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CONSTRUCTION OF SUSTAINABLE FRUGAL INNOVATIONS INDEX FOR THE AGRICULTURE SECTOR

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ABSTRACT

The proliferation of agriculture innovations require stakeholders to have an accurate measurement scale to screen and select the best inventions for returns maximisation. Agriculture has evolved to become a scientific business hence the need for scientific measurements of agro-innovations and their consequences. The concepts of sustainability and frugality, hence sustainable frugal innovations are trending themes in agriculture. High quality scientific measures of these innovations remain scarce. The purpose of this study has been to develop a Sustainable Frugal Innovations index for use in the agriculture sector. A data collection instrument derived from sustainability and frugality constructs was developed and administered to 450 Agriculture experts across Zimbabwe. Twenty-five (25) constructs were extracted through Confirmatory Factor Analysis (CFA), validated and analysed, culminating in a composite Sustainable Frugal Innovation Index.

Contribution/Originality: This study originates a new index to measure the sustainability and frugality of agriculture-oriented innovations. The index guides innovations design thinkers to be sensitive to sustainability and frugality issues while helping users in making adoption choices.

1. INTRODUCTION

The incessant changes in the ecological, economic and social environment of global agriculture have triggered many agriculture innovations. These innovations emerged as agronomic innovations, agrochemical innovations, mechanisation innovations, horticultural innovations, digital innovations, agro-processing innovations among others (Anandajayasekeram, 2011). Despite its many limiting factors, agriculture productivity has to cope with increasing food demand due to global population growth. The agriculture sector has always relied on innovations from pre-historic times, this fact was supported by Boserupian theories of Agriculture innovations (Darity, 1980) which focused on increasing productivity through agriculture intensification. Today, as farmers are faced with conflicting objectives of increasing productivity and attaining sustainability in a constrained environment, Sustainable Frugal Innovations (SFIs) seem to be the panacea to the agricultural sector conundrum (Ganguly, Gulati, & Braun, 2017). Sustainable Frugal Innovations (SFIs) are a special breed of innovations, which seek competitiveness in constrained and scarce resourced circumstances. They are known by different names such as alternative innovations, smart agriculture, conservation agriculture, disruptive agriculture technologies among others (Krishnan, Banga, & Mendez-Parra, 2020). There is a growing interest in these innovations in most emerging economies (Sissoko & Castiaux, 2018) and developed economies as well (Imhof & Mahr, 2017) due to a number of economic shifts, degenerating ecological conditions and the louder calls to go green.

The United Nations Sustainable Development Goals (SDGs) calls for sustainable agriculture innovations hence the relevance of Sustainable Frugal Innovations. The Sustainable Development Goal (SDG) number 2 aims to "*End hunger achieves food security and improved nutrition and promote sustainable agriculture*". Fischer-kowalski (2015) concurred with the ability of innovation as a tool of sustainability in agriculture. Growing calls for sustainability and frugality in agriculture innovations requires that the goodness of any agriculture innovation be measured by how it perform against the sustainability dimensions and frugality dimensions (Borini, 2019) Despite increased attention on Sustainable frugal Innovations, an objective measurement for goodness or badness of them remain elusive. The purpose of this study has been to construct an index to measure the sustainability and frugality of agriculture innovations.

2. LITERATURE REVIEW

2.1. Definitions of Sustainability and Frugality

Literature is rich in sustainable innovations and frugal innovations, as well as their application in modern agriculture. Diverse definitions and dimensions on the two subject matters are well documented. According to Abubakar and Attanda (2013) Sustainable agriculture is defined as a system that, over the long term, enhances environmental quality and the resource base on which agriculture depends, provides for basic human food and fibre needs, is economically viable and enhances the quality of life for farmers and society as a whole. It is clear from the definition that sustainable agriculture seek to attain environmental, economic and social sustainability. The concept of sustainable agriculture has evolved over the years (Fischer-kowalski, 2015) and this is evolution is expected to continue in the future. On the other hand, Radjou and Prabhu (2013); Prabhu (2017) defined frugal innovation as the ability to 'do better with less resources for more people". Bencsik, Renáta, and Tóth (2016) summarised the role of frugal innovation as that of creating cheaper but qualitative products. Radjou and Prabhu (2013) used the term ***jugaad,*** *as* fugal innovation is affectionately known in India from a Hindi word meaning an innovative fix or an improvised solution born from ingenuity and cleverness. Application of frugality concepts is often termed jugaadisation. Levänen et al. (2015) recognized the importance of frugal innovation as an integral part of sustainable development. The definitions given present sustainability and frugality as the solutions to the complex problems confronting farmers today.

