

## Variability In Household's Mean Income Along The Kenya's Lake Victoria Ecosystem

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### Abstract

One of the ways of minimizing rural urban migration and subsequent population explosion in the urban centers is to create income earning opportunities in the rural areas. One of the valuable resources in Kenya is the Lake Victoria ecosystem which is predominantly rural. This research sought to determine existence of significant differences in mean income per household along the Lake Victoria ecosystem. The ecosystem was clustered in Counties with known administrative boundaries. These counties were Busia, Siaya, Kisumu, Homa Bay and Migori. The sources of income that were identified included fishing, crop farming, livestock farming, sand harvesting, transport, tourism and trade. Three stages purposive sampling technique was used. Skillfully structured questionnaires of both open and closed ended questions were administered during the collection of data of sample size 394. Direct valuation method was used to calculate the mean income generated associated with various economic activities per household. Single factor ANOVA technique was used to determine if there exist significant differences in mean income per household across the counties. The data collected was subjected to analysis via the Statistical Package for Social Scientists (SPSS). The results obtained shows that there exists statistical significant mean differences in income between Busia and Migori, Busia and Homa Bay, Homa Bay and Kisumu, Migori and Kisumu, Homa Bay and Siaya and Migori and Siaya. Households in Migori and Homa Bay earn higher mean income compared to their counterparts.

**Keywords:** Mean income, Single factor, Anova, Direct Valuation

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### I. Introduction And Background Of The Study

Lake Victoria is well known to be the second largest fresh water lake in the world covering a surface area of 59,947 km<sup>2</sup>, (Stuart and Hamilton 2018). Lake Victoria covers across three countries in East Africa namely Kenya, Uganda and Tanzania. Tanzania claims the biggest share of Lake Victoria (49%), followed by Uganda with 45% share of the lake. Kenya has only 6% claim to the lake which is a paltry share of the lake compared to her neighbors. Lake Victoria shoreline runs to a length of 7,142km with islands within the lake contributing 3.7% to the length of the shoreline. The Kenyan side of the Lake Victoria experiences an inland equatorial type of climate, (USAID 2011). The rainfall pattern is bimodal with rains received in mid-February to May and July to October. The average rainfall received per annum is between 500-1,000mm per annum. Temperatures around Lake Victoria vary with altitude rising from 21° C to 22.50° C in the high-altitude areas while in low altitude areas it ranges from 16.3° C to 29.1° C. The evaporation mean falls between 1,800mm to 2,200mm per year within the region. Projections show that by the early 2040's temperature may increase by 0.4°C, with the first wet season projected to increase by 0.5% in the first wet season and 3% in the second.

In Kenya, Lake Victoria cuts across four Counties of Siaya, Busia, Kisumu, Homa Bay and Migori. The main economic activities around Lake Victoria include fishing, farming, transport, tourism, sand harvesting and trade. The neighborhood around the lake is mostly rural set ups with limited formal employment a part from residents serving in the public service. A number of studies have been done around the Lake Victoria Ecosystem Basin and also on variability on household income. Some of these studies have been used to help form the basis for this research. Kangalawe, Limenga, Kabumbuli and Walingo (2008) carried out a study on livelihood diversification and implications on poverty and environment in the Lake Victoria Basin. The study looked at how the rapidly changing social, economic and environmental conditions contributes to diversification of livelihood land use changes in the Lake basin. The results obtained showed that fishing is the main activity

around the Lake Victoria Basin. The findings further noted that decreasing trends in the availability of land over time is attributed mainly to livelihood diversification and the ever increasing population pressure.

Fiorella et al (2014), did a study on the analysis of links between fishing and food security around Lake Victoria, Kenya. The research examined if fishing households consumed more fish and if their food security was higher than the non-fishing households around Lake Victoria. The results showed that there was no significant association between fishing as a source of livelihood and food security or household fish consumption. Households with higher income consumed more fish than those with low income. The results further showed that household food security was highly associated with higher assets index scores and incomes.

Muyanga (2014) analyzed rural households' income poverty incidence over a period of time. The results obtained showed that there exist great disparities in the regional welfare and dynamics over time in rural Kenya. The factors that were found to significantly impact on rural households' income included geographical locations and demographic factors (household dependency, burdens, gender and the level of education). Munga (2015) did research on evolution and decomposition of income inequality in Kenya. The study looked at the origin of income inequality in Kenya and gave a breakdown of the inequalities. The research found out that income inequality is sensitive to the part of the income distributions given more weight. The research further noted that there is no correspondence in the changes in inequality over time between urban and rural regions. Juma, Wegulo and Otieno (2017) carried out a study to assess the relationship between the land use and rural poverty among households in Muhoroni and Nyando Sub Counties. The results of the research showed that maize was the most dominant crop and that there was a significant relationship between land use and rural poverty in the mentioned sub counties.

