

Enhancing Livelihood of Pastoralists in Arid and Semi-Arid Lands of Kenya under Climate Change

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Introduction and Problem

- Since the advent of industrialization, in **1950s**, **rapid increase** in global temperature has been observed and has led to **changes in average weather** conditions, **shift** in rainfall **season** and **increased** frequency of **extreme** weather **events** (IPCC, 2014).
- Climate change **attribution** studies have documented various causes of the changes i.e. ocean processes, biotic processes, volcanic eruptions, **anthropogenic factors**, and variation in solar radiation on Earth. However, many studies indicate that climate change is based on the Anthropogenic Global Warming **(AGW) theory** (Change, 2007; Delingpole, 2009; Data, 2009; IPCC, 2014).
- These changes are likely to pose severe **impacts** on **agricultural** and **livestock farming** which impacts negatively on the **livelihood** of farmers.

Cont...

- **Livestock** system is characterized by rapid changes as a result of **urbanization**, increase in **demand** for livestock products as a result of **population** increase, and **climate change** (Thornton et al., 2007; Omolo, 2010; Gaughan et al., 2015).
- These challenges faced by pastoralists will be address through the following theories; **AGW** theory, **Malthusian** theory of population, **Action** theory of adaptation, and **Bayesian decision** theory (Eltis, 2000; Malthus, 2006; Change, 2007; Delingpole, 2009; Data, 2009; Bast, 2010; Eisenack and Stecker, 2010 & 2012; Park et al., 2012; Hitendra and Krutarth, 2015).



Research Question/Hypothesis

- Why does pastoral livelihood suffer the most from climate change and population increase?
- The formulated research **Hypothesis** below are based on the theories above;
 - 1) If methane increase, then climate change increase.
 - 2) If climate change increases, then pastoral livelihood decreases.
 - 3) If population increases, then pastoral livelihood decreases.
 - 4) If the adoption of Action and Bayesian theory increases, then pastoral livelihood increases.



Objectives

- The study's main objective is to **enhancing pastoralist livelihood** in Arid and Semi-Arid Lands (**ASALs**) of Kenya under the **changing climate**. This will be achieved through the following specific objectives;
 - a) To assess the temporal and spatial variability in rainfall and temperature in the past and present climatic periods over Kenya.
 - b) To assess the skill of statistical downscaled models over Kenya.
 - c) To assess the contribution of methane from domestic livestock to climate change.
 - d) To assess the impact of increase in population on pastoral livelihood over Kenya.
 - e) To determine the appropriate climate change adaptation strategies for livestock farming.



Justification

- ▶ **Climate** information is **critical** to the **ASALs** pastoralist of Kenya as they relies mainly on **rainfall for pasture** and water. This poses greater challenges to pastoral **livelihood** and the countries **economy** due to the **highly variability** in weather and climate (Kipkogei *et al.*, 2016).
- ▶ By assessing the impact of climate change and population increase on pastoral livelihood; this study will contribute to the **realization** of **Kenya Vision2030**; **AU Agenda 2063** (Aspiration NO. 1); and Sustainable Development Goals (**SDG**) numbers (No. **1, 2, and 13**) [The Ministry of Planning and Devolution, 2007; Sachs, 2013; Griggs *et al.*, 2013; Fan and Polman, 2014; Union, 2014; Lu *et al.*, 2015].



Data and Methods

➤ DATA

- Daily/monthly **rainfall**, maximum and minimum surface air **temperature (KMD)** for the period of 1951-2016 and gridded data (**CHIRPS** period **1981-2016**) from Climate Hazard Group with a resolution of 0.05° (Funk *et al.*, 2015).
- **Population data** will be obtained from **KNBS** from **1962 to 2009** and **world population** (1950 to 2016). **Methane** data for the period **1961 to 2016** will be obtained from ILRI.
- The Global Climate Model (**GCM**) **data** will be obtained from the **CMIP5 database** for the period **2005 to 2100**, RCP 2.6 and RCP 8.5 (Driscoll *et al.*, 2012).

Proposed Methods

- Z-score normalization;

$$Z = \frac{\bar{X} - \mathbf{E}[X]}{\sigma(X)/\sqrt{n}}$$

- Gaussian Kernel Distribution;

$$g_y(fs) = \sum_{t=1}^T \frac{1}{h^N} K\left(\frac{y_t - fs}{h}\right)$$

- K-nearest neighbor weather generator;

$$y_{i,t+1}^j = x_{i,t+1}^j + \lambda \sigma_i^j z_{t+1}$$

- Statistical downscaling approaches, BCSD and BCSA

$$x'_{t,i} = F_{\text{obs},i}^{-1} (F_{\text{sim},i} (x_{t,i}))$$

$$\rho_{i,j} = \frac{1}{N} \frac{\sum_{t=1}^N (x_{t,i}^* - \bar{x}_i^*) (x_{t,j}^* - \bar{x}_j^*)}{\sigma_i^* \sigma_j^*}$$