2.2. Sustainability Concept and its Constructs

Kuhlman and Farrington (2010) defined sustainability as a multidimensional word which means to achieve a higher quality of life for people through economic development, social development and environmental protection. The **three constructs**; economic, environmental and social are also known as the **three Ps**, Profit, Planet and People in the triple bottom approach (Kotob, 2015). Ben-Eli (2006) suggested that the three constructs of sustainability are interdependent and mutually reinforcing components of sustainable development. Interestingly, the concept of sustainability started in Agriculture. Kuhlman and Farrington (2010) traced the concept of sustainability from its first ever use in forestry, where it means never harvesting more than what the forest yields in new growth. The word ***Nachhaltigkeit*** (the German term for sustainability) was first used with this meaning in 1713 (Kuhlman & Farrington, 2010). Pansera and Sarkar (2016) further emphasized the importance of sustainability in agriculture where it all started. From the definition and constructs it is clear that, sustainability is a function of economic sustainability, environmental sustainability and social sustainability as expressed by the researcher in the below equation.

$$\boldsymbol{Sustainability = f(Economic, Environmental, Social\ constructs)}$$

2.3. Sustainable Innovations Constructs

Sustainable innovations are innovations, which exhibit and satisfy the constructs of sustainability in their manufacturing, utilisation and disposal. There is need for agriculture innovations to include the concept of sustainability to achieve Sustainable Development Goals (SDGs) particularly SDG number 2. Economic, environmental and social tenets must permeate agriculture innovations to achieve sustainable agriculture. The three constructs namely; economic, environmental and social can further be disintegrated into to their sub-constructs for a deep understanding of each of them Waage et al. (2005). The following Table 1 summarise the sub-constructs of sustainability applicable to sustainable agriculture innovations.

Table-1. Economic. Environmental and Social sustainability constructs.

Economic sustainability	Environmental sustainability	Social sustainability
• Profit maximisation	• Biological safety	• User health
• Cost minimisation	• Toxic accumulation	• Labour intensity
• Number of materials	• Air pollution	• Gender sensitivity
• Availability of materials..*in*	• Water pollution	• Social inclusivity
	• Land pollution	• Human dignity
	• Visual pollution .....*in*	• psychic…in

Source: Synthesized by the researcher.

The above listed sub-constructs are the building blocks of sustainable agriculture innovations. The lists include..***in*** to mean infinity, giving room for other researchers to add on the sub-constructs depending on their own understanding of the concept.

2.4. Frugality Concept and Its Constructs

According to the Oxford Dictionary, the word *frugal* is of Latin roots originally meaning economic thriftiness. Witkowski (2010) traced the frugality discourse in America to the 17th century and before, mentioning its use in Christianity circles and its use in economic constrained circumstances such as war aftermath. Linked to sustainability concept, frugality focuses on achieving more from using fewer resources. Bencsik et al. (2016) defined frugal innovation as the implementation of a new business strategy that enables companies to create much more business and social values while saving resources. Earlier on, Fredriksson and Tömmervik (2013) had defined frugal innovation as a thrifty, modest and affordable innovations, valuable for BoP (Bottom of Pyramid) customers. Radjou and Prabhu (2013) viewed frugal innovation as the ability to do more with less by creating more business and social value while minimizing the use of resources such as energy, capital and time. The above definitions underlines the importance of frugality for farmers in a global economy in which economic recessions are common place due to pandemics such as Corona virus, natural disasters, political and social disturbances. The land remains finite, pestilence increasingly pose a threat, soil fertility continue to dwindle due to over cultivation, soil erosion persists while the farmers earnings remain suppressed due to commoditization of produce. Agriculture innovations can address these challenges though frugality. According to Khan, Laurens, and Bas (2019) the constructs of frugality are functionality, affordability, usability , performance and accessibility. Other scholars such as Singh, Seniaray, and Saxena (2020); Sissoko and Castiaux (2018); Numminen and Lund (2017) identified other constructs such as aesthetics, modularity , robustness and left the list open ended for other scholars to contribute. The frugality function is illustrated in the below equation build by the researcher.

