



## **Impacts of Social-Cultural Factors on the Management of Deep Pools of Likangala River, Malawi**

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### **Authors' contributions**

*This work was carried out in collaboration between both authors. Author RM designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript and managed literature searches. Author VC managed the analyses of the study and literature searches. Both authors read and approved the final manuscript.*

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### **ABSTRACT**

The study was conducted to analyse the impact of social cultural factors on the management of deep pools in Likangala River during Lake Chilwa recession period. A comprehensive survey which covered 120 households was carried out. Using logit analysis, the study showed that the use of local leaders, indigenous knowledge, initiation ceremony, age of the household heads, culture and traditional beliefs were significant factors affecting the management of the water resource in the pools. The study concluded that the sustainable management of water resource in the pools can be achieved by integration of scientific principles with indigenous knowledge, traditional beliefs and culture of the communities. The study further recommended the involvement of local leaders in policy formulation regarding integrated water resource management in order to achieve sustainable use and management of the water resource in Likangala River.

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## 1. INTRODUCTION

Likangala River is a perennial river flowing east to the closed Lake Chilwa basin in Southern Malawi. For the past years, the river has been exposed to potential threat as the result of climate change, poor waste management, rapid population growth together with urbanization and poor forestry and agricultural practices [1].

Makwinja et al. [2] reported that some important pools in Likangala River have apparently become shallower due to increased silt deposition resulting from altered flow regimes. Based on this assessment, it is imperative to prioritize hotspots for intervention now. However the intervention can only be meaningful if the impact of social-cultural factors on the management of deep pools of Likangala River by the communities around are documented.

## 2. MATERIALS AND METHODS

Primary data consisting of demographic and socio-economic characteristics was obtained from a comprehensive survey which covered 120 households living along Likangala catchment. At each household, enumerators interviewed the household head or second household head in the absence of the head. This was done to ensure that most accurate information is obtained. Secondary data was obtained from relevant literatures.

### 2.1 Statistical Analysis

A logistic regression model was built to assess the significant influence of social-cultural factors on management of the pools. Based on Gujarati [3], the following logistic regression model was used:

$$P_i = F(\alpha + \beta X_i) = 1 / (1 + \alpha^{-(\alpha + \beta X_i)}) \quad (1)$$

Where: subscript  $i$  denote the  $i$ -th observation in the sample,  $P_i$  is the probability that an individual will make a certain choice given  $X_i$ ,  $e$  is the base of natural logarithms and approximately equal to 2.718.

$X_i$  is a vector of exogenous variables  $\alpha$  and  $\beta$  are parameters of the model and  $(\beta_1, \beta_2, \dots, \beta_k)$  are the coefficients associated with each explanatory variables. The above function can be rewritten as:

$$\ln \left[ \frac{p}{(1-p)} \right] = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_k X_{ki} + e_i \quad (2)$$

It should be noted that the estimated coefficients do not directly indicate the effect of change in the corresponding explanatory variables on probability ( $P$ ) of the outcome occurring. Rather the coefficients reflect the effect of individual explanatory variables on its log of odds. Where the expression for log of odds is given as:

$$\ln \left[ \frac{p}{(1-p)} \right] \quad (3)$$

The positive coefficient means that the log of odds increases as the corresponding independent variable increases. The coefficients in the logistic regression model are estimated using the maximum likelihood estimation method. For this study, the empirical model is specified as:

$$Y = \beta_0 + \beta_{x1} + \beta_{2x2} + \beta_{3x3} + \beta_{3x3} \dots \beta_{ixi} + e_i \quad (4)$$

Where  $Y$ = dependent variable,  $\beta_0$  is the intercept and  $\beta_1, \beta_2, \beta_3, \dots, \beta_i$  are the regression coefficients of explanatory variables  $X_1, X_2, X_3, \dots, X_i$  and  $e_i$  is random error or disturbance term.

## 3. RESULTS AND DISCUSSION

### 3.1 Explanatory Variables

*MSW= main source of water, GE=gender, SKMP=scientific knowledge of the management of the pool, EL=Education level, PTP= proximity to the pool, AG= Age, IC=influence of culture, TB=traditional beliefs, IRB= influence of religious belief, ACWRM=access to communication about water resource management, WRMT=any form of training regarding water resource management, IFLL= influence of local leaders, URL=use of religious leaders, AIC= access to information about climate change, ITB= influence of traditional belief, IK= influence of indigenous knowledge, MSI= main source of income.*

The results for logistic regression analysis are shown in Table 1. The study revealed that the correlation coefficient ( $R$ ) was 0.99 which indicated strong correlation between two ratio level variables. Regression results further showed that the coefficient of multiple determinations ( $R^2$ ) for social cultural factors varies from 0.994 to 0.991 which indicates that

99.4 to 99.1 percent of the total variation in social-cultural factors were explained by the fifteen independent variables included in the model. Similarly, the values of the F statistic for all the models were at least significant at 5 percent level of confidence.

The results derived from applying the logistic regression model to the data indicated that the t values of age of the household heads, initiation ceremony, traditional beliefs, influence of local leaders, influence of traditional beliefs, influence of indigenous knowledge as predictors of management of the pools were statistically significant (P=0.001, P=0.043, P=0.03, P=0.035 and P=0.045) at 5 percent level of confidence.