Egde et al (2017) carried out a study to construct a wealth index to understand the trends of wealth and determine the predictors of wealth change index in Kenya. The study used the health survey and demographic data. The results showed an increase in wealth between 1993 and 2008 in Kenya. However, there was no significant difference in the wealth increase between the rural and urban areas that was recorded. The strongest predictor was education; those with higher education levels had a higher standard deviation difference than those with no education. Households head who were women and those who had partners had less wealth in rural areas compared to their counterparts in the urban areas.

Ymeri, Musliu and Shkodra (2020) did a study to determine income distribution inequality and factors contributing to rural households' poverty. Results showed that the middle-income households possessed the highest potential in finding alternative employment in the non-farm sectors. The family size, number of family members above the age of 18, years of formal education and total income were seen to have had a positive impact on non-farm revenues. The poorest rural household had the highest share of income from farm activities. Nonfarm revenues have a positive impact on poverty alleviation. The study suggested adoption of suitable and sustainable policies to enhance non-farm employment for vulnerable households in rural areas.

Sassi et al (2021) applied the extended decomposition of Gini to examine household seasonal food expenditure inequality along the Lake Naivasha Basin. This research found that inequality reduces during the harvesting period of various food categories. The results further showed that there should be structured set of policies on poverty, food security and agriculture. This will contribute to the overall growth of the economy and achievement of the vision 2030.

Muyonga et al (2021) extended the application of spatial regression in determining the existence of relationship between inequality and migration. The county data was used in the study as it considered migration intensity as the response variable. The explanatory variables were access to clean water, access to consistent electricity, county Gini and composite index of county human development index. The results obtained showed that the income inequality within households had a nonlinear relationship with migration. Iraoya and Isinika (2022) examined the relationship between diversification and intensification of rural households in Nigeria using Panel data models. The results obtained showed that income diversification is increasing among Nigerian rural households. The study recommended a policy measure that households should not be encouraged to diversify their income but should also transmit productivity gains from diversification into agricultural intensification for the betterment of the rural economy.

This research sought to determine the existence of significant differences in mean income per household across the five counties. The research first computed the mean income per household per county using the direct valuation method. Little research has been done to determine the disparities in household mean income among the residents bordering Lake Victoria across the five counties. The results of this research will enable the policy makers and the local authorities to assess if the resources of the lake are fully exploited. It may also help address the challenge of rural urban migration which has given rise to the emergence of slums in most urban centers in Kenya.

## II. Materials And Methods

### Design

The approach employed in this study was a cross sectional study design. Data was collected at point in time and there was no room given for manipulation. Cross sectional study design allows the researcher to study many variables at ago.

### Study Population and sampling procedure

Three stages purposive sampling technique was used. The first phase was to purposively pick the five counties that border Lake Victoria. These counties include Busia, Siaya, Kisumu, Homa Bay and Migori. A sample size per county was picked based on the length of the shoreline running across the county and the population size of the county (2019 Kenya Population Census). Using the nature of the economic activities around the beaches, purposive sampling was used to pick beaches from each county. Finally the subjects were picked at random from the selected beaches keeping a uniform distance between any two subjects.

Using the formulae given by equation 1, a sample size of 369 was obtained. However, to take care of none response 25 additional subjects were conveniently added bringing total sample size to 394. The sample size was obtained as

$$n = \frac{z^2 p(1-p)}{e^2 \left( 1 + \frac{z^2 p(1-p)}{e^2 N} \right)} \quad (1)$$

Where: confidence level ( $\alpha$ ) of 95% with  $z = 1.96$ ,  $p =$  proportion (expressed as a decimal),  $N =$  population size and  $e =$  margin of error was adopted.

Well-structured questionnaires were administered in the data collection process with the aid of Kobocollect toolkit where data was collected electronically.

### Household Income

Calculating the mean household income was done using the value of the gross output. This is a technique for determining the economic activity occurring in natural environment. It is mostly used because of its ability to accurately measure the household likelihoods (Lwesya 2004). The key indicators that were used to assess the gross output value were crop production, catches of fish, livestock production and self-empowerment. Crop production was considered as the market value of all agricultural products. Catches of fish was measured in terms of the total annual catch of biomass and the average price of the catch per kilogram. Livestock production was calculated as per the market value of stock activities within and outside the farm. Self-employment was calculated as the gross income

Equation 2 defines the model that was used to measure the income.

$$TL_{i\&r} = \sum_{i=1}^n [C_i P_i - (k_i)] \quad (2)$$

where  $TL_{i\&r}$  - total income  $C_i$  - yield of  $i^{\text{th}}$  product,  $P_i$  - market price of the  $i^{\text{th}}$  product and  $K_i$  - production costs for  $i^{\text{th}}$  product

### Single Factor Analysis of Variance

To determine existence of significant differences in the mean income of households across the five counties, single factor analysis of variance was used. Using analysis of variance with a single factor the following null hypothesis was tested;

$$H_0; \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$$

The alternative hypothesis was that there is significant difference in at least a single pair of means.