$$\boldsymbol{Frugality} = \boldsymbol{f}\begin{bmatrix} \boldsymbol{Functionality, affordability, usability, accessibility, performance} \\ \boldsymbol{, aesthetics, robustness, adaptability, modularity \ldots in} \end{bmatrix}$$

2.5. Innovation

Innovation is a widely used term in scientific and technological circles. It is often linked to scientific research and provision of solutions to humanity problems. Luqmani, Leach, and Jesson (2017) traced innovation to Schumpeterian Economics which described innovation as a perennial gale of creative destruction. The definition underline the innovation's ability to create new order. Bean and Radford (2002), cited in Anandajayasekeram (2011) defined innovation as the economically successful use of invention. The later definition looked at innovation as a solution to a problem. In the context of the current study inventions aimed to enhance sustainability and frugality are termed innovations. The details of innovation, its processes and types are out of scope of the current study.

2.6. Sustainable Frugal Innovations (SFIs)

The concept of Sustainable Frugal Innovation (SFIs) is relatively new thus, its literature remain scarce. Khan et al. (2019) defined sustainable frugal innovations as hybrid innovation with both sustainable and frugal traits. In other words, a sustainable frugal innovation is that which exhibit both sustainability and frugality characteristics. The definition is informed by the realisation that sustainability and frugality overlaps, sharing a common convergence.

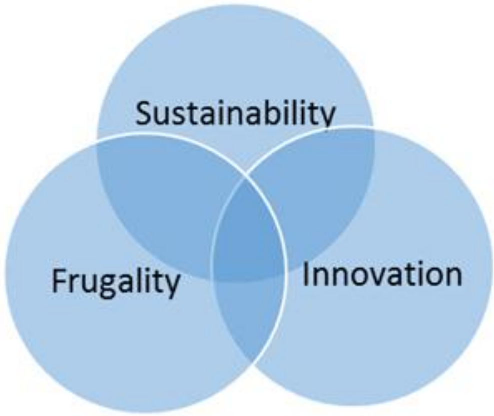

Figure-1. Sustainable frugal innovations.

Khan et al. (2019) concluded that frugality contribute to sustainability but not all frugal innovations are sustainable innovations. Similarly, not all sustainable innovations are frugal. The convergence of sustainability and frugality occurs in the context of innovation (Levänen et al., 2015) as both are enhanced by the same.

2.7. The Sustainable Frugal Innovation Index Conceptual Framework

Khan et al. (2019) classified sustainable frugal innovations as Strong Sustainable Frugal Innovations (SSFI) and Weak Sustainable Frugal Innovations (WSFI) without specifying the quantitative measurement criteria. The current study constructed Sustainable Frugal Innovation (SFIs) index through quantification of the documented constructs of sustainability and frugality reviewed in literature. The SFIs index is composite index (Boateng, Neilands, & Frongillo, 2018; Mazziotta & Pareto, 2013) which comprises of multiple constructs gained from literature. The multiple constructs can build their own indices used autonomously. For example, Economic sustainability, Environmental sustainability and Social sustainability can be measured in isolation. Carmines (2015) prescribed that a composite index constructor must design empirical indicants, which are specific and bounded by the theoretical framework. In this research, the indicants used to approximate and locate the concept imperially were the sustainability and frugality constructs outlined in the below word equations

