



**Developing a Framework for Transdisciplinary Communication in
Multifaceted Agricultural Research Organisations**

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Abstract

Agriculture represents a class or expression of complexity which researchers need to look at because of its immense contribution to rural development and poverty reduction. Scientists and researchers per their disciplinary trainings and specialisations differ in wider perspectives and methodologies. In addition to the compartment functioning processes of organisations, fluid interaction and collaboration of actors are further limited. This study examines how actors in Crops for the Future (CFF) interacted formally and informally as a complex agricultural research organisation to address the transdisciplinary communication challenges it faces. Using ethnographic methods with participant observation, interviews and official document reviews, the study revealed that, the structuring of CFF into themes and programmes was intended to network and work in their areas of disciplines. The study revealed that, internal policies of CFF such as the research value chain (RVC), the doctoral support programmes (DTP) and flagship projects aim to improving research collaboration and as a research strategy, tend to support working together effectively. However, it further revealed that, though actors collaborate and network across different knowledge communities, elements of personal interest and power appear to play a significant role in that drive. Raising questions of communication and reporting process, revealed a mix form of vertical and horizontal hierarchies, supported with project and functional structures of management in CFF. The informal practices of actors in CFF (social networking, friendship, interactions etc.) tend to strongly support and enhance the formal structures and policies (programmes, themes, reporting and management structure etc.).

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Dedication

This research work is dedicated to my lovely parents

Table of Contents

ABSTRACT	I
ACKNOWLEDGEMENT	II
DEDICATION	III
LIST OF TABLES	IX
LIST OF FIGURES	X
LIST OF ABBREVIATIONS	XI
CHAPTER ONE	1
INTRODUCTION	1
1.1. BACKGROUND AND THE RESEARCH SETTING	1
1.2. RESEARCHER'S POSITION AND REFLEXIVITY	2
1.3. COMPLEX SOCIETAL PROBLEMS	4
1.3.1. APPROACHES TO DEALING WITH COMPLEXITY	6
1.4. PROBLEM STATEMENT	8
1.5. RESEARCH QUESTIONS	10
1.6. RESEARCH OBJECTIVES	11
1.7. SIGNIFICANCE OF THE STUDY	12
1.8. SCOPE AND LIMITATIONS OF THE STUDY	12
1.9. LITERATURE REVIEW	13
1.9.1. RESEARCH APPROACHES FOR COMPLEX RESEARCH PROBLEMS	13
1.9.2. SINGLE DISCIPLINARY APPROACH	14
1.9.3. MULTIDISCIPLINARY APPROACH	15

1.9.4. MULTIDISCIPLINARY APPROACH TO COMMUNICATION IN PROJECTS	17
1.9.6. TRANSDISCIPLINARY APPROACH TO RESEARCH	31
1.1.1. CROPS FOR FUTURE (CFF) AS A CASE STUDY ORGANISATION	49
1.1.1.1. EMPIRICAL OVERVIEW OF CFF	49
1.1.1.2. CFF APPROACH TO RESEARCH	50
1.1.1.3. ADMINISTRATIVE SUPPORT UNIT OF CFF	52
1.1.2. THESIS OUTLINE	53
CHAPTER TWO	56
THEORETICAL FRAMEWORK	56
2.1. INTRODUCTION	56
2.2. SOCIAL CAPITAL (SC) THEORY	57
2.2.1. SOCIAL CAPITAL GENERATION AND ACTORS' PARTICIPATION	60
2.2.2. SOCIAL CAPITAL IN ORGANISATIONS AS SOCIAL NETWORKS	62
2.2.3. MEASURING SOCIAL CAPITAL (SC) IN COMMUNITIES AND PROJECT TEAMS	66
2.3. ORGANISATIONAL COMMUNICATION THEORIES	67
2.3.1. FORMAL ORGANISATIONS	68
2.3.2. THEORY OF BUREAUCRATIC MANAGEMENT IN ORGANISATIONS	71
2.3.3. LEADERSHIP AND COMMUNICATION IN ORGANISATIONS	76
2.3.4. COMMUNICATIVE LEADERSHIP THEORY	80
2.4. CHAPTER CONCLUSION	85
CHAPTER THREE	86
METHODOLOGY	86
3.1. INTRODUCTION	86

3.2. THE RESEARCH PHILOSOPHY AND PARADIGM	87
3.3. THE RESEARCH APPROACH	90
3.4. DATA COLLECTION PROCESSES AND METHODS	92
3.4.1. PARTICIPANT OBSERVATION	93
3.4.2. INTERVIEWS	95
3.4.3. OFFICIAL DOCUMENT REVIEW	97
3.5. DATA ANALYSIS AND INTERPRETATION	98
3.5.1. GROUNDED THEORY	98
3.6. ETHICAL CONSIDERATION AND APPROACH	99
3.6.1. ANONYMITY AND CONFIDENTIALITY	100
3.6.2. THE CONSENT FORM	100
3.7. GAINING ACCESS INTO CFF FOR ETHNOGRAPHY AS PART OF THE METHODOLOGY	101
3.7.1. AUDIENCE MAPPING /TARGET RESPONDENTS	101
3.8. CHAPTER CONCLUSION	104
<u>CHAPTER FOUR</u>	<u>105</u>
<u>THE RESEARCH VALUE CHAIN (RVC) STRATEGY OF CFF: A MEDIUM FOR RESEARCH</u>	
<u>COLLABORATION</u>	<u>105</u>
4.1. INTRODUCTION	105
4.2. UNDERSTANDING THE 'VALUE CHAIN' (VC) CONCEPT	105
4.3. THE CFF MODEL OF VC INTO 'RESEARCH VALUE CHAIN' (RVC)	108
4.4. COMMUNICATION IN RVC PROJECTS	125
4.5. THE INFORMAL PERSPECTIVES OF ACTORS ON RVC IN CFF	127
4.6. CHALLENGES OF THE IMPLEMENTATION PROCESS OF RVC	132
4.7. CHAPTER CONCLUSION	136

CHAPTER FIVE	139
---------------------	------------

THE FORMAL AND INFORMAL CROPS FOR THE FUTURE	139
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5.1. INTRODUCTION	139
5.2. THE HOPE AND NEED FOR UNDERUTILISED CROPS BY CFF	139
5.2.1. THE ICONIC DOMES AND SYMBOL OF CFF	142
5.2.2. THE OFFICE LANDSCAPE ARRANGEMENTS AND RESEARCHERS INTERACTIONS	145
5.2.3. THE REPORTING PROCESSES AND FLOW IN CFF	150
5.2.4. MOTIVATION AND REWARDS TO COLLABORATE IN CFF	155
5.2.5. MEASURING PERFORMANCE AND FUNDING IN CFF	160
5.2.6. ENGAGEMENTS AND CONTRACTS OF ACTORS IN CFF	163
5.3. THE INFORMAL CROPS FOR THE FUTURE	165
5.3.1. INFORMATION SHARING AND SOCIAL NETWORKING IN CFF	166
5.3.2. MONTHLY STAFF FORUM	169
5.3.3. CELEBRATING FESTIVALS AND FAMILY DAYS TOGETHER	171
5.3.4. WEEKLY SOCIAL GATHERING SESSIONS AND PRESENTATIONS	172
5.3.1. VISITS OF IMPORTANT GUESTS	173
5.4. POWER AND LEADERSHIP AT PROGRAMME AND THEME LEVELS	174
5.5. CHAPTER CONCLUSION	179

CHAPTER SIX	181
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THE CONTRIBUTIONS OF KNOWLEDGE COMMUNITIES IN CFF	181
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6.1. INTRODUCTION	181
6.2. KNOWLEDGE GENERATION AND CO-PRODUCTION IN CFF	181
6.3. KNOWLEDGE MANAGEMENT, DATA POLICY AND COPY RIGHT	189
6.4. ADMINISTRATIVE AND NON-TECHNICAL CONTRIBUTIONS TO KNOWLEDGE	195

6.5. KNOWLEDGE COPRODUCTION AND COMMUNICATION	198
6.6. CHAPTER CONCLUSION	200
CHAPTER SEVEN	202
PROPOSED FRAMEWORK AND CONCLUSION	202
7. INTRODUCTION	202
7.1. FRAMEWORK FOR TRANSDISCIPLINARY COMMUNICATION IN CFF	203
7.1.1. FORMAL AND INFORMAL ORGANISATIONS	203
7.1.2. THE KNOWLEDGE COPRODUCTION AND INTEGRATION DIMENSION	204
7.1.3. THE INTEGRATIVE PROCESS	206
7.1.4. LEADERSHIP SUPPORT DIMENSION OF THE FRAMEWORK	208
7.1.5. FRAMEWORK APPLICABILITY	208
7.2. CONTRIBUTIONS TO KNOWLEDGE	210
7.2.1. CONTRIBUTION TO THE LITERATURE	210
7.2.2. METHODOLOGICAL CONTRIBUTION	212
7.3. SUMMARY OF KEY FINDINGS OF THE STUDY	213
7.4. IMPLICATIONS AND FUTURE RESEARCH	220
7.4.1. IMPLICATIONS OF THE FINDINGS	220
7.4.2. FUTURE RESEARCH	222
7.5. CONCLUSION	222
REFERENCES	224

List of Tables

Table 1.1 Overview and features of Multidisciplinary, Interdisciplinary and Transdisciplinary Research Approaches.....	44
Table 3.1 Features of Interpretive paradigm for this study.....	89
Table 3.2. Data Gathering Framework.....	92

List of Figures

Figure 1.1. Blind Men and the Elephant	1
Figure 1.2. Multidisciplinary Collaboration Concept	16
Figure 1.3. Interdisciplinary Approaches to Collaboration	31
Figure 1.4. Evolution of Transdisciplinary Approach	37
Figure 1.5. The Research Structure of CFF	51
Figure 3.1. Nationalities of CFF Employees	102
Figure 3.2. Most Frequently used Medium for Interactions Within CFF	103
Figure 4.1. CFF Research Value Chain through Research Themes	108
Figure 4.2. Bambara Nuts Exemplar Research Value Chain Approach	112
Figure 4.3. Themes and Programmes Relationship	115
Figure 4.4. Collaborations in the Research Value Chain Of CFF	124
Figure 4.5. The Flow and Working Process Of RVC in CFF	132
Figure 5.1. CFF Head Quarters- The Domes	144
Figure 5.2. Open Office Landscape System Of CFF	147
Figure 5.3. Example of Functional/Matrix Reporting Processes	154
Figure 6.1. Actors Perspective on the Types of Knowledge CFF produces	186
Figure 7.1. Proposed Transdisciplinary Communication Framework	207

List of Abbreviations

AIRCA	Association of International Research and Development Centres for Agriculture
CGAIR	Consultative Group on International Agricultural Research
CFF	Crops for Future
CFFRC	Crops for the Future Research Center
DTP	Doctoral Training Partnership
FAO	Food and Agriculture Organization
GFU	Global Facilitation Unit for Underutilized Species
GVC	Global value chains
HQ	Head Quarters
ICUC	International Centre for Underutilised Crops
LFA	Logical Framework Approach
NUC	Not Underutilized Crops
P	Participants
RVC	Research Value chain
R	Respondents
SC	Social Capital
TDR	Transdisciplinary Research
UNMC	University of Nottingham Malaysia Campus
VC	Value chain

CHAPTER ONE

INTRODUCTION

1.1. Background and the Research Setting

To clearly set the scene for this study, the researcher used the analogy of the blind men and the elephant by (Saxe, 1882). This describes the elephant and the complexity of opinions or perspectives of the blind men based on their experience of touching an elephant. The following narrative ensue after six of them touched the elephant;

- o “It is very like a wall, a feeling from the sturdy side of the elephant, first person
- o So very round and smooth and sharp from tusk, the second person
- o From the trunk is very like a spear, the third person
- o From the hand and the knee, is very like a tree and pillar, the fourth person
- o A touch from the ear is very like a fan, fifth person
- o The tail is like a rope and brush, said the sixth and last blind person”



Figure 1.1 Blind Men and the Elephant *Source: (Saxe John Godfry, (1882)*

After their experiences, they each argued strongly on why they were right whilst others were wrong based on the feeling and understanding of the different parts of the elephant they each touched. Though they were all given correct description of their feelings and understanding of what they touched, the reality was that of an elephant. This analogy and tale (Figure 1.1) applies to issues of scientific disciplines and complexity and illustrates how different disciplines appreciate, protect and interpret aspects of single reality and how this shapes knowledge. In effect, instead of them sharing their experiences, beliefs, feelings, and knowledge about the elephant to understand each other, as well as the elephant, they ended up in hot arguments. In truth, this happens every day in organisations and projects where many knowledge communities cooperate and collaborate with each other.

This study seeks to develop a framework to understand how scientists co-produce knowledge to solve complex communication problems and to test the approach in relation to Crops for the Future (CFF) and agricultural research organisations.

1.2. Researcher's Position and Reflexivity

As a public servant with extensive experience in policy formulation and implementation as well as an appreciation of bureaucratic processes in organizations, the researcher is familiar with the interdisciplinary and transdisciplinary challenges that face organisations. In this study, the focus is on scientists' interacting with each other within the organisation, thus formal as outlined in internal structures, policies and regulations, and informal mechanisms which facilitate these interactions. These issues are discussed in relation to

programmes that use disciplinary collaborative concepts to solve complex challenges in complex environments.

The research is a qualitative study which employs some principles of ethnographic perspective, hence intersubjective issues in the data generation and interpretation process is relevant. Knowing the nature of CFF as a research organisation with a well-defined research culture, having participants of multi nationalities and disciplinary diversities and the way it functions, the research observation and the outcome of interactions between the researcher and the researched can have an effect. It is not also assumed that the entire research produces objective insights; rather, the subjective influences are strongly linked to it. The meanings and interpretations generated from this study are interactive, socially and culturally constructed or influenced by the writer's perspective, whilst guided by standard theoretical principles and empirical literature.

George Soros states in Umpleby, (2007) that participants in organisations thinking of the world and their environment including the observed and the observer always have their own different world view of issues which partially tend to influence situations with which they relate to. This requires the author to examine his own relationship with every participant in Crops for the Future so as to frame and reframe the types of questions, forms of interaction and observational patterns within.

1.3. Complex Societal Problems

Nature and society is complex and the world is full of encounters between people, groups, nature, and nations who think, feel and act differently. A greater number of heterogeneous objects including these encounters among which local interactions create multiple levels of a collective assembly of units, layers, structures, and organization is what Bourguine et al., (2009) consider as complex systems. Even more, globalisation and the interconnectedness of world economies, products, and services as well as burdens and challenges are shared and linked (Oecd, 2013). These are added up to recognising that, most global issues are complex and more effort is required to deal with connected challenges such as climate change, migration, energy sustainability and food and income insecurity. As such, the emergence of multiple perspectives of issues to understand and keep up to these complex social phenomena are essential (Gilpin & Miller, 2013).

Focused on this study, agriculture represents a class or an expression of complexity, which requires urgent attention due to its immense contribution to rural development and poverty reduction (Fuller & Stevens, 2009). Global food security issues have taken different dimensions over the last two centuries. Food security which is classified as a public good and centers on national security of sovereign nations has moved from availability and accessibility to nutritional balance, affordability, and sustainability. This security is hinged on very few agricultural commodities globally, namely; rice, wheat, maize, and livestock. About 50% of the daily global requirement of proteins and calories is met by just three crops – maize, wheat and rice (Macauley, 2015).

