

## **SMART FARMING: (LIVING LAB)**

### **MOBILE KILIMO, HYDROPONIC FODDER, AQUAPONIC, AZOLLA AND CAGE CULTURE**



**Economic and Social Research Foundation**  
**51 Uporoto Street, (Off. Ali Hassan Mwinyi Rd.) Ursino Estates**  
**P.O .Box 31226 Da es Salaam, Tanzania**  
**Phone: (+255 22) 2926084-9**  
**Mobile: (+255-754) 715 780133 Fax (+255 22) 2926083**  
**Email: [esrf@esrf.or.tz](mailto:esrf@esrf.or.tz) Web: [www.esrf.or.tz](http://www.esrf.or.tz)**

**MARCH 2016**

# TABLE OF CONTENTS

---

TABLE OF CONTENTS .....	ii
1.0 INTRODUCTION .....	1
2.0 SMART/PRECISION FARMING – ESRF INTERVENTIONS.....	2
2.1 INTERACTIVE MOBILE PLATFORM – M-KILIMO .....	2
2.2 THE HYDROPONIC SYSTEM – FODDER .....	2
2.3 AQUAPONICS .....	3
2.4 AZOLLA.....	6
2.5 AQUACULTURE.....	7

## 1.0 INTRODUCTION

---

Farmers have always used information about wind and weather to know when to plant and harvest. Recent development and dissemination of advanced technological tools at an affordable price have resulted in both large and small-scale farmers having new and more precise tools to produce more with less (Global Opportunity Report, 2016).

These Tools makes the farming smarter by producing more with less, lead to increase productivity, profit as well as reduce the use of water, fertilizer and other farm inputs.

All these technologies allow for the farmer to use the inputs – including water and fertilizers well. As the price of inputs rising high, this seems to be a good solution  
Moreover, minimizing the use of fertilizers can significantly reduce greenhouse gas emissions

Smart farming is also an opportunity in cities. In urban areas, lack of vacant plots of land is driving more and more urban farmers to produce food upwards on the side of buildings rather than outwards. Even today, urban agriculture produces 15 to 20 percent of the world's food supply and plays a major role in global food security (Global Opportunity Report, 2016).

The Economic and Social Research Foundation in collaboration with the Government of Tanzania (GoT) and United Nations Development Programme (UNDP) / United Nations Environment Programme (UNEP) through the Poverty and Environment Initiative and Capacity Development for Results Based Monitoring, Evaluation and Audit (CD-RBMA) have introduced among other interventions the precision/smart farming in the country. The projects are implemented in six project districts namely; Ikungi, Sengerema, Nyasa, Ileje, Bukoba Rural and Bunda.

The interventions that ESRF/GoT and UNDP/UNEP supports include:

- Interactive Mobile Platform – M-KILIMO
- The Hydroponic System – Fodder
- The Aquaponic System – Vegetables
- Azolla- Animal feeds and bio-fertilizer
- Cage culture

## **2.0 SMART/PRECISION FARMING – ESRF INTERVENTIONS**

---

### **2.1 Interactive Mobile Platform – M-Kilimo**

Due to fast growth of technology and telecommunication sector, mobile phone has been used by farmers to get information and data on weather and climate which assist them to know where and when to plant, when to harvest, even linking farmers and buyers, get to know the market price for different crop, and exchange information and knowledge with extension officers. In recognition of the above advantages; ESRF through CD-RBMA projects developed the Mobile Kilimo Platform (M-Kilimo). The platform provides market information by connecting farmers and buyers and facilitates flow of expert information from extension officers to farmers. Farmers can as well request for expert information from extension officers. Further the platform is used to send and receive alert information on environment distraction. The platform is currently working in Bunda, Kilosa and Ileje district. Efforts to scale it up to other districts in under way.

