University of Nairobi

College of Biological and Physical sciences

School Of Mathematics

"A statistical method of Assessing Socio-economic benefits of weather in information"

A project Submitted to the School of Mathematics in Partial Fulfillment of a Degree of Master of Science in Social Statistics

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By

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Declaration

I the undersigned declare that this project is my original work and to the best of my knowledge has not been presented for the award of a degree in any other university

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Dedication

To my fiancée Irene

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Chapter One

INTRODUCTION

1.1 Overview of the study

The government exists in principle to provide collective means to protect their citizens from harm and enhance overall benefits to the society. They work to achieve these objectives through a combination of information and provision of services, regulations, payments and inducements, based on tax rates set to achieve monetary as well as societal benefits (Gordon McBean 2008)

The provision of services, including information, must be paid for through taxes generated. The national Meteorogical-Hyrological Services (NMHS) provides Meteorogical-Hyrological information to various stakeholders. As of spring 2008, almost all countries of the world,188 countries, have become members of the world Meteorological Organization, indicating their national interest in meteorology and having their own NMHS or equivalent organization

Protection of citizens includes provision of information and appropriate warning of weather related events. The number of disasters where communities are impacted beyond their capacity to cope with local resources has risen dramatically (at about a factor of six over the past four decades) and more of the 75% trigger events are hydro meteorological (storms, floods, droughts)and related events There is hence a strong need for those services which should be a central role of the government(Adger N. Arnella,2004)

In most cases this role is entrusted to the National Meteorological-Hydrological Service(NMHS) in partnership with emergency management organizations. From an NMHS perspective, the user for these services are directly or indirectly, citizens and the emergency management organization and often an intermediary user and the media in all it,s form. Hence, the first of the NMHS user communities are all citizens, especially those vulnerable to weather and weather related stresses and the media as a partner of delivery of this service and their benefits

Governments also act to enhance the national economy and generate benefits that occur both directly to individuals, such as subsidies, allowances, etc and also indirectly through enhancing the economy. It is is this second aspect that the government plays a role.A government role is the provision of services, including information, to society such that society is more efficient, less impacted and otherwise enhanced. In this case, the user communities of the NMHS are a wide variety of weather sensitive sectors of society and the economy

Most socio-economic sectors in Horn of Africa are sensitive to weather/climate conditions. Over 80% of disasters of natural origin are weather/climate related, extreme climate/weather events often result in severe socio-economic impacts such as scarcity of food, water and energy, with adverse impacts on human health, economy and the environment (D.Runnalls 2006)

Available climate information if properly used can ;(1) reduce risk and enhance production (2) identify suitable activities for specific areas and (3) Design appropriate infrastructure in climate dependent sectors.

There has been increased appreciation of the role that climate plays in the lives of Kenyans in recent years. This awakening has been occasioned by an increase in intensity and frequency of occurrence of extreme climate events such as severe droughts and flooding.

This has caused increased demand for more specialized and accurate weather and climate predictions and advisories. The response to these needs has resulted in establishment of mechanisms that might enable the country adapt to climate variability.

These mechanisms include formation of the National Disaster Management Authority. Another adaptation mechanism addresses dissemination of weather and climate information to rural communities named the Radio Internet project (RANET). There is also a coping mechanism for development of climate reporting in Kenya that resulted in formation of the Kenya Network of Journalists and Meteorologists (KENJOM).

The meteorological service has also embraced the concept of integrated approach to issues by working with users and professionals from other sectors to develop climate Products that are more readily applicable to specific fields. A strategy for enhancement of the capability of the Kenya Meteorological Department (KMD) to render better service has also been adopted.

In spite of the sensitivity of various socio-economic sectors to climate variability. The use of climate product has not been fully utilized. Furthermore the providers of weather information do not have adequate capacity to deliver appropriate climate products and services for the benefit of the key socio-economic sectors. This has diminished the visibility and relevancies of the service providers at National levels.