There is a serious concern that agriculture and the world food production are not sustainable with current population growth trends. With a total of 150million km square of the world's land, of which only 10% of it, is considered arable land suitable for agriculture (FAO of the Nations & Nations, 2005). Feeding a population of 7billion requires new interventions and technologies. For instance, in 2014, the agricultural sector employed 30.7% of the world's 7, 243.8 billion people on a 2,781 million hectares of land and produced 2,471.2million metric tonnes of grains, and 2.29 million metric tonnes of fruits (OECD & FAO, 2015). Yet, within the same period, 805 million people globally suffered from hunger and malnourishment (FAO, 2009). These are indications that the world may be less than 40 years away from global food shortage which can create serious implications for people and governments. With a projection of the human population reaching approximately 9 billion by 2050, 3 billion greater than the present population, complex technology and research are required ((Kaye-Blake et al., 2009).

It is increasingly recognised that the development of ways of meeting societal needs that are productively and environmentally sustainable, requires an approach capable of linking a range of perspectives to solving complex challenges (UNESCO, 2010). However, research in agriculture remains strongly focused on discipline-oriented, natural science-based approaches to increasing production with success measured by short-term, neoclassical economic evaluation (Francis et al., 2008). While this approach may have contributed to the impressive increases in food production over the last half century, hunger, starvation, and malnutrition remain widespread. This is an indication that the current approaches

are either ineffective, obsolete or at the very least not suited to deal with current concerns; including environmental impacts, changes in the livelihood patterns of rural communities and distribution of benefits of current agricultural systems (Francis et al, 2008).

1.3.1. Approaches to dealing with complexity

According to Noelle and Cees-Van (2002), complex societal problems are characterised by the involvement of many actors with different backgrounds and values. In this regard, collective problem-solving starts with mutual understanding and recognition of the interdependencies between different actors involve in addressing the problem to be solved. The complexity involved requires an effective communication process and negotiation amongst all the actors, characterised by social learning (Janssens & Wildemeersch, 2003; Pahl-wostl et al., 2007; Urry, 2005; Woodhill, 2004) Such an approach will allow scientists and other relevant actors to gradually move away from their perspectives, opinions, and disciplinary views, to an, agreed and common perspective (Little, 2013; UNESCO, 2010). Governments, scientists, and researchers, in general, have had to try different approaches to deal with complex problems. These include the use of communication, participatory, integrative and negotiated approaches. Leeuwis & Aarts, (2010)also enumerated some other approaches as; collaborative problem solving by Gray, (1989), joint problem solving (Dunning, 1986), social learning (Rolling, 2008) and consensual (Susskind and Cruikshank, 1987), adapted to solving some elements of these complex problems.

(Noe & Alrøe, 2007) suggested that, previously, multifunctional farming was primarily used to define the relationship between agriculture and society concerning the range of commodity and non-commodity goods that farms or farming systems provided for society. However, while mono-disciplinary studies and research will continue to play an important role in deepening knowledge within focused disciplines, no single intervention can suffice in curing the ills and challenges facing the world farmers today.

Research related to agricultural and rural development is dependent on effective management of a range of interdependent physical and natural resources, forms of capital, cultural factors, and institutional arrangements. Effectively addressing the multiple challenges facing agriculture requires cooperation, collaboration, and integration of knowledge from the scientific and social disciplines (IAAKATD, 2009).

Added to this, Noe & Alrøe, (2007) explains that, multifunctional farming generates challenges in relation to the role of agriculture in society and, in particular, to rural development. The shift from farmer focus only to other multi-stakeholders and providing attention to gender related issues in agriculture, conflict management, and negotiation, give more importance to off farm activities for a broader actor involvement (Cristovao, 2007). This has given rise to the use of multidisciplinary, interdisciplinary and transdisciplinary approaches. Complex agricultural research programmes bring together actors whose ideas about the objects (problems) being researched is shaped by different perspectives and understandings.

1.4. Problem Statement

Farming systems and agriculture, in general, are complex and require multifaceted, interdisciplinary approaches and diverse disciplines to deal with the complexity they face (Christian, 2000; Noe, Alrøe, & Langvad, 2008; van Mil, Foegeding, Windhab, Perrot, & van der Linden, 2014). Multifaceted organisations and projects assemble numerous technical disciplines and non-scientific knowledge communities to address an issue. Crops for the Future (CFF) is an example of a multifaceted agricultural research organisation as it possesses and reflects many of these characteristics using interdisciplinary and transdisciplinary approaches to solve some of the challenges facing the agricultural sector. CFF is a research organisation established in 2011 to work on underutilised species and crops in a larger spectrum of agricultural diversity. Its mandate is aimed at contributing to global food security through advance innovative research in breeding, agronomy, agro-climate, food and nutrition, policy, market and supply chain as well as general agricultural systems to support agricultural diversification, address climate change and significantly reduce the enormous challenges discussed above.

Replacing the International Centre for Underutilised Crops (ICUC) at the University of Southampton in the UK, CFF has its headquarters (HQ) in Malaysia. It is incorporated as a company limited by guarantee without share capital. Its guarantors are the Malaysian Government and the University of Nottingham. In 2014, Crops for Future Research Centre (CFFRC) merged with its parent company Crops for the Future (CFF) to become a single research organisation (CFF Operations Guide, 2015).

Structured in Programmes and Themes, it operates as an academic and research institution where the research activities are tailored to academic and scientific standards due to its link with the University of Nottingham. As at the time of the start of the study, Bambara groundnut, wing bean, kedondong fruit, moringa and debate fruit in addition to the other NUCs were some of the key exemplar crop species they were working on.

Participants who responded to the early interactive part of the study, revealed these as their disciplines and specialisations; aquaculture, agriculture, biological science, management and finance, sociology, political science and rural development, environmental science, computer science, geographic information systems, industrial chemistry, project and facilities management, food science, communications and human resources management. Each of these knowledge communities has the mandate to contribute to the overall mission of developing solutions for a diversified future agriculture using underutilised crops/species. As a research institution with such diverse specialisations and actors coming from most parts of all the continents, it shows some level of complexity of the research teams of CFF.

Uncertainties and multi-perceptiveness in teams and projects often tend to create lack of understanding and communication problems (Hong & Reynolds-Keefer, 2013). Communication and other transdisciplinary challenges arise not because disciplines do not want to interact with each other, but could also likely be that, the understanding and appreciation of each actor's opinion may be lacking (Hall &

Rourke, 2012; Mâsse et al., 2008) This situation is more acute in research institutions, projects, and higher educational institutions as scientists often cocoon themselves to their beliefs, opinions. Knowledge generated within CFF on underutilised crops must flow to all participants and knowledge communities including farmers, the researchers themselves, academia, industry, and partners. This requires fluidity in the communication process amongst actors in the knowledge system. However, Hugo F Alrøe & Noe, (2007:9) argued that it is not possible to effectively communicate directly across different perspectives of different actors, as the communication may likely be error prone and with uncertainties, as one's view may not mean the same even with the same terms or keywords.

CFF does not have a framework or approach that addresses the complexity of communication within its knowledge community and research stakeholders. An ideal goal will be achieved if all the actors and knowledge communities within and around CFF can overcome the communication barrier, establish a common understanding with one another and create effective information sharing process and system. It is therefore essential for this research project, in particular, to develop a framework that can enhance an effective transdisciplinary communication within CFF and its actors as well as other similar multi faceted research organisations.

1.5. Research Questions

In an attempt to address these challenges, the following research questions are critical for consideration:

- I. What internal procedures, policies, and regulations exist to address the challenges of communication amongst different knowledge groups?
- II. How does formal and informal CFF seek to relate to scientists and stakeholders to interact and work together?
- III. What are the contributions of different knowledge communities to the research theme of CFF?
- IV. How do actors within CFF relate and claim ownership to knowledge co-produced from transdisciplinary teams?
- V. What form of a qualitative framework to understand communications in a research consortium like the CFF should be?

1.6. Research Objectives

The study generally aims to develop a framework that enhances transdisciplinary communications in research organisations such as CFF. The specific objectives of the include;

- I. Examine the internal procedures, policies, and regulations existing in CFF to address the challenges of communication amongst different knowledge groups.
- II. Examine how scientists relate to the formal and informal CFF and how they interact with each other.
- III. Analyse the contributions of different knowledge communities to the research theme of CFF.
- IV. Explore how actors within CFF relate and claim ownership to knowledge co-produced from transdisciplinary teams.
- V. Develop a framework to understand communications in a research consortium like the CFF.

1.7. Significance of the study

As explained in the problem statement, complexities of real-life issues cut across several disciplines and knowledge domains which require better integrated, overarching and all-encompassing approaches to addressing it. The study will explore and contribute significantly to deepening the discourse of disciplinary studies, organizational communication and knowledge co-production, particular from the transdisciplinary perspective. The proposed framework of the study will contribute to improving the communication processes with actors and stakeholders in complex organizations like CFF and other similar research organizations. Significantly put, the findings will deepen the methodologies used in gaining access and entry to organizations for ethnography and ultimately help to broaden the scope and symbiotic relation between formal and informal originations relative to interactions.

1.8. Scope and Limitations of the Study

The research is an organizational communication study with a focus on how actors interact in multi faceted complex environments. It explores the evolution of single disciplinary, multidisciplinary, interdisciplinary and transdisciplinary approaches to dealing with complex issues related to communication with a specific and detailed narrative on transdisciplinary communication. It highlights the case of CFF and how actors and stakeholders co-produce knowledge through formal and informal interactions. It used ethnography and participant observation approach with emphasis on the communication process of researchers from different academic disciplines in CFF, and not on the generic catch all mainstream communication.

Participants for the research were mainly researched academics, senior management staff, administrative staff, field technicians and farm field workers of CFF.

Again, the researcher could not gain full access to some key and important stakeholders such as members of the board and other directors in some themes. Their opinions could have further shaped and enriched the findings. Farm field workers were considered as farmers for the purpose of this research due to their roles, however, they were not independent farmers but farm labourers performing those roles. As an approach and principle of transdisciplinary studies, the farm field workers assumed the position of not academics who offered their views in that regard. This was a limitation as they should have been independent farmers who are partners of CFF. As at the time of the study CFF had no key or pronounced farmer groups as partners who utilises their outputs. Lastly, as a limitation, the framework developed from this study could not be tested and applied in CFF for further improvement due to some technical factors.

1.9. Literature Review

1.9.1. Research Approaches for Complex Research Problems

Several approaches have been developed to addressing complexity and real life problems such as the disciplinary communication challenges faced by CFF. Thus, in the next section, the author outlines how single, multi, interdisciplinary and transdisciplinary concepts evolved and used in projects and organisations. Following this, it attempts to explore and relate how CFF use of the value chain concept as a research strategy and a transdisciplinary tool to enhance

collaboration. It further tries to argue that, social capital theory and its concept adopted in teams, projects and organisation may tend to contribute to actors bonding and working together.

1.9.2. Single Disciplinary Approach

Operationally, disciplines are bodies of knowledge addressing domains of objects to be investigated and a language to describe them. A knowledge domain that evolves to solve a set of problems and methods to determine solutions and a theoretical framework that explains and predicts associated phenomena (Mitchell, Agle, & Wood, 1997; Klein 1996, 2004; Naiman 1999)see also Klein 1996, 2004, Naiman 1999, Schoenberger 2001, Rhoten 2003). Scientists coined the term “disciplinary” around 1834 which was not popularly used until the late 19th or early 20th century, when it was modernised into terms like physics, chemistry, agronomy etc. which later evolved into various sub areas of specialization, evolved (Alexandra Oleson, 1979).

Disciplinary studies have been the norm in knowledge generation and transfer, producing a linear specialization. This specialization leads to a deep understanding and mastering of subject specifics by scientists of all types. It also helps to perpetuate the deeper understanding of specific knowledge areas (medicine, engineering, environment etc.). Tress et al., (2006) points out that single disciplinary approach tends to produce concrete solutions to simple scientific problems as opposed to the knowledge that is immediately applicable to complex real world problems. It is carried out within the boundary of a single academic discipline, and it is executed by individuals or group of experts from the same

discipline. The current dynamics and structures supporting multi- disciplinary and interdisciplinary studies and research are gains based on existing scientific disciplinary structures (Kuhn, 1962, 2002; Pohl, et al, 2007).

Each research activity is designed to answer a specific research question or problem and to follow the principle of a sequential or single-track problem-solving approach (Tress et al, 2006). This approach (disciplinary) has been criticised for several decades now. According to Miller et al., (2008: 3), "disciplinary research limits the potential variety of scientific and local knowledge that can contribute to our understanding of the issues at hand and the generation of new knowledge". Since problems are getting more complex (heterogeneous) as explained earlier, single disciplinary issues alone cannot find solutions to them as it goes beyond the knowledge boundaries (refer to Figure 1). Therefore, using multiple disciplinary approaches are required when addressing complex problems that are beyond the scope of single disciplinary approaches.

1.9.3. Multidisciplinary Approach

Multidisciplinary approaches have been described as a 'close side by side of disciplines', where different disciplines analyze the same subject matter independently of each other without integrating their methodologies and perspectives. The approach is understood mainly as a form of cooperation that preserves the boundaries between disciplines and also maintains their disciplinary autonomy, with separate approaches, own framings and methods, and perspectives (see more in Figure 1.2) where boundaries do not touch or cross. Each activity and responsibility of actors relate only to one of the researchers in

the team (Mobjörk, 2009) Melvin, 1989: 70; Rothberg, 1981: 62). Consequently, a multidisciplinary approach means that a certain phenomenon is investigated and that this investigation is made by several researchers from different disciplines, working from their respective disciplines with little synergy and cross fertilization of members (Pohl, et al, 2007).

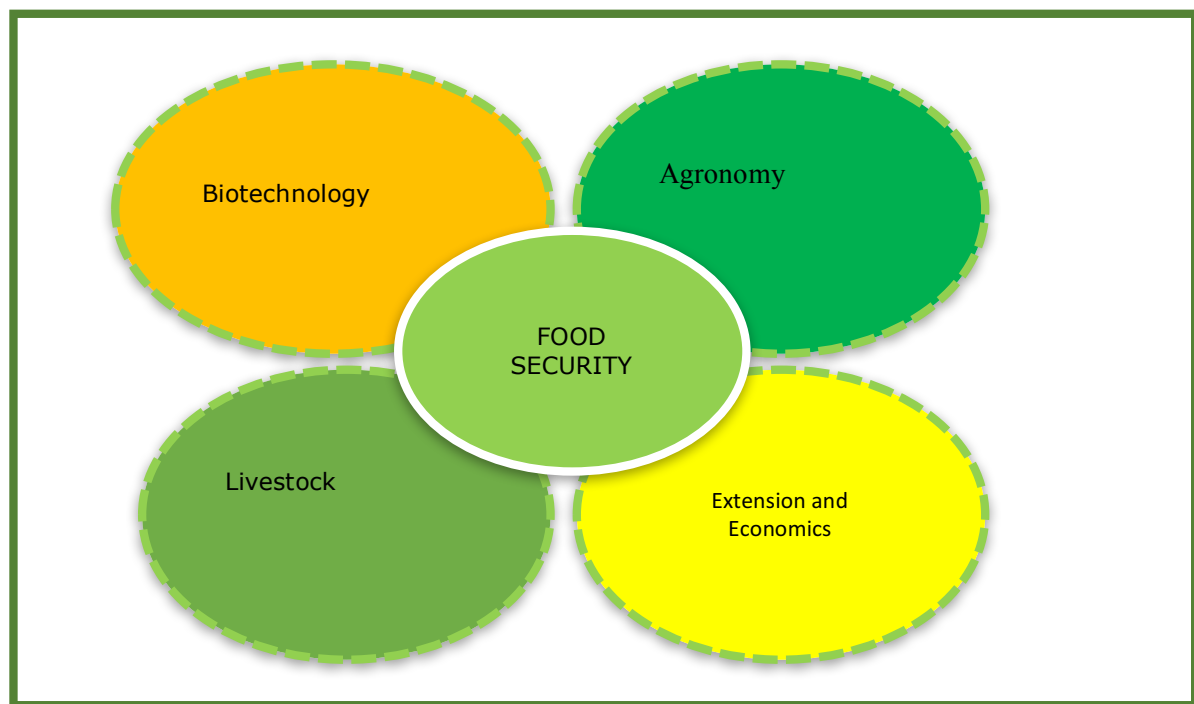


Figure 1.2 Multidisciplinary collaboration Concept

Researchers working on multidisciplinary projects are presumed to behave as disciplinarians with differing perspectives, whereas participants in interdisciplinary projects are believed to purposefully seek integration of disciplinary perspectives and thus engage in more cross-communication and cross-coordination (Lattuca, 2003). Since the approach involves individuals coming from various disciplines, mutual respect between disciplines and actors occurs with little interaction between the groups and actors. Hence, actors' autonomy and independence with no form of integration or interaction are maintained (Choi and Pak, 2008).