### 3.2 The Influence of Local Leader

The study revealed that under the influence of local leaders, many local communities around Likangala River recognized the importance of managing the water resource in the pools. The study conforms to the work of Kalanda-Sabola et al. [4] who observed that communities are able to analyze situations and interpret the results using their practical experience of tackling problems and perspective of having an overview of the management issues. Moller et al. [5] further reported that a few simple rules suggested by indigenous knowledge may produce good management outcomes consistent with fuzzy logic thinking. Hence, the study revealed that the regression coefficients of local leader was 3.03

which was significant at 5 percent level of confidence suggesting that the local leaders had an influence on the management of the water resource in the pools.

### 3.3 The Influence of Indigenous Knowledge

Leveque [6] reported that indigenous knowledge and traditional practice may yield new ideas about conservation and management of natural resources. This was indicated in the model which showed a significant (P=0.045, P<0.05) positive regression correlation coefficient (1.02) between the influence of indigenous knowledge and management of water resource in the pools. The findings from this study are in line with the work of Mwale and Malekano who reported that indigenous knowledge has permitted its holders to exist in harmony with nature allowing them to use natural resources sustainably.

### 3.4 Influence of Traditional Belief

The study revealed that traditional belief had significant (P<0.05) influence over adoption of management of the pools. The results are supported by the findings of Makwinja et al. [3] who reported that most important pools in Likangala River were named by the locals after mammals living in them. These included poisonous snakes and aquatic mammals. The pools were given special attention and treated as sacred places. Similarly, Rim-Rukeh et al. [8]

Table 1. Logistic regression coefficients and related statistics

Explanatory variables	Regression coefficient	t. value	SE	P.value
constant	0.96	84.68	0.076	0.002*
IC	0.76	18.01	0.081	0.043*
GE	0.30	28.62	0.081	0.15
SKMP	0.15	0.43	0.082	0.79
EL	0.74	0.29	0.074	0.884
PTP	0.11	64.7	0.078	0.19
AG	0.69	89.4	0.082	0.001*
IRB	0.37	0.62	0.068	0.782
ACWRM	-0.42	0.35	0.064	0.981
TB	-0.67	8.07	0.081	0.03*
WRMT	0.05	0.07	0.082	0.82
IFLL	0.87	10.12	0.064	0.035*
URL	0.01	0.05	0.07	0.790
AIC	-0.04	0.26	0.91	0.412
ITB	0.06	0.18	0.074	0.91
IK	0.92	0.87	0.058	0.045*
MSI	0.08	0.37	0.075	0.82

\*Significant at (P < 0.05); R = 0.99, R<sup>2</sup> = 0.994, Adjusted R<sup>2</sup> = 0.991, SE = 0.05; R<sup>2</sup> Change = 0.994, F. Change 248, Sig 0.003

observed that people are willing to take care of natural resources in their respective communities voluntarily. Areas without these traditional beliefs; its natural resources have been vandalised at alarming rate. Rim-Rukeh et al. [8] further observed that traditional beliefs and taboos help in enforcing rules and regulations for environmental preservation as people refrain from using resources carelessly, especially those related to sacred places.

### 3.5 Influence of Culture

The study observed the significant ( $P < 0.05$ ) relationship between culture and the management of water resource in the pools. The study revealed that some of the important pools are used as places for conducting initiation ceremonies. These places are considered sacred and are well protected by the locals. The study findings are in line with Cheserek [9] who observed that frequent application of taboos protect water from being contaminated and such taboos help the community to protect and manage their water resources. Cheserek [9] further observed that most indigenous trees considered as sacred are used to perform rituals. This practice ensures trees to grow to maturity hence, the preservation of water catchments. On the other hand, it is apparent that the loss of important pools in places along the river is due to cultural influx. Kayambazinthu et al. [10] reported that influx of alien religions have brought changes in the local institutions. This means social-cultural character, many customs and traditions of long settled lake societies are being lost and forgotten. Hence vulnerability to change of such old cultures has resulted into degradation of natural environment resulting into loss of important pools.

### 3.7 Age of the Household Heads

The effect of age of the household heads on the management of the pools is unclear. However, the study revealed that as the age increases, the awareness about water management issues hypothetically increases. Therefore, it was hypothesised that old people preferred to keep up traditions and less likely to use the scientific knowledge in the management of the pools. This was evidenced by the significant ( $P = 0.001$ ,  $P < 0.05$ ) positive correlation between the influence of age of the household heads and the management of the pools in the Likangala river. Likangala River, near the river mouth, there were several important deep pools actually named by

old people and treated as sacred places. Evidently, it was discovered that these pools were important feeding and spawning grounds for several species, such as *Hippopotamus amphibious*, *Chamaeleo dilepis*, and *Proatheris superciliaris*, birds, such as *Dendrocygna*, *Phalacrocorax africanus*, *Gallinula angulata*, *Porphyrio porphyrio*, *Plectropterus spp.*, *Pelecanus spp.*, *Bubulcus spp.*, *Larus spp.*, and *Diplachne fusca*, and fish species, such as *Barbus paludinosus*, *Barbus trimaculatus*, *Clarias gariepinus*, and *Oreochromis shiranus chilwae*

## 4. CONCLUSIONS

The study observed that meaningful intervention in management of pools in Likangala River can only be successful if the old people are strongly involved in the formulation of policy. Again, management approach, as the best tool of conserving water can only succeed if direct scientific principles in management of water resource in the pools are integrated with the traditional beliefs, cultural beliefs and practices.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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