Wherever the null hypothesis is rejected, post ANOVA test was done using Tukey's HSD test to determine which specific pair of counties has significant mean differences in household income.

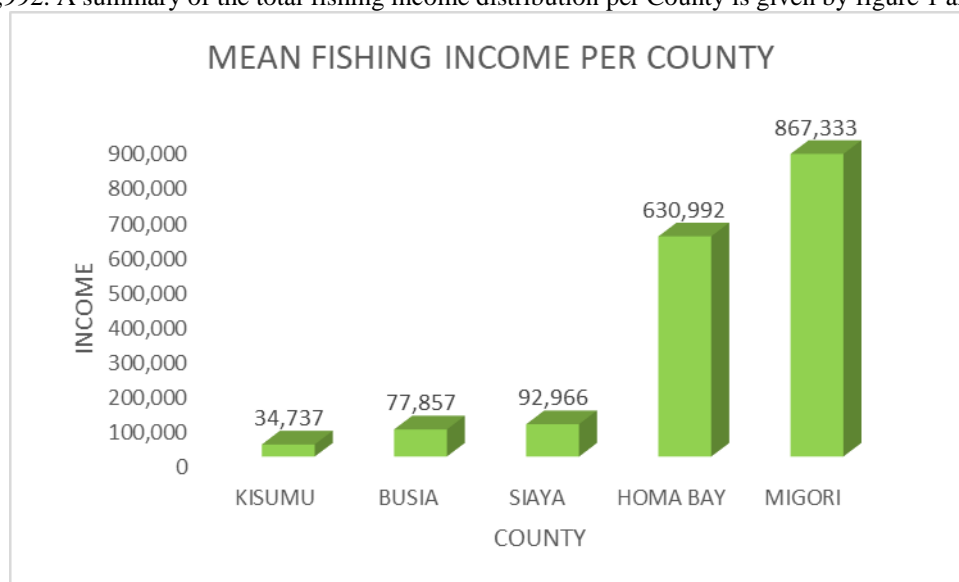
## III. Results and Discussions

The sources of income were mainly fishing, crop farming, livestock farming and none farming/fishing activities

### Income from Fishing

Incoming from fishing comprised monies earned through sale of fish, sale of fishing gear and fishing craft and employment in fishing activities. The total amount of income earned from fishing related kind of activities in the past one year was found to be Kshs. 101,437,100. Mean annual income from fishing related kind of activities was found to be Kshs. 400, 937 per household involved in fishing. The bulk of this income came from Migori

county which had a mean income of Kshs. 867,333 followed by Homa Bay County with a mean income of Kshs. 630,992. A summary of the total fishing income distribution per County is given by figure 1 and Table 1.



**Figure 1.** The Annual Fishing Income

**Table 1**  
*Annual Income from Fishing Related activities (Kshs)*

| County      | Statistics | Sale of Fish | Sale of Fishing Gear and Fishing Craft | Casual Employment in Fishing Activities | Fishing Total |
|-------------|------------|--------------|--|---|---------------|
| Busia       | Mean       | 56,667       | 40,000                                 | 41,667                                  | 77,857        |
|             | Total      | 340,000      | 80,000                                 | 125,000                                 | 545,000       |
| Homa Bay    | Mean       | 628,376      | 160,696                                | 101,500                                 | 630,992       |
|             | Total      | 65,351,100   | 3,696,000                              | 1,624,000                               | 70,671,100    |
| Kisumu      | Mean       | 24,544       | 83,571                                 | 18,630                                  | 34,737        |
|             | Total      | 1,104,500    | 585,000                                | 186,300                                 | 1,875,800     |
| Migori      | Mean       | 873,750      | 575,000                                | 49,333                                  | 867,333       |
|             | Total      | 20,970,000   | 2,300,000                              | 148,000                                 | 23,418,000    |
| Siaya       | Mean       | 89,113       | 58,250                                 | 51,714                                  | 92,966        |
|             | Total      | 4,099,200    | 466,000                                | 362,000                                 | 4,927,200     |
| Grand Total | Mean       | 408,288      | 161,977                                | 62,700                                  | 400,937       |
|             | Total      | 91,864,800   | 7,127,000                              | 2,445,300                               | 101,437,100   |

A deeper interrogation of Table 1 reveal that Migori County had the highest mean annual income in sale of fish (Kshs. 873,750) and sale fishing gear and crafts (Kshs. 575,000). Homa Bay was the second highest in mean income from sale of fish (Kshs. 628,376) and sale of fishing materials (Kshs. 160,696). In terms of mean annual income from fishing related employment Homa Bay had the highest (Kshs. 101,500). A pictorial representation of the same is given by figure 2.

