REPUBLIC OF KENYA

MINISTRY OF AGRICULTURE, LIVESTOCK, FISHERIES AND COOPERATIVES

STATE DEPARTMENT FOR FISHERIES, AQUACULTURE AND THE BLUE ECONOMY

Concept Note

Upscaling Food and Nutrition Security-Backyard Aquaponics Unit

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May 2020

CONCEPT NOTE

Title	**UPSCALING FOOD AND NUTRITION SECURITY**
Background Information	Fishing and Aquaculture contributed only 0.5% (Kes 17.95 Billion) to the Agriculture GDP which stood at 34.2% of the National GDP. This was 9.7 % growth as compared to year 2017 in which Fishing and Aquaculture GDP was Kes 16.36 Billion. (KNBS Economic Survey 2018). The average annual fish production in the country stands at 165,000 metric tons against a demand of 475,000 metric tonnes. This implies that there exists a fish demand gap of 310,000 metric tons of fish annually. The gap between demand and production is projected to increase to 360,000 metric tonnes per year by 2025, resulting in rising prices and a continuing decline in fish consumption The per capita fish consumption in the country is low and currently stands at 4.7 kg/person/year compared to a continental average of 10 Kgs/person/year and a global average of 20 Kgs/person/year.
Strategic context	Smallholder agriculture and livestock production are under mounting pressure in Kenya from shortages of productive land and the negative effects of climate change, particularly on rain fed crops, pastures, livestock and fisheries. In response, the mass of subsistence farmers on the margins of markets are seeking ways to adjust their mixed farming systems to minimize risks, make optimum use of their scarce resources and earn a living. Despite advances in the national economy, a significant proportion of rural people remain in poverty. In this deteriorating rural economic context, diversification of agricultural production and rural incomes is extremely important. Aquaculture has been identified as one such diversification strategy. The inland aquaculture subsector in Kenya has been growing rapidly in response to declining capture fisheries and increasing national demand for fish. The need to meet the increased demand for fish has promoted intensification in aquaculture production which will consequently lead to increased demand for aquaculture inputs, capacity building and adoption of aquaculture Technologies, Innovations and Management Practices (TIMPs) for efficient production. This demand will cascade to all other levels along the value chain such as post-harvest fish management, marketing, consumption and linking the various aspects in order to operate aquaculture as a successful business venture.

<table>
<tr><td></td><td>Fish value addition will play a key role in diversification of products that can meet different customer tastes and preferences and increase fish consumption.</td></tr>
<tr><td>Proposed Intervention</td><td>Development of backyard aquaponic units to boost fish availability for food and nutrition security</td></tr>
<tr><td>Concept</td><td>To establish backyard Aquaponic units that integrates fish and vegetable farming in urban and peri-urban areas.</td></tr>
<tr><td>Advantages of aquaponics</td><td>Aquaponics is a recirculating food production system that uses less than 10% of the water normally required for fish farming and plant production.

<table>
<tr><th>Freshwater systems rely on three major elements</th></tr>
<tr><td>Freshwater aquatic Fish</td></tr>
<tr><td>Nitrifying Bacteria</td></tr>
<tr><td>Plants</td></tr>
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It is therefore suitable for small-scale/domestic consumption as well as commercial fresh food production, particularly in communities where water is scarce.
Major benefits of Aquaponic system