2.8. Conceptualisation of SFI indices

Sustainability is a function of Economic, Environmental and Social sustainability

$$\textbf{Sustainability} = f(\textbf{Economic}, \textbf{Environmental}, \textbf{Social constructs})$$

$$Economic\ sustainability = f[profit, cost, availability, number\ of\ materials..in]$$

$$Environmental\ sustainabilty = f[biological\ safety, water\ pollution, air\ pollution, land\ pollution, visual\ pollution..in]$$

$$Social\ sustainabilty = f[health, labour\ requirements, gender\ sensitivity..in]$$

$$Economic\ sustainability = f[profit, cost, availability, number\ of\ materials..in]$$

$$Environmental\ sustainabilty = f[biological\ safety, water\ pollution, air\ pollution, land\ pollution, visual\ pollution..in]$$

$$Social\ sustainabilty = f[health, labour\ requirements, gender\ sensitivity..in]$$

Sustainability Index

$$\text{Sustainability Index} = \frac{\sum_n^i \{\boldsymbol{Eco}, \boldsymbol{En}, \boldsymbol{So}\}}{\sum_n^e \{\boldsymbol{Eco}, \boldsymbol{En}, \boldsymbol{So}\}} \text{ X } 100$$

Where $\boldsymbol{i}$ are observed mean scores on a 5 point Likert scale.
e are expected (maximum) scores on a 5 point Likert scale.
Econ is Economic sustainability.
En is Environmental sustainability.
So is Social sustainability.
$\boldsymbol{n}$ is the sample size.
Frugality.

$$Frugality = f\begin{bmatrix} Functionality, affordability, usability, accessibility, performance, \\ aesthetics, robustness, adaptability, modularity \ldots in \end{bmatrix}$$

$$\textbf{Frugality index} = \frac{\sum_n^i [\boldsymbol{F,A,U,Ac,P,Ae,R,Ad,M,\ldots n}]}{\sum_n^e [\boldsymbol{F,A,U,Ac,P,Ae,R,Ad,M,\ldots n}]} \textbf{ X 100}$$

Where **i** are observed mean scores on a 5 point Liker scale.
e are expected (maximum) scores on a 5-point Likert scale.
F,A,U,Ac,P,Ae,R,Ad,M,…n is functionality,affordability,usability,accessibility,performance,aesthetics,robustness,adaptability,modularity…in
$\boldsymbol{n}$ is the sample size

2.9. Sustainable Frugal Innovation (SFI) Index

SFI is a combination of sustainability and frugality indices divided by 2

$$SFI = \frac{(Sustainability\ index + Frugality\ Index)\ degree\ of\ innovation}{2}$$

Or

$$SFI = \frac{(Sustainability\ index + Frugality\ Index)\ degree\ of\ innovation}{2} x\ 100$$

The outlined constructs, formed the basis for the research instrument construction hence the formulation of the Sustainable Frugal Innovation index. Aggregation of weighted constructs of SFI indices gave a score expressible as a percentage or in a decimal.

3. METHODS

The study adopted an inductive philosophical approach in developing a theory (in this case an index) from the observed data (Bhattacherjee, 2012). The research methodology followed a sequential approach, which started with a systematic literature review, items identification, and validation, data collection and analysis. The methodology was greatly influenced by Mazziotta and Pareto (2013) guidelines of composite index construction as well as Eduardo Rossetto (2017) who construct an index in the same area of study. A deep literature review was meant to understand the fundamentals of sustainability and frugality as well as their convergence into sustainable frugal innovations. The review helped to discover the constructs of sustainable frugal innovations, which later were included in the instruments as the indicants. A total of thirty constructs were extracted which were ;later reduced through factor analysis (Boateng et al., 2018). Validation is critical in indices building (Bhattacherjee, 2012) if the indices are to be of any use. Face validity of the constructs was done among the experts in innovation and agriculture fields to ensure that items linguistically and analytically look like what they are supposed to be. Content validity was conducted among the experts in agriculture to check if the measurement instruments used were relevant to the targeted constructs. The construct discriminant and construct convergent validity were confirmed through factor analysis (Taherdoost, Group, & Assessment, 2017).