### **2.2 The Hydroponic System – Fodder**

Hydroponic fodder is young tender grass grown from a cereal grain mostly barley and wheat. The hydroponic fodder system is a temperature and humidity controlled growing room that is specifically designed to sprout grains that are very nutritious. A selection of grains are put into trays without soil and sprayed with water solution at predetermined intervals. After only 7 days, the fodder is removed from the tray and can be fed to the animal. The animal eats everything (i.e. roots, leaves and nuts, the hydroponic fodder system is waste-free, sustainable and cost-effective.

The hydroponic fodder systems were automatically controlled and depended on electricity. Of late ESRF in collaboration with other stakeholders have localized the technology to suit local situation. The locally made systems are not automated and do not depend on electricity. The temperature and humidity inside the hydroponic fodder system are controlled using only a hydro-net and a hydro-cloth, to ensure higher growth and the best nutritional value possible.

Hydroponic fodder which globally, is considered to be the best livestock feed replaces grains like dairy meal; pig's feeds and poultry feed concentrates which are very expensive.

In Tanzania hydroponic fodder has been introduced in Bukoba Rural and Bunda Districts. The construction of demonstration sites is going on in Bunda District, and at Ruvu National Service Camp in Coast Region.

The private sector has also shown interest to adopt the technology. Milkcom Farms, the producer of Dar Fresh products have installed the hydroponic fodder system at their factory at Kigamboni in Dar es Salaam.

Imported hydroponic fodder systems v/s locally made system

IMPORTED / AUTOMATED SYSTEM	LOCAL MADE SYSTEM
1. It's an Automated System	1. Made from Several Local Materials available
2. Need electricity to operate	2. No need of electricity
3. Currently installed at Dar Fresh in Kigamboni	3. Mr. Ahmed Mbae in Bukoba Rural District and Nyantwali farmers Association in Bunda they constructed the system using hydro-net of different sizes depending on weather/climate
4. Two demonstration sites are under construction at Ruvu JKT and in Bunda district	

**Automated Hydroponic Fodder in Kigamboni**



**Localization of the technology – Bunda and Bukoba Rural District**



### 2.3 Aquaponics

Is the combination of aquaculture (raising fish) and hydroponics (the soil-less growing of plants) that grows fish and plants together in one integrated system. The fish waste provides an organic food source for the growing plants and the plants provide a natural filter for the water the fish live in.

ESRF through CD-RBMA project is establishing two demonstration sites. The sites at Ruvu JKT and Bunda are ment to provide hands-on training. Currently the Installation of the green houses and some other systems have been completed.

### **Nutrient Film Technique**



### **Advantages of Aquaponics**

- The system grows six times more per square foot than traditional farming.
- Aquaponics uses 90% less water than traditional farming.
- With aquaponics, we can grow any time of year, in any weather, anywhere.
- Fewer pests to deal with since it is in a green house.
- There's no weeding
- Plants grows twice as fast due to the naturally fortified water from the fish.
- For the commercial farmer, aquaponics produces two streams of income, fish and vegetable
- Aquaponics farm does NOT require farmland with fertile soil, or even land with soil; aquaponics can be done just as successfully on sand, gravel, or rocky surfaces, which could never be used as conventional farmland.
- Reduced labour time
- Higher production rate
- Aquaculture waste products are used as fertilizer
- Makes use of limited space availability – can use top roofs/floors

## Aquaponic system in Bunda District



## 2.4 AZOLLA

Azolla is an aquatic fern regarded as “Live Nitrogen Manufacturing Factory” originated in the Americas. It harbors nitrogen-fixing Cyanobacteria. Azolla has been extensively used both as bio fertilizer and green manuring for rice cultivation in the South East Asian countries.

More than 50% nitrogen can be supplemented when *Azolla* dual cropped with rice. Azolla can also be used as organic feed supplement.

Azolla has been spotted in some parts of the country and therefore, ESRF with Support from the United Nations Development Programme (UNDP) have established four demonstration sites for the Azolla. Two demonstration sites were constructed in Bukoba Rural District and other two in Bunda District. Currently azolla is used in as feed supplement for fish and other animals including chicken.