Sustainable and intensive food production system.
Two agricultural products (fish and vegetables) are produced from one nitrogen source (fish food).
Extremely waterefficient.
Does not require soil.
Does not use fertilizers or chemical pesticides.
Higher yields and qualitative production.
Organiclike management and production.
Higher level of biosecurity and lower risks from outer contaminants.
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	• Higher control on production leading to lower losses • Can be practiced even in an urban and peri-urban set-up • Creates little waste. • Daily tasks, harvesting and planting are laboursaving and therefore can include all genders and ages. • Economical production of either family food production or cash crops in many locations. • Construction materials and information base are widely available.
How aquaponics unit works	This method relies on fish waste to be used as an organic nutrient solution to grow vegetables. In a system, water flows from the fish tank into a bio filter where bacteria break down the fish waste into an organic nutrient solution for the growing vegetables. The plants then absorb the nutrients from the water which essentially cleans it before being re-circulated back into the fish tanks. The bacteria are fundamental to this process, they convert the ammonia, which is a major component of fish waste, into nitrate (a more accessible form of nitrogen for plants), preventing the water from becoming toxic to the fish. It is vital that every aquaponics unit has a biological filtration component to house the bacteria, allowing them to constantly convert the ammonia into nitrate.
Design	***Utilize the Media-Filled Bed Aquaponic systems*** Media-filled Grow Bed units are the most popular design for small-scale aquaponics as they are efficient with space, relatively low cost and suitable for beginners as they are a very simple design. In grow bed units, the media used to support the roots of the plants also functions as the means of filtration. Then fish are grown in tanks and water filtered from plants is pumped fish tanks and vice versa. There can be several designs of simple backyard aquaponic units