In the recent years there has been increased interest by the providers of the metrological, hydrological and climatological services to attempt to asses and quantify the socio-economic benefits of such services to various economic sectors. This has been as a strategy to meet one of the major challenges facing governments worldwide, especially developing ones, which is the attainment of sustainable socio-economic development

1.2. Problem Statement

The metrological department provides weather –related services to a wide range of users, who include the general public, specific economic sectors and policy makers. However most of the users lack a clear and precise understanding and recognition of the impact of the products and services they require or use. The service providers also have inadequate information on the benefits derived by users from their products. The Purpose of this study is to quantify the benefits of weather information by comparing the companies that used weather products to those that did not during 1999/2000 Eli Niño The knowledge that information and forecasts of weather and climate bring socio-economic benefits could be used in decision making and in turn make it possible to prevent economic damage

1.3. General Objective

To find out on the factors that affect the use of weather products and the benefits derived from the use

1.4. Specific Objectives

1. Develop a logistic model on factors that affect use of weather products

2. Develop a model on the use of climate information and the extent of losses among the Hydropower Companies

1.5. Data and Methodology

A structured questionnaire was developed and a number of 49 companies in Nairobi interviewed as respondents. The companies were classified according to zones i.e. Kasarani/Westlands, Nairobi Central/Embakasi, Embakasi C, Embakasi B and companies selected from each zone. We use logistic regression to fit a model with use of weather information as a response variable comparing it other variable and the extend of loss of this companies as a result of the level of use of weather products

1.6. Literature Review

An appropriate place to start interms of theoretical framework is a paper by Freebairn and Zillman (2002).Responding to the need to for a more rigorous and more broadly based determination of the economic value of meteorological services, they provide the background on approaches. They suggest that these could be used as an aid to decision making on the appropriate level of funding to be commited to their provision at the national level.First they note that in economic terms, meteorological infanstructure and weather, climate and air quality forecasts and warnings have no rival consumption or use properties.

This means that the economic benefits to society from meteorological services are given by the sum of benefits by the very many and diverse users of the services, both now and in the future. To clarify, the non –rival economic sense means that once the information is available, its use by one set of the users does not reduce the information available for use by other users. This often referred to as public good services. In this case the total benefits and marginal benefits functions of meteorological services with non rival consumption properties should be the sum of benefits for all users.

The very many and diverse users makes it inherently difficult to evaluate all their benefits. They provide analysis as to how to determine these functions, at least in theory. Within these approaches there are four main methodologies that are appropriate for use in valuation studies: market prices, normative or prescriptive decision making models, descriptive behavioral response studies and contingent valuation studies (Agardy et al. 2005)

The market technique has applicability for those services which have private good characteristics of rival consumption and ease of exclusion. Where there are mixed public and private goods, some measure of benefits gained may be ascertained from market prices. For the areas where public services dominate, there is very limited applicability of market prices for valuing meteorological services.

Prescriptive or normative models are the most common set of techniques used to estimate the benefits of meteorological services. Simplified optimizing decision models under conditions of imperfections at knowledge about weather or climate conditions are solved for different levels of meteorological services provided. The gain in expected payoffs, including more profits, lower costs and higher utility, are a measure of the marginal benefits of the increased services. Changes in decisions following the use of extra or better meteorological information are assumed not to alter the decisions of others, nor to change the prices of outputs or the costs of inputs. Excellent descriptions of the procedures and example are given by Johnson & Holt (1997) and Katz & Murphy (1997b)

Descriptive behavioral studies can be used to make estimates of the value of meteorological services by inferring values from the observed behaviors of individuals, businesses and governments as determined by user surveys of decision making. Descriptive studies are considered more realistic, in comparison to prescriptive in that they are based on, and recording, actual -behaviour.However in attributing changes in decisions and extra benefits to meteorological services and to increases in the volume of metrological services, a common difficulty is that other parts of the decisions environment are also changing. Asking questions about decisions responses to increase in the volume of meteorological services involves hypothetical situations which make vulnerable to the same criticisms as those raised against prescriptive studies.