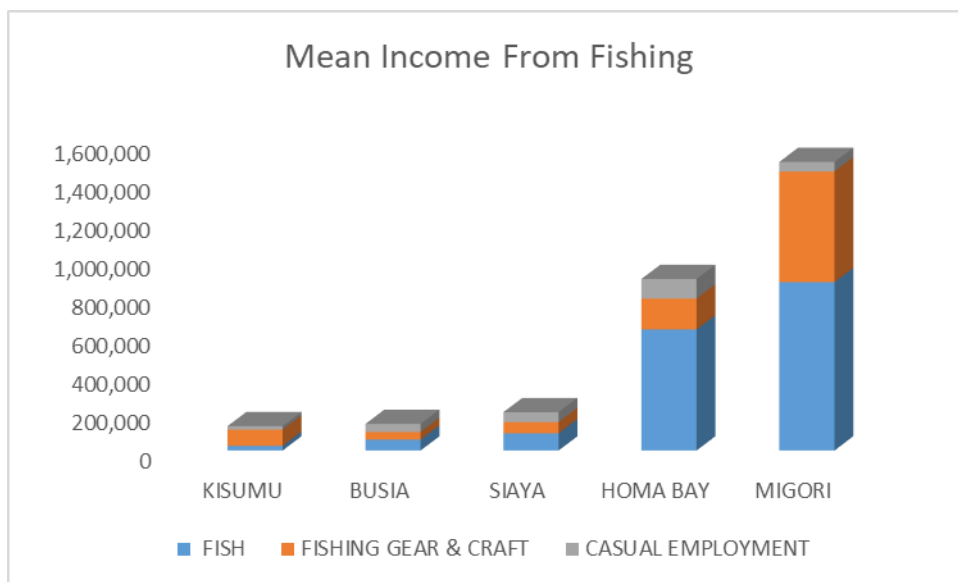


Figure 2. Mean Income from Fishing

**Income from Crop Farming Related activities**

The farming related activities that were considered included rain fed farming, irrigation farming, sale of crops (tubers), sale of fruits and vegetables and casual employment in farming activities. The mean income from farming was highest in Homa Bay (Kshs. 615,424) followed by Migori. A summary of this is given by figure 3.

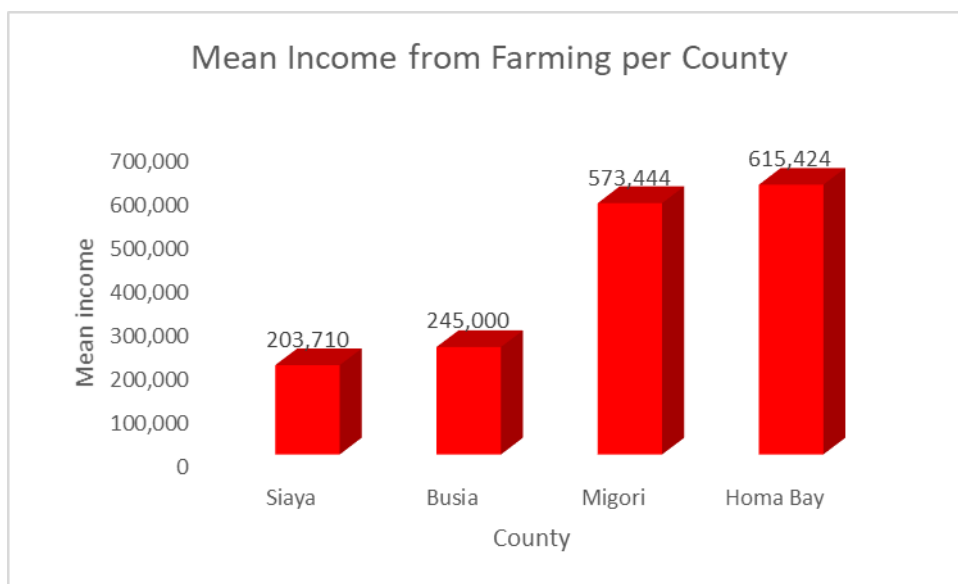


Figure 3. Mean Income from Farming

The bulk of the mean income came from sale of fruits and vegetables (Kshs. 221,016) and income from produce of irrigation farming (Kshs. 219,000) as shown by figure 4.4.

