



<p>UNIVERSITY OF THE WEST of SCOTLAND</p> 	<p>CAREED 7th Annual Conference</p>	
<p><i>Title of the Paper</i></p>	<p>Cost-Effective Solutions for Developing Farmers in Rwanda: Equity and Inclusion Impacts from an Aquaponics Project.</p>	
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<p><i>*Purpose of the paper</i></p>	<p>This study aims to explore the potential equity and social inclusion outcomes in a recent cost-effective aquaponics project for developing farmers in Rwanda. The project was funded under the Innovate UK Agri-Tech Catalyst Programme during the 2019-22 period. This paper has three objectives: i) to critically explore the dimensions of social inclusion in food production among farmers in Rwanda; ii) to critically assess the role of equity in food production; iii) to critically examine cost-effective aquaponics as a solution for achieving inclusivity for developing farmers within the community. Rwanda, a small hilly country in East Africa, is fondly referred to as the land of a thousand hills. The landscape is predominately characterised by its rolling central hills, and swamp and savanna in the eastern region. The country has the highest population density per-square metre in Africa, and is landlocked, with 59% of the total country’s land currently used for agriculture at 1.4 million acres. Ninety per cent of this is steep hillside areas, susceptible to landslides and erosions (Mutuyimana, 2015).</p>	
<p><i>*Design/methodology/ approach</i></p>	<p>This study employs a quantitative exploratory survey design as part of the larger pilot research regarding community perceptions of aquaponics farming, both in residential areas as well as in industrial community-established farming systems. Purposive sampling was used to recruit a sample of 320 respondents from several districts in Rwanda, and statistical analysis along with machine learning clustering was conducted on both dimensions and elements of social exclusion and inclusion in the context of prevailing Rwandan culture. These included economic, social, environmental, legal,</p>	

	<p>physical, political, physical, relational, as well as spatial variable quantities. These were then followed with a T-test to compare means as well as an ANOVA test across a range of demographic variables.</p>
<p><i>*Findings</i></p>	<p>Summary of the findings:</p> <p>Based on demographic information, using the clustering approach,</p> <ul style="list-style-type: none"> • The accuracy of the model is more than 60% (though the prediction is 85%). • ANOVA age and education: there is a significant effect here (farmers in different age groups have different motivational influences). • When comparing the means with the T-Test, there is a significant effect of gender in the source of income. • The majority of respondents were found to prefer vegetable farming than fish farming. Vegetable seems to be a more appealing product than fish. • Overall, there were five different behavioural responses.
<p><i>Study Limitations</i></p>	<p>It was unfortunate that due to travel restrictions caused by the Covid-19 pandemic, the UK based research team was unable to travel for primary data collection, and hence relied on local research assistants. This led to a data set containing some missing values, though the data collected and sample size were sufficient to carry out meaningful statistical analysis.</p>
<p><i>Policy Implications</i> (if applicable)</p>	<p>Research in this study recommends multiple actions for policy implications, such as strengthening property and land rights. Critical steps toward a more equitable food system can be achieved through the recognition of property and land rights. These conditions should apply not only to women but also to minority groups and indigenous people, where many have lost access and rights to their property and land. Furthermore, a holistic system approach is crucial for transforming food systems, where a deeper understanding of the different interconnections is necessary to identify possible trade-offs and solutions. Farmers' participation in the creation of agricultural policy should be considered, just as much as the food industry and its profit-oriented presumptions. Simultaneously, women, young people and indigenous groups in communities need more knowledge about how to access markets, and how to interact with them. To ensure a shift towards equitable</p>

	and inclusive systems, everyone must be involved from local to multinational levels.
<i>Practical Implications</i> (if applicable)	<p>The most recommended actions for promoting gender equality and social inclusion in food production amongst farmers in Rwanda are two-fold:</p> <p>Firstly, using the aquaponics system which aims to produce fish and vegetables in a circular economy throughout the year, should be made more attractive and profitable. Agriculture needs to be able to offer highly skilled, meaningful, and green jobs followed by economic investment that makes it more profitable for youths and women to engage fully in the process.</p> <p>Secondly, sustainable consumption patterns need to be facilitated. Food systems are becoming more uniform as the variety of crops farmed and consumed has fallen dramatically, replacing the wholesome and nutritious diets of the past. One causal factor is today's mischievous marketing strategies, supported by culturally dominant narratives, that affect our consumption patterns and eating habits. Instead, healthy, sustainably produced and culturally diverse food choices need to be provided and promoted.</p>
<i>Social implications</i> (if applicable)	Inclusive decision-making needs to be promoted. Through acknowledging and including marginalised groups, the overall understanding of food systems can be deepened, and creative solutions provided. Equally, young people, and women, are often overlooked and excluded from decision-making processes.
<i>*Originality/value of paper</i>	The main contribution of this project, and this particular research study is that it provides a strong contribution to a range of Sustainable Development Goals (SDGs). These include Goal 2: <i>Zero hunger</i> ; Goal 5: <i>Gender equality</i> ; Goal 8: <i>Decent work and economic growth</i> ; Goal 10: <i>Reduced inequalities</i> ; and Goal 14: <i>Life below water</i> . Using primary data, the researchers were able to provide valid recommendations for this project's start-up, commercialisation, and development. The project was also able to empower local youths by providing them with a wide range of employment opportunities, and during periods of construction at the site, between 30 and 40 employees at a time were paid for various activities, such as clearing the land/site, digging, and moving small equipment and materials instead of using expensive machinery and equipment.
<i>**Key Words</i>	<i>Gender; Equality; Social inclusion; Aquaponics; Food production; Rwanda.</i>
<i>Paper Type (theoretical or empirical)</i>	Empirical

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