Contingent Valuation methods are sometimes used to estimate the benefits of public goods by asking users to nominate the sum they would be willing to pay for a particular level of public good. Although the procedure is somewhat controversial, the contingent valuation method has been used to obtain estimates of the value of meteorological services. A sample of users, which maybe individuals or businesses asked to provide information. It is best if these users are a random sample. The direct interviewing method, which is costly, is considered necessary to ensure respondents fully understand the context of 'willingness to pay' questions and to follow for cross checking of answers. For example ,users may be asked what would they be willing to pay to have access to currently available general forecasts relative to no forecast; or if the accuracy of rainfall forecasts for the next season were to be increased by 50%,what would they be willing to pay for this extra accuracy?

Gunasekera analyzes further these approaches and adds other approaches. Conjoint analysis is similar to contingent valuation in that it also uses a hypothetical context in a survey format involving users of hypothetical information. It requires survey respondents to rank or rate multiple alternatives where each alternative is characterized by multiple attributes. This enables the estimation of the value consumers derived from various attributes of such information

In my case we introduce Binomial logit models to asses different levels of use of weather information. Binomial logit are used to model relationships between a binary response variable and a set of regressor variables

Chapter Two

Generalized Linear Models

2.1. Basic Concepts

2.11 Linear Regression

A classical linear model involves a relationship of the form

Response=Pattern + Residual

Where the residual represents measurement error. as well as any variation unexplained by the linear model. This model assumes a Gaussian (Normal) distribution for the response variable and an identity link

The linear Regression is limited by three main assumptions namely:

1. The errors are assumed to be identically and independently distributed: this includes the assumptions that the variance of Y is constant across
2. The errors are assumed to follow a normal distribution
3. The regression function is linear in the predictors

2.12. Generalized Linear Models

This is a mathematical extension of linear model that allows for non-linearity and non-constant variance structures in the data. This model is defined interms of a set of independent random variables $Y_2, \ldots\ldots, Y_N$ each with a set distribution from the exponential family (Binomial, Poisson, Gamma, Negative Binomial and Normal) and has the following properties

1. The distribution of Y_1 has the canonical form and depends on a single parameter θ_i (the $\theta_i's$ do not all have to be the same), thus

$$f(y_i;\ \theta_i) = \exp\left[b_i(\theta_i) + c_i(\ \theta_i) + d_i(y_i)\ \right] \qquad (2.1)$$

Where b, c and d are known functions

2. The distribution of all the Y's are of the same form so that the subscripts on b,c and d are not needed. Thus the joint probability density function of $Y_2, \ldots\ldots, Y_N$ is

$$f(y_1 \ldots\ldots y_N; \ldots\ \theta_1, \ldots\ldots \theta_N) = \prod_{i=1}^{N} \exp\left[\ y_i b_i(\theta_i) +\ C_i(\theta_i\ ) + d_i\ (y_i)\right] \qquad (2.2)$$

$$= \exp\left[\sum_{i=1}^{N} y_i b_i\ (\theta_i) + \sum_{i=1}^{N}\ C_i(\theta_i\ ) + \sum_{i=1}^{N} d_i\ (y_i)\right]$$

The linear relationship between predictors X and a response variate $\underline{y}$ is given by

$$\underline{y} = X\underline{\beta}\ + \underline{\varepsilon} \qquad (2.3)$$

Where $E(\underline{y})=\underline{\mu}$, $V(\underline{y}) = \sigma^2 I_N$ and $\underline{\mu} = X\underline{\beta}$

The vector $\underline{\varepsilon}$ is the the error term that measures the discrepancy of the fitted model and observed data.The error terms are assumed to be normally distributed with zero mean and the unit variance, and $\underline{\beta}$ is a set of unknown regression coefficients. Equation (2.3) is often referred to as the generalized linear model and has three components namely

