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Research Paper

Potential Benefits of Crowd-Collaborative Farming in Sustaining Small-Scale Dairy Farming Business Performance

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Abstract

The importance of small-scale agricultural sustainability is gradually declining in low- and middle-income economies due to the assortment of changes in agriculture and the environment. Moreover, the high withdrawal of small-scale farmers from the market disrupts the direct relationships between producers and consumers, and also puts food security at risk, primarily on the local and regional scales. This paper focuses on optimizing farming activities of the small-scale dairy farmers (SSDFs) through crowdsourcing and synergy (CSS) platforms. The methodology for this paper is anchored on the construction of resolve using logic and rationality. This paper points that agricultural outputs are more valuable when delivered by teams because of positive synergies. Moreover, agricultural activities could be optimized through collaborative farming and community supported agriculture as CSS platforms known as crowd-collaborative farming (CCF). CCF could effect increased benefits due to suitability of the crafted member composition, yielding improved local market performance in many settings. Moreover, research on CCF as a tool to develop efficient mechanisms for revenue distribution among the collaborators is necessary. The study further recommends that SSDFs should be trained towards CCF to enhance their production output, especially those experiencing high failures and less returns due to debt erosion. SSDFs they should keep in sync with the consumers.

Keywords: *Synergy; Optimized Performance; Farmer Awareness; Crowdsourcing*

INTRODUCTION

Crowdsourcing and synergy (CSS) are concepts that are consistent with a famously known cultural concept of '*Ubuntu*' (humanity) (Cossa, 2023). Ubuntu practice example is a collaboration between a community of various people who plough fields for each family, one by one until all the fields are ploughed, and related tasks undertaken by that crowd till harvesting period (*"Live for yourself, you'll live in vain, live for others, you'll live again"*). Eze (2023) and other researchers inform that the collaboration would continue as the crowd performs other developmental tasks for the community. As a result, community development and welfare become sustained and optimized. In addition to the sustainability of welfare and wealth, additional benefits would emerge. That is, in many instances, no single member among them would have been able to produce when working alone. This concept is inherent across all disciplines and the small-scale dairy farming business is no exception to these effects of "*Ubuntu*".

The small-scale dairy industry, which is among the sectors receiving less capital investments in most developing countries, contributes immensely towards employment creation, rural development and poverty alleviation (Kowo et al., 2019; Osabohien et al., 2019; Shaheen et al., 2019; Mhlanga, 2020). The prominence of small-scale agricultural sustainability is gradually declining due to the effects of changes in agriculture and its environment (Struś et al., 2020; Mokoena et al., 2023). The high withdrawal of farmers from the market disrupts the direct relationships between food producers and consumers, and also puts food security at risk, primarily on a local and regional scale (Jayne et al., 2019; Stringer et al., 2020). New and innovative public-

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private partnerships, increased investments in research and extension systems, among others, are imminent to offset agricultural unviability (Eastwood et al., 2021; Jayne et al., 2021; Liu, 2021; Mazhar et al., 2021). To mitigate some of these issues faced by the small-scale dairy industry, literature endorses the adoption of community supported agriculture (CSA) due to its consequence to proliferate rural economic growth and contribute towards sustainable agriculture and food sufficiency (Morgan et al., 2020; Chen et al., 2019; Samoggia et al., 2019; Sulistyowati et al., 2023). Other studies (Velten et al., 2021; Du et al., 2022; Tran et al., 2022; El Fartassi et al., 2023) highlight the novelty of collaborative farming (CF) opportunities to mitigate the lack of feasibility in the agricultural activities, yield high returns, and improve farmers' resilience. However, SSDFs among others in South Africa, who both lack economic incentives, market access and technical support to enhance their adaptive capacity and lessen the socioeconomic vulnerability inherent in the region, are yet to experience the effects of CF and CSA. The delimitations of CF and CSA are affordability to pay membership fee, management perceptions, member recruitment and retention, and government interventions, among others (Grashuis, 2018; Cheng et al., 2019; Samoggia et al., 2019; Blekking et al., 2021; Sulistyowati et al., 2023).