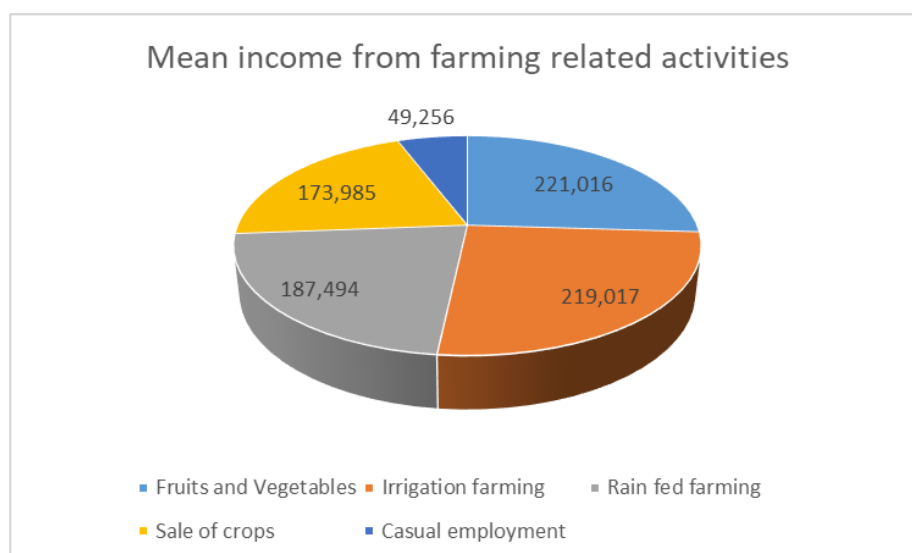


Figure 4. Mean income from farming related activities

Table 2  
Annual Income from Crop Farming Related Activities (Kshs)

| County      |       | Rainfall Farming | Irrigation Farming | Sale of Crops (Tubers) | Fruits and Vegetables | Casual Employment in Farming | Farming Total |
|-------------|-------|------------------|--------------------|------------------------|-----------------------|------------------------------|---------------|
| Busia       | Mean  | 211,111          |                    | 125,000                |                       | 50,000                       | 245,000       |
|             | Total | 1,900,000        |                    | 500,000                |                       | 50,000                       | 2,450,000     |
| Homa Bay    | Mean  | 240,128          | 226,708            | 222,256                | 203,979               | 48,750                       | 615,424       |
|             | Total | 11,286,000       | 10,882,000         | 8,668,000              | 9,587,000             | 195,000                      | 40,618,000    |
| Migori      | Mean  | 82,000           | 228,750            | 113,333                | 406,667               |                              | 573,444       |
|             | Total | 246,000          | 915,000            | 340,000                | 3,660,000             |                              | 5,161,000     |
| Siaya       | Mean  | 102,857          | 160,714            | 98,750                 | 47,000                | 50,000                       | 203,710       |
|             | Total | 2,880,000        | 1,125,000          | 1,975,000              | 235,000               | 100,000                      | 6,315,000     |
| Grand Total | Mean  | 187,494          | 219,017            | 173,985                | 221,016               | 49,286                       | 470,207       |
|             | Total | 16,312,000       | 12,922,000         | 11,483,000             | 13,482,000            | 345,000                      | 54,544,000    |

Migori County had the highest mean income from sale of fruits and vegetables (Kshs. 406,667) followed by Homa Bay County.

#### Mean Annual Income from Livestock Farming Related activities

The main sources of income under this were sales of livestock and sales of livestock products. Siaya County had the highest mean income of Kshs. 252,889 followed by Homa Bay with a mean income of Kshs. 130,194. The mean income per county from sale of livestock was 123,000 while the mean income per county from the sale of livestock products was Kshs. 77,969. Table 3 presents a summary of the mean income per county by related activity.

Table 3  
Mean Annual Income from Livestock Farming Related Activities (Kshs)

| County   |       | Sales of Livestock | Sales of Livestock Products | Total   |
|----------|-------|--------------------|-----------------------------|---------|
| Busia    | Mean  | 150,000            | 61,667                      | 161,667 |
|          | Total | 300,000            | 185,000                     | 485,000 |
| Homa Bay | Mean  | 74,412             | 102,714                     | 130,194 |

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|             |       |           |  |           |  |           |
|-------------|-------|-----------|--|-----------|--|-----------|
|             | Total | 2,530,000 |  | 2,157,000 |  | 4,687,000 |
| Migori      | Mean  | 62,000    |  | 13,500    |  | 71,000    |
|             | Total | 186,000   |  | 27,000    |  | 213,000   |
| Siaya       | Mean  | 716,667   |  | 21,000    |  | 252,889   |
|             | Total | 2,150,000 |  | 126,000   |  | 2,276,000 |
| Grand Total | Mean  | 123,000   |  | 77,969    |  | 150,216   |
|             | Total | 5,166,000 |  | 2,495,000 |  | 7,661,000 |

**Mean Income from Other Activities.**

There were other non-fishing and non-farming activities that were considered in the study. These included sand harvesting, petty trade, business establishments, casual employments and other activities around the lake.