1. Systematic part (or the linear predictor) given by $\eta_i = x_i^T \beta$
2. Random component Y_i s are independent and random variables with mean

   $E(Y_i) = \mu_i$ a member of the exponential family of distributions
3. A link function $g(\mu_i)$ η_i =where $g(\mu_i)$ is a differential function. We notice that

   for a canonical link. $\theta i = \eta_i$ and for GLMs. $E(Y_i) = \mu_i = k'(\theta_i)$

   Also $Var(Y_i) = a_i(\emptyset)k''(\theta_i) = a_i(\emptyset)v(\mu)$ .where $v(\mu)$ is the variance function. It

   can also be shown that $\theta_i = (k')^{-1}[g^{-1}(\eta_i)]$

2.13.Exponential distribution family

The distribution of a random variable y_i (with mean μ_i) is said to belong to the exponential family if it has a probability density function or a probability mass function of the form

$$f(y_i; \theta_i, \emptyset) = \exp\left[\frac{y_i\theta - b(\theta_i)}{a(\emptyset)} + C(y_i.\emptyset)\right] \quad (2.3)$$

Where $\emptyset$ is a constant dispersion parameter, θi is the natural or canonical parameter that can be expressed as some function of mean μ_i and kθ_i is a cumulant generating function.Among many of the common distributions that are known to belong to this distribution include:Normal,Gamma,Poisson and Binomial

2.14.Logistic Regression for Binary Data

Logistic regression models are the most widely used models as a parametric tool for modeling binary data. In Biomedical studies which (in the past two decades) has seen much use in social science research and marketing. Recently, logistic regression has been used in business applications. Some credit -scoring applications use logistic regression to model the probability that a subject is credit worthy. A company that relies on catalog sales may determine whether to send a catalog to a potential customer by modeling the probability of a sale as function of indices of past buying behavior

Consider the explanatory variable X of a binary response variable Y and let

$$\pi(x) = \text{Prob}(Y = 1 / X = x) = 1 - Prob(Y = 0/X = x) \tag{2.4}$$

This gives yield to logistic regression model;

$$\prod(x) = \frac{\exp(\alpha+\beta x)}{1+\exp(\alpha+\beta x)} \tag{2.5}$$

In this model, the log-odd, which are also called *logits* has the linear relationship given by

$$logit[\prod(x)] = log\ [(\ \prod(x))/(1-\prod(x))] = \alpha + \beta x, \tag{2.6}$$

Which is the logit link function to the linear predictor. The sign of the β log-odds determines the slope of the curve i.e. whether ∏(x) is falling or rising. For quantitative x with β >0, the curve of

$\prod(x)$ has the shape of the cumulative distribution function of the logistic, and since the logistic distribution is symmetric, then the $\prod(x)$ approaches 0 and 1 at the same rate

2.15. Multinomial logistic Regression

Multinomial distribution provides the basis for modeling categorical data with more than two categories. Considering a random variable Y with J categories. Let $\pi_1, \pi_2, .. \pi_j$ denote the respective probabilities, with $\pi_1 + \pi_2 + \cdots \pi_j = 1$. If there are n independent observations of Y which result in y_1 outcomes in category 1, y_2 outcomes in category 2 , and so on, then

$$\text{Let } y=\begin{bmatrix} y_1 \\ \vdots \\ y_j \end{bmatrix}, \text{ with } \sum_{j=1}^{J} y_j = n.$$

The multinomial distribution

$$f(y|n) = \frac{n!}{y_1! y_2! \ldots y_j!} \pi_1^{y_1} \pi_2^{y_2} \ldots \pi_j^{y_j} \tag{2.7}$$

If $J=2$ then $\pi_2=1-\pi_1$, $y_2=n-y_1$ and the above formula is the binomial distribution.