However, combining both CF and CSA as CSS platforms in the small-scale dairy farming setting could offset the delimitations of the two approaches and proliferate the market indicators (return on capital and resilience, among others) of farming business (Cappa et al., 2019; Liu, 2021; Vermicelli et al., 2021). Moreover, these approaches could potentially reduce lack of affordability, lack of access to equipment, lack of technology among farmers and improve local market access. Also, the approaches could potentially improve the relationship between dairy producers and local consumers, allow for access to a variety of products from different farms in collaboration, without having to re-subscribe. Crowdsourcing is the process of aggregating a crowd (pooled information from the general public) wisdom to solve a problem (Brabham, 2008). On the other hand, synergy is the interaction between two or more individuals to produce a combined effect greater than the sum of their separate effects (Corning, 2003; Caesar & Cech, 2019). Both frameworks have substantial benefits when cross-examined individually to effect optimized performance. CSS is effective in offsetting many challenges. Its platforms include exchange of ideas, communication flow, collaborators' responsibility, crowdsourcing and its necessities, conditions for worthy mutual learning and synergistic podium, among others (Dandadzi et al., 2020). SSDFs are confronted with failure because of the challenges that affect small and medium enterprises (SMEs) in general. Lack of sustainability in this industry is as a result of the challenges encountered. Thus, this study seeks to define an unrestricted synergy model for increased productivity, to develop as CSS concept for local SSDFs, and to apply CSS platforms on SSDFs to address the challenges encountered.

LITERATURE REVIEW

CSS in other fields

Landy et al. (2020) reveal that sourcing the general public (crowd) opinions can serve as a measure of reliability and consistency in claims made by scientists. The crowdsourced results when correlated with scientists' claim reveal true consistency of empirical support and minimized scientist biasness. Vermicelli et al. (2021) affirmed the importance of crowdsourcing in the fight against the covid-19 pandemic. Online platforms like *TopCoder*, *Openinnovability*, *InnoCentive*, *NineSigma*, and *Kaggle*, among others, were used to gather public innovation to inform the government and scientists about the possible response action plans to adopt against the covid-19 pandemic. A block chain-empowered crowdsourcing system for 5G-enabled smart cities was developed in response to the difficulties of the central institutions, which are third parties responsible for processing online payments. The model yielded effectiveness as a crowdsourcing system, and also in the facilitation of online payments (Tan et al., 2021). In the above studies, much has not been explored about the possibilities of CSS platforms in the small-scale dairy farming

industry, hence, there is a need to profile these platforms for local SSDFs to proliferate and become market competitive and resilient.

In another study, Rostam et al. (2023) developed a database to proliferate knowledge dissemination concerning bimolecular condensates (this are membrane less organelles that selectively concentrate biomolecules, that is, proteins and nucleic acids in the cell) and to profile their role in disease, discovery and validation. Liu (2021) documented the feasibility of crowdsourcing functions in allowing the general public through government enablement to coproduce knowledge, innovative ideas to public problems and policy preferences. During the covid-19 pandemic, the main challenges, which were experienced and were beyond reach for the healthcare practitioners was screening of the citizens to establish the severity of the disease and herd immunity. However, the findings of Orlandic et al. (2021) appeared to be effective in gathering data for screening purposes through crowdsourcing to make informed decisions concerning the covid-19 outcomes among the public. Cappa et al. (2019) reiterated the importance of collaboration between the crowd and firm stock market. These researchers mentioned that stock firm can extract value from the crowd to effect positive stock market reaction in line with their brand value and investment opportunities. SSDFs lack a database system to access market related information, and network with other farmers, amongst others. Hence, the challenges in this industry are perpetuated.

Crowdsourcing presents countless opportunities and benefits for the research community, which include reducing company costs by providing once off reward to the crowd for an optimal solution (Li et al., 2020; Nakanishi & Syozugawa, 2021). It also allows administrators to create problems and find solutions through the crowd (Li et al., 2022; Puttinaovarat & Horkaew, 2022), another benefit/potential is that the crowd removes perceived employee bias by providing managers with fresh perspectives (Palacios-Marqués et al., 2021). The drawbacks associated with crowdsourcing are not limited to, lack of confidentiality (Ma et al., 2020), duplication of someone's ideas to get the rewards (Chen et al., 2019; Du et al., 2022), and intellectual property rights (Liu & Shestak, 2021) among others. Different studies profiled frameworks to offset the drawbacks posed by crowdsourcing (Daniel et al., 2018; Eickhoff, 2018; Draws et al., 2021). Caesar and Cech (2019) demonstrate that interactions between numerous agents can be antagonistic, additive/non-interactive, or synergistic, where additive and non-interactive mixtures designate that the combined effect of a number of substances is a simple effect of summation, while an antagonistic interaction results in a lower than additive effect. Positive interactions, known as potentiation or synergy, occur when the combined effect of constituents is greater than the expected additive effect.