Sand harvesting was the highest income earner with a mean income of Kshs. 210,111. Migori had the highest mean in sand harvesting of Kshs. 441,429 per year. Casual employment along the lake was also another source of income with mean wages of Kshs. 167, 000. Table 4 summarizes these results.

**Table 4**  
***Annual Income from Other (Non-Fishing & Non-Farming Related) Activities (Kshs)***

| County   |       | Sand Harvesting | Petty Trade | Business (not fisheries and agriculture) | Wages last year (Kshs) | Other activities taking place around the Lake Victoria waters | Total      |
|----------|-------|-----------------|-------------|--|------------------------|---|------------|
| Busia    | Mean  | 80,000          |             |  |                        |   | 80,000     |
|          | Total | 80,000          |             |  |                        |   | 80,000     |
| Homa Bay | Mean  | 95,800          | 106,000     | 210,889                                  | 217,000                | 58,429  | 207,563    |
|          | Total | 479,000         | 318,000     | 1,898,000                                | 217,000                | 409,000   | 3,321,000  |
| Kisumu   | Mean  | 13,500          | 18,500      | 27,144                                   |                        | 29,000  | 39,082     |
|          | Total | 27,000          | 166,500     | 434,300                                  |                        | 232,000   | 859,800    |
| Migori   | Mean  | 441,429         | 13,667      | 182,857                                  | 35,600                 | 84,000  | 333,933    |
|          | Total | 3,090,000       | 41,000      | 1,280,000                                | 178,000                | 420,000   | 5,009,000  |
| Siaya    | Mean  | 35,333          | 50,000      | 126,667                                  | 369,333                | 28,500  | 231,375    |
|          | Total | 106,000         | 200,000     | 380,000                                  | 1,108,000              | 57,000  | 1,851,000  |
| Total    | Mean  | 210,111         | 38,184      | 114,066                                  | 167,000                | 50,818  | 179,368    |
|          | Total | 3,782,000       | 725,500     | 3,992,300                                | 1,503,000              | 1,118,000   | 11,120,800 |

**Total Economic Value from the resources of Lake Victoria**

The total economic value from the resources of the Lake was derived from Fishing activities, crop farming, Livestock farming and other activities (non-fishing and non-farming related activities). The main sources of income (mean) from the lake were identified as crop farming (Kshs. 470,207) and fishing (Kshs. 400,937). Figure 5 presents the summary of mean income per activity.