2.16. Nominal logistic Regression

Nominal logistic regression is used when there is no natural order among the response categories. One category is arbitrarily chosen as the reference category. Suppose this is the first category.Then the logits for the other categories are defined by

$$logit(\pi_j) = \log\left(\frac{\pi_j}{\pi_1}\right) = x_j^T \beta_j, \quad for\ j = 2, \ldots j. \tag{2.8}$$

The (j-1) logit equations are used simultaneously to estimate the parameters β_j. .Once the parameter estimates b_j have been obtained.the linear predictors $x_j^T \beta_j$, can be calculated

$$\hat{\pi}_j = \hat{\pi}_j \exp\left(x_j^T b_j \right) \text{ for j=2....J} \quad (2.9)$$

But $\hat{\pi}_1 + \hat{\pi}_2 + \ldots \hat{\pi}_j = 1$ (2.91)

So

$$\pi_1 = \frac{1}{1+\sum_{j=2}^{J} \exp\left(x_j^T b_j\right)} \quad (2.92)$$

And

$$\pi_j = \frac{\exp\left(x_j^T b_j \right)}{1+\sum_{j=2}^{J} \exp\left(x_j^T b_j\right)}. \text{ for j=2....j} \quad (2.93)$$

Fitted values, or 'expected frequencies', for each covariate pattern can be calculated by multiplying the estimated probabilities $\hat{\pi}_j$ by the total frequency of the covariate pattern

The Pearson chi-squared residuals are given by

$$r_i = \frac{O_i - e_i}{\sqrt{e_i}} \quad (2.94)$$

Where O_i and e_i are the observed and expected frequencies for i=1,....N where N is J times the number distinct covariate patterns.The residuals can be used to assess the adequacy of the model

Chapter 3

Analysis Output

3.1. Variable Description

1. **Info:-**This is a binary description defined as 1 if climate plays a significant role in the company's production process and 2 if not
2. **Q5:-**This is a binary variable defined as 1 if the respondent uses weather information and 2 if he does not use
3. **Q6 :-**This is a polytomous variable ,with 5 categories. It finds out from the respondent that do not use weather products, whether they will be interested and how frequent they will be interested in this products
4. **Q7:-** This is a polytomous variable, with 5 categories. It finds out from the respondent the type of weather information the company requires for it's operations
5. **Q9:-**This is a polytomous variable with 5 categories.It shows the respondent's source of weather information
6. **Q16:-**This is a binary variable, defined by 1 if the company generates his own electricity and 2 if the company does not
7. **Q18:-**This is a polytomous variable of 5 categories, it shows the frequency of the company's experience with losses due to extreme weather conditions
8. **Q26:-**This is a binary variable defined by 1 if the company suffered a major loss due to power rationing and 2 whether the company did not suffer any losses

9. **Q27:**-This is a binary variable defined by 1 if the firm withheld any investment due to frequent power rationing and 2 if it did not
10. **Q30:**- This is a binary variable defined by 1 if the firm lost it's market share due to frequent power rationing and 2 if it did not
11. **Q33:**- This is a binary variable defined by 1 if the firm laid of workers/staff due to frequent power rationing and 2 if it did not
12. **Q32:**- This is a binary variable defined by 1 if the firm damaged any equipments due to frequent power rationing and 2 if it did not

3.2 .Exploratory data analysis

Table 3.1: Summary statistics of the variables used

Variable and Category	Count	Percent	Test of Significance
Gender			
• Male	40	81.6	0.007
• Female	9	18.6	
Level of Education			
• Secondary	2	4.1	
• High School	3	6.1	0.0167
• Technical College	10	20.4	
• University	34	69.4	
Respondent's position within			
• Director	5	10.2	
• Manager	24	49.0	
• Supervisor	10	20.4	0.000
• Senior Employee	8	46.3	
• Others	2	4.1	
Is climate information Significant to the company?			
• YES	25	61	.516
• NO	16	39	
Use of Weather information		63.3	
• Use	31	36.7	.605
• Do not use	18		
Company not using weather information whether interested			
• Interested	49	100	.616
• Not interested	0	0	
Type of weather information Required			
• Rainfall	25	78.1	
• Temperature	4	12.5	.0026
• Others	3	9.4	
Sources of climate information			
• Kenya Meteorological Department	25 4 5	78.1 12.5 9.4	.0034
• Television and Radio			
• Others			