CSS in agriculture

Minet et al. (2017) report that one way that the farmers can harness their collaborative abilities to improve farming performance is through usage of crowdsourcing platforms. In a study by Nozari et al. (2021), internet of everything technology was used as a crowdsourcing mechanism to promote company brand awareness, and ensuring sustainability and sustainable development. A mobile application was designed by Posadas et al. (2021) to collect data for precision agriculture through the crowd, as a way of minimizing business costs while attaining an optimal solution. David (2020) highlights affordability as a determinant in farmer participation in crowdsourcing technologies like WhatsApp. Although, some farmers were constrained, other farmers commended the knowledge dissemination through WhatsApp between farmers, which helped to improve their business activities and receive market information. Yu et al. (2023) provided a cost-effective crowdsourcing platform known as FarmWatch for ground truth data collection for efficient crop mapping.

In another study, Chancellor et al. (2019) report that the lack of availability of data concerning insect pests of crops affects the profitability of the business and the development of

strategies by management. To combat this, Chancellor et al. proposed that farmers needed to become the main role players in crowdsourcing that enabled the much-needed data for strategy implementation.

In the Democratic Republic of Congo (DRC), Kahasha and Zuva (2020) highlighted the effectiveness of mobile crowdsourcing in improving the developments of agricultural activities. To address the lack of access to extension officers in the small-scale dairy farming, Steinke et al. (2021) highlight the novelty of harnessing the power of digital media. Despite the countless potential of crowdsourcing in the agricultural sector, the small-scale dairy industry is yet to experience the full potential of crowdsourcing (Wulandari & Rahmah, 2020; Vázquez-López et al., 2021). Other studies also highlighted the adoption of community supported agriculture (CSA) due to its consequence to proliferate rural economic growth and contribute towards sustainable agriculture and food sufficiency (Morgan et al., 2020; Chen et al., 2019; Samoggia et al., 2019; Sulistyowati et al., 2023), other researchers (Velten et al., 2021; Du et al., 2022; Tran et al., 2022; El Fartassi et al., 2023) also highlighted using CF opportunities to mitigate unviability in the agricultural activities, yield high returns, and improve farmers' resilience.

Studies which cross examine the challenges faced by small scale farmers are plentiful, together with endless possible optimization of farming activities and business failure. However, in low- and middle-income countries, the challenges still persist for some of these farmers. Hence, this necessitates imploring other innovations to adequately contribute in addressing the drawbacks in this sector. The literature affirms the potentials that could be achieved through adoption of CSS in the dairy business, mainly the approach to collaborative and cooperative farming, without taking into farmer affordability. However, there is a dearth of studies that profile how rural SSDFs could benefit from CSS platforms, given their limited financial powers. Thus, the focus of the study is on optimizing farming activities of rural SSDFs through adoption of CSS platforms is imminent.

METHODOLOGY

The theoretical model for this study consists of philosophical logic. Hence, the methodology for preparing this paper was anchored on the construction of a resolve using logic and rationality. Construction of the resolution for the study problem depends on life axioms. Firstly, no human knows everything, no one can always deliver all the world needed solutions at all times, solutions to all the life problems exist with someone and can be located. These fundamentally implies that humanity is interdependent and humans co-exist, also duplication of someone is a complete waste. Moreover, everyone has a unique space to fill, and specific tasks to accomplish. Therefore, people have to synchronize to complete a project. The poor level of SSDFs output is addressed using a concoction of CSS. Creativity and innovation are implored in the development of the resolve. This study used a qualitative, exploratory and descriptive research approach. Given the lack of information on the challenges faced by SSDFs in the Bojanala Platinum District (BPD) of North West Province (NWP) in South Africa, there is a need for exploratory qualitative studies. Thus, this exploratory study was conducted to explore the challenges faced by SSDFs. Kim et al. (2017) used a systematic review research to show that qualitative description research offers a detailed textual description of respondents. This paper follows their approach. The study was conducted in the BPD of the NWP, South Africa. The district is one of the four districts in the NWP. It is subdivided into five sub-regions. The surface area of the district is 18 333 km^2 and by census 2011, it boasted a population of approximately 1 507 505, of whom 52.7% were men, and 47.3% were women (Ngyende, 2012). The dominant ethnic group (55.3%) living in the area are Setswana-speaking people.