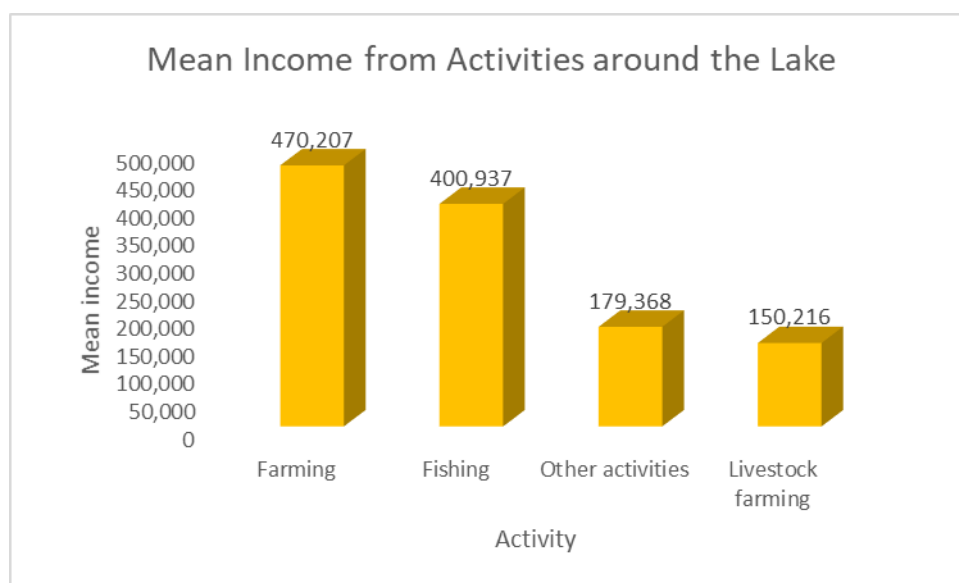


Figure 5. Mean Income Per Activity

**Table 5**  
**Total Economic Value Derived from The Water Resources of The Lake Victoria**

| County   |       | Fishing Total | Crop Farming | Livestock Farming | Other Activities | Total Income |
|----------|-------|---------------|--------------|-------------------|------------------|--------------|
| Busia    | Mean  | 77,857        | 245,000      | 161,667           | 80,000           | 209,411      |
|          | Total | 545,000       | 2,450,000    | 485,000           | 80,000           | 3,560,000    |
| Homa Bay | Mean  | 630,992       | 615,424      | 130,194           | 207,563          | 745,606      |
|          | Total | 70,671,100    | 40,618,000   | 4,687,000         | 3,321,000        | 119,297,100  |
| Kisumu   | Mean  | 34,737        |              |                   | 39,082           | 47,992       |
|          | Total | 1,875,800     |              |                   | 859,800          | 2,735,600    |
| Migori   | Mean  | 867,333       | 573,444      | 71,000            | 333,933          | 719,170      |
|          | Total | 23,418,000    | 5,161,000    | 213,000           | 5,009,000        | 33,801,000   |
| Siaya    | Mean  | 92,966        | 203,710      | 252,889           | 231,375          | 217,691      |
|          | Total | 4,927,200     | 6,315,000    | 2,276,000         | 1,851,000        | 15,369,200   |
| Total    | Mean  | 400,937       | 470,207      | 150,216           | 179,368          | 492,289      |
|          | Total | 101,437,100   | 54,544,000   | 7,661,000         | 11,120,800       | 174,762,900  |

From Table 5 it can be concluded that the estimate of the mean annual income from the lake is kshs. 492,289.

Figure 6 presents a comparison of the mean income per county per activity.



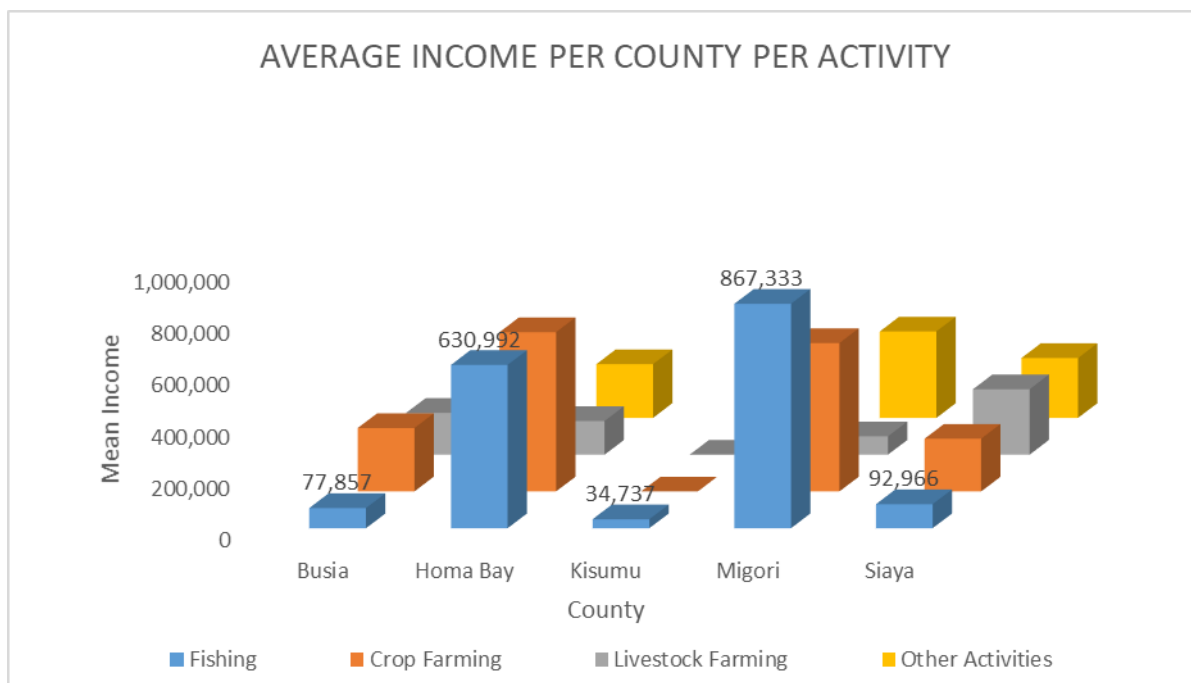


Figure 6. Mean Income Per County Per Activity

Homa Bay County and Migori County are more economically viable compared to other Counties as displayed by figure 7.