3.1. Instrument Development and Data Collection Procedures

A standardised data collection instrument was developed from the sustainability and frugality constructs. A 5-point Likert was chosen as the optimum measurement continuum, Boateng et al. (2018). A 5 (five) point Likert was preferred to reduce difficulties in data collection and scale interpretation. Responses were presented in a descending order, without any overlap to ensure high data quality. The responses on every construct were coded as 5=Very important, 4=Important, 3=Indifferent, 2= Unimportant and 1=Very Unimportant. The instrument was configured into an online form distributed to 450 respondents using electronic means in compliance of Covid 19 protocols. Data collection run from November to 25 2020 to 18 February 2021. The respondents' were drawn from Zimbabwe agriculture sector, with specific professional areas accommodating specific categories such as agronomy, horticulture, farm mechanisation, animal husbandry, soil science and academia. Telephonic calls were made to fulfil axiological protocols, to remind and to thank respondents.

3.2. Sample and Response Rate

The agricultural sectors from which the sample was drawn is shown by the below figure.

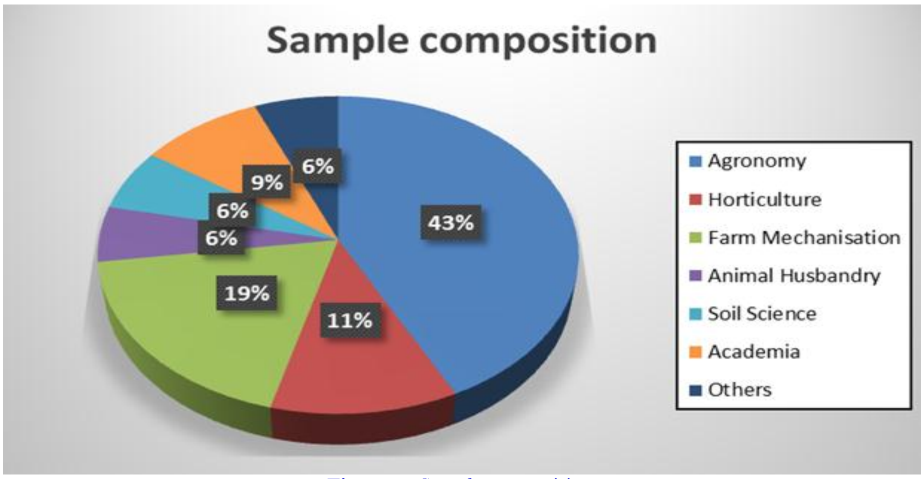

Figure-2. Sample composition.

A total sample of 450 respondents was drawn from the shown Zimbabwe agriculture sub-sectors. 338 appropriately completed questionnaires were received for analysis translating to a 75.11%.

3.3. Reliability

Using IBM SPSS v22, reliability test was performed for every item and for the entire instrument with a rejection for every item whose Cronbach alpha was below 0,7.

Table-2. Constructs reliability scores.

Measured item	Mean	Corrected Item-Total Correlation	Cronbach's Alpha
Importance of Economic sustainability	4.89	0.382	0.88
Importance of Environmental sustainability	4.87	0.633	0.876
Importance of Social sustainability	4.81	0.655	0.875
Importance of profit in Economic sustainability	4.9	0.412	0.88
Importance of cost in Economic sustainability	4.74	0.212	0.883
Importance of availability of materials in Econ sustainability	4.76	0.595	0.874
Importance umber of materials in Economic sustainability	4.6	0.751	0.869
Importance of Biological environmental sustainability	4.82	0.59	0.876
Importance of air pollution in environmental sustainability	4.59	0.538	0.876
Importance of water pollution in environmental sustainability	4.56	0.538	0.876
Importance of land pollution in environmental sustainability	4.55	0.567	0.875
Importance of visual pollution in environmental sustainability	3.8	0.223	0.896
Importance of health considerations in social sustainability	4.95	0.229	0.882
Importance of Labour intensity in social sustainability	4.8	0.368	0.88
Importance of gender sensitivity in social sustainability	4.62	0.277	0.883
Importance of psychic in social sustainability	4.21	0.525	0.877
Importance of functionality in frugality of innovation	4.91	0.635	0.877
Importance of affordability in frugality of innovation	4.89	0.651	0.876
Importance of usability in frugality of innovation	4.88	0.663	0.876
Importance of accessibility in frugality of innovation	4.88	0.673	0.876
Importance of performance in frugality of innovation	4.88	0.542	0.878
Importance of aesthetics in frugality of innovation	4.14	0.64	0.872
Importance of robustness in frugality of innovation	4.32	0.432	0.881
Importance of adaptability in frugality of innovation	4.6	0.583	0.874
Importance of modularity in frugality of innovation	4.16	0.449	0.879

The overall reliability score of all the constructs was as shown by the below output

Table-3. Instrument reliability.