The research team first contacted the relevant senior staff at the Directorate of Agriculture in the BDP to obtain relevant information about the number of SSDFs and the different regions they are situated at around the BPD area. A list of stakeholders to be interviewed was provided. The local

organizations and authorities were consulted to validate the list. This list contradicted the lists that other local authorities possessed. Despite the differences of the lists, there were some farmers who were listed in all the registers. These common ones were targeted to become the study sample to be interviewed. The study population included all farm owners/managers/farm representatives of the registered SSDFs in the district. In total, there were 1159 farmers in the BPD region, 44 in Kgetleng river area, 488 in Madibeng, 148 in Moretele, 374 in Moses Kotane, and 105 in Rustenburg municipalities. Of these farmers, 43 were household vulnerable producers (producing primarily for household consumption and have limited skills to operate a market-oriented production), 311 household subsistence producers (produces for household consumption, which make a turnover of up to R50 000, from the surplus marketed), 741 small scale farmers, 13 medium scale farmers, 23 large scale farmers, and 28 mega farmers respectively across the different local municipalities (North West Report, 2021). The study participants aged 18 years and older with three or more years of working experience managing the farm, who also agreed to participate in the study, were included in the study. Those who did not respond to the participation request or decided not to participate for other reasons were excluded from the study.

The study adopted non-probability, purposive and snowball sampling techniques and recruited farm owners, managers and representatives who met the inclusion criteria. Althubaiti (2022) defines the sample size (*n*) as the number of subjects to be included in a study from a population. Qualitative samples usually require small samples (Indrayan & Mishra, 2021; Vasileiou, 2018). Rosenthal (2018) states that the qualitative sample size should be large enough to allow addressing of the study phenomenon but sufficient as guided by saturation, which refers to the point in data collection when no additional insights are identified from new responses (Saunders et al. 2018). While, Keshoofy et al. (2023) argue that there is no consensus on the minimum sample size for qualitative studies, fundamental elements for qualitative sample sizes are data adequacy and saturation. On saturation, data begin to repeat so that further data collection is redundant, signifying that an adequate sample size is reached. Therefore, in this study, the sample size (n = 24) was determined by saturation at the data collection stage. That is, the researcher continued interviewing the SSDFs until no newer useful information emerged.

The researchers travelled to the locations where the participants resided in order to conduct in-depth face-to-face interviews. Data were collected using a semi-structured interview guide. The guide included questions related to participant demographics such as participant age, gender, race, place of residence, level of education, farm role, whether participants had any experience in farming and number of years in farming, number of cows the participants have, number of years having these cows, the primary use for the cows and reasons for milking. To gain a clearer understanding of the challenges faced by a farmer, the following open-ended question was asked: "What are/were the challenges you are/were facing as a farmer". Though straightforward as it sounds, the guide was given to experts in the field for content validation and piloted before the actual data was collected. The analysis was performed using the thematic content analysis technique which is a descriptive presentation of qualitative data (Braun & Clarke, 2006). Firstly, the researchers read through the transcripts several times to identify emerging themes that provided an understanding of the challenges faced by farmers. After reading all the transcripts, a list of similar topics was compiled, grouped per the theme. Synergy resulting from efforts of a crowd that consists of beneficial human resources is essential for improving performance, and the performance can even be proliferated to flexibly high limits. This is the basis for the plus '1' effect in 1 + 1 = 3.

Caesar and Cech (2019) demonstrate that interactions between numerous agents can be antagonistic, additive/non-interactive, or synergistic, where additive and non-interactive mixtures that designate that the combined effect of a number of substances is a simple effect of summation, while an antagonistic interaction results in a lower than additive effect. Positive interactions, known as potentiation or synergy, occur when the combined effect of constituents is greater than

the expected additive effect. The problem is to critique the restrictive notion 1 + 1 = 3 of synergy where views synergy as being unenterprising.

The classical adopted definition of synergy is 1 + 1 = 3 or 2 + 2 = 5, but Caesar and Cech (2019) somewhat dispute this narrative. Why should synergies be bounded? (Lawford, 2003). This paper proposes a dynamic and optimized synergy model as:

$$\hat{1} + \hat{1} + \hat{1} \cdots = \sum_{i=1}^{n} i > \tilde{\hat{n}} \ldots (1)$$

where
i = individual SSDF
^ = attribute (s)/qualities of individual SSDF
~ = attribute (s)/qualities of another individual SSDF
– = attribute (s)/qualities of yet another individual SSDF

The principles stipulated in Kyngäs et al. (2020) and Shufutinsky (2020) to ensure trustworthiness in the qualitative study were applied. Credibility was ensured through prolonged engagement with the farmers and member checks to enable them to correct or change what they viewed to be a wrong interpretation of their contributions. To ensure the dependability of the study findings, consistency was upheld in the detailed study methodology, such as data collection, which was checked for conveying a common message. Confirmability was confirmed by using multiple researchers to evaluate the results, interpretations, and recommendations. The ethical clearance for this study was obtained from Sefako Makgatho Health Sciences University Research Ethics Committee (REF: SMUREC/S/324/2021:PG). All participants were informed of their confidentiality, aim of the study, benefits, voluntary participation and the right to withdraw from the study without penalty. The participants gave written informed consent before participating in the interviews. The study adhered to the principles of fairness, privacy, confidentiality, anonymity, and participants' rights to voluntarily participate in the study.