*Azolla Ponds in Bunda and Bukoba Rural Districts*



## 2.5 Aquaculture

Aquaculture refers to the breeding, rearing, and harvesting of fish in all types of water environments including ponds, rivers, lakes, and the ocean. It includes growing fish in ponds, tanks and cages. Tanzanians have shown interests in aquaculture especially pond culture. Unfortunately with little knowledge and existing poor conditions this has not fulfilled the expectations of many.

The Economic and Social Research Foundation with support from the United Nations Development Programme (UNDP) have been supporting these initiatives in the six project districts. The production of fish in ponds has been improving as days goes on. In 2014, ESRF established a “Cage culture” demonstration site at Bulamba JKT in Bunda District where more than 50 fish cages were constructed. Cage culture is the best choice where suitable water bodies are available.

In bid to scale up to other districts, ESRF conducted a suitability study on Cage culture in Lake Victoria to determine suitable areas for cage culture. More than 3 suitable sites in Bunda and Bukoba Rural Districts were identified. The identified sites are Kemondo Bay, Karukekere and Rubafu. Unfortunately, Tanzania is not taking advantage of Cage culture; so far there are less than 100 fish cages in the country as compare to our neighboring country Uganda, with more than 50,000 cages in Lake Victoria.

### Cages at Karukekere – Bulamba JKT



### LESSONS LEARNT AND IMPACT

There are several lessons learnt from the implementation of the smart farming in Tanzania. But we have also registered several report impact both negative and positive from implementation of the project.

## LESSONS LEARNT

- We have learnt that ICT interventions have multi-effects in implementation of CD-RBM project. The Mobile Kilimo apart from supporting farmers and agriculture expert directly to agriculture, it can be integrated into other interventions such as micro financing and banking to support management of loans and database of borrowers/loans. Can also be used as a database of farmers, buyers and borrowers for other interventions such as beekeeping and forestry.
- Mobile Phone usage in rural area is playing a vital role for the enhancement of farmers business and access to better understanding of agricultural market situation. Farmers appreciate mobile phone as easy, fast and convenient way to communicate and get prompt answers for their respective problems.
- We have also learned that more training /capacity building to extension officers on the use of tablets and m-kilimo system is needed for the platform to fully achieve its objectives
- The Introduction of new technology in Agriculture has been accepted by communities in Bukoba Rural District. The communities are utilizing their own resources to introduce Hydroponic fodder systems and Azolla ponds.
- Engagement in Radio and TV programmes through FURSA CAMPAIGN hosted by Clouds Media Group have shown big demand from the community. People are more interested on agribusiness/ agricultural activities but they lack dedicated institutions to support them with expert information/technology.
- Efforts to improve agriculture should go hand in hand with strategies for adoption of new technologies. Hydroponic, aquaponic and azolla technologies will enhance agriculture and livestock keeping in the country while preserving the environment
- Cage culture can be used to reduce overfishing and illegal fishing in Lake Victoria but also minimizing environmental and ecosystems degradation.
- Implementation of project requires thorough investigations, preparations and knowledge otherwise it can prove failure. This is learned from Bulamba Cage fish farm. Lack of the above resulted to loss of all fingerling from the cages during storm.
- There are more than 50,000 cages in Uganda as compared to 50 cages in Tanzania. The 50 cages belong to JKT which are supported through PEI project

## **IMPACT**

- Through Mobile Kilimo Farmers are more informed on the modern agricultural practices and get market information of their products. Thi has enabled them to get fair prices for their products. For Example at Itale Village in Ileje District farmers are now receiving double price per tin of beans (from Tshs. 25,000 to Tshs. 50,000/-)
- Through promotion and marketing of the initiative; many people have shown interested on the Hydroponic Fodder, Aquaponic and Azolla and want to know more. We receive more that 15 guest everyday from different corners who want to know more on the fodder technology and they are willing to practice
- Cage fishing and fishing ponds have succeeded to raise income of households by producing high quality fish. For Example five (5) fish cages can produce a total of 25,000 pieces of fish of high quality, better its price, increase income and improve the livelihood