

Article

Feasibility Study of a Small-Scale Recirculating Aquaculture System for Sustainable (Peri-)Urban Farming in Sub-Saharan Africa: A Nigerian Perspective

Emmanuel O. Benjamin ^{1,*}, Oreoluwa Ota ²  and Gertrud R. Buchenrieder ³ 

¹ Department of Agricultural Production and Resource Economics, Technical University of Munich (TUM), 85354 Freising, Germany

² Department of Governance in International Agribusiness, Technical University of Munich (TUM), 85354 Freising, Germany

³ RISK Research Center, Universität der Bundeswehr München (UniBw M), 85577 Neubiberg, Germany

* Correspondence: emmanuel.benjamin@tum.de

Abstract: The (peri-)urban population in developing countries, especially sub-Saharan Africa, is rapidly increasing. As towns and cities grow, so does the demand for fish protein. While flow-through aquaculture can provide fresh, healthy and nutritious fish protein, it is plagued by extensive land requirements as well as effluent discharge and is thus unsuitable for city regions. Alternatively, small-scale Recirculating Aquaculture Systems (RAS) could improve food and nutritional security and livelihoods as well as reduce environmental degradation in (peri-)urban areas despite land and water constraints. The question, however, remains—what are the key technical, business and managerial issues surrounding small-scale RAS in (peri-)urban farming? To answer this question, first, a systematic literature review on RAS in sub-Saharan Africa is conducted. Second, the RAS prototype of the Sustainable Aquaponics for Nutritional and Food Security in Urban Sub-Saharan Africa (SANFU) II project is assessed. This assessment is based on the mass balance and stock density, relevant for fish survival and/or availability as well as net cash flow analyses. The results suggest that small-scale RAS are technically and financially viable with efficient filtration and family labor having proper aquaculture monitoring and management skills. Furthermore, access to adequate equipment and inputs as well as electricity for the recirculating system are crucial. (Peri-)urban innovation actors will adopt RAS if operations are profitable.

Keywords: food security; (peri-)urban farming; fish protein; RAS; land; water; Nigeria; sub-Saharan Africa



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1. Introduction

The increasing population and urbanization in sub-Saharan Africa is reaching unprecedented levels. In a number of instances, urbanization has passed the 50% threshold [1]. A number of factors ranging from high fertility rates to rural–urban migration drives population growth and urbanization [2,3]. This implies that there will be a substantial increase in the demand for animal-sourced foods (ASF), specifically fish protein, in cities and towns, which today's (rural) producers will be unable to meet [4]. Furthermore, prospective (rural) fish farmers, often young and agile, seek greener pastures in cities abandoning farming altogether. This exacerbates the fish supply deficit observed in sub-Saharan Africa, particularly in Nigeria, where the fish consumption rate is less than 10 kg compared to the world average of 19 kg per person per year [5]. This is more severe among women and children, resulting in malnutrition and one of the highest stunting rates among children under the age of five [6]. To compensate for this deficit, (peri-)urban vulnerable groups often turn to backyard gardens and other micro- and small-scale agribusinesses for subsistence as well as income generation [7]. Thus, one of the alternatives and viable options for ensuring food

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Aquaculture for the Developing Countries Frederick W. Bell, E. Ray Canterbury, 1976 Monograph on the use of aquaculture fish culture and farming of aquatic plants and animals in helping to increase the supply of protein rich food in developing countries covers food shortages and food security technology transfer in aquaculture bio economic models etc and includes recommendations for future biology research and economic research Annotated bibliography pp 153 to 261 and statistical tables

Aquaculture Management James W. Meade, 2012-12-06 Although some nations such as Japan have invested in aquaculture research and developed major aquaculture industries the opportunities for similar development in the United States remain largely unnoticed In a typical recent year the United States which claims 20% of the world's marine fisheries resources imported seafood worth 4.8 billion and exported 1.3 billion In addition to the 3.5 billion deficit in food fish was another 2.7 billion deficit for nonedible fishery products Next to oil fishery products constituted the second highest drain on the United States balance of payments and accounts for a significant portion of the foreign trade deficit Furthermore fish consumption has been increasing in North America In response to the demand for fishery products aquaculture managers not only have the opportunity to realize economic profit but in doing so can make an important contribution to reducing the national debt providing employment and enhancing our diet This book might be considered a farm management text for those in aquaculture It is intended to provide an introduction to aquaculture principles and an introduction to management including business and people management microeconomics and the concepts of efficiency and productivity I hope it will bridge the gap between conservationists the academic community and commercial culturists Abundant references should enable the reader to quickly access literature on most topics germane to the management of culture systems