However, the results of their specialized individual contributions are included in a collective final report in projects.

In a general view, considering the distance between certain disciplines like biology and anthropology, it is challenging to close the loop and understand theories and methods of learning from other actors. Whilst some disciplines use laboratory and quantitative techniques, others use the qualitative approach to unravelling real life issues. In typical higher educational settings and based on epistemological proximity, disciplines often cluster into groups (or knowledge subsystems) such as: the natural sciences (e.g. physics, chemistry and biology), the social sciences (e.g. psychology, sociology and economics), the humanities (e.g. languages, music and visual arts), among others (Choi and Pak, 2008).

1.9.4. Multidisciplinary Approach to Communication in Projects

In multidisciplinary projects, it is observed that mutual respect between actors occurs with very little interaction between the disciplines and the team with no commitment to synthesize their results. Rather, the independent results may be included in a collective final report of projects. A project called- 'The Future Dairy project' in Australia used multidisciplinary approach with focus on 'collaboration and interactive innovation' in executing its project activities by involving different actors from dairy science, extension services, and others from social research to assist farmers adapt forages and feeding techniques and innovations for commercial farming (Kabore, Nettle, & Paine, 2008). The use of the approach helped fast track the adoption of the techniques and innovation of the dairy culture/concept to farmers although not as expected due to conflicts, idea

contestations, working together challenges and lack of understanding of each other in the execution process (Kabore et al., 2008).

Again, the Urban Rooftop Farming Project (URFP) in Barcelona, an urban agriculture multidisciplinary development concept, where roof top spaces were used for agriculture through open-air and protected technologies. Use of multidisciplinary approach for the project saw managing expert opinions and methodologies challenging during the implementation process (Sanyé Mengual Esther, Jordi Oliver-Solà, Juan Ignacio Montero, 2015) despite the widespread success of the concept.

Given this approach, the relevance and boost, is the adoption by a number of donor, development and multilateral organisations like the International Fund for Agricultural Development (IFAD), Food and Agricultural Organisation (FAO), World Food Programme (WFP) and the World Bank Group. For example, the FAO used this approach in the Eastern part of Africa to address major food production and value chain challenges (C. Leeuwis, 2014). The support system of the project provided by the food organization was related to the conservation and development of agro-ecosystems functions and environmental services. Bringing different professionals together by FAO, to individually contribute and offer expert opinions on the subject matter helped in the implementation process (C. Leeuwis, 2014).

Aside that, the European Commission (EC) of the EU developed a project 'BRIGHTANIMAL', a precision livestock farming with multidisciplinary teams

(government regulators, animal welfare groups, livestock researchers, livestock farmers and the consumers) to help reduce cost and improve the efficiencies of livestock farming, improve animal health and welfare and reduce the gap between producers and consumers for sustainable livestock production. The project developed successful guidelines and framework on livestock precision farming and a network of teams including animal production scientists to serve the interest of the EU and beyond. The project touched on the specialty and need of every stakeholder in the team as criteria and method of stakeholder or actor's involvement which contributed to the success of the project (EU, 2015).

The United States Department of Agriculture (USDA) in highlighting successful multidisciplinary research projects argued that collaboration between plant scientists and economists at Virginia Polytechnic Institute and State University developed new solutions and ideas to inhibit pathogens in nursery and crop irrigation waters using the approach. According to the team of researchers at the State Polytechnic and the University, use of collaboration and effective interactive processes in multidisciplinary projects tend to address the societal and economic benefits of research investments and provide answers to real world problems better. This approach delivers increased efficiencies through shared learning and experiences, information and research findings (NIFA, 2013). Participants in multidisciplinary teams learn to listen to each other and offer compliments that tend to improve their professionalism and specialized fields (Choi and Pak, 2008).

Despite these successful applications of multidisciplinary approaches in projects, the implementation processes encountered some challenges as explained.

Disciplines or stakeholders understanding of each other due to time pressures and different backgrounds appeared to be a major challenge in multidisciplinary projects (Hsien-Hui, 2013). For example, working on food security project (Figure 1.2) shows the four disciplines only contribute their knowledge towards food security without crossing boundaries. Since the level of integration at the multidisciplinary level is non-existent as argued, single specialty outputs are still being produced. However, the approach is argued to work better than single disciplinary approach practiced on isolated concepts because it takes ideas from other actors. This is where interdisciplinary research comes in, where the collaborative and integrative gap appeared addressed and a common output and knowledge co-produced.

1.9.5. Interdisciplinary Approach to Research

As a concept and approach that evolved in the 1920s and 1930s, interdisciplinary approach as espoused by Pohl and Hirsch-Hardon (2007) posit that it is a coordinated and integrated process of thoughts of different research actors. These research actors do have a responsibility to the team or group they work with, which often necessitate effective communication for team members (Melvin, 1989: 70; Rothberg, 198: 6). With an exchange and flow of information in teams, Matthiasson (1968: 65) explained that scientific collaboration normally will extend from the problem identification and definition stage of the research to the final project reporting stage.

To work on highly complex problems relevant to society, large research consortiums are increasingly created with the need for better and effective

interdisciplinary collaborations. In practice, the challenges in carrying out this kind of research are multiple and the majority of these challenges are closely connected with group communication, conflicts of interest, methodologies and procedures, different views of problems, unclear objectives, status and hierarchies of actors involved (Klein, 1996). These can lead to a personal- and subject-based conflicts, lengthy group-dynamic processes, talking at cross purposes, etc. The result of these challenges can be inefficiency, disintegration, and termination of such projects.

The use of interdisciplinary approach is therefore critical, especially in such situations where single and multidisciplinary approaches cannot be used to address these challenges. Understanding the meaning of interdisciplinarity continues to be contested by practitioners. Critics of interdisciplinary studies frequently charge that it has no widely accepted definition. For example, Jeffrey, (2006) intimated that

'Interdisciplinary has become so fuzzy that, universities and research commitment to the approach are close to being meaningless'.

It is generally seen and considered as a way of life and a way of thinking which opens fresh and deeply creative ways of engaging with the world and its complexity (Choi & Pak, 2008). This fills in the gaps of multidisciplinary approach where each scientist remains in their world of thinking. Similarly, according to the US National Academy of Sciences, interdisciplinary approach refers to the 'mode of research by teams or individuals that integrates information, data, techniques,

tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice' (NRC, 2005). For Moran, (2002: 16), any form of dialog or interaction between two or more disciplines is interdisciplinary and argue that teamwork and integration best explain what interdisciplinary really means.

Knowledge integration concepts and methodologies from different actors appeared centered to interdisciplinarity, unlike multidisciplinary approaches where disciplines and concepts do not cross. This starts with acknowledging that knowledge integration is difficult and challenging, especially when the methodologies and theories differ (Golding, 2009; Graell-colas & Gill, 2008). The acknowledgment comes with a combined effort in working together with the differences. On that, Miller et al., (2008:3) and Habermann et al., (2013: 2-14) explained that interdisciplinary approach to research incorporates more of elements of integration at the start of projects when the scope and role of actors are defined. It encourages unified problem formulation and sharing of methodologies of different disciplines from different actors in projects in order to address a common problem differently (Gray, 2009). The approach analyses problems from different perspectives and that helps to understand the complex nature of the World. Generally, interdisciplinary research allows researchers' freedom from disciplinary boundaries or constraints by assisting them to explore any theory or method or phenomenon the researcher thinks are appropriate (Habermann et al., 2013: 2-14).

However, Lattuca (2001: 80) disagreed with the integration concept of interdisciplinary and prefers to distinguish between types of interdisciplinarity by focusing on the kinds of questions asked rather than on integration. Actors should share knowledge and information, build consensus and collaborate better to produce knowledge, rather than just focusing on integration. Proponents of integration-based definitions often argue that interdisciplinary projects achieve a higher level of integration than multidisciplinary projects that merely link disciplines or their components (Davoudi, et al. 2010).

Aside the integrative element of interdisciplinarity, IDN, (2014) and Choi & Pak, (2008) emphasized the approach helps in building collaborative bridges, enabling the exploration of innovative pathways and marking of the willingness of actors to interact and respond to each other in projects and organisations. Howard Gardner (2006:3) prefer relating it a synthesis of the mind and the balancing of multiple perspectives to produce knowledge and ensure a better understanding of actors and the disciplines they represent (Golding, 2009).

It is argued to encourage comprehensive cooperation of several disciplines and actors such as agriculture and sociology or physics and with medicine (RayMaster International, 2006). Scientific projects using this approach gets closer and more frequent collaborative exchanges among actors drawn from different knowledge communities who are working together on common problems (Rosenfield, 1992), 1992).

Another critical element of this approach is the element of collaboration with others during team work. Bernard-Bonnin et al, (1995) argued that when projects or teams use an interdisciplinary approach, it offers a more profound level of collaboration of different disciplines, thus mutually combining their knowledge at every phase and stage of the project. The collaboration in this instance, under this approach, is largely on the methodologies and concepts for mutual knowledge sharing and integration. These positions espoused on interdisciplinary approaches shows how it draws its strength from collaboration, cooperation, and integration of perspectives on knowledge to solve complex challenges.

Again, the use of the approach generates communities of discourse, which offers a detailed response to specific problems by deepening knowledge and explicitly steps outside the boundaries of the discipline. Friedman (2013) believes, stepping outside the disciplinary boundaries breaks through the walls of knowledge communities. This he argues, rejects the solidarity of discourse and language that enable members of the community to recognize one another and to speak together. The discourse community may treat this as a signal of disrespect or a sign of ignorance.

However, as better as it appears to solve complex problems than single and multidisciplinary approaches, Domino, Smith, & Johnson, (2007) argued that there are some challenges with an interdisciplinary approach which does not completely addresses bigger and more complex issues. They started by arguing that if interdisciplinary research is so important, why is everybody not doing it? Hence, maintaining the barriers to interdisciplinarity are both practical and institutional.

Practical barriers to interdisciplinary research include the difficulties of organizing meetings, developing a common language, shared perspectives and as well as understanding the task at hand. For the institutional barriers, Domino, Smith, & Johnson, (2007) post that;

“An academic and research tradition organizes research works through disciplinary departments creating barriers to promotion, for those who have interdisciplinary careers by disagreement over what constitutes high-quality research, significant teaching effort, and appropriate service”.

The approach is further critiqued by Baigent et al., (1982), who argued that the approach is being too speculative and often actively discouraged by researchers and scientists. Another challenge of the approach in projects relates to the unreliable and misleading feedback from other members of the research team that often frustrate members (Paley, Klavans; Kevin Boyack & Dick; Bradford, 2009; Quagliana Charles, 2014). It is often a challenge for researchers of a discipline to judge the value of research or knowledge that does not arise from within the framework of a community of peers (Friedman. 2013) or in effect from their scientific beliefs. For Denis, (2013), interdisciplinary research can sometimes be frustrating because some concepts and methods are often rooted in the disciplines that shape the way scientists think about the world and how research is conducted. More so, the approach is considered to consist of actors largely from academia and scientific disciplinary backgrounds without the beneficiaries and non-academics (Naiman, 1999). Knowledge produced from interdisciplinary approach

is argued to be skewed towards scientific contributions alone without community and real life involvement, unlike transdisciplinary approach.

Again, the challenge to the interdisciplinary approach is more of arguments and disagreements especially at the point of intersections (see Figure 1.3). Crossing over from their disciplines represents topics and problems for discussion where each sub-discipline agrees on how best to solve the problem. But often, the opinions of each sub discipline conflicts seriously at the integration point (intersection) and this causes arguments, disagreements and long discussions between the sub-disciplines. Hence the conflicting tendencies of actors on whose idea is better to prolong the time taken for the problem to be solved or the project executed (Figure 1.3) Hadorn et al., (2008).

From (Morse, Nielsen-Pincus, Force, & Wulfhorst, (2007) perspective, interdisciplinary research often focuses on disciplinary mechanics, jargons with lack of creativity, technical aspects such as a preference for individual work over team projects, and the fear of addressing issues of teams or projects openly. Further to this, Lélé & Norgaard, (2005) enumerated some barriers to effective interdisciplinary research and working together, which includes; strong allegiance to one's school of thought rather than exploring different contextual explanations and embracing complexity. Other challenges postulated by Lele and Norgaard, are the epistemological differences between different disciplines in the same project or team and lastly the influence of society on the perception of a particular discipline and its perceived importance and relevance over others.

Therefore, broader agreements and consensus building amongst scientists in this form may tend to be the approach, since the gaps in interdisciplinary research can be filled in by crossing boundaries. As in Figure 1.3, the transdisciplinary diagram appears integrated and crossed that it is becoming a single discipline compared to gaps in single and multi-interdisciplinary approaches.

1.9.5.1. Interdisciplinarity and working together in projects

Disciplinary language is often a barrier to collaboration, integration, and understanding among researchers and it is a serious challenge in practical integrated development projects (Morse, Nielsen-Pincus, Force, & Wulforth, 2007; Vanasupa, McCormick, & McDonald, 2012). Interdisciplinary approach facilitates the processes for actors to 'speak one another's languages', allowing scientists share methods, terminologies, and epistemologies of others (Jill-Trehwella, 2009). This is tended to help build relationships and create a good interaction amongst team members in projects (Borrego and Newswander, 2009). In the educational sector, for example, interdisciplinary curricula and programs expose students to diverse and multifaceted areas of knowledge that shape them to endure and solve complex problems (Nardi, 1996).

The contributions and benefits of the approach are seen in several research and development projects (Tang, Molas-gallart, & Rafols, 2014) (Tang, Molas-gallart, & Rafols, 2014). For instance, the FAO believes that creating and sharing knowledge for sustainable agriculture requires a multi-stakeholder, cross sectorial and interdisciplinary engagements (FAO, 2013; INRA, 2016; Jerrell, 1983) An

agricultural biodiversity and global collaborative project in Nepal established by the FAO, designed the project with interdisciplinary concepts and teams to help strengthen the scientific need for conservation in Nepal. Stakeholders involved in the teams were strengthened to undertake conservation, utilization and sustainable management of agro-biodiversity initiatives for the community with diverse contributions from experts (Food and Agriculture Organization of the United Nations (FAO), 2003). As a project with diverse team membership, they supported the principle of conservation for rural development and livelihood improvements using various existing integrated knowledge perspectives from actors. The project benefited a lot from the existing traditional farming systems and adequate indigenous knowledge systems available, by blending native and scientific knowledge in favour of dynamic, evolutionary process of conservation (FAO, 2003).

