small businesses had the highest returns. Due to high agricultural productivity in lowland compared to upland and midland zones especially for the 2007/2008 agricultural season, lowland villages became an important supplier of food around study area, this made selling of crops more profitable.

However, results also indicate that few respondents were engaged in highly paid activities in all three zones, i.e. only 8% and 10% for those who did small business in upland and midland villages, respectively. While in lowland villages, those involved in selling crops were only 8%. This findings are in line with Saxowsky and Wachenheim (2001), who argued that profits accrued not to the management but to those willing and able to bear the risk inherent in production.

Table 3: Incomes from Off-farm Coping Strategies (N=150)

	n	%	Min	Max	Mean	Std. Dev.
Upland						
Livestock income	49	98	0	1 000 000	121 402	228 065
Casual labour	26	52	40 000	108 000	87 154	23 854
Remittances	12	24	20 000	300 000	100 417	95 023
Selling of crops	7	14	45 000	168 000	95 714	51 279
Small business	4	8	50 000	800 000	437 500	309 233
Overall	**50**	**100**	**30 000**	**1 800 000**	**236 794**	**286 901**
Midland						
Livestock income	44	88	0	3 922 000	298 157	734 396
Casual labour	27	54	18 000	360 000	80 111	68 202
Remittances	21	42	20 000	890 000	181 667	219 176
Selling of crops	13	26	15 000	168 000	80 769	58 983
Small business	5	10	50 000	800 000	506 000	308 513
Overall	**50**	**100**	**30 000**	**4 920 000**	**453 538**	**847 832**
Lowland						
Livestock income	47	94	0	745 000	201 267	211 164
Casual labour	25	50	40 000	2 588 000	279 160	515 859
Remittances	22	44	20 000	1 380 000	177 500	274 776
Small business	14	28	60 000	3 120 000	619 786	845 874
Selling of crops	4	8	360 000	1 920 000	945 000	705 668
Overall	**50**	**100**	**60 000**	**4 071 000**	**656 011**	**781 455**

Overall income comparison by location: Upland Vs midland: t = -1.712*, Upland Vs lowland : t = -3.561**, Midland Vs lowland : t = -1.242

***Significant at P<0.05 and **Significant at P<0.01**

Furthermore, results in Table 3 indicated that in all the three zones slightly over a half of respondents in upland, midland and lowland villages were involved in casual labour activities which entirely involves selling of labour. This was

due to poor harvest for the past two agricultural seasons (i.e., 2006/2007 and 2007/2008), therefore most of the people decided to sell their labour to earn something for their survival.

3.4 Ability of Off-farm Coping Strategies to Cover Household Food Requirement

This study considered the difference between costs of purchasing maize in the available markets and the income gained from off-farm activities to measure the coverage ability. Price per kg of maize in the 2008/2009 agricultural season and the average households' maize requirement per year were used to have the cost of maize a given household needs per year. In other hand, total revenue and amount of money received from off-farm activities were used as income gained from those activities.

The overall ability or adequacy of off-farm incomes in the lowland was highly significant ($P<0.01$) in comparison to both upland and midland off-farms incomes (Table 4). This is reflected in the positive figure for mean difference in income from off-farm activities (i.e. 231 235) and the monetized food requirement compared to negative figures (i.e. -120 750 and -60 962) for upland and midland, respectively. As explained earlier in the methodology, the mean income difference is obtained after deducting 25% from income which is normally spent on non-food items, this was influenced by the various business opportunities that are available in lowland zone which increases money circulation and therefore increases the purchasing power, hence, improving the adequacy of off-farm activities in covering the food requirements.

Moreover, results in Table 4 indicate that midland villages suffered most compared to upland and lowland villages. It was observed that only 14% (Table 4) of respondents from midland villages managed to cover food requirement for the whole 2007/2008 agricultural season from income gained from off-farm activities. This is due to little returns received by individuals from off-farm activities in midland zone.

However, results in Table 4 show the number of household managed to cover food requirements for the whole season for the other two remaining zones (i.e.,

upland and lowland) was less than 50% of the total number of respondents for both zones. This was due to breakdown of farming activity which is the main economic activity of individuals in study area caused by climate variability.

Table 4: Ability of Off-farm Coping Strategies to Cover Household Food Requirement

	N	%	Min	Max	Mean	Std. Dev.
Upland						
Have ability	11	22	2 820	200 445	73 573	73 136
Have no ability	39	78	-506 773	-18 637	-247 834	124 634
Overall	50	100	-533 625	1 296 300	-120 750	285 798
Midland						
Have ability	7	14	23 246	2 983 862	1021 171	1 052 315
Have no ability	43	86	-882 769	-2 630	-385 355	213 491
Overall	50	100	-816 500	4 560 000	-60 962	898 056
Lowland						
Have ability	20	40	448	2569 041	560 457	655 604
Have no ability	30	60	-492 761	-37 052	-179 061	119 960
Overall	**50**	**100**	**-879 600**	**3675 000**	**231 235**	**791 058**
Overall comparison of ability by location: Upland Vs Midland: t=-0.593, Upland Vs Lowland: t=-4.053*, Midland Vs Lowland: t=-7.627						

*significant at P<0.001

4.0 CONCLUSIONS AND RECOMMENDATIONS

From the finding this study concludes that, crop production was low compared to household food needs during 2008/2009 agricultural season. None of the zones managed to produce enough food to sustain entire household for the whole season. However the findings underscore the importance of off-farm activities in rescuing

farmers during various livelihood shocks, especially when there is crop failure. Sell of livestock and livestock products; small businesses; labour intensive activities; as well as transfer payments were the major off-farm strategies used by farmers to cover household food shortage due to crop failure in the 2008/2009 agricultural season.

Although off-farm activities have shown a vital role in reducing livelihood risks, farmers are advised to do most of the off-farm activities which have comparatively high returns with fewer risks. Therefore, livestock keeping is more advisable to rural people as animals can be kept not only for security purposes during the time of shocks but also as a business aiming at increasing household income, since livestock found to have high returns during sells.

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