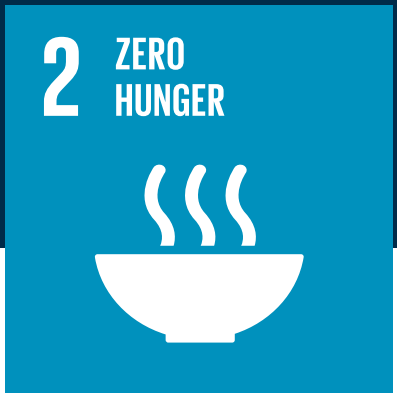
arm University Program

Zero Hunger and Sustainable Food Challenge



The African Context

It is widely known that hunger is a larger issue in Africa than the rest of the world. Africa's lack of food sovereignty has made it a net importer of food since the 1980s, consuming valuable foreign exchange, even though it is blessed with some of the most fertile land and highest rainfall in the world. In 2011, the World Bank estimated that the region had 200m hectares of suitable land that was not being used for crops—almost half of the world's total, and more than the cultivated area of America.

A few contributing factors for this problematic situation are:

- changing weather patterns
- a lack of farming skills and equipment
- a rapidly growing population, in particular its middle class, and a
- permanent loss of fertile land due to poor soil management.

This is complicated by the pervasiveness of subsistence farmers rather than large scale commercial farming partly due to poor crop selection, access to pesticides and herbicides and lack of capital. There is also a last mile problem in terms of logistics as the transport infrastructure is poorly developed for the moving of farming resources such as fertilizer or herbicides, but also in terms of the shipment of crops for processing.

These problems and a range of IoT solutions are set out in a short case study video on smart farming and weather sensing.

The UN Global Goals

https://www.globalgoals.org/

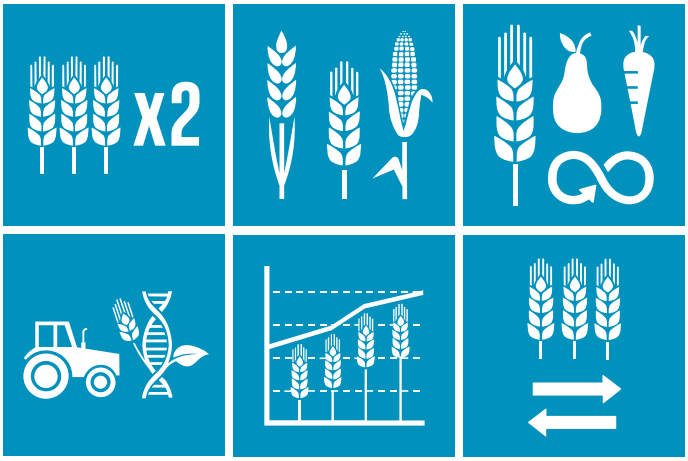
The UN Global Goals were introduced in 2015 to create a better world by 2030. One of these goals relates to hunger and sustainable agriculture. Details of the Global Goal is shown below:

By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.

THE GLOBAL GOALS

Setting the scene for your task

The UN have asked you design a cost effective, efficient and scalable 'smart farm' using modern technology to feed the local population whilst being self-sustaining economically as a project. The project will be housed in an existing 100m^2 greenhouse which has motorised roof panels that can be controlled. The greenhouse has a power supply and water supplied from a well. Water scarcity is a major concern and any design must maximise water use efficiency; the UN have suggested a hydroponic solution. They are also interested in the most efficient way to use liquid fertilizers in the proposed system and how to automate the process to both efficiently dose the system as well as maximise crop yields.



Success criteria

- Design a cost effective, efficient and scalable 'smart farm' to fit in 100m^2
- The solution must use as little fresh water as possible
- The solution must automate:

  - Watering
  - Feeding
  - Light
  - Ambient air conditions considering local weather conditions
  - Pest management

- The solution must record the crop yield and compare this to farm metrics to improve yields further for multiple crops
- The solution should balance profit with sustainable food supply using data
- Find appropriate data sources to set wholesale prices for crops

Stretch tasks

- Build a prototype model for a space of <1m^2 to demonstrate the design using readily available technology
- Present your designs to a peer group or lecturer for critical review against the success criteria
- Develop a machine learning algorithm that takes in farm metrics as well as weather data over time, and then suggest optimisations to farm management to increase yields
- Consider communication between sensor nodes and gateways and whether a wired or wireless solution is most appropriate.

THE GLOBAL GOALS