Similarly, an interdisciplinary project, 'Mitigation of Climate Change in Agriculture (MICCA) Project in Tanzania initiated by the FAO and the Tanzanian and Finnish Government, developed critical climate change adaptation strategies that could mitigate climate effects, ensure food security and sustainable development with several team members and stakeholders was established (Majul A. E., Janie Rioux, Mathew Mpanda, 2014; FAO, 2003). The project effectively contributed to improving the country's conservation culture in forestry to improve on carbon emissions and reduce the vulnerabilities posed to the agricultural sector (Majul A. E., Janie Rioux, Mathew Mpanda, 2014; FAO, 1996; 2000).

A project on climate variability, human decisions and agricultural ecosystems in the Argentine Pampas was established between 2004–2007 to assess the use of seasonal climate forecasts that could enhance decision-making in agriculture (Podestá, Natenzon, Hidalgo, & Ruiz Toranzo, 2013)(Podestá, Natenzon, Hidalgo, & Ruiz Toranzo, 2013). The project used interdisciplinary approach which involved several stakeholders including state meteorology, farmers and other actors (Podestá et al., 2013). One important contribution of the project was, the capacity to predict and forecast with reliable climate information for beneficiaries including farmers as a result of an effective collaboration from relevant stakeholders in the project. However, as a challenge using the approach, there were difficulties getting members to agree on common issues related to criteria for assessment of results and outputs from the project (Podestá et al., 2013). As a way of addressing this challenge, the project team leadership allowed members to express their perspectives and experiences which were taking on board in the execution process (Podestá et al., 2013).

These outcomes from the projects explain and corroborates the scholarly position that interdisciplinary approach tends to tend to enhance some level of cooperation and collaboration at the team and project levels (Roper & Pettit, 2002; Sciences, 2004) As argued by Perry, (2014) and (Jill Trehwella, 2009), researchers who cooperate or work together in perspectives, are likely to have more published scientific articles to share knowledge and solve problems than uncooperative actors. Researchers' cooperation as explained is one of the elements that can likely create a more fluid leadership in projects and organisations and also allow

everyone to participate actively without fear of censure as a result of the mutual benefit at stake (Jill Trehwella, 2009).

From these projects, it can fairly be inferred that, a cooperative and collaborative research environment created by actors may likely increase the number of ideas and perspectives, improve the quality of the research or project outcome and outputs and also facilitates a better working environment (Figure 1.3) (Jill-Trehwella, 2009; Friedman, 2013). The success of the projects attributed to efforts of the approach appeared effective because of elements actors' willingness to cooperate and collaborate to achieve the project goals. Aside that observation, some other processes, and principles including;

1. Shared leadership
2. Learning the problem-solving methods
3. Allowing time
4. Using the principle of reciprocity
5. Sharing resources and information to other members.

(Perry, 2014; Jill-Trehwella, 2009 and Friedman, 2013)

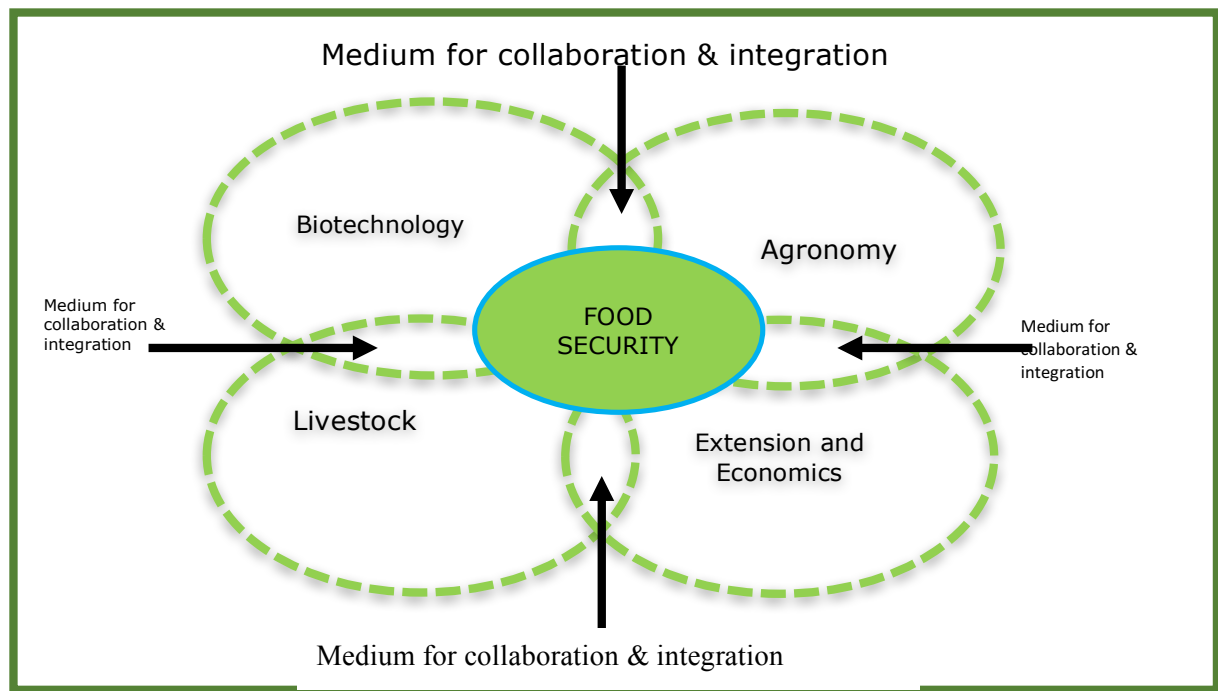


Figure 1.3 Interdisciplinary approaches to collaboration

1.9.6. Transdisciplinary Approach to Research

Definite definition of transdisciplinarity has largely been tailored to broader explanations than a single statement (Cassinari et al., 2011). Trans-disciplinary science as a research approach is argued to be the current paradigm of sustainable science and research shifting from disciplinary focused based on a more societal mode of knowledge production from between, beyond and across disciplines and stakeholders to find solutions. In the last two decades and more according to (Cassinari et al., 2011), there has been a growing interest and efforts towards the practice of transdisciplinary research in the social sciences in particular, after Jean Piaget formally used the term transdisciplinary in 1970. Continuously with time and consistent research, the term evolved within the scientific fraternity through a process of bringing different theoretical and practical viewpoints and

methodologies to bear on research problems. Nicolescu believed that transdisciplinary research ought not to be understood as a new discipline or specialisation; it is a complementary form of research focusing on the linkage and communication between the external and internal world of actors. It is argued as a 'science and art of discovering bridges between different areas of knowledge and perspectives amongst different beings' (Elander, 1994: 3). Elander and Nicolescu's arguments are focused on the linkage and communication of different actors in teams to co-produce knowledge aimed at solving complex issues and not for their personal interest, which often sways actors.

Alroe and Noe view that, transdisciplinary approach through systemic research or reviews has the tendency to affect an effective collaboration by allowing actors to holistically cover all aspects knowledge and how to integrate it. This approach is also advocated by Hammond & Dube, (2012) who claim for example that such holistic considerations appeared not considered most often when actors are collaborating on projects. They explain for example that, agriculture, health, and environmental systems are not well connected at the disciplinary level due to the epistemological differences with narrow system view. When epistemological differences set in, conflicts may likely ensue and uncertainties can build up in the process. Whilst, transdisciplinary approaches are best fit for uncertainties, it is, in this case, argued not as a conflict resolution approach but to address complex problems under uncertainties.

Transdisciplinary research tries to address complex problems, multiple and diverse perceptions and the underpinnings of real world issues Cassinari et al., (2011).

Hirsch et al., (2008) added that transdisciplinary concept was introduced as an innovative form of managing research with the involvement of natural and social science disciplines as well as non-academics which go beyond knowledge integration to knowledge co-production. Pohl and Hirsch-Hardon, (2007) argues that transdisciplinary concept of research is strongly required when the levels of uncertainties are high and there exist disputes over the nature of problems to be solved.

Others like Lang et al, (2012), insist transdisciplinarity as an approach should be focussed on the reflexive, integrative and method-driven process involving the practitioners, policy makers, beneficiaries, and communities as well. However, the integrative concept of inter and transdisciplinary approaches are not the final panacea to scientists cooperating. Ison, (2008: 249) argues that methodologies for the integration of knowledge are needed for synthesis and sense making in transdisciplinary projects and not just the notion that it is a set of hidden objective social "truths" waiting to be revealed by actors but negotiated.

Lele and Norgaard, (2005) argue that elements related to collaboration, integration, and crossing of disciplines are becoming so prevalent in some fields that some critics assert the notion of distinct disciplines are outmoded. For (Aenis, 2010; Klein, 2008), they see the approach as a process of crossing boundaries between scientifically-trained individuals and non-scientists collaborating to solve real life challenges. Hadorn et al., (2008) also defined transdisciplinary as a form of scientific cooperation concerning content and methods of research meant to produce the most relevant potential solution. While at it, Hirsch et al., (2008)

shifted focus to the cooperation and integration level of actors and not the knowledge generation part, since that represents the main challenge for multi-interdisciplinary teams. When actors come together, knowledge is always assumed to be generated, leaving the issue on how to integrate it (Omotayo, 2015) and (Hirsch et al., 2008).

Rosenfield, (1992), strongly views transdisciplinary approach in relation to the use of a holistic framework framing for new inquiries in problem-solving. He claims that;

“Cutting across disciplines through the use of a common conceptual framework to address a particular problem, blending together commonly accepted concepts and theories and linking it to the introduction of a new inquiry”.

Godemann viewed trans-disciplinarity as “problems outside the scientific world which may only be solved by scientists in cooperation with experts in possession of practical experience from outside the academic world” (Godemann, 2006). The concept of Godemann is the ‘everyday real life experiences’ as it goes beyond scientists and the academia to other stakeholders like farmers, farm workers, community members etc. depending on the type of problem as Aenis, (2010) and Klein, (2008) all argued.

The actors from the scientific and non-scientific communities forming the transdisciplinary teams are argued to develop a conscious effort at collaboration

with each other. This is because, as Eigenbrode, Morton, & Martin, (2014) put it; “complex problems are uniquely formulated and cannot be captured within single existing disciplinary domains. Collaborators need to accept and adopt different epistemological perspectives unique to the collaborative effort and distinct from those of any of the cooperating disciplines” (Eigenbrode et al., 2007). To more efficiently coordinate research, some proponents of the transdisciplinary research argue that philosophical issues guiding the research must be brought to the fore. Merrill et al., (2007) emphasized coordination within the sciences; the argument could easily be used in combining the sciences with other disciplines like the arts and social sciences. As some scholars (Av, 2010; Ciannelli et al., 2014; Rademaekers, 2015; Schmitz, Stinson, & James, 2010) noted for example that, biologists, environmentalists and other scientists addressing the emerging complex social and ecological problems will need to excel in collaboration. Achieving this requires actors to have a better understanding of the philosophical dimensions to help ensure effective working together and collective knowledge production.

In relation to co-producing knowledge by scientists and researchers working together, (Azam-Ali, 2010) explained that scientists, researchers, policy makers and practitioners need both qualitative and quantitative knowledge to be integrated into common formats and databases that conform to standardized rules and formats acceptable by all disciplines as evidence of knowledge. He posits further that, the combination of both vernacular and scientific knowledge can likely help bridge the gaps of different knowledge disciplines within the agricultural sector.

While that argument is legitimate and critical, common formats and databases conforming to statistical rules are itself a major challenge under methods and knowledge philosophies which several scholars disagreed with. Transdisciplinary principles consciously argue that knowledge co-produced jointly should not take the image of a single discipline or methodology (positivists and interpretive) but an integrated form that can solve complexity.

1.9.6.1. Participation and Communication in Transdisciplinary projects

Transdisciplinary research process often utilises some forms of participatory research. This involves stakeholder engagement where community members or beneficiaries of the research/project, practitioners and scientists are given lead roles and encouraged to participate in the research process (Cornwall & Jewkes, 1995). Participants are therefore key actors in the transdisciplinary team and the knowledge generated is believed to represent the views of all actors, academic and non-academic researchers working together (Figure 1.4) to solve a problem (Cronin, 2008).

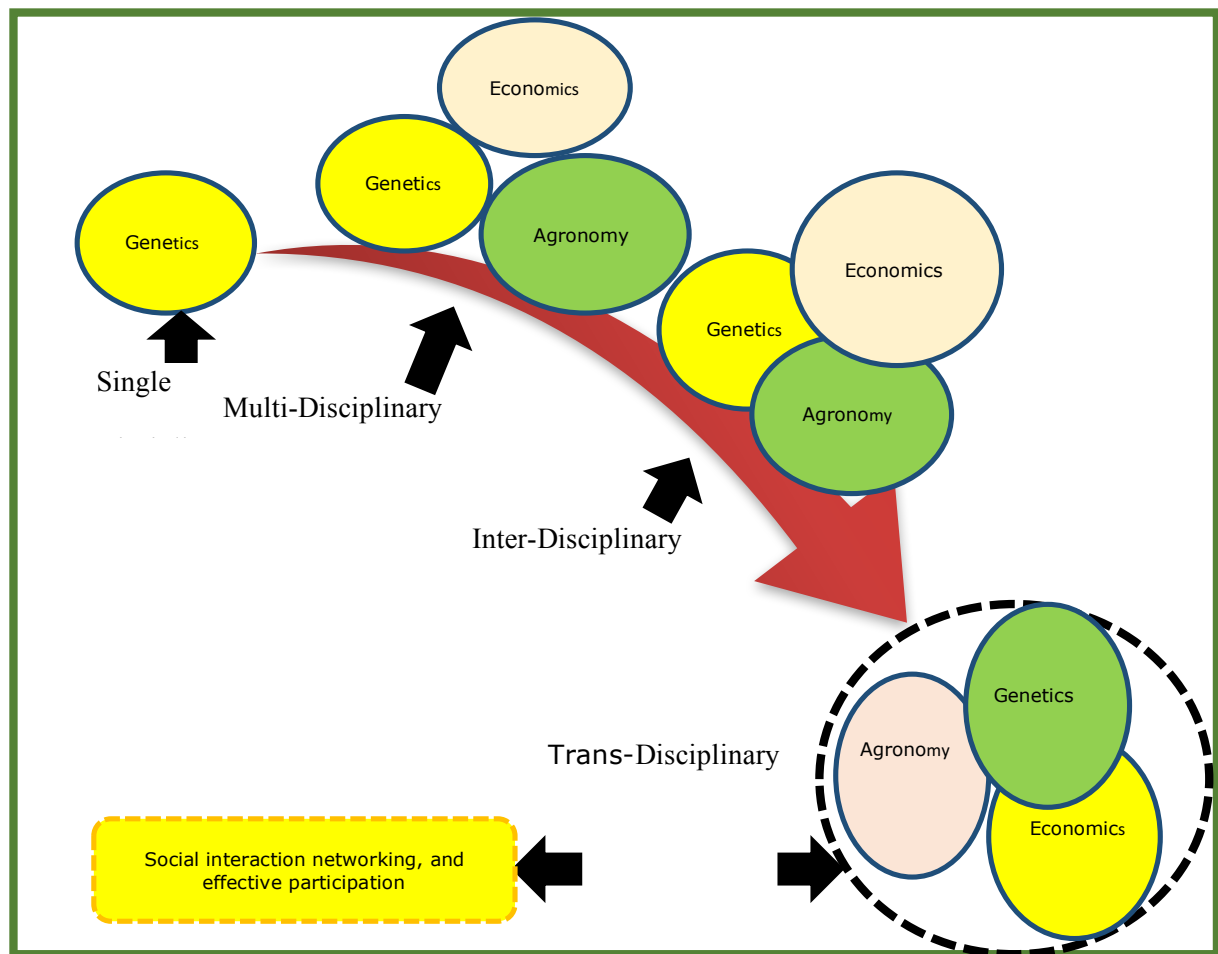


Figure 1.4 Evolution of transdisciplinary Approach

Cassinari et al., (2011) argues that a broad and generic definition of a stakeholder or practitioner is any person or organization who is affected by the social context and effects of the research projects or who can contribute to the process of knowledge production. Participation by practitioners in transdisciplinary research and stakeholders can vary depending on the focus and goals of a project. Participation can take different forms, involve different actors and different roles, take real or virtual forms, and be effective, token or symbolic. Practitioners may be involved in a transdisciplinary project as stakeholders, but can also be part of the scientific core or the coordinating team of transdisciplinary projects (Cassinari et al, 2011). The stakeholders involved in a transdisciplinary project can include

professional practitioners, NGOs, policy makers, activists, research institutions, and academics, but in general any type of user of the research results and methodologies of the project (Figure 1.4). Issues of office landscape and structure is argued to also facilitate actors' participation and communication at work as well as improving employees' social relationships and networking. Holbrook et al., (2007), posits that, open office landscapes help in actor networks and collaborations especially if work required are interdisciplinary or projects in nature.