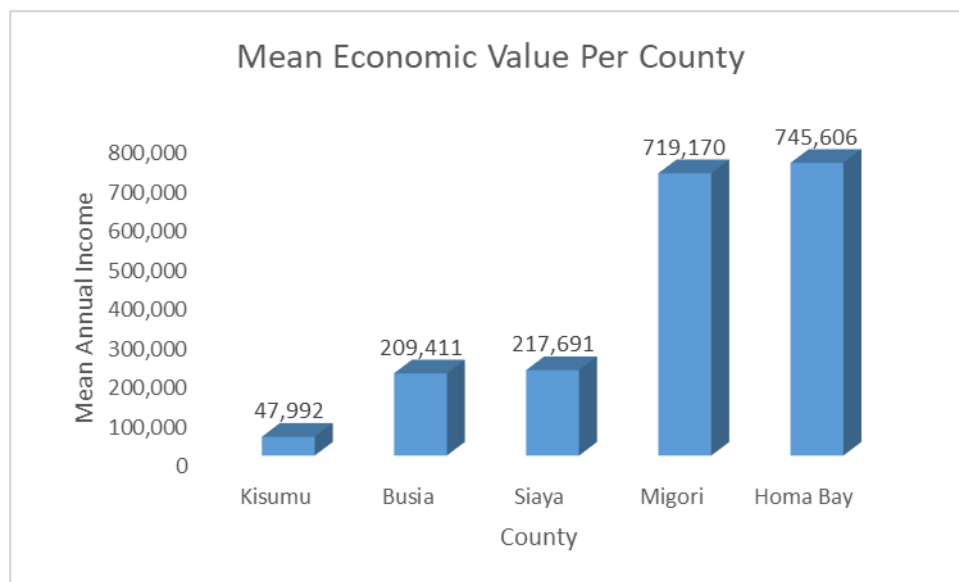


Figure 7. Economic Value per County

In determining if there is exists a significant difference in mean income per county, analysis of variance was done (ANOVA). The null hypothesis tested was setbe no mean difference exists in the incomes across the counties. The null hypothesis is rejected wherever the p value of the test statistics is less than 0.05. The results are presented by Table 6.

Table 6  
ANOVA Table

|                | Sum of Squares      | df  | Mean Square       | F      | Sig. |
|----------------|---------------------|-----|-------------------|--------|------|
| Between Groups | 31,292,260,572,782  | 4   | 7,823,065,143,195 | 17.357 | .000 |
| Within Groups  | 157,749,878,630,710 | 350 | 450713938944.887  |        |      |
| Total          | 189,042,139,203,492 | 354 |                   |        |      |

Results in Table 6 shows that there is at least a significant mean difference in mean income between two counties. To determine which counties have significant mean difference in income a post ANOVA analysis was done using least squares difference (LSD). The results obtained are given by Table 7.

**Table 7**  
**Post ANOVA Analysis using LSD**

| (I) County Origin | (J) County Origin | Mean Difference (I-J) | Std. Error | Sig. |
|-------------------|-------------------|-----------------------|------------|------|
| Busia             | Homa Bay          | -536,195*             | 171,258    | .002 |
|                   | Kisumu            | 161,418               | 185,525    | .385 |
|                   | Migori            | -509,758*             | 190,005    | .008 |
|                   | Siaya             | 1,719                 | 180,563    | .992 |
| Homa Bay          | Busia             | 536,195*              | 171,258    | .002 |
|                   | Kisumu            | 697,613*              | 103,557    | .000 |
|                   | Migori            | 26,436                | 111,385    | .813 |
|                   | Siaya             | 537,914*              | 94,380     | .000 |
| Kisumu            | Busia             | -161,418              | 185,525    | .385 |
|                   | Homa Bay          | -697,613*             | 103,557    | .000 |
|                   | Migori            | -671,177*             | 132,275    | .000 |
|                   | Siaya             | -159,698              | 118,313    | .178 |
| Migori            | Busia             | 509,758*              | 190,005    | .008 |
|                   | Homa Bay          | -26,436               | 111,385    | .813 |
|                   | Kisumu            | 671,177*              | 132,275    | .000 |
|                   | Siaya             | 511,478*              | 125,221    | .000 |
| Siaya             | Busia             | -1,719                | 180,563    | .992 |
|                   | Homa Bay          | -537,914*             | 94,380     | .000 |
|                   | Kisumu            | 159,698               | 118,313    | .178 |
|                   | Migori            | -511,478*             | 125,221    | .000 |

Results from Table 7 shows that there is significant mean difference in mean income between Busia and Migori, Busia and Homa Bay, Homa Bay and Kisumu, Homa Bay and Siaya, Migori and Siaya, and Migori and Kisumu. However, there is no significant mean differences between Homa Bay and Migori and among Kisumu, Siaya and Busia. Households in Migori and Homa Bay are earning a higher mean income compared to their counter parts in Kisumu, Siaya and Busia.

#### IV. Conclusion

From this research it can be concluded that there are significant differences in mean income per household. Mean income per household resulting from the activities around the lake is higher in Homa Bay and Migori counties compared to Kisumu, Siaya and Busia. The results showed that the people of Homa Bay and Migori counties have exploited the resources of the lake more than their counterparts from Kisumu, Siaya and Busia.

#### V. Recommendation

This study recommends that the residents of Busia, Siaya and Kisumu counties should be sensitized on the importance of exploiting the resources around the lake to the maximum. The research further recommends that other scholars should carry out a study to determine reasons behind the disparity.

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