Reliability Statistics	
Cronbach's Alpha	**N of Items**
0.882	25

A reliability score of .882 showed the reliability of the instrument in measurement of the Sustainable frugal innovations constructs

4. RESULTS

The results were generated in STATA using the formulas given below. The **mean scores** of the latent variables (each construct) were expressed as a score against the expected total possible scores. Four Indices were created which are ECONSI, ENVSI, SSI and FRUI

Where;

ECONSI – Economic Sustainability Index.

ENVSI – Environmental Sustainability Index.

SSI – Social Sustainability Index.

FRUI- Frugality Index.

4.1. Development of Sub-Indices

4.1.1. Economic Sustainability Index

egen ECONSI = mean (Profit + Cost + Availability + Materials)

replace ECONSI = (ECONSI)/5

ECONSI score of **0.76** (76%) was obtained

4.2. Environment Sustainability Index

egen ENVSI = mean (Biological + Air pollution + Water pollution + Land pollution + Visual pollution)

replace ENVSI = (ENVSI)/5

ENVSI score of **0.893018** (89%) was obtained

4.3. Social Sustainability Index

egen SSI = mean (Health cons + Labour intensity + Gender sensitivity + Psychic)

replace SSI = (SSI)/5

SSI score of **0.743077** (74%) was obtained

4.4. Frugality Index

egen FRUI = mean (Functionality + Affordability + Usability + Accessibility + Performance + Aesthetics + Robustness + Adaptability + Modularity)

replace FRUI = (FUI)/5

FRUI score of **0.925773** (93%) was obtained

4.5. Developing Sub-Composite Index ESESI

In developing the composite Economic, Social and Environmental Sustainability Index (ESESI), the assumption was that ECONSI, ENVSI and SSI have equal loads towards a conglomerate variable.

egen ESESI = mean (ECONSI + ENVSI + SSI)

replace ESESI = (ESESI)/3
ESESI score of **0.798698** (80%) was obtained

4.6. Developing the Overall SFI index

In developing the Overall Sustainable Frugal Index (SFI), the assumption was that ESESI and FUI have equal loading/ weighting towards the conglomerate/composite index.

egen SFI = (ESESI + FRUI)/2

The overall Index score was **0.862235** (86%)

5. DISCUSSION

The Sustainable Frugal Innovation index and all its sub-components gave scores, which are greater than 50% with a range of 74%-93%. The goodness of an agricultural innovation in regards to a measured item must be based on the extent to which the obtained score gravitate around the scores obtained in this research. The **ideal/model** Sustainable Frugal Innovation score is 0.86 (86%).

5.1. Measurement Rules, Norms and Recommendations

To guide users of any developed indices or measurement scales, developers are expected to include the decisional rules or norms. Churchill (1979), advised measurement scales developers to accompany such scale with rules and recommendations. If an agriculture innovation score 50% and above on the SFIs index, such an innovation is acceptable as one that adequately include the aspects of sustainability and frugality. The higher the score and its closeness to 86% the most ideal the innovation or intervention. Any score above 86% is exceptionally good and the exceptionality increase towards 100%.

Where users compute the sustainability and frugality of innovations obtaining answers in decimals, generally any coefficient from 0.5 and above is acceptable. The strength of a sustainable frugal innovation is stronger with its coefficient's closeness to 1. For example, if innovation X score 0.78 and Y score 0.93 on the SFI index then Y is better than X.