FINDINGS AND DISCUSSION

Demographic characteristics

This study included a total of 24 SSDFs (all males). Their median age was 38 years (interquartile range: 34 years). Most (n = 18; 75%) were aged 30 years and older. More than half (n = 14; 52.8%) had primary education, (n = 5; 20.8%) had secondary education, and (n = 5; 20.8%) had tertiary education. Nearly two-thirds (65.2%, n = 16) of the participants were farm representatives and only (n = 8; 34.8%) were farm owners. The reasons for milking were multipurpose, that is, no farmer was milking for a single reason as each one had multiple reasons for milking and the total reasons were 40. Some of the reasons were to sell to the community (n = 17; 70.8%) and for household use (n = 13; 54.2%) (see Table 1).

Table 1. Demographic Characteristics for Participants (n= 24).

	n (%)
Age (years)	
<30	6 (25.0%)
30–50	11 (45.8%)
>50	7 (29.2%)
Level of education	
Primary	14 (58.2%)
Secondary	5 (20.8%)
Tertiary	5 (20.8%)
Farm Role	

	n (%)
Owners	8 (34.8%)
Farm representatives	16 (65.2%)
Years of farming experience	
<5	2 (8.3%)
5–10	8 (33.4%)
>10	14 (58.3%)
Reason for milking	
Household use	13 (54.2%)
Sell to community	17 (70.8%)
Sell to other farmers	10 (41.7%)

Source: Primary Data.

Themes and sub-themes

Six main themes emerged from the answers about the challenges faced by small-scale dairy farmers in Bojanala Platinum District. The themes were*, high cost*, *unpredictable weather patterns*, *physical assets*, and *agricultural services*. They are discussed below.

Theme 1

Theme 1 is "*High cost*". The theme was subdivided into subthemes of "*feed"*, *"fertilizer "*, *"medication"* and *"electricity"*. These came about because of the financial difficulty of managing the production of milk due to the very high costs required to purchase feeds for the cattle and for the extremely high expenses needed to purchase fertilizers for the milk cows. In order for the cows to produce milk, the cows need food and water. The cows further need fertilizers in order to produce feed.

Theme 2

Theme 2 has the title "*Unpredictable weather patterns*". The theme was subdivided into subthemes of *"sickness"* and *"power failure"*. Uncertain weather fluctuations influence the production of milk production. In winter the respondents reported low milk yield and in non-winter seasons the respondents reported high milk yields. Also, bad weather causes power failure as reported by other study respondents.

Theme 3

Theme 3 is "*Lack of physical assets*". It was further divided into subthemes "milk *equipment*", and "*milk technology*". These refer to the insufficiency of bottles for packaging the milk, and also of the machine used for milking. The fact that many owners rent land and farms and do not have their own fixed assets is a concern in the small-scale dairy farms.

Theme 4

Theme 4, which is "*Agricultural services*", has been subdivided into "*Local government support"* and *"Unsupportive agricultural extension officers*". The participants grumbled about the lack of empowerment and information sharing from the local government, and the way that the agricultural officers dedicated to supporting them were ineffective.

Crowd-Collaborative Farming Solution for the Local SSDFs

In Table 2, the results revealed that SSDFs had varied challenges. However, what one farmer finds to be a challenge, another farmer will be able to offset. Under High Cost, Medication (n = 13; 38.24%) and Feed (n = 12; 35.29%) were the challenges affecting SSDFs. Also, in some instance, one SSDF faced multiple high-cost challenges, while electricity (n = 4; 11.76%) was the challenge

least reported by the SSDFs. In the Unpredictable Weather Pattern, the Cattle Sickness affected (n = 11; 73.33%) SSDFs. Under Physical Asserts, Equipment affected (n = 9; 64.29%) SSDFs. The negative ramification of the lack of agricultural services was also raised by the farmers, with Government Support affecting (n = 13; 54.17%) SSDFs. The results show that not all SSDFs in the region failed to offset challenges experienced individually. Among the 24 SSDFs, at least one of them has a solution towards challenges encountered by any other one, which other SSDFs were not aware of.