- Taylor diagram;

$$E'^2 = \sigma_r^2 + \sigma_t^2 - 2\sigma_r\sigma_t\rho$$

- Geary's (c) and Moran's (I) indices;

$$\text{Geary's } (c) = \frac{(N-1)/2S_0 [\sum_i \sum_j w_{ij} (x_i - x_j)^2]}{\sum_i (x_i - \mu)^2}$$

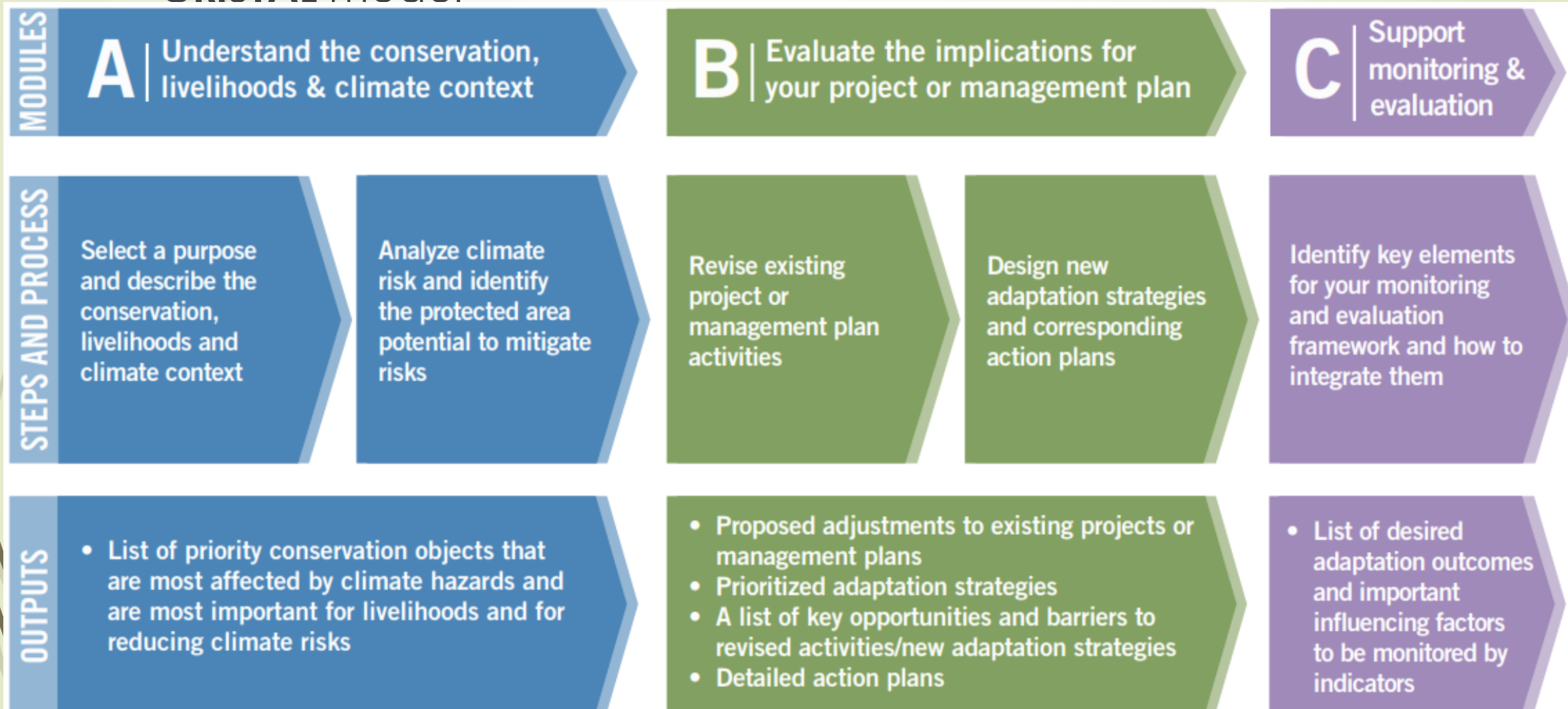
$$\text{Moran's } (I) = \frac{(N/S_0) \sum_i \sum_j w_{ij} (x_i - \mu)(x_j - \mu)}{\sum_i (x_i - \mu)^2}$$