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Integrated Irrigation and Aquaculture in West Africa Food and Agriculture Organization of the United Nations, 2006-01-01 This publication contains background documents and papers presented at a workshop on integrated irrigation aquaculture IIA held in Mali in November 2003 as well as the findings of FAO expert missions on IIA in the West Africa region The rationale for IIA development lies in its potential to increase productivity of scarce freshwater resources and to reduce pressure on natural resources issues of particular importance in the drought prone countries of West

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Aquaculture zoning, site selection and area management under the ecosystem approach to aquaculture Food and Agriculture Organization of the United Nations, 2018-11-19 The ecosystem approach to aquaculture provides the conceptual guideline to spatial planning and management This publication describes the three major steps in spatial planning and management namely zoning site selection and design of an aquaculture management area or AMA The rationale for and objectives of each step the ways methodologies to implement it and the means tools that are available to enable a methodology are described in a stepwise fashion Recommendations to practitioners and policy makers are provided A separate policy brief accompanies this paper The benefits from spatial planning and management are numerous and include higher productivity and returns for investors and more effective mitigation of environmental economic and social risks the details of which are provided in this paper This publication is organized in two parts Part one is the Guidance it is the main body of the document and describes the processes and steps for spatial planning including aquaculture zoning site selection and area management Part two of the publication includes six annexes that present key topics including i binding and non legally binding international instruments which set the context for sustainable national aquaculture ii biosecurity zoning iii aquaculture certification and zonal management iv an overview of key tools and models that can be used to facilitate and inform the spatial planning process v case studies from ten countries Brazil Chile China Indonesia Mexico Oman the Philippines Turkey Uganda and the United Kingdom of Great Britain and Northern Ireland and vi a workshop report The country case studies illustrate key aspects of the implementation of spatial planning and management at the national level but mostly within local contexts **Report of the FAO World Conference on Fisheries Management and Development** Food and Agriculture Organization of the United Nations, 1984-01-01 **Guide to Sources for Agricultural and Biological Research** J. Richard Blanchard, Lois Farrell, 2023-07-28 **Bibliographies and Literature of Agriculture**, 1988 **Aquaculture Research and Development in Rural Africa** Barry A. Costa-Pierce, 1991 Foreign Assistance and Related Agencies Appropriations for 1973 United States. Congress. House. Committee on Appropriations. Subcommittee on Foreign Operations and Related Agencies (1968?-1978), 1972 *Aquaculture Development and Economics* Ann Townsend Young, 1993

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Table of Contents Aquaculture For The Developing Countries A Feasibility Study

1. Understanding the eBook Aquaculture For The Developing Countries A Feasibility Study
 - The Rise of Digital Reading Aquaculture For The Developing Countries A Feasibility Study
 - Advantages of eBooks Over Traditional Books
2. Identifying Aquaculture For The Developing Countries A Feasibility Study
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Aquaculture For The Developing Countries A Feasibility Study
 - User-Friendly Interface
4. Exploring eBook Recommendations from Aquaculture For The Developing Countries A Feasibility Study
 - Personalized Recommendations
 - Aquaculture For The Developing Countries A Feasibility Study User Reviews and Ratings

- Aquaculture For The Developing Countries A Feasibility Study and Bestseller Lists
- 5. Accessing Aquaculture For The Developing Countries A Feasibility Study Free and Paid eBooks
 - Aquaculture For The Developing Countries A Feasibility Study Public Domain eBooks
 - Aquaculture For The Developing Countries A Feasibility Study eBook Subscription Services
 - Aquaculture For The Developing Countries A Feasibility Study Budget-Friendly Options
- 6. Navigating Aquaculture For The Developing Countries A Feasibility Study eBook Formats
 - ePub, PDF, MOBI, and More
 - Aquaculture For The Developing Countries A Feasibility Study Compatibility with Devices
 - Aquaculture For The Developing Countries A Feasibility Study Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Aquaculture For The Developing Countries A Feasibility Study
 - Highlighting and Note-Taking Aquaculture For The Developing Countries A Feasibility Study
 - Interactive Elements Aquaculture For The Developing Countries A Feasibility Study
- 8. Staying Engaged with Aquaculture For The Developing Countries A Feasibility Study
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Aquaculture For The Developing Countries A Feasibility Study
- 9. Balancing eBooks and Physical Books Aquaculture For The Developing Countries A Feasibility Study
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Aquaculture For The Developing Countries A Feasibility Study
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Aquaculture For The Developing Countries A Feasibility Study
 - Setting Reading Goals Aquaculture For The Developing Countries A Feasibility Study
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Aquaculture For The Developing Countries A Feasibility Study
 - Fact-Checking eBook Content of Aquaculture For The Developing Countries A Feasibility Study
 - Distinguishing Credible Sources

13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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