Table 2. Summary of high-cost related challenges

High Cost	
Sub-theme	**No. of SSDFs**
Fertilizer	12
Feed	5
Medication	13
Electricity	4

SSDFs in the study were found to be involved in individual farming (farming silos). Hence, the challenges experienced of high cost cannot be offset. However, when farmers come together, issues of high cost can be offset through:

1. Buying in bulks (feed/fertilizer, medication)
   What one SSDF could not achieve alone, when a crafted crowd membership is formed, they can buy in bulks to reduce costs.
2. Have common storage
   When the SSDFs are together they can have a common storage to cut electricity costs. Also, those with generators can assist SSDFs struggling with electricity affordability.

Table 3. Summary of unpredictable weather pattern related challenges

Unpredictable Weather Pattern	
Sub-theme	**No. of SSDFs**
Cattle sickness	11
Power failure	4

Applying the CCF solution in Table 3, at least one SSDF has either knowledge or a solution about cattle sickness, and in the same manner for power failure. That is: $1 + 1 + \cdots > 2$ ... (2), which narrates to the synergy.

Table 4. Summary of physical asserts related challenges

Physical Asserts	
Sub-theme	**No. of SSDFs**
Milking Technology	5
Equipment	9

Similarly, at least one SSDF in Table 4 has a solution concerning milking technology and equipment challenges. Moreover, those with partial solutions, or failing to offset the challenges individually, when working together in crowd offsetting the issues can be realized.

Table 5. Summary of agricultural service-related challenges

Agricultural Services	
Sub-theme	**No. of SSDFs**
Government support	13
Agricultural extension officers	8

The local SSDFs experienced lack of government support (n = 13; 54.2%), and poor access to agricultural extension services (n = 8; 45.8%). This is mainly due to them farming in silos. However, forming a crafted crowd member solution can offset the hesitancy of government support for the market. Moreover, SSDFs can also apply for funding as a consortium, which could potentially contribute towards addressing the challenges experienced. Affordability of extension services would be achievable when farmers have combined their contributions towards a common agricultural goal. Other potential benefits of CCF include exchange of ideas, crowdsourcing and its necessities; conditions for worthy mutual learning, and synergistic podium, includes exchange of ideas which some of the farmers highlighted that there are no organized workshops and forums in the local area, and to attend workshops elsewhere they require travelling incentive. Also, crowdsourcing and its necessities is yet another potential benefit to get a large group of people to work together by locating needed services, ideas or content by lobbying contributions with each participant willing to participate (Dandadzi et al., 2020).

Participants can combine their efforts to exceed expectations. In this study, farmers can collaborate to collectively mitigate the high failure, unprofitable, and lack of market access, they can increase their customer base through variety of products produced. Also, conditions for worthy mutual learning asserts that collaborators should not dictate, except when the meeting gets out of control. If delegates respect one another, it also encourages increased willingness to contribute. Delegates should also give each other a chance to speak. They should listen to one another and they should speak only when it is their turn. This avoids messy dialogues and time wasting. Concerning, synergistic podium, the creation of a whole that is greater than the mere sum of its parts is necessary (Dandadzi et al., 2020). It spirals competitiveness, improves strategy and promotes network identity to breed an eccentric tool to compete in the market. This is the basis for the plus '1' effect in 1 + 1 = 3. In a project, CSS is about identifying skills of crucial importance and then resourcing them on activities in such a way that coordination is efficient, and has little or no wastages (such that non-value adding components are excluded). Lastly, elimination of adverse effects should also be looked upon, that is, when an additional member in CSS disrupts the functioning of some members of the crowd and de-synergize. If that happens, that is antagonistic, it should be removed from the crowd/mixture (Fulker & Riedl, 2023). Gaballah et al. (2023) explain that the case of a person who causes conflict in a crowd is toxic to the crowd and should not be included in that crowd. When such antagonistic people are found to be already included in the crowd meant for CSS activities, their inclusion should be reviewed with the view to remove them. Such individuals are viewed as increasing CSS team, or crowd numbers, and can be considered to be negative side-effects. Other additions may be leading to no improvement in the outcome of the crowd or interaction. These additional members are non-value adding components, and should be removed from the crowd on a task or should not be recruited if they are not yet members of the crowd. A synergy component may be responsible for increasing value to the CS project outcome, or the effectiveness of other team members.

Identifying constituents responsible for combination effects

Sustainability should be at the heart of every development plan and thus, monitoring, evaluation and corrections are insinuated. Clear and realistic value-adding ideas are essential for developing synergy (Jensen et al., 2023). These are ideas that are convertible into projects with activities that can be resourced. To identify individuals who can add value to the crowd activities commences with the people willing to participate (Kouzes & Posner, 2023). Then each member willing to participate should be able to perform at least one activity while not causing adverse effects on other members or on other components of the project. This suggests that value adding researchers who have definite contributions to make should be included, provided they do not also have negative influences on aspects of the efforts. Also, any participant of no value to the efforts

being planned should not be included, or should be discarded if by mistake they have been included. Hence, antagonism on CSS efforts should be avoided.