Mitroff and Linstone, (1993) also believe that collective participation requires tapping into a range of epistemologies from different disciplines and actors, available local knowledge and key participants who could be active members or beneficiaries of the research work. This argument means that collective participation of members in transdisciplinary groups exposes actors to new knowledge and theories that are considered to influence the research outcomes to solve issues of complexity.

Following this for example, Friedman, (2013) explain that, 'hermeneutics is an example of transdisciplinary research outputs, both as a first-order practice used to solve interpretive problems and as a second-order theory of understanding and interpreting expressions and information arising in language and other forms of communication or experience' with more participation and involvement of all knowledge communities. The participation of members, according to Friedman, can lead to an improvement in relationships with actors involved which helps to improve communication amongst them. Active participation by a range of actors is thus considered as a central element of the concept of transdisciplinary. While

Pohl, Hirsch Hadorn, (2007) argue that when there is the wider participation of actors in projects, it gives an indication that, the problem or object in question is not predetermined by a few and rather needs a mutual and better negotiation with each actor/participant from academics and non-academic. Fisher & Holland, (2003) opined about the assumption of expert roles/titles by actors from the academia in bigger projects that requires a contribution from multiple stakeholders, raising a challenging issue of 'interest' of such actors other than the productive goals of the projects. Hence the use of actors' participation in transdisciplinary projects is perceived as an approach to promote 'social robustness' of collective knowledge co-production and conflict resolution (Hage, Leroy, & Petersen, 2010).

For all these relationships to form and scientific knowledge integrated and co-produced, an element of close and continuous collaboration, time for social networking, and conscious transfer of knowledge with other stakeholders which can be costly sometimes are essential. It takes time to build consensus and to combine research methods and cultures, thus making them more difficult to plan in research projects. Cronin, (2008); (Hage et al., 2005);(Kuziemy et al., 2009). Frasier et al., (2005), believe there is an abundant literature on transdisciplinary approaches indicating that time helps to develop trust and synergies amongst scientists of different perspectives and interest. It takes time to allow actors to accommodate different work styles and personalities and integrate disciplinary perspectives with methodologies. Better outputs are gotten from transdisciplinary teams and considered better when actors work together for a long time to develop professional relationships and collaborative experiences (Cassinari et al., 2011).

Most writers agree that the ability to communicate effectively with a broad range of different people is an important element in the success or otherwise of a research programme, yet this ability is still poorly covered in research programmes and projects (Hobbs, 2005). For Aenis, (2010), disciplinary communication in large research consortiums is classified as; team, process, and organizational communication concepts. Process communication includes planning, monitoring and evaluation of networked projects at different levels in large working groups and in meetings and workshops. The exchange of knowledge and information at "the process level", takes the form of large group sessions and gatherings (Aenis, 2010). Team communication according to the classification deals with group dynamic processes within various smaller groups which are formed during the course of the consortium's work at the intra group level. Organizational communication he suggests includes group dynamic processes within the large group consortium and the creation of project structures – both direct intra-group and indirect inter-group communication levels (Aenis, 2010). Participation of actors in projects and organisations according to Aenis, has many benefits including; the possibility to create new friendships, a sense of group accomplishment and assigning roles and responsibilities.

Several development projects have used transdisciplinary methods as an approach towards implementation. Participation, team work, integration, communication, and collaboration in transdisciplinary projects and consortiums are good for the scientist to work together for common purposes in projects. However, there can be tension and anxiety among actors in complex projects because of poor

communication and other factors. A project to strengthening rural transformation in the Northern part of Ethiopia to help boost food security and rural development (the 'TRANSACT' project) which used transdisciplinary research methods was established (Birgit Habermann, Birrat Misganaw, 2013). The project used transdisciplinary methodology by engaging stakeholders from government agencies, researchers, members of higher education, development partners and farmers to develop a better-integrated framework that could address issues of agricultural production, landlessness of farmers, land shortage for farming, resource conflicts and policy gaps (Birgit Habermann, Birrat Misganaw, 2013). In the process of executing the project, language and communication became a bigger challenge for the team (farmers, researchers, students, community leaders and government officials) due to their background and multiple perspectives (Birgit Habermann, Birrat Misganaw, 2013). This made the project operation difficult and the use of knowledge sharing and participatory strategy as an aspect of scenario analysis to build consensus and explain to farmers and other partners on every aspect of the project helped reduced the communication and understanding gaps (Birgit Habermann, Birrat Misganaw, 2013).

A Sustainable river basin management project in the Upper Ewaso Ng'iro North basin of Kenya also used transdisciplinary elements of participation in the project 25-year period (Cassinari et al., 2011). The project significantly impacted on the ecological processes and socio-economic and institutional management of water resources and knowledge & technology transfer. This enhanced better integration of scientific and local knowledge systems as well as long-term ownership of preferred interventions by the project (Cassinari et al., 2011). The important

element in the process is the community's choice of a preferred project and deliberately getting involved by participating in the process, led to their ownership and sustainability of the project. When beneficiaries of projects or interventions and other actors are active participants and contributors with other stakeholders on the project, it tends to lessen disparity between the academics and non-academics and help accelerate development (Aniekwe et al., 2012; Horowitz, Robinson, & Seifer, 2010).

Another successful multi-level transdisciplinary project worth noting is the Bombay HIV prevention project that drew multiple specialties from different countries in the health sector to execute the project. The project collaborated with epidemiologists, physicians', anthropologists, psychologists, demographers, and representatives of other fields and sectors. The project aim was to test a transdisciplinary conceptual model with a community-based formative research and to utilize the results in the development and implementation of the interventions (Cassinari et al., 2011) and (Schensul et al., 2009). The project was on a bigger scale which covered a large spectrum of beneficiaries who all required different unique attention. Community level interaction and interaction amongst members in the project became a serious challenge for the project leaders. Use of street drama, community meetings, and communication with informal gatherings of men, use of print materials and posters, participation in religious festivals, and video presentations were the activities developed to foster closer communication (Schensul et al., 2009). The effective management of the communication process between these actors by project leaders allowed for a mutual and productive participation and coordination of the project activities.

These project examples show that the approaches adopted come with a set of challenges especially at the implementation level of the projects. The challenges observed in these practical development projects using inter-transdisciplinary approaches emanated from either at the actors' relationships and interactive level, the structuring of the institutions that govern and implement the projects, the leadership structure and style of the projects and critically, the disciplinary differences. As Cronin, (2008) argued, the commitment of project leaders as well as institutional and leadership commitments during the project execution periods are perceived challenges (Cronin, 2008). Effective communication and fluid interaction amongst team members from some of these projects appeared to be a challenge, due to the diversity of membership and backgrounds. Aside from that, understanding each other during project conception stages is considered 'time-consuming' (Cronin, 2008) and the linkage of abstract and theoretical knowledge to reality in projects can be daunting for actors (Hirsch et al., 2008) and (Petts, Owens, & Bulkeley, 2008).

1.9.6.2. The Differences of Transdisciplinary with other Approaches

Table 1.1. Overview and features of Multidisciplinary, Interdisciplinary and Transdisciplinary Research Approaches

Single Disciplinary	Multi-disciplinary	Interdisciplinary	Transdisciplinary
Highly specialized in one discipline	People from different disciplines working together, each drawing on their disciplinary knowledge.	Integrating knowledge and methods from different disciplines, using a real synthesis of approaches.	Creating a unity of intellectual frameworks beyond the disciplinary perspectives.
No cooperation with other disciplines	Not focused on problem solving but requires expert opinions	Focused on problem framing and solving from disciplinary perspectives	Solving problems by going beyond disciplinary perspective to involving practitioners, beneficiaries and non-academia
Development of a detailed new disciplines	Members cooperate in their contributions but do not integrate their perspectives,	Perspectives are integrated with stronger levels of cooperation	New knowledge is generated through the use of multi and interdisciplinary concepts
	Disciplinary theory development	There is a common understanding on methodological approaches, epistemological and ontological perspectives	Considered as the highest form of integration of all actors in a participatory approach form to solving real life problems
			It synthesis or integrate new disciplines and theory among science and society

Source: (Balsiger, 2004; Scholz et al, 2000; Tress, 2006; Miller, 2008; Klein 1996; Lattuca, 2001; Alroe and Noe, 2006; Pohl & Hirsch, 2007:2007 etc.).

The big difference and additions of this approach are the involvement of the non-technical/non-academic or scientific group who are not part of the single, multi, inter and transdisciplinary approaches. Transdisciplinarity recognises that, science is part of the processes it describes, and therefore focusing on a systemic view of social and 'natural' dynamics that are shaping the world., Haberli, Bill, Scholz & Welti (2000) suggested that the approach embraces the plurality of knowledge, world views and the ethical values connected to them within different social and cultural groups.

As an approach, it aims also to create knowledge beyond disciplinary borders and to acknowledge the separation between researchers and social actors unlike single disciplinary and interdisciplinary approaches (Table 1.1). Therefore, transdisciplinary research includes interdisciplinary reflections and methodologies. Gibbons, (1994) gave further distinctions to transdisciplinary research identifying four distinct features: it develops a framework to guide problem-solving efforts; it develops its own distinct theoretical structures, methods and modes of practice (which do not necessarily depend on disciplinary knowledge); the communication extends the conventional organisational channels and is orientated to those who have participated in the research; and finally, it is dynamic, the process cannot be predicted as is the case with discipline-based research. Again, transdisciplinary favors collective participation of actors in teams and argues for a minimal use of jargons and terms by members for interactions, which other approaches tend not to focus on. However, (Balsiger, 2015) posited contrary views to these arguments and explains that transdisciplinarity does not necessarily depend on disciplinary knowledge but how to solve a problem is the most important element for

transdisciplinary team members. As a requirement for transdisciplinary research or study, there should be a problem to be solved with multiple stakeholders or researchers and practitioners.

1.9.6.3. Challenges of Transdisciplinary Approach

Several authors (Pohl & Hadorn, 2008: 2; Hollaender et al., 2008, 388; Klein, 2008, pp406) argue that the literature on transdisciplinary studies and research does not propose detailed and coherent theories and methodologies but it rather identifies relevant skills that scientists and researchers should use. After several years of scholarly discourse on this approach, there is no universally accepted definition of transdisciplinarity resulting in a low quality standard of critical empirical knowledge on that (Jahn, Bergmann, & Keil, 2012).

This makes literature on a variety of empirical projects adopting a transdisciplinary approach to address issues exist in widespread form, which makes it difficult for interested researchers and practitioners to review and become familiar with (Lang et al., 2012). Lang and co, enumerated some other challenges of transdisciplinary research in projects namely; insufficient problem framing within teams and projects that results in lack of agreement on the problem by members, unbalanced problem ownership from within teams and outside stakeholders, insufficient legitimacy of the team or actors involved, conflicting methodological differences, integration challenges on epistemologies, legitimacy challenges of transdisciplinary outcomes resulting in gaps within knowledge communities (Lang et al., 2012).

Scientists' choices of not bridging these knowledge communities and moving away from their comfort zones of disciplines are limited especially in the agricultural research front. For example, Azam-Ali (2010) argues that current agricultural cropping systems are failing through the loss of substantial indigenous knowledge because current research approaches use the silo and rigid base methods. In advancing the argument, he pointed out that the trend is not getting better as the scientific disciplines with fundamental research concepts, gets the higher impact journal publications than the applied research works and disciplines. High impact journals, for instance, are discipline focused and peer reviews are sourced from experts in specific discipline and specialties. This process further makes the integration of various knowledge communities difficult in projects (Azam-Ali, 2010; Friedman, 2013) and at worst argued that specialisation into disciplines leads to the fragmentation of efforts and understanding of knowledge (Perez Vazquez and Ruiz Rosado, 2005) (Perez Vazquez and Ruiz Rosado, 2005). However, scientific disciplinary integration and better interaction are some of the solutions to agricultural complexity.

Aeins, (2010) argues that, with team members from academic and non-academic backgrounds, there are bound to be communication and understanding issues. Crossing to other disciplines comes with its own uncertainties for members and issues of who takes credit or ownership for outputs produced are challenging to actors in the co-production process (Campbell & Vanderhoven, 2016) & Cassinari et al., 2011) and (SCAR, 2012).

Alroe and Noe, (2006) suggested that issues of communication can be achieved through what they call a poly-ocular approach where a detailed insight is produced based on the observation of the observations or moving away from the knowledge of the research object, to the knowledge of the process as the basis for effective communication. Communication is defined by Conrad, (1994) and Conrad & Poole, (2012: 5), as a;

“Process through which people, acting together, creates, sustains, and manages meanings through the use of verbal and nonverbal signs and symbols within a particular context.”

Conrad (1994) believed strongly that, anything short of these attributes and requirements within a team or group will likely cause a challenge to effective communication. In the same vein, Hobbs, (2005) argued that disciplinary communication entails breaking down old disciplinary rivalries and barriers, achieving a common language, and recognizing the value of different approaches as well as the need to work together to address the complex real world problems (the big issue confronting us today). With these, this study aims to contribute perspectives to address some of the barriers and challenges of a transdisciplinary approach to research and complex project execution, by examining and exploring further literature related to the social capital theory and organizational communication theories of which the study draws some views and strength points from.

1.1.1. Crops For Future (CFF) as a Case Study Organisation

As a case study research, this section provides an overview of Crops for the Future (CFF) as a case study organisation for this study. It describes what CFF represents, its research strategy and mandate, the complexity of disciplines and actors within and why the organisation was considered as a case study for agricultural research organisations.

1.1.1.1. Empirical Overview of CFF

CFF as an organisation has 32 global partners (including universities, research institutions and government agencies) and 20 partner institutions within Malaysia and it champion the use of underutilised crops with a diversified future agriculture (CFF Profile & Plan, 2014). At the time of the research, CFF had about 70 employees including research scientists, technical staff, supporting staff, part time staff and interns. Out of this number, 25 were females and 45 were males. The distribution of gender cut across the hierarchical line within the organisation with some females as theme and programme directors as well as administrative managers together with their male colleagues. Some of the staff had master degree qualifications, especially for the programme support managers and some of the administrative support staffs, whilst most of the coordinators (postdocs), directors and leaders had PhDs or with extensive industry experiences. The field and laboratory technicians and the farm workers had lower levels of qualifications. These makes CFF an organisation with highly mixed set of skilled human resources across departments. English is the official medium of communication in the organisation, however, Bahasa Malayu, Tamil and Mandarin represents the

unofficial language of which actors within CFF switch to interact with one another informally. At the start of this research CFF had employees from over 16 countries.

