A Sustainbale Food System Outlook Decision Support Framework (SFSO-DSF): Coupling scenarios designs and analytical frameworks for optimal Food System analysis

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1. INTRODUCTION

In recent years, there has been world-wide recognition of the problems associated with our current food system (FS). These problems including global warming, acute hunger, food inequality and insecurity have been studied extensively with the aim of creating a better future. These studies have brought to bear the fact that the silo and top-down approach to food system challenge is neither efficient nor sufficient. Rather the mobilization of multi-stakeholders and the implementation of strategies and action plans through a system thinking approach have been deemed indispensable in achieving a sustainable food system (Monasterolo, Pasqualino, Janetos, & Jones, 2016). Now, the majority of stakeholders agree to the need for a systemic solution to food system challenges rather than quick fixes.

The inclusion of SDGs into policies has led to the development of new FS frameworks which provide opportunity to test, assess and identify key roles of stakeholders. These frameworks are intended to create pathways for synergistic effect towards a global sustainable FS. Generally, Food System Framework (FSF) must deliver relevant insights to understanding FS challenges as they are used frequently to argue certain reforms to achieve a sustainable food system. Carlisle and Miles (2013) proposed a framework that incorporates biological diversified farming systems that ameliorate the impact of modern agriculture systems on the environment. In a follow-up study, Delonge, Miles, and Carlisle (2016) found that adopting ecological principles will sustainably meet the food needs of society while addressing the associated environmental challenges. Although these studies have provided evidence of the efficacy of proposed frameworks, they address certain aspects of a sustainable system. Thus, it is essential to identify optimal FSF regarding the four sustainability dimensions and their associated trade-offs. Relatively, little research has been carried out to qualitatively and quantitatively assess existing FSF. Brouwer, Mcdermott, and Ruben (2020) presented a qualitative assessment of FSF by considering a broad view of the food environment, equity and inclusion, health and food and nutrition outcomes. However, the study did not to consider the different performance indicators within these dimensions.

The dramatic loss of livelihood and income caused by COVID-19 pandemic has undoubtedly presented shocks that have motivated us to innovate and rethink our patterns of production , distribution and consumption as a planetary community (Bank, 2020).

Taken together, our planet is in danger as the estimated number of people suffering from acute hunger doubled by the end of 2020 (Crisis, 2020). Agriculture and diets are depleting our soils, changing our climate and driving biodiversity loss so much that our life-supporting ecosystems are now under threat. The year 2020 demonstrated to a high extent, the volatility of our world, with unexpected events and crisis. Benton (2019) presented on four plausible alternatives to the future of food based on the axes of global connectivity and dietary global. Similarly, Moffatt and

Schwartz (2017) explored four future worlds under the lens of two drivers, namely; demand shift and market connectivity. However, these studies failed to link the scenarios developed to transformational frameworks, which can inform the structuring of healthy, inclusive and circular FS programs.

Therefore, in this study, we (1) assess existing FSF by deploying Fuzzy-TOPSIS decision model to identify optimal FSF for analysing the sustainability dimensions, (2) construct scenarios to explore what future worlds can we experience, and (3) link the scenarios constructed to the FSF assessed, to develop a decision support framework that could be invaluable to stakeholders in implementing strategies that can speed up FS transformations in such futures.

2. MATERIALS AND METHODS

This study adopted a methodological framework which, utilised a Multi-Criteria Decision-Making (MCDM) tool to assess FSF, developed scenarios which broaden stakeholder perspectives of futures of the food system, and coupled both to design a decision support framework. The strength of the framework lies within the scenario design approach stage, which allows the authors to initiate discussions on the potential scenarios and how they influence key stakeholders to ensure the sustainability of the food system.

From a careful study of literature in the FS space and the FAO 2019 annual report, four sustainability dimensions, namely social, economic, environment, and food security and nutrition are used to characterise the current state of the food system. The next step involved identifying the critical uncertain and invariant driving forces that influence the current situation.

Once these two have been established, the next step involves the formulation of causal links or plots that show the interrelationship between the current state of the food system and the driving forces. Finally, the scenario design approach concludes with the construction of alternative future outlooks of the FS. Five future scenarios namely: the developed world, developing world, conflict world, a world facing pandemic and an uncertain world are considered. The assessments are based on critical dimensions, determined through a ranking of the fundamental traits of the scenarios developed. This was determined by carrying out a questionnaire survey and the method of Complementary Judgement Matrix in combination with the Feasible Weight Space.

Prior to the scenario development, we leverage a MCDM tool; Fuzzy-TOPSIS to identify optimal FSF for analysing the different sustainability dimensions. Then identify a set of sustainability criteria or attributes to classify the selected FSF. Next, we deploy the decision-making model, fuzzy-TOPSIS to select optimal FSF by considering economic, environmental, social and food and nutrition dimensions. The final step in the framework focuses on the development of a decision support framework that will inform FS analyst on the different strategic directions to achieve sustainability.

3. RESULTS AND DISCUSSION

From the scenario analysis, our future FS is unsustainable and frail to meet the nutritional and dietary requirements. Also, there are several frameworks for analysing FS, some address all the sustainability dimension whilst others focus on a unit dimension. Again, each future scenario has a key driver of interest in achieving sustainability. This introduces a lot of challenges when selecting a framework that can sustainably analyse FS concerns in any likely future scenario.

Therefore, we developed a Sustainable Food System Outlook Decision Support Framework (SFSO-DSF) that is useful to the FS analyst and stakeholders.. Figure 1 shows one of the many interactive pages of the application. The application has three interesting modules: (1) Future shapes of GF, this allows integration of other scenarios presented in literature into the scenario layer; (2) Co-creation: here stakeholder can create a possible future outlook of the FS with the support of the application,; (3) Future Outlook of FS, this module has 5 predesigned future scenarios that the user can select from.

Figure 1: Intereactive User Interface of the SFSO-DSF

In all the modules, the application provides the user the opportunity to view spider plot of a ranking of the critical drivers, radia splot of the ranking FSF and a documentation of the optimal three FSF for understanding of the pathways towards susbtainable

4. CONCLUSION

Returning to the question posed at the beginning of this study, it is now possible to state that; First, there is an optimal framework for FS analysis considering any sustainability dimension. The results show that CIRAD, EATa, Mamo and CIRAD are optimal FSF for food and nutrition (health), social and economic sustainability dimensions, respectively.

Second, the future of the FS is unstable, countless uncertainties, and shocks exist. Nevertheless, in the near term, scenarios constructed can offer guidance to the national and international policy community by helping them anticipate emerging crisis and translating them into adequate practical policies and actions to build to a sustainable food system.

Third, by linking the scenarios constructed to the FSF analysed, we developed a FSO-DSF. The support framework shows that by assuming a hypothetical food system analyst who selects the world facing a pandemic, the FSO-DSF proposed CIRAD framework to sustainable analyse food systems in such a world. This result demonstrates the ability of the tool to support the selection of food system transformation frameworks for healthy and circular food systems, and improve the societal understanding of possible future outlooks.

In conclusion, whether food insecurity will be eliminated by the end of the century is clouded in uncertainty, however, with gradual steps coupled with a collaborative effort and adequate infrastructure such as the decision support system presented, there should be no insurmountable constraints.

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