Robust approach to excavate maximal benefits of CSS

Robust means being resistant to undesirable influences (Mylo & Speck, 2023) such as a resource(s) not delivering on their tasks, or delivering wrongly and (thus) wasting time. Zach and Greslehner (2023) equate robustness to being immune to negative influences, resisting challenges and resilient against disturbances. A robust approach to excavate maximal benefits of CSS, according to Sesale et al. (2017), entails attributes of being capable, having interest in the tasks at hand, visionary and waste elimination (called the CIVW sensation) to realize quality outcomes of unlimited value. The CIVW sensation is expounded as follows:

1. ***Capabilities*** are competences, which are used wisely.
2. ***Interes*t** refers to attentiveness of the members in CS and synergism.
3. ***Vision*** is to be far-sighted, and having the desire to reach desirable outcome.
4. ***Waste elimination*** is the removal of unwanted/unneeded components, which are antagonistic.

Crowd-collaborative farming solutions towards sustainable agriculture

This paper pointed that agricultural outputs are more sustainable when delivered by teams, and that agriculture can be improved by CSS. CSS advocates for consideration of CCF by consumers and farmers. For an effective CSS team, there should also be an enthusiastic start to the work, which is backed by sustained efforts. There should also be continuous monitoring and evaluation, followed by necessary corrective action. Moreover, CCF should have CIVW embedded in it. The paper therefore, counsels that agricultural initiatives should be fueled by visionary minds, which are of role players with interest to participate, and who are capable to undertake the activities required (Landy et al., 2020; Vermicelli et al., 2021; Rostam et al., 2023). This implies that when one project is in progress, new ideas for next projects are generated. Such ideas can develop from experiences on ongoing projects, while others are completely new unrelated ideas. This can ensure sustainability of agricultural outputs. However, the paper also warns against inclusion of antagonistic or disruptive members of no value in the farming projects, and who are disruptive when useful ones embark on their activities. This is the waste elimination component. For every new project, the initiator and collaborator should be evaluated and unusable ones removed while beneficial ones are retained and/or recruited (Fulker & Riedl, 2023; Gaballah et al., 2023).

CCF concept is rooted on effective collaboration, using a crowdsource based on strict criteria of usefulness and willingness to contribute. The selected crowd forms a team required to synergize; each collaborator is expected to offset negative elements that are said to be antagonistic. The strengths of CCF are reliant on collaborative and robustness concepts, which include waste elimination in activities, and sustainability of the production yield. It is important that CCF is open to the mix of skills and expertise, which makes the collaborations of unlike disciplines of experts to participate on similar projects. The discussions have no restrictions, and as such, multidisciplinary approaches can be entrenched in CCF.

The local small scale dairy farming business have not been effectively productive in its operations, and financial non-sustainability still proliferates (Lotti et al., 2023). Lotti et al. (2023) also showed the possibilities of small and medium consortium in realizing potential benefits. However, the approach highlighted is not optimal and entirely inclusive of the rural SSDFs in the region, who are already financially constrained and lack access to numerous farming resources (Kowo et al., 2019; Osabohien et al., 2019; Shaheen et al., 2019; Mhlanga, 2020; Uddin et al., 2021) and farmers whose profits are eroded mostly by debts and expenditures. The approach is suited for those small-scale businesses who already have financial backing or access to capital, but the marginalized and non-profitable small scale farming businesses are excluded due to financial

instability (Mhlanga, 2020). Since, the needs and expectations of the small and large business vary, and capital asymmetries persist in the industry, and the SSDFs sustainability is compromised. Thus, adapted mechanisms that could inclusively address the delimitations of the SSDFs, warrant access to local market and direct access to consumers abounds. The novelty of consortium establishment as a crowdsource platform (Lotti et al., 2023) could be crafted to suit the needs and financial powers of the non-commercialized SSDFs. Concerning possibilities of improvements, Lotti et al. (2023) affirmed that blending financial methods with analysis of the interest coverage ratios (ICRs) which is a debt and profitability ratio used to determine how easily a company can pay interest on its outstanding debt, and could assist in potentially sourcing credit for the SSDFs.