1.1.1.2. CFF Approach to Research

CFF operates through *Themes* and *Programmes*. The Themes serves the oversight faculty role under which the programmes come as departments and operates through daily activities and projects. The Themes offers research guide, direction and support to the programmes, with members of the themes together with the CEO and other administrative staff constituting as management for the organisation.

CFF as a research organisation tries to demonstrate international research excellence on underutilised crops through cutting-edge technologies that generate new knowledge, coherent and well planned research programmes that span the `research value chain` and by communicating research outcomes to academic and non-academic audiences including farmers (CFF Corporate Plan, 2014). Its working culture tries to recognise the value of others` opinions, beliefs and cultures irrespective of gender and ethnicity or level of education. CFF claims that, respect and tolerance are their ultimate character in the conduct of their relationships with each other and with their stakeholders as captured in their corporate plan, 2014 and that, integrity underpins their actions covertly and in-covertly.

With all the elements that constitute CFF activities and actors resonates with the complex agricultural, food and research networks by producing outcomes with a truly global reach, as well as being aligned with local perspectives. It tries to

respond appropriately to local conditions and sensitivities, as well as to its wider global responsibilities on underutilised species and food security. Environmental sustainability guides what they do which is visible in the state of the art new headquarters built in Semenyih close to the Malaysian campus of the University of Nottingham. With a 'green workspace' agenda, efforts in this regards includes energy-efficient, low-carbon buildings, use of sustainable technologies and related policies.

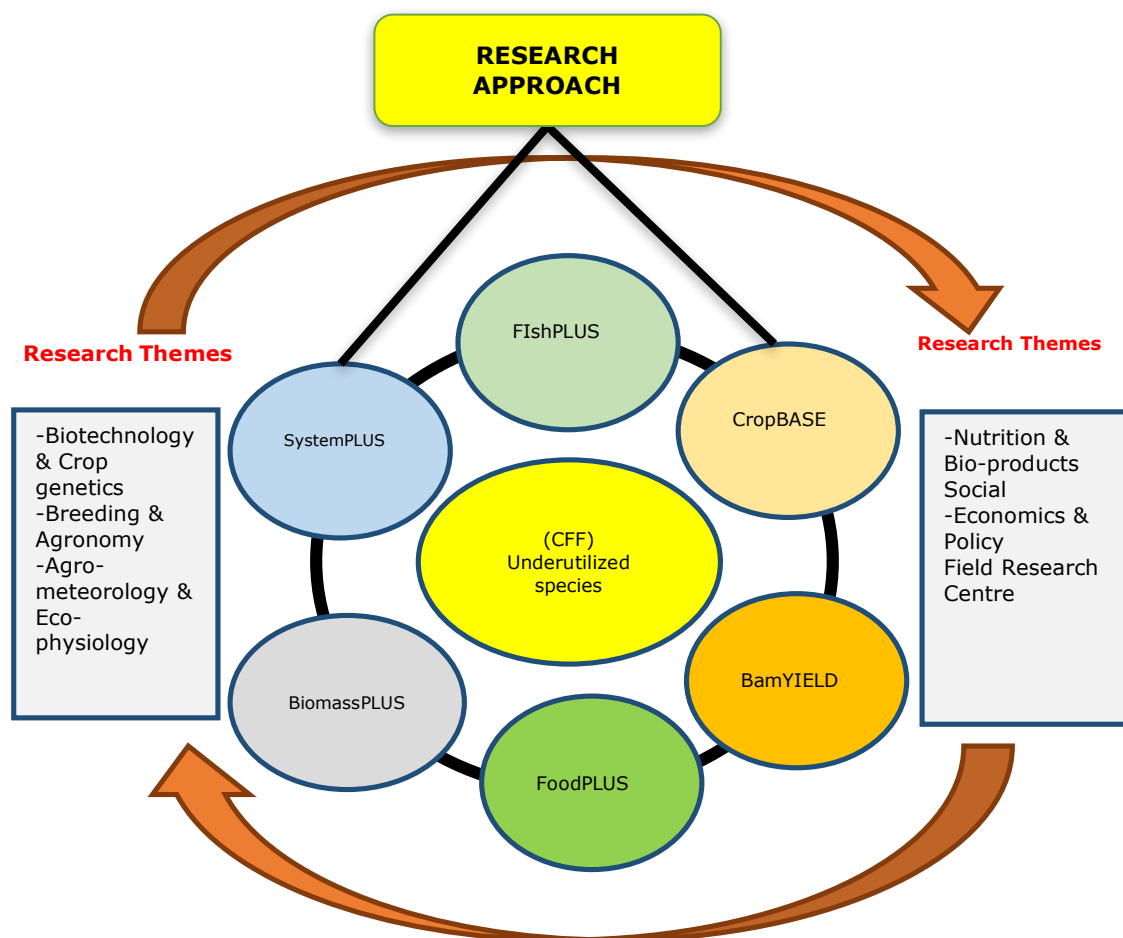


Figure 1.5 The Research Structure of CFF, 2014

The knowledge communities within from figure 1.5 reveals the diversity and variety of the scientists under CFF and the socio cultural and technical differences

that exist for them to understand each other interact and collaborate. So, who are the actors and how are they networked? Actors in CFF are the programme support managers; the theme leaders, the theme coordinators, the programme coordinators, the chief executive, the board, the field research centre workers and the supporting administrative staff i.e. operations (Figure 1.5).

1.1.1.3. Administrative Support Unit of CFF

The administrative support unit of CFF is broad ranging from; finance and audit, administration and facilities management, communications and branding, information technology (IT), facilities and laboratories, business development, donation and fund raising, advisory and consulting. These supporting or non-technical unit of CFF provides a significant support to the research programmes and themes. As the names of units implies, actors within these groups differed significantly regarding their disciplines and roles, compared to the agricultural led research programmes and themes. CFF argues as an organisation that, it drives a significant strength from the diversity of staff and disciplinary specialisations from its members to support its core research mandate. The explored units and department of CFF reveals how complex its constituents are regarding disciplines of actors and its core functions on agriculture and underutilised species. It shows how linked each research programme and themes are and the importance of the non-technical actors of the organisation.

These actors are all networked through programmes, themes, projects, operations with other non-human elements. Like any other social institution, the network density differs from these various links depending on the actors involved, the

shared socio cultural elements, how they view and share the values of CFF and the informal relationships. Power control and participation, influence and dominance also play a key role in this type of an environment, with many different actors involved (Law, 1991).

A need therefore, to use some elements of participant observation and ethnographic methods and principles to understand how CFF as an organisation and its actors relate and interact in their daily operations is essential and needful. Uncovering this means, the research requires an exploratory and long term contact with those being researched. This allows the researcher to experience the regular patterns and routines of the community or organization of study, as well as seeing how it responds to novel situations.

1.1.2. Thesis Outline

The thesis is divided into seven chapters. Chapter one is further divided into three; the introductory and background section, the literature review section and CFF as a case study organisation. The introductory and background section captures the research setting, researcher's position and reflexivity complex societal problems and approaches, the problem statement, the research questions and the significance of the study, and the scope and limitations of the study. The literature review section of chapter one examined; single, multiple, interdisciplinary and transdisciplinary approaches in dealing with complexities and development issues, while the CFF part explains the background of CFF, its research strategy and why it was chosen for this study.

The chapter two of the study is theoretical framework which explored the theories underpinning this study, including; Social Capital Theory (SC) and Organisational Communication Theories (Theory of Bureaucratic Management in Organisations and Communicative Leadership Theory). These theories provided the basis and linkage to transdisciplinary communication, the social elements that contributes to working together and interactions and situating that in in formal organisations with its structures and processes.

Chapter three explained the methodology used for the study including the philosophical considerations, the research approach, how the data was collected, how the researcher gained access into CFF for the data collection and how the data was analysed within the approved ethical considerations.

Chapter four examined the research value chain (RVC) as one of the internal policies of CFF within which actors collaborate for research and the centre sphere where serious communication takes place. Chapter five further looked at the findings focusing on the formal and informal CFF and how actors use the inter-linkage of some social elements to collaborate and interact within the formal structure. Chapter six examined the aspect and significance of knowledge contribution of actors to CFF, data policy issues and how that forms part of their interactive processes.

Chapter seven discusses the proposed framework of the study from the empirical data gathered and the conclusion of the thesis. It lays out how the study

contributes to knowledge and field of study and discusses how the research questions were answered, the summary of the findings, the implications of the research and the conclusion.

CHAPTER TWO

THEORETICAL FRAMEWORK

2.1. Introduction

While many scholars argued for a better and effective method of collaboration and working together on organisations, projects and teams, sustaining that act without knitting the social aspects of actors, networking and enhancing their bonding process, will still make effective collaboration and cooperation difficult. The researcher believes that the adoption of the elements of Social Capital Theory (SC) and organisational communication theories (bureaucracy and leadership) for this study and for actors in an organisation like CFF may tend to enhance and fill in the gaps of low social interaction, networking, sharing, and bonding. SC theory is used in the study as a concept to deepen the understanding of both formal and informal ways actors influence the course of events in organisations using actors' social and other resources. As such, the section argues that, in addition to the interdisciplinary and transdisciplinary concepts of relating to one another, social capital and organisational communication theories are relevant to collaboration, integration and networking in teams and organisations. Specifically, the study it focused on adopting elements of social capital in relation to transdisciplinary communication, actors' interactions, formal and informal organisations, knowledge co-production by exploring and relating the; SC generation, criteria and predictors in measuring social capital in organisations, SC in organisations and organisational communication theories (bureaucracies and leadership) with a link to inter and transdisciplinary discourse.

2.2. Social Capital (SC) Theory

The idea of social capital (SC) theory was developed and discussed in Lyda Judson Hanifan's discussions on 'rural school community center' (Hanifan, 1916: 1920, p 130), practically describing it as 'those tangible substances that count for most in the daily lives of people'. As a theory evolving strongly from the late years of the 1990s and early 2000s, reviewers of the social capital theory have not been able to clearly agree on the unanimous and precise definition of social capital (Nahapiet & Ghoshal, 1998; Rønning, 2008) and (Schuller et al. 2000). Some scholars believe that a perfect and a distinctive meaning may not be gotten (Mondak, 1998).

Astone and Mclanaham, (1991) however described it, as a relationship between different family members that determines how individual members can take advantage of whatever financial and human capital they each possess with the principle of reciprocity. The World bank, (1999) defined it as: 'institutions, relationships, and norms that shape the quality and quantity of society's social interaction'. Social capital in organisations and society, in general, is argued to recognise the need for social investment in relationships. It is believed to be one of the elements that serve as a glue and a bedrock with trust, networking, and reciprocity at the center of its principle that helps to shape how actors build relationships amongst themselves (Baumane-vitolina, 2012). These elements in principle can be related to transdisciplinary narratives where actors and stakeholders are required to function well in a project team. Understanding the social environment within which actors operate is important as it helps to create

a better networking process. In interdisciplinary and transdisciplinary environments, access to multiple resource and information from different networks (including academic and non-academic), are enhanced with a stronger social cohesion (Freyer et al, 2009).

Social capital is used in different situations and can be approached from different angles depending on the theoretical background and specific applied dimensions (The U.K. Office for National Statistics, 2001). It is argued by scholars (Nahapiet & Ghoshal, 1998; Schuller, Baron and Field, 2000; Field, 2002 and Nahapiet, 2008) that some elements of SC that defines what the theory represents include; family, friends, trust, norms, communality, gatherings, networks, bond, values, reciprocity etc. These elements allow membership in formalized groups such as communities, organizations, farmer based organizations and research teams to adhere to mutually-agreed or commonly accepted rules, norms and sanctions. Antoh, (2005) argue that networking between individuals with shared interests, increases people's trust and ability to work together and expand their access to wider institutions, such as political or civic bodies.

In the agricultural sector for instance, the shared norms, trust, networking and connection of farmers helps them to access good agricultural information and technology from farmer groups, extension officers and input dealers (Munyasi, Auma, Ngode, & Muyekho, 2015; Ntume, Nalule, & Baluka, 2015). These are attributed to benefits of social capital with some nuances of informal networks. Apart from accessing information and networking claim of social capital, it is again argued that solidarity and exchange of support with each other help farmers

during periods of droughts, poor yields, pest and disease outbreaks and with inputs, shared labor in the affected member's farms. Roslan et al., (2010a: 2010b); Balogun and Yusuf (2011) confirmed that networking, exchange, and support to each other during periods of hardship are elements that help farmers to cope with the vulnerabilities or disasters.

It is further explained that communities with a high level of social capital tend to produce greater outcomes through community networks (Bhuiyan & Evers, 2009). They simply argued that social capital is the glue that holds societies and institutions together. Adding to the binding effect of social capital, Serageldin (1998) concludes that, without social capital, society at large will collapse, and today's world presents some telling example. Employees with a high level of social capital are paid better, promoted faster, and promoted at younger ages. It allows groups and members to cover for each other in organisations (Baker Wayne, 2000). Ron Burt (2000) discovered that social capital can be in the form of entrepreneurial opportunities and propensities that yields rewards. According to Choi, (2005), about 70 percent of learning in the workplace takes place via informal interactions where social capital takes its strength from. Based on these arguments, organisations and teams may require these positive attributes of social capital in order to facilitate the informal flow of relationships and enhance the social exchange from actors for better performance and competitiveness. It may even be critical if members come from different diverse backgrounds (disciplines, beliefs, culture etc.) as in the case of transdisciplinary teams.

2.2.1. Social Capital generation and Actors' Participation

Having explained SC and its elements in groups, communities, teams, and organisations, it is imperative to determine how these elements of the social capital theory are generated or created by actors through active participation. Nahapiet & Ghoshal, (1998) grouped social capital generation in two categories; thus, individual and collectivist form (staff and organisation). The generation of SC starts from the individual level and enhanced at the collective level for the benefit of all. At the research team level, SC can be generated through tapping into the positives of these research actors and create an enabling environment to enhance better relationships and interactions. It is therefore important that, since individuals are the locus of knowledge where issues of capabilities-based assessment and performance indicators (KPIs) have become the focus for organisations, which directly or indirectly are considered to be from individual and collective actions of actors build over time, leaders should focus on how SC is generated and utilised (Tantardini & Kroll, 2014).

Tantardini & Kroll, (2014: 21) and Nahapiet & Ghoshal, (1998) went further and classified social capital elements into structural (networks and configurations), cognitive (shared codes, language, beliefs) and rational dimensions (trust, norms, etc.). These three clusters in research and academic sense should be able to create an intellectual capital that is needed for an effective inter-transdisciplinary discourse. Again, such predispositions of SC are argued to foster development at the community level through its combined effect of strengths and networks from active participation. The active participation of all actors thus facilitates a

sustained level of human and physical developments of the rural and local communities (AKPABIO, 2008).