Variable and Category	Counts	Percentage	Test of Significance
Factors of choice of source of weather information			
• Timeliness	3	8.1	
• Accuracy	4	10.8	
• Readily Available	26	70.3	.006
• No charging of info. Provided	3	8.1	
• Others	1	2.7	
Frequency of Use of weather Info.			
• Daily	7	17.5	
• Monthly	1	2.5	.712
• Seasonally	20	50	
• Others	12	30	
Services on weather provided by KMD/ICPAC that are known			
• Daily forecasts	26	81.3	
• Weekly forecasts	4	12.5	.006
• Monthly forecasts	1	12.0	
• Seasonal forecasts	1	12.0	
Services provided by KMD/ICPAC that are easily accessible to the respondent			
• Daily forecasts	35	92.1	
• Weekly forecasts	3	7.9	
• Monthly forecasts	0	0	
• Seasonal forecasts	0	0	0.112
Whether willing to pay weather services if commercialized	35	92.1	0.341
• Yes	3	7.9	
• No			
Generation of own electricity			
• Yes	25	51	0.245
• No	24	49	
Major loss due to extreme weather	25	51	
• Yes	24	49	0.056
• No			

Table 3.4: Cross tabulation Of Baseline Factor and Use of Weather Information

Factor	Yes	Chi-square(d.f)	P-Value
Gender 1.Male 2.Female	27(87.1%)	1.7(1)	.195
Education 1. Secondary 2.High School 3.College 4.Universty	2(6.5%) 21(3.2%) 8(25.8%) 20(64.5%)	3	.283
Occupation 1.Director 2.Manager 3.Supervisor 4.Senior Employees 5.Administrator	4(12.9%) 16(51.6) 5(16.1%) 4(12.9%) 2(6.5%)	4.277(1)	0.518

Table 3.5: Cross Tabulation between Use Of Weather Information And Factors

Factor	Yes	Chi-square(d.f)	P-Value
Type of weather info. required 1.Rainfall 2.Temperature 3.Wind and Speed	18(90%) 1(5%) 1(5%)	4.452(2)	.0108
Source of weather Inform 1. Kenya Met. Depart 2.T.v&Radio 3.Local and International Media 4.Internet Mobile	19(61.3%) 10(32.2%) 1(3.2%) 1(3.2%)	3.854(3)	.0208
Generation of Own Electricty 1.Yes 2.No	1(3.4%) 28(96.6%)	4.277(1)	0.030
If a company has suffered loss in sales 1.Yes 2.No	1(3.4%) 28(96.6%)	1.091(1)	.0296
Whether staff were laid off 1.Yes 2.No	7(22.6%)	.245(1)	.620
Perception of Weather information in production process 1.Significant 2.Not Significant	19(79.2%) 5(20.8%)	8.050(1)	.009

Table3.6: Logistic Model of Use of Climatic Information And Socio-Economic Factors