The resolve that no farmer knows all things, but as a collective, innovations and new knowledge could be realized from CSS and added benefit towards sustainability of the SSDFs. Kahasha and Zuva (2020) highlighted the effectiveness of mobile crowdsourcing in improving the developments of agricultural activities. Also, to improve the lack of access to extension officers in the small scale dairy farming, Steinke et al. (2021) highlight the novelty of harnessing the power of digital media, where farmers could interact with extension officers in other regions to seek assistance. Despite the countless potential of crowdsourcing in the agricultural sector, the small-scale dairy industry is yet to excavate the full potential benefits of crowdsourcing and synergy (Wulandari & Rahmah, 2020; Vázquez-López et al., 2021). The paper explains the value of CCF in sustainable agriculture, which SSDFs can implore to continually engage in improved agricultural activities, and continue to produce quality outputs to realize improved capital returns.

To achieve a more locally sustainable small scale dairy farming business, a re-evaluation of the industry needs to happen inclusive of all role players and stakeholders to source innovations and insights. Also, the local small-scale dairy farming industry needs to be revised as part of a broader livelihood strategy while continuously seeking alternative entry points towards thriving rural livelihoods, local market access and risk optimization (Azizfan & Heamatzai, 2023; Beck, 2023). This suggests that support for transition to more collaborative farming and community supported agricultural activities for those with interest and resources should be invoked (El Fartassi et al., 2023; Iversen & Hydle, 2023; Johansson et al., 2023; Kalogiannidis et al., 2023; Liu et al., 2021; Obeng-Odoom, 2023). Other studies affirm that when events are carried out in sync/collaboratively, failure experienced by an individual farmer can be easily mitigated. This can occur through CSS of information and assistance (Velten et al., 2021; Du et al., 2022; Tran et al., 2022; Cossa, 2023; Eze, 2023; Kusmiati et al., 2023). Local SSDFs need to work together as a collective to mitigate failure occurrence, improve farm performance, and become resilient and market competitive.

CONCLUSIONS

The study showed that due to small sizes, SSDFs cannot secure funds and lack some tools. However, it was also seen that what one farmer lacks, some SSDFs tend to have. Thus, by crowd-collaborating the existing problems can be solved by a collective. The issue of obtaining funds becomes addressed when the SSDFs form cooperatives, as they make a bigger number to demonstrate their worth in community building. Many SSDFs plus their employees contribute a large body of employed people that funders want to support. Regarding expensive feeds and materials, the combined group of SSDFs forms a crowd-sourced team that can collectively sponsor bulks of feed and some materials at cheaper costs. These feeds can then be divided appropriately per contribution and at a relatively low cost for each single SSDF. This means that selfishness and doing things alone mentality cannot lead to sustainable progress, while collaborating in a CCF pattern can enhance resilience and some immunity against industry deficiencies. The implementations should ensure that antagonists (time wasters and irrelevant acquaintances) are excluded from the consortium (crowd platform). The benefits of CCF are that it has the potential to

effect increased benefits due to the suitability of the crafted member composition, yielding improved local market performance in many settings. Moreover, research on CCF as a tool to develop efficient mechanisms for revenue distribution among the collaborators is necessary. The study further recommends that small-scale dairy farmers should adopt the CCF to enhance their production output, especially those experiencing high failures and less returns due to debt erosion and also keep in sync with the consumers.

LIMITATION & FURTHER RESEARCH

Limitations of the Study

This study had two limitations. Firstly, the high cattle theft and robberies in local region constrained the district offices to not disclose the exact location of the farmers for their safety. Hence, the researcher had to snowball (ask other farmers for location of other farmers). This was done with consent, as the farmers contacted each other and were notified of our visitation to their farms for sourcing information and assistance. Secondly, travelling to different SSDFs since the researcher did not have adequate funding for the study, and also the covid-19 restrictions measures put in place, it was challenging to travel to different farms to conduct interviews. Also, the reality of not knowing where the farmers were located compounded to the challenge of travelling to the farmers. Sometimes the researcher would travel to a location and the information he was looking for could not be provided by the farmers due to undisclosed reasons.

Further Research

The prevention strategies for high cost, unpredictable weather patterns and access to agricultural equipment should be developed and implemented to avoid collapse of the industry and farmer withdrawal from the market. Currently, this is not the case, and the dairy markets are perishing gradually. In addition, the local government should develop strategies to subsidize SSDFs to manage and sustain their dairy businesses, and also improve the farmers' access to agricultural services to enhance their agricultural knowledge and skill. This can be achieved through workshops, which can build collaboration between government, extension officers and SSDFs. Moreover, research on CCF as a tool to develop efficient mechanisms for revenue distribution among the collaborators is necessary. Also, the SSDFs should be made aware of the possible benefits of CCF to enhance their production output, especially those experiencing high failures and less returns due to debt erosion and also keep in sync with the consumers.

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