Further on active participation of actors in social networks to furthering developments, (O'Reilly, 2012) & Krishna, (2002) argued that, development programmes by local communities are in itself part of the social networks because actors who themselves had certain understandings and views about what development programmes are, tend to have different perspectives when they are involved in the practical work out processes. Getting involved through active participation enhances better project formulation and execution as well for community members and practitioners' awareness (McNeil & Mumvuma, 2010; Ponce, Rosas, & Lorca, 2014; Wasilwa, 2015; Wollebæk & Selle, 2003) Therefore, such social networks should be seen not just as a social infrastructure, but much more as a "space" of transformation. Actors networking in teams are considered immaterial, not infrastructural, but observable, with boundaries and missions (Jansen, De Leeuw, Hoeijmakers, & De Vries, 2012; Orlikowski & Scott, 2015). Rather, it can be viewed as a way of thinking about action and ongoing interactions between people (Oliveira, , 2008). Individuals within the structure of relations and boundaries (networks) have the ability, by virtue of these connections and relationships, to achieve one's objective which otherwise would not have been possible (Portes, 1998).

Putnam, (2000) brought another dimension of social capital as being the "measure of the number of networks" actors can build in a community or organisation. Putnam argues that a better and higher social capital in a group is likely to increase

the number of networks between actors. From this position, it is viewed that when there are many networks in organisations, actors level of participation increases because each member may likely have a group they belong. Following this theory, a voluntary organisation or community constitutes just one particular network that can be joined but, at the same time, almost everybody has constituted networks that are independent of the organizations. Putnam, (1988, 1993, 2000), focused on trust, norms, and networks and emphasizes the central role of civic engagement in a broad range of associations that can facilitate collective action for community and institutional development.

Bueger & Stockbruegger, (2016); Gray, (2009); Latour, (1996) observed that, the use of the actor network can be a useful tool in complex transdisciplinary environments could help actors manage the excesses and limitations of researchers, as it does not only focus on the human aspect alone but also on the non-human contribution to real life issues. He argues that the social network aspect of actor network creates a focus on the entire systems of linkages than on one connection in a team. This enhances deeper interactions amongst researchers which help to determine the collaboration level from one connection to the other. Betweenness Centrality is used to identify brokers, critical personnel, and leaders in a social setting.

2.2.2. Social Capital in Organisations as Social Networks

Transdisciplinary organizations and research institutions require stronger human and social capital resources to develop because of some its positive attributes. Gooderham, (2007); (Nahapiet & Ghoshal, 1998); Maskell, (2000); Rønning,

(2008) agreed that the networking through SC in organisations helps to facilitate the sharing of knowledge across boundaries of disciplines and functions like CFF. The structural dimension of social capital in organisations and teams focuses on the characteristics of the configuration of connections among members within the network. Hence, the frequency of interaction among team members, and the strength of ties among them are common indicators of how SC and its elements of networks are structured (Nahapiet & Ghoshal, 1998). Teams in which members know each other well and interact frequently with each other are considered to be in dense networks, that tends to encourage cooperation, information and knowledge sharing (Labianca, 2004).

Social networks in research teams facilitate easy interaction and communication amongst team members and other stakeholders (Gooderham, 2007). This assertion of social networks makes the integration process and crossing of disciplinary borders advocated by transdisciplinary concepts easy as they share their beliefs and perspectives about the problem at stake (Gooderham, 2007).

The interconnections between these capitals (Human and social) are closely shared because of the interdependencies and links to each other. For example, multiple memberships in create farmers' base organisations, tend to extend knowledge derived from other associations into the activities and operations of the local organisation under focus (AKPABIO, 2008). AKPABIO argued further that, farmers are quicker to learn from each other better than being taught by agricultural extension officers, irrespective of their differences. This is much more linked to how actors in complex/transdisciplinary projects, tend to learn from each other more than from the formally structured environments (Nordén & Anderberg,

2011). Learning from each other as colleagues mean that, actors communicate and understand each other better.

Understanding the cultural elements of organisation and its actors are critical to working together and collaboration (Roper & Pettit, 2002). Some elements of social capital can be used as a strong base to improve the culture of organizations, the communication processes and ultimately on key performance indicators (KPIs) set by organisations (Robinson, Cody, Williams, & Spellerberg, 2001). Research findings indicate that social networks and their attendant products attributed to social capital, strongly correlates to business performance and KPIs (Akhter, 2011; Statistik, 2014). The collectiveness and resultant synergies of employees' informal networks support for each other and the sense of organisational belongingness helps to improve outputs for organisations. Targets and milestones developed by organisations are easily scaled through if the networks of the actors are strong and cohesive (Robinson et al., 2002). These efforts of social networks in organisations are considered to contribute towards the increase in individual commitment and flexibility, create normative integration, promote shared culture, enhance innovation and organizational agility, increases efficiency and help to reduce transaction costs (Adler, & Kwan, 2002; Bolino, Turnley, & Bloodgood, 2004; Roth, Kostova, & Roth, (2003); Nhapiet, J., & Ghoshal, S. (1998).

However, some other scholars including Bebbington et al. (2004) strongly argue that social capital is a result rather than a cause of institutional performance. Thus, impacts attributed to SC on the performance and success of organisations appeared challenging (Krishna, 2002:14). While agreeing with this position, it is

important to note from other perspectives that, the barriers and challenges identified and linked to interdisciplinary/transdisciplinary approaches in organisations/projects are prevalent when the social cohesion and networks levels are weaker (Cassinari et al., 2011) and (J. Fuqua, Stokols, Gress, Phillips, & Harvey, 2004; Leenhardt et al., 2015; Morse et al., 2007).

Research project leaders, for example, require effective interaction and socially cohesive actors in their teams to drive their research objectives (Cooke & Hilton, 2015; Cooke & Hilton, (2015); Fuqua et al., 2004; Thamhain, (1999). These interactions are facilitated by the physical proximity, social and organizational propinquity and the available open channels of communication in projects. Others asserted that networks of actors in an organization enable leaders to get their work done, transact with customers, transfer knowledge, innovate, and create value.

It is argued that, trust issues from actor's relationships and networks can facilitate negative actions, exclusion or even oppression of social groups (tribe, religious extremists, nepotism etc). Similarly, societies and institutions may be well-organized and structured, with strong regulations and embedded control mechanisms, but can be from fear and power struggle through the hierarchy of discrimination and unjust societal establishment (Pretty & Ward, 2001). Portes, (1998), also noted some likely negative tendencies that are attributed to social capital in groups. These include restricted access to opportunities for some members, restrictions on individual freedom because of regulations, excessive claims and expectations on group members and other adverse norms. Coleman, (1988) adds that some elements of SC could even yield useless or harmful effects

for a society depending on the values and beliefs of the people and how the interactions are networked. It will be significant to explore how the link of weaker or negative attributes of SC enhances or limits the communication of actors in CFF and other research organisations.

Social actions are heavily vested in social and cultural significance through social relations in which actors are embedded (Callon 1991 in O'Reilly, 2012). An effort to understand how society works must consider how it is constituted through these activities. Different actors have different interests in objects while the same actors may vest an object with different meaning at different times. In building bonds and networks as elements of SC, the process may likely result in some adversaries as explained by some scholars. Actors collaborating on research or development projects who have different interest should thus consider the flow of events during which actors very literally "make sense" of the world, giving meaning to the world around them as they interact (O'Reilly, 2012).

2.2.3. Measuring Social Capital (SC) in Communities and Project Teams

Social capital measurements can be very difficult to measure based on how it is generated and considered as a capital (Halpern, 2005). However, Roslan et al. (2010a, 2010b); Balogun and Yusuf (2011), categorised some elements of SC and it can be measured as follows:

- "Groups and networks
- Information and communication
- Trust and solidarity
- Collective action, cooperation, and negotiation

- Social cohesion, empowerment, and inclusion”.

The extent of membership in a formal or informal organization or association, ability to get support from these members, learning from each other and access to markets can be used to identify stronger groups and networks. Whilst perceptions related to trust and social support from members can also be used to measure the level of trust of members in a network, the frequency of interactions, use of the audio visuals, webinars and the prints by the networks within is also a good measurement factor for information and communication (Roslan et al. 2010a, 2010b; Balogun and Yusuf 2011). Other ways of measuring SC are the level of satisfaction of members in a network, comfort and control in the decision-making process, economic gains and equal participation by members. However, in research environments and in teams, level of partnerships, negotiations, and collaboration amongst the researchers on subject matters, indicates how the well social capital approach has been adopted. Putnam (2000), states that, social capital can be measured according to “the density of of networks of actors or groups existing inside a community.

2.3. Organisational Communication Theories

This section provides a review of key text related to theories in organisations and leadership with a view to identify and understand how complex transdisciplinary environments such as the Crops for the Future (CFF) functions both at the formal and informal level. This is to help provide a pattern of focus in the data analysis part of this study. In current literature, there is little material linking complex and transdisciplinary environments with existing organisational and management

theories and how they function (Simonette et al., 2008)(Na Li, 2012). However, to understand how an organisation such as CFF works through the combination of the standard norms of organisational bureaucracies on one hand, and the complexity surrounding actors of different interest and different backgrounds which cut across projects, on the other hand, it is imperative to explore the linkage and its relationships to transdisciplinarity.

2.3.1. Formal Organisations

An organisation as defined by Leavitt (1962) refers to a specific configuration of the structure, people, task and techniques where the structure describes the units, departments and hierarchy incorporated into a sub system (Katz and Kahn, 1978). Greenberg and Baron, (1995: 11) and McNamara (2012) also states that organisations are behaviors seen as a group of people coming together intentionally to work and achieve a common goal. They classified organisations as social structures that consist of groups and individuals working together on a set of mutually agreed objects. The actors are the employees, the partners, the stakeholders, the services providers, the customers, and the policy makers who all have a contribution or stake in the organisation at a given point in time.

Organisations are structured to function along with its mission and goals which actors are engaged to work to achieve through laid down procedures and policies. These procedures and policies stipulate that organisations can be structured (horizontal, vertical, bureaucratically) with a certain form of leadership styles (Cludts, 1999). Members/actors in these structured environments can be predictable through their functions and roles assigned that help to optimize the functioning system of the organisation. Stephan Cludts, (1999) posits that such

norms create bureaucratic structures and control mechanisms in the form of authority, command structure, and task specialisations.

However, with these explanations of what organisations are, it turns out in most cases that organisations sometimes do not function or operate normatively as stipulated or enshrined in their charters (Cludts, 1999). Day to day interactions, informalities, and issues of power are considered as some of the factors contributing to shaping the course of what organisations set out to do (Pohl et al, 2008; Kraut et al, 2002). These assertions seem more visible and critical especially in transdisciplinary environments where multiple interest and perspectives are the issues (Funtowicz & Ravetz, 2008; Pohl et al., 2008).

The elements of the formal organisation include; organisational bureaucracy and hierarchy; leadership; organisational culture and communication. Henry Fayol, (1916) developed the principles of management; on leadership theories (see also Farris, 1988; Burns, 1978; Scot and Bruce, 1998), Max Weber (1978) promoted the Administrative and Bureaucratic Theory Approach and Frederick Taylor, (1911) came with the principles of Scientific Management in organisations. It is significant to relate how CFF adapts and operate as a research and corporate body with these management and organisational theories.

Having explained some of these elements of formal organisations, the informal structure of organisations also remains critical. The informal structure cannot be separated entirely from the formal organization structure because it brings together the socio-technical aspect of the organisation (work, technology, people,

processes, structures, and information) (Cohen, Nelson, & Walsh, 2002; Sarlak, Mohammad Ali, 2014) There is the potential for a greater influence of the informal aspect that helps to drive the formal approaches of organisations (Mullins, 2011) and (Nickerson and Zenger, 2002).

It is argued that formal organisation cannot function perfectly and orderly without the informal organization or structure as it is referred to, as 'the hidden energy provider or the soft component' (Wang and Ahmad, 2002). Others believe it is the structure that assists to govern the social linking and networking of people for better collaboration and working together in an organisation (Reilly, 1998; Soda & Zaheer, 2012). At the informal organizational level, employees, actors, members are tied to each other in a network through social, out of office relationship, mutual friendships, companionship and cooperation in social settings (Wang and Ahmad, 2002). Employees' activities are not regulated or policed with rules and policies but on free will and mutual level base agreements. Actors with the informal organizations work together not in their individual official capacities but as people. They share their personal life experiences, hopes, and fears, their joys, and sorrows. This means there is no status of relationship and authority within this setting but only leadership for direction and guide (Sociology Guide, 2014).

Advocates of informal structures in organisations argue that, the formal part of organizations tend to work better and achieve its set target with the going concern principle if; some elements of informal practices (strong goodwill amongst actors,

socialization and interactions, professional and informal networking and social cohesion) are mixed in its operations (Sociology Guide, 2014).

For example, unions such as the Farmer Based Organisations (FBOs), Farmer Cooperatives, Farmer Credit Unions are groups and associations that use more elements of informal practices to execute their mandate and operations (Eponou, 1996; Thompson-Klein, 2004). Since most actors in these groups are farmers, input dealers, processors and other stakeholders, it is considered challenging acting in formal styles to meet their professional and social objectives (Eponou, 1996).

In complex organizations, Ali, (2014) argued that the formal and informal structures need to complement each other with a good blend of an effective interaction. Such blends bring out the best of actors own social understanding in executing the formal projects of organisations. Since individual social contracts are at play in their daily interactions and networking, it tends to provide the quickest means of communication and dissemination of information (Monge & Contractor, 2003). However, the level of interactions amongst actors and the effectiveness of actors' relationships within their informal social networks, depending on some of the internal regulations, management and bureaucratic structures in organisations.

2.3.2. Theory of Bureaucratic Management in Organisations

As an idea of Weber, (1921; revised in 1978), bureaucratic processes was to help streamline the functioning system of organisations through process and rule of

law. Max Weber theory of bureaucracy argues that organisations tend to have bureaucratic structures if these conditions exist. That is, when there is formal hierarchical structure with class and a clear reporting system and decision making processes; when the principles of organisations are managed by rules to make decisions at the higher levels; if it operates through functional disciplines in departments or units due to their similar skills and pieces of training; if organisations are established and expected to function in order to satisfy its members or satisfy its stakeholders or owners (profit or regulation), then the principles of bureaucratic management have been followed. These arrangements, processes, and conditions exist in every formal organisation which help shape how institutions work and how actors relate to each other in delivering their responsibilities (Zenger et al., 2002).

Bureaucracy came with the concern of improving performance and predicting organisation operations through the explicit division of labor with detailed rules, procedures, regulations, formal relationships and command systems (Richard, 1976 and Weber, 1978). The command process allows for coordination where different parts or units of the organisation are integrated or linked for a collective accomplishment of tasks (Weber, 1978; Richard, 1976).

Some existing organisational structures include the flat, hierarchical/vertical and decentralised system (Max Weber, 1921; republished in 1978). The vertically structured organisation has power emanating from the top of the organisation to the bottom part or front line. The vertical structure has a clear line of the reporting system, command, decision making processes well established and normally

captured in the organogram of the organisation. Employees report to the person directly above them in the structure with assigned responsibilities. Unlike the vertical structure, the horizontal organization has limited levels of commands. Actors within this structure are seen to have equal and similar input on how the organization is operated. Team work is encouraged more with the horizontal system and they may report to different supervisors within the team and the organisation (Baker, 1999).

By these normative positions of management theories, the reporting process attempts to define and add to the narrative of what formal organisations are, and how that guides actors' relationships in the management processes of organisations. It also tends to focus on how activities of actors in the organisation are planned, coordinated and structured with an explicit goal and proportionate labor divisions and responsibilities (Schein, 1988: 15). This makes everything orderly and carefully executed with a certain level of adherence to principles, the brand, internal policies, guidelines and regulations, line of reporting, hierarchies and job descriptions that every actor should accept and follow within the organisation (Mullins, 2010: 80). The structure allows people membership and categorization within an organisation ranging from the support, technical to management roles and functions. The formal state of an organisation is its face and representation to the public (Mullins, 2010).