Use of Weather information		B	Std. Error	Wald	Df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Yes	Intercept	19.483	1.049	345.089	1	.000			
	[Q8=1]	-18.937	1.115	288.370	1	.000	.000	.000	.000
	[Q8=2]	-17.181	.000	.	1	.	.000	.000	.000
	[Q8=3]	.000	.000	.	1	.	1.000	1.000	1.000
	[Q8=4]	0(b)	.	.	0	.	.	.	.
	[Q16=1]	.600	1.195	.252	1	.616	1.821	.175	18.947
	[Q16=2]	0(b)	.	.	0	.	.	.	.
	[Q18=1]	-19.592	.799	600.815	1	.000	.000	.000	.000
	[Q18=2]	-18.388	1.070	295.450	1	.000	.000	.000	.000
	[Q18=3]	-19.592	1.333	186.443	1	.000	.000	.000	.000
	[Q18=4]	-18.206	.000	.	1	.	.000	.000	.000
	[Q20=1]	-1.023	1.164	.772	1	.379	.359	.037	3.522
	[Q20=5]	0(b)	.	.	0	.	.	.	.
	[Q25_a=1]	1.838	.665	7.644	1	.006	6.286	1.708	23.138
	[Q25_a=2]	0(b)	.	.	0	.	.	.	.
	[Q25_b=1]	-17.051	.868	386.027	1	.000	.000	.000	.000
	[Q25_b=2]	-18.180	.000	.	1	.	.000	.000	.000
	[Q25_b=3]	0(b)	.	.	0	.	.	.	.
	[Q26_a=1]	1.417	.670	4.480	1	.034	4.125	1.111	15.322
	[Q26_a=2]	0(b)	.	.	0	.	.	.	.
	[Info=1]	1.941	.714	7.385	1	.007	6.967	1.718	28.251
	[Info=2]	0(b)	.	.	0	.	.	.	.

Table3.7: Logistic Model Regression for Use of weather information with the type of losses incurred

Use of Weather info(a)		Std. Error	Sig.
Yes	Intercept	.606	.763
	[Q26_a=1]	1.005	.055
	[Q26_a=2]	.	.
	[Q27_a=1]	.942	.544
	[Q27_a=2]	.	.
	[Q30=1]	1.013	.286
	[Q30=2]	.	.
	[Q32=1]	.000	.
	[Q32=2]	.	.
	[Q33=1]	1.040	.837
	[Q33=2]	.	

The use weather information significantly determines whether a company will lay off its staff or not. For companies that did not use weather information for their daily operations were more likely to lay off their staff up to 50% in case of a weather disaster.Use of weather information also affects whether a company will withhold investment in future or not, Lose it,s market share or experience damage of it's equipments

The use of weather information is determined by whether the respondent weather information to be significant in the operation of his business, the source of weather information, whether the company generates its own electricity, whether the company experienced a major loss due a weather event and the type of weather information that the company requires.

Chapter 4

4.0. Summary and Conclusions

The use of weather information is determined by: whether the respondent perceives weather information to be significant in the operation of his business, the source of weather information, whether the company generates its own electricity, whether the company experienced a major loss due a weather event and the type of weather information that the company requires. There is a significant relationship between those that perceive weather to be significant and those that use.

Most companies access services from meteorological department only when there is need. The use weather information significantly determines whether a company will lay off its staff or not. For companies that did not use weather information for their daily operations were more likely to lay off their staff upto 50% as shown in case of a weather disaster. The Use of weather information also affects whether a company will withhold investment in future or not, Lose it,s market share or experience damage of it's equipments. This shows that weather important in the socio-economic sector

All the companies that do not use weather information are actually interested in receiving weather and climate information .Of the75% of those who do not use weather information,44% require Rainfall for their operation,19% require temperature information,13% wind speeds and wind direction information for their operation

The weather information being readily available is the main reason for the choice of where the respondent sources the weather information. The main source of the respondent's climate information is KMD/ICPAC 78%, Local electronic media(T.V and Radio) 12.5% and internet mobile 5%

Of the services provided by KMD/ICPAC Daily forecasts are the commonly known having 81.3% of the respondents knowing it

4.1. Recommendations

Most companies perceive weather information to be significant in their operation and of all those that do not use the weather information are actually interested in using it. Since the use of weather information is determined by the source of weather information among other reasons and where the company sources the weather information is largely determined by how readily available the source is. The provider of weather services should derive policies to bring closer the sources of this weather information to the users, this will spread the use of weather information and also improve the use of other KMD/ICPAC weather services apart from Rainfall forecasts which is the commonly known and used service

Policies to improve the use of weather services should focus on improving perception of weather services. How significant the user perceives a weather service greatly determines the use of the services

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