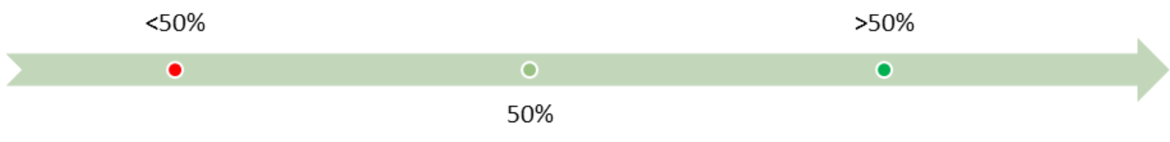

Figure-3. SFIs score interpretation.

A sustainable frugal innovations score of less than 50% (<50%) is a poor score denoted by a red colour. A less than 50% score show that an innovation is unsustainable and unfrugal to the extent of its deviation from 50%. A 50% score is acceptable as a fair innovation represented by a light green colour. A score greater than 50% (>50%) with 86% being ideal, is a good score whose strength increase towards 100% represented by a dark green colour.

The researcher recommended that users must compare innovations from the same category for example agronomic concepts such as Pfumvudza farming concept must be rated separately from mechanization innovations such as tillage equipment.

For users who choose to use sub-component indices in isolation, the ideal sub-index scores must guide them. For example, a Women lobby group interested in Social Sustainability of an agricultural implement must consider 74% as the ideal score. Where possible it is allowed to use ratio data, substituting the ordinal Likert scale. For example if one is measuring economic sustainability, one can make use of raw cost figures , revenue figures, profit figures, number of hectares grown instead of ordinal Likert scales. Users can group the financial figures into intervals.

Where farmers, innovation adjudicators, innovation practitioners, human rights, or environmental pressure groups are faced with many innovations, which save the same purpose. They must consider the one with the highest score as the best innovation. In case of competitions or exhibitions, a participant whose innovation scores highest must be declared the winner.

5.2. Applications and Usefulness of the Sfis Index

The Sustainable Frugal Innovation index is an innovation and technology management tool. Inventors or originators of innovations such as Agronomists, Agro-chemists, Technologists and Engineers are guided by the index. The index redefines the agro-innovation quality aspects by reminding innovation developers to consider sustainability and frugality in their Quality Function Deployment (QFD). Using a post hoc approach, the index provides a base for objective innovation evaluation efforts when the innovation has been deployed. In the same vein, policy makers can make use of the index to enforce sustainability and frugality compliance in innovation regulation.

The Sustainable Frugal Innovation index is useful in selection of innovations in terms of sustainability and frugality. It is useful in decision making where potential users of innovations are faced with a choice dilemma. A rational innovation user, for example a farmer, chooses an innovation with a higher SFI index score to maximise economic earnings whilst scoring on the environmental and social front. The index help farmers to know which innovation to take or not when faced with sustainability, climatic and economic constraints

Agricultures shows and exhibitions are common in farming. Such exhibitions are important to promote agriculture innovations (Rzemieniak, 2017). The Sustainable frugal innovation index is useful in adjudicating innovations for agriculture exhibitions. Where innovations are exhibited from multiple stakeholders, such as farmers, NGOs and Agriculture value chain members, exhibitions cause a conflagration of innovations in the agriculture sector. The SFI index remove bias, thump sucking and guesstimating methods in choosing the winners

The SFIs index is useful for social representative groups and environmental activism groups to measure the sustainability of innovations on sensitive groups and environments respectively. The SFIs index is therefore an advocacy and lobbying tool. For example, a women representative group can use the social sustainability index to lobby for a moderation of an agricultural chemical innovation selectively affecting women in agriculture. The environmental lobby groups can use the environmental sustainability index within the Sustainability frugal innovation index to portray the negative or positive impact of an agricultural innovation on the environment.

Furthermore, with minor modifications the index can be applied to any other discipline such as energy sector, construction, mining and manufacturing to measure sustainability and frugality. The concept of sustainability and frugality are crosscutting all sectors and so is the usefulness of the SFI index.

6. CONCLUSION

The sustainable frugal innovations index was successfully constructed, with an ideal score of 0.86. In the contemporary farming environment characterised with climate change, turbulent markets and declining profit margins there is increasing need for scientific selection of agriculture innovations. The sustainable frugal innovations are of wide uses among different stakeholders in agriculture and beyond.

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