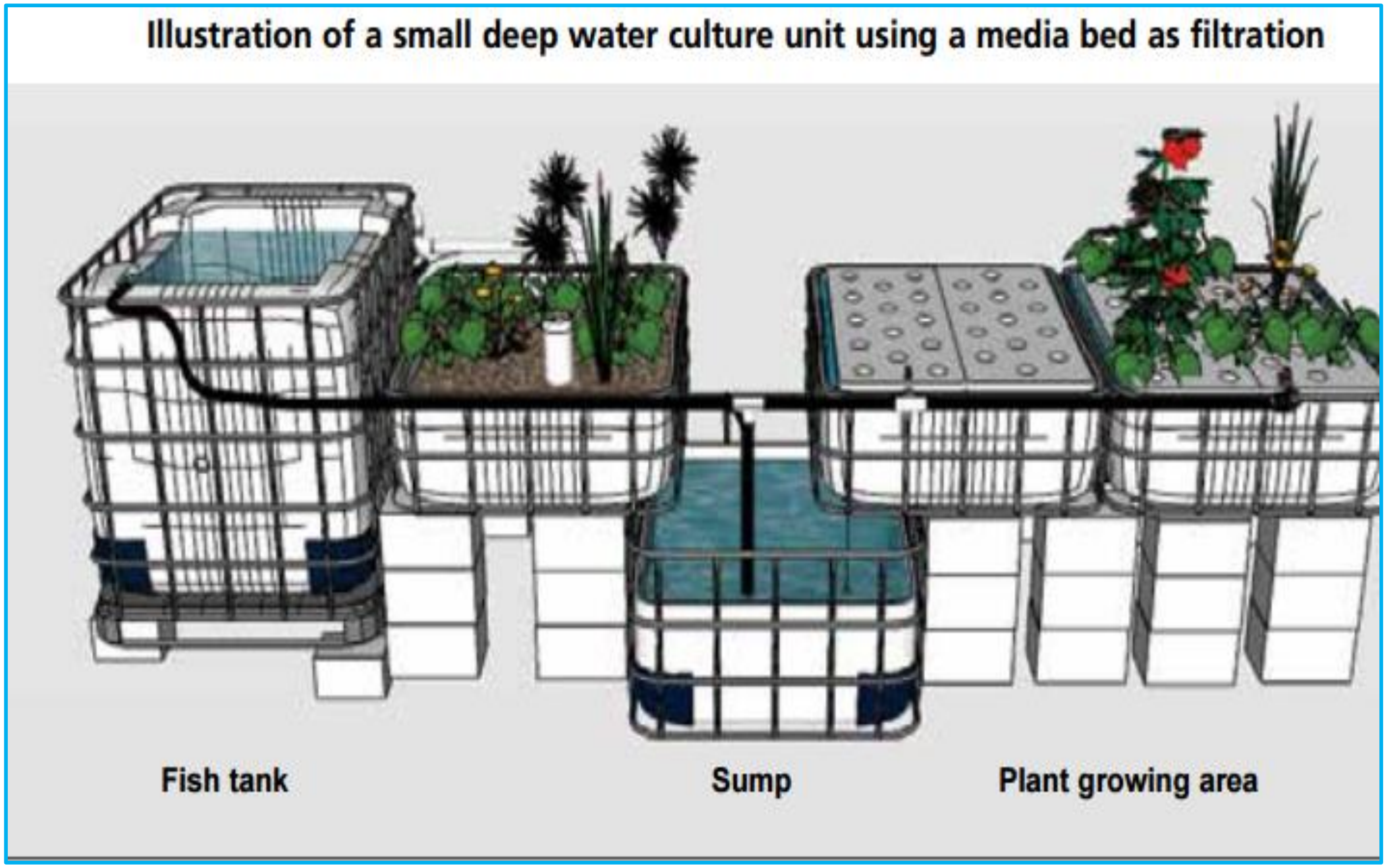

Figure 1: Illustration of an aquaponic Unit (Photo Courtesy of FAO)

	There can be Different Designs of Backyard Aquaponic Units  
	How the system works Water flows by gravity from the fish tank(s), through a simple mechanical filter and into the plants media beds in pipes or troughs. These media beds are made of non-reactive porous material that serves as both the mechanical and biological filter and location for mineralization. These beds both host the colony of nitrifying bacteria as well as provide the place and support for the plants to grow. Once the water floods the medium, it flows out by gravity through a stand-pipe into the sump tank which act also as biofilter. At this point, the water is relatively free of solid

	and dissolved wastes. Finally, this clean water is pumped back to the fish tank, which causes the water level to rise and over-flow from the fish tank back into the media beds, completing the cycle.		
Production and Cost Analysis	***Fish Production and sales*** The 1000 litres' tank can be stocked with 100 fish fingerling at a weight of about 20g each, if the fish are grown to 500g then harvested, each tank will produce about 50kg every six months and 100kg per year. At an average of Kshs 400 per kilogram of fish, the annual sales from the tank can be Kshs 40,000. It should be noted that there can be several fish tanks or such units if the space would allow and in this case we can have continuous or monthly production and therefore the earnings can be enhanced above what is indicated above. This makes the system capital investment to be recovered within a short time. ***Crops production and sales*** Crop production and sales will depend on the type of plants grown in the growth media. Considering a media bed of about 5 meter squared, the area can produce vegetables/fruits in the range of Kshs 10,000-40,000 per year		
Materials and Equipment required			
	Component and specifications	**Purpose**	**Estimate Cost (Kes)**
1.	Fish tank (with flat bottom, low-density polyethylene (LDPE) plastic, UV-resistant, 1000 litres capacity)	To support growth of fish. UV treatment protects the tank form direct sunlight that can destroy plastic. Flat bottom allows water to flow uniformly and ease of waste collection because it collects at the center due to centripetal force.	12,000
2.	Covers and shading (Wire mesh/net mesh/cloth attached to a wooden support)	The shade covers prevent algal growth, prevents fish from jumping out, prevents leaves and debris from entering, and prevent predators such as cats and birds from attacking the fish.	5,000

3.	Media bed (Rectangle, LPDE Plastic, 3m length by 2m Width by 30cm depth)	The bed will hold the growth medium	6,000
4.	Growth media (Volcanic gravel (tuff), Limestone) Media must have/be; Large surface area for bacterial growth, neutral pH and inert, good drainage properties, easy to work with, sufficient space for air and water to flow within the medium, available & cost-effective and lightweight if possible.	Medium is used to support the roots of the plants and also the same medium functions as a filter, both mechanical and biological	5,000
5.	Sump tank (Low-density polyethylene (LDPE) plastic , UV-resistant, 1000 litres capacity)	For holding water from plants before pumping into the fish tank	10,000
6.	Water pump (0.5 HP)	For pumping water	12,000
7.	Operating costs	Fingerlings, fish feeds, seedlings, piping system, water cost, power costs)	50,000
		Total Cost	**100,000**