Phase 1 - Feasibility Study and Selection of farms   Duration: 1 month

Lead by **Principal Investigator, Dr Mohamed Blango with Project team**

The first phase will include an assessment of local farms for technical feasibility and future field tests, focusing on vegetable farms, subsistence farmers and small acreage. The feasibility study will include an evaluation of suitability for the irrigation system, potential product demand and adoption by farmers. This will take about one month and culminate in the selection of specific parameters, indicators, and farms for the research. Proximity to the Njala University campus will be given consideration.

Phase 2 - Prototype development   Duration: 6 - 8 months

Lead by **Investigator, Oluwokay Victor Johns with Project team**

This phase will incorporate the following activities based on industry best practices.

- Collect and document hardware and firmware requirements based on application.
- Generate hardware and firmware architecture documents using requirements as input
- Select LoRaWAN modules and associated microcontroller modules that will run the firmware images.
- Generate   prototype hardware design using KiCAD as the design tool
- Implement prototype firmware using dev kits to run initial implementations.
- Provision and commission LoRaWAN nodes using dev kits running developed firmware.
- Review hardware design schematics internally and with external stakeholders
- Contract PCB layout and send design to external PCB manufacturer for layaout and fabrication.
- Receive and verify populated PCBs.
- Integrate firmware on prototype PCBs
- Provision and commission LoRaWAN nodes on custom prototype hardware

Phase 3 - Field Trials   Duration: 9 months

Lead by **Investigator, Dominic Ibrahim-Sayo with Project team**

This phase involves running field trials of the application. To carry out field tests, local soil analysis needs to be carried out to determine factors such as infiltration rate and other drainage characteristics. Short duration crops such as cucumber, pepper and cowpea will be cultivated under sprinkler irrigation up to 5

times to have a rich data set. During the field tests, irrigation quality determinants such as irrigation efficiency and distribution uniformity will be investigated in order to assess the effectiveness of the system. A control test will be done prior to the application of the system to ensure effective comparison of the impact. During this phase, we will document field trial results and lessons learned.

Phase 4 - Feedback and testing of market acceptance   Duration: 5 months

Based on the feedback from the field trials and perfection of the LoRaWAN system, the product will be fine tuned and a patent application will be made to ensure protection of Intellectual Property Rights(IPR). Ing. Victor Johns who leads the innovation will take the lead on the patent application. Parameter and data set results will be used to inform the market research on potential customer base for commercialization and future work based on the lessons learned. The results will be peer reviewed and published in a Science and engineering journal to prepare for future work. The results will be used to prepare a full business plan model for commercialization when further funds are available.