➤ Standard detection and attribution method;

$$\mathbf{T}_{obs} = \sum_{i=1}^m \mathbf{U}_i \beta_i + \mathbf{U}_0$$

➤ R-programming, Geo-Information System (**arcGIS**) based tools

➤ **CRiSTAL** model

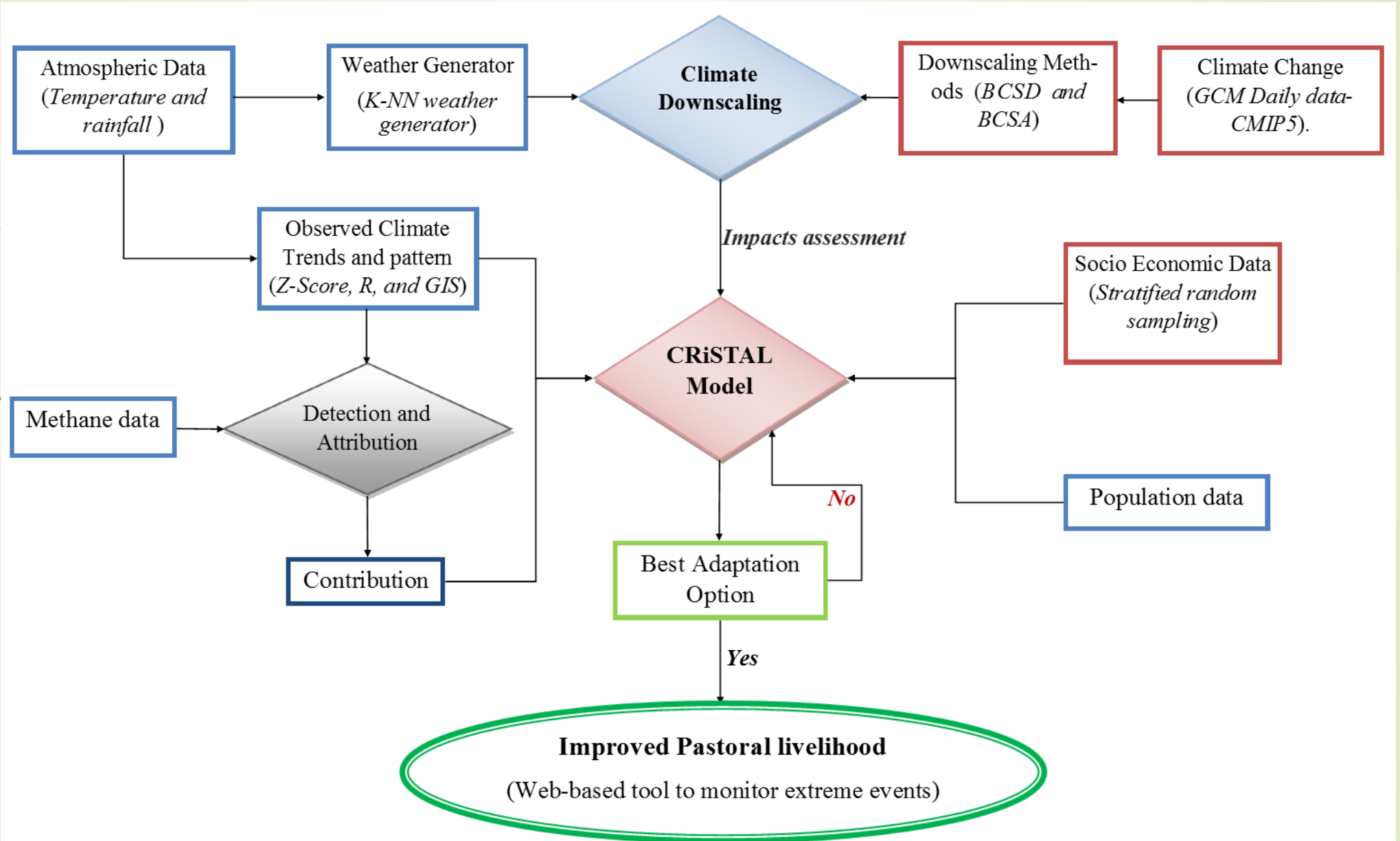




Expected Result

- The results of this study are expected **contribute** to improvement of pastoral **livelihood** in the ASALs of Kenya and the **realization** of the Kenya Vision 2030, African Union (AU) Agenda 2063, and the Sustainable Development Goals numbers 1, 2, and 13.
- The results are also expected to effectively **inform decision makers** as they develop livestock related policies as well as climate change policies.

Theoretical Framework



Proposed budget for the study

Items	Unit	Cost per Unit(KShs.)	Total Cost (KShs.)
Data Collection Charges			
i) Atmospheric Data (Per Station)	39	1,500	58,500
ii) Livestock Data (Per County)	20	2,000	40,000
iii) Field Survey (Enumerators)	6	20,000	120,000
iv) Research Assistant	2	25,000	50,000
v) Supervisor	2	50,000	100,000
Computing facilities			
i) Desktop computer (core i7)	1	75,000	75,000
ii) Softwares	3	15,000	45,000
iii) Printer	1	24,000	24,000
iv) Portable Hard Disk (2 TB)	1	25,500	25,500
Publications and dissemination			
i) Journal Processing Fees	3	25,000	75,000
ii) Printing and Binding of Reports	5	7,000	35,000
iii) Printing and Binding of Thesis	8	7,500	60,000
Grand Total (KShs.)			708,000

Reference

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