The functional structure of organisations represents the new models of structuring command systems where work is done by specialists and other knowledge communities organized on the disciplines and skills. According to (Alhindawi,

2015) functional organisations rely on formal rules and procedures, coordination, planned budgets, and they are segmented by department and their functions. Functional bureaucratic structuring of organisations is effective with teams around disciplines or assigned roles such as breeding and genetics, agronomy, extension or nutrition. An organisation that relates to functional structures considers their core strengths derived from disciplinary specialisations (Anderson, 1988) and the nature of their outputs (Trist, 1977; Cummings, 1978). However, due to some level of weakness in the delivery of services and additive power control in some public service organisations such as the civil service, functional organisational structures are considered not so popular and used (Rogger, 2013).

Project structure also exists as one of the formal ways of managing organisations. It is the process where actors are assembled to work on a given assignment over specific time and budget (Hobday, 2000 and ICCPM, 2010). Project based structures bring different stakeholders and disciplines together (Cummings, 1978; Hobday, 2000). It is argued to allow for faster response to real life and societal issues through the teams and the outputs cross fertilisation of perspectives from different members of the different unit and allow for integration and knowledge co-production (ICCPM, 2010). The matrix structure is considered to assemble different teams for new problems and allow flexible and less cumbersome communication process to team members (Guggenheim, 2006; Hobday, 2000).

Project based organizations often deal with new and more complex globalized issues and environments in which unstructured problem-solving through projects are becoming the new rules (Trist, 1977; Cummings, 1978; Manz & Sims, 1987;

Walton, 1985). Jossey-Bass, (2008); Guggenheim, (2006), links matrix structure to evolve from the functional structure of organisations which tilts towards multiple lines of the reporting process and cross functions where actors within have more than one superior officer he/she reports to.

Agriculture and rural development services at the national and local level, for example, are run by government agencies and operate under rules and regulations of the civil and the public sector where bureaucratic processes are the operational models (Vijayaragavan & Singh, 1992). One clear example of the project system is agricultural projects (interventions) by donors or development partners in developing countries to improve production and the livelihoods of small scale farmers. Such interventions are run as projects within established local governments or agencies of government for better delivery of the project outcome. Similarly, agricultural research organisations are often disciplinary clustered and team based (Hawkins et al., 2009) and (Vandermeulen & Van Huylenbroeck, 2008). It is inclined to a functional and project design structures of administration where researchers are put together as teams to work on approved projects, proposals for funding and sometimes engages beneficiaries of their research who are outside of the scientific community.

Relating these formal and informal organisational structures to transdisciplinary environments, scholars believe that actors working and relating across disciplines in organizations may be strongly influenced by the type of internal regulations, reporting structure and leadership styles (National Research Council, 2015; Reilly, 1998; Vandermeulen & Van Huylenbroeck, 2008). According to Reilly, 1998,

research projects with different actors of various disciplines and specialization under a flexible bureaucratic system and structure can create a better interaction and good networking if members of the organisation share similar goals.

In effect, bureaucracies and hierarchies in organizations may seem to contradict the apriori assumptions that such structures and management approaches stifle interdisciplinarity and transdisciplinary concepts of working together. Nonetheless, since bureaucracies and management structures instruct and direct actors on who to relate to and how thus operate in a box ticking process which can cause or serve as barriers to an effective teamwork networking.

2.3.3. Leadership and Communication in Organisations

According to Omoptayo, (2015) (2004) and Chemers, (1997), leadership is the process of social influence in which one person can solicit the support of others in the accomplishment of a common, social and organisational goal. This social influence part the leader gets, the capacity to influence and motivate others are normally considered as power, (H. Fuqua, Payne, & Cangemi, 2000) and (Yukl, 1999). According to Yukly, effective leaders must have the power and expertise to persuade, lobby, negotiate, collaborate and cooperate with their followers or colleagues. It is argued that, when the power of control is exerted and used by leaders, results, and performance are often considered achievable in organisations. Diefenbach & Sillince, (2011), viewed the nature of the influencing process, its resultant outcomes and the context of the influence occurrence to the followers as leadership, which can be exercised in multiple ways diagonally and up/down within the formal organizational hierarchy (Hunt, 2004).

The practice of leaders influencing followers to accept and follow the culture and vision of organisations require lots of efforts and team work to network and shape team climate. The character/personality, focus, trust, communication, charismatic and interpersonal tendencies depend on the type/style of leadership by the leader. A leader could be considered as democratic/collaborative, autocratic, transformational and Laissez-faire style of leadership. Depending on the type of organisation, these leadership styles could be appropriate or otherwise.

Autocratic leadership is considered as organized, strict orders, and mainly focused on the task at hand. For democratic leadership, leaders call for suggestions, consult other members, group, and team work, discuss plans before execution and behave like other members of the team.

Laissez-faire leadership normally leaves the group and team members to its own fate to sort out themselves with their own agenda with very low level of intervention from the leader. Regarding transformational leadership, there is conscious to affect individual and social change. The transformational process tries to create a valuable and a positive change amongst followers through mentoring and development (Yukl, 1994).

Collaborative leadership involves influencing employees or researchers by ensuring that the appropriate framing and vision for the organisation which will serve as the guiding point for members to follow (Gray, 2009; Holly, 2012). It encourages team leaders to align ideas, perspectives and scientific aspirations of

individual actors towards the overall vision of the project or organisation (Kirkpatrick and Locke, 1996; Shamir et al, 1993). This style of leadership helps leaders to envisage the likely overlapping situation of various disciplines in transdisciplinary teams and see how that can generate a scientific breakthrough. Having the vision and framing ability is not enough in complex projects or complex teams. According to Mullin, (2010), leaders in complex organisations and bigger corporations normally tilt towards the collaborative style of management which have these attributes.

- Flexibility and good ethics
- Nondiscriminatory and delegation responsibilities to subordinates
- Use of bottom up approaches to inform decisions making agendas
- Goal getters with team focus utilising the strength of each member
- Approachable, sociable and accepts opinions of another scientist
- Create an environment for all-inclusiveness

The cohesiveness and bonding of team members can offer a solution to complex world problems whilst developing the skills and performance level of researchers as team members whose speed towards innovation and research excellence are enhanced (Holly, 2012; Kozlowski et al., 2009). Irrespective of the type of organisation or project, the principles of management functions include; planning, organizing, staffing, coordinating and controlling, can all help compliment the positives and challenges of these leadership styles in managing people and organisations(Vries, 2009).

Leadership comes with huge challenges and leading is complex. Influencing followers to accept and work for the organisations they belong to is often difficult due to personal agendas or different interests from that of the organisation (H. Fuqua, Payne, & Cangemi, 2000). Managing change is also difficult especially if it is not favouring their interest. Getting members to collaborate and work together in teams or organisations are challenges for leaders because of differences, competition and power play (Vries, 2009).

Overall, the type of leadership style used is critical in transdisciplinary and complex environments because of several layers of actors to satisfy. With the involvement of several stakeholders, the style must agree with the principles of transdisciplinary approaches (collaboration, cooperation, integration, participation, academic and non-academic etc). As David and Frank, (2013 pp 162) put it, the consequence of leadership is cooperation and collaboration amongst individuals and groups in pursuit of common goals. Limerick and Cunningham, (1993) perspective on leadership is that leaders in transdisciplinary environments 'should get their mind set right' by insisting that, working in the alliance is the best option for organisations.

Leadership in scientific organisations tends to be an important issue if the objective of achieving transdisciplinary collaboration is a priority (EICP, 2005). Transdisciplinary environments such as research organisations have disciplinary focused actors called scientists or researchers who steer the affairs of their organisations. Conflicts do follow when the management of these research institutions are people who do not have the same or related scientific disciplines

organisations focuses on. In avoiding this challenge, it has become a general practice that scientific research institutions (agricultural research institutions) be managed by professionals in specialized fields. In doing so, a certain level of organisational culture is developed which is sometimes skewed to some actors considered superior disciplines (see more Ensher, 2001), this tendency turns to create an unsuitable environment for research and effective collaboration amongst scientists. This builds an argument that, it is not scientists alone who just do not want work with each other or collaborate, but also the leadership style of organisations or projects that creates the environment and frame as well.

2.3.4. Communicative Leadership Theory

Communicative leadership theory in organizations stipulates that, good leadership creates effective communication in organisations, creates value and positive competition amongst actors, creates a better decision making process (Johansson et al. 2011). The theory argues that when leaders of institutions are communicative, it creates an engagement and dialogue processes with with colleagues and which builds motivation, provide clarity of information sharing and enhances active participation. When these attributes are generated through leaders, they are referred to as communicative leaders (Johansen, 2014;2011). Communicative leadership theoretical concept emerged in Sweden in the 1990s (Eriksen, 1997). This theory came from Barge and Hirokawa, (1996: 172) argument that, leadership occurs through the process of interaction and communication in organisations. It is agreed that good internal communication enhances job satisfaction, greater productivity, less absenteeism, improved quality of goods and services, reduced costs, and increased levels of innovation

(Johansson, 2011). Others (Husain, 2013) posits that, employees who are more satisfied with top management's communication styles are more likely to have high commitment to the organization, higher motivation and good personal and performance feedback feedback.

From the transdisciplinary perspective, careful structuring and processes have to be established in order to enhance the interactions of actors with different disciplinary backgrounds and responsibilities. It is a challenge for organisations to be structured without chains of commands and it is equally difficult for vertically structured organisations to have an effective line of communication. Whatever the case may be, it is better to advocate for a more flexible structure that recognises both lines of commands or better still opt for a flexible and workable linkage of scheduling, delegation and work reporting flow for effective communication. The structure, procedure and process required for transmitting messages through a division, group, department, and programmes to other stakeholders further explain organisational communication. It can also be looked at the way language is used to create different forms of social structures, teams, networks, and relationships (Jason S. Wrench, 2012).

Communication is one of the most important elements of sharing knowledge, perspectives, and information from one person or group to another. This often is connected to the sender and the receiver of the message that is linked to the subject matter through a common system of verbal, written, symbols, signs, and behaviours (James G Webmaster and Jacob J Wakshilak, 1983; Leydesdorff, 1987). Often, it is effective if both the sender and the receiver are satisfied with

the feedback with no barrier or ambiguity. A person's style and way of communicating to others are often influenced by the culture, the environment, the language, education and the technical discipline.

To this, (Hobbs, 2005:237) argue that leaders need to understand their members well for a productive and better communication under interdisciplinary setting as follows;

"Communication of complex ideas and issues in science is often difficult and potentially fraught with problems and is still seen by many scientists as a risky area. Different people respond to different stimuli. For instance, some researchers respond more clearly to visuals than to auditory information. Others take in numeric or quantitative data much more easily than qualitative information, and vice versa. Some need concrete data and examples, while others gain more from conceptual information. People respond to humor, gravity, and passion in a variety of ways, depending on the situation. Furthermore, some people like passive learning, while others need more active learning experiences. These considerations can be used to construct effective communication package" (Hobbs, 2005: 273).

Language represents one barrier to effective communication in teams as misunderstanding often dominates their interactions. The proficiency level of members and unstructured pattern of communication processes cause some difficulty. Generational gaps or age differences in team members, the trust of one other, cultural differences, gender etc. are all barriers to effective communication

in organisations and projects (Frydrychova & Semradova, 2012; Hills, Maitland, Hills, & Maitland, 2014; WHO, 2011).

Given the challenges of communication in organizations, issues of strong effective leadership may be worth considering in order reducing that barrier. Effective leadership in transdisciplinary teams tends to take the concerns of every actor, team members and beneficiaries who are stakeholders are incorporated into the discourse. In teams, leadership direction and focus is required to ensure that the purpose of the consortium is on target. Doing that requires an understanding of communication within and outside of the team. Each knowledge community within such networks has a preferred form and pattern of interaction in both formal and informal setting (Conole, Galley, & Culver, 2011; Pohl and Hadorn, 2008). It is often considered that, the leader in charge has the burden to ensure that organisations and team members appreciate the importance of communication.

Shared decision-making principles, close coordination, mutual respect, and highly refined process skills are vital leadership required to sustain effective transdisciplinary collaborations in a complex environment (Gray, 2008). A clear leadership communication to members about the needs, expectations, and requirements of each actor often helps to reduce the level of uncertainties (Pohl and Hadorn, 2008). A Higher level of uncertainties in organisations results in complex communication challenges (Clampitt & Williams, 2000; Husain, 2013; Watson, 2004).

The quality of leadership skills and personality traits influences the interactions and networking of members in teams whether at the formal level or informal level. Autocratic leadership style offers firm and one-way communication to members without the expectation of a feedback from subordinates. It is argued that leaders in this category flout organizational communication processes and channels and rather see the organisation as flat beneath them when communicating (O'Daniel & Rosenstein, 2008). Organisations with higher hierarchies are considered to have common barriers to effective communication and collaborations (O'Daniel and Rosenstein, 2008). Communication is likely to be distorted or withheld in situations where there are hierarchical layers amongst team members, particularly when one person is concerned about the seeming incompetence of others, or does not want to offend the other or with stereotypes (Dansereau and Marhkam, 1987).

These attributes at the organisational level should be extended to the project and small team levels where the problems are to be solved. The team leader according to Mullin should also have a similar attitude in order to get the support of his fellow scientists. It is necessary to consider several interrelated factors, including the characteristics and behavior of the researchers or project members, their social skills, and interrelationships with an emphasis on trust and clear communications. This is a clear requirement of good leadership either for the organisation or the project (Mullen, 2010:365).

To help research leaders succeed in technical projects, it is imperative to encourage broader participation and involvement of every actor from technical to non-technical backgrounds on decisions bordering the collective goal of the

project. Wider involvement and participation by requisite team members on research teams are required to help reduce communication and misunderstanding challenges. Aside this, (Sasirekha, 2008) suggest that project leaders need to sharpen their negotiation skills when dealing with very highly qualified scientists with deeper specializations that will easily allow them to work and share their perspective with others as well as accept any change that comes up in programmes and projects.

2.4. Chapter Conclusion

This chapter explored the linkage and relevance of SC and organisational communication theories to the discourse of transdisciplinary research, and contextualising it to this research. It did this, by arguing that, some elements of SC and organisational communication theories (the social networks, the trust, friendship and other informalities as well as communicative leadership, types of leaderships, formal and informal, reporting structures etc.) can enhance the narrative and by that, assist this study to unearth complexity of communication in CFF with a developed framework.

CHAPTER THREE

METHODOLOGY

3.1. Introduction

This research study is a qualitative method of research. The approach focuses on subjective and qualitative data that is not easily coded in to numbers but rather based on feelings, words, actions and emotions. The chapter clearly explains the philosophy underpinning this study, description of how the researcher accessed CFF, the data collection methods used and how the data is analysed using thick description with NVIVO software. It used multiple methods of data collection (participant observation, official document review and interviews) in order to examine the interplay of interactions of actors in CFF. The study covered all employees of CFF including academic (academic researchers and some management staff), non academics (supporting staff, and farm workers from the field research center), for interactions and observations as part of the unit of study.

Qualitative data collection methods vary using unstructured or semi-structured techniques. Some common methods include focus groups meetings and interactions, individual interviews, and participant observations (Wyse Susan, 2011). The sample size is typically small and respondents are selected to fulfil a given quota unlike quantitative methods where the sample size of the study population is recommended to be larger (Sarantakos, 1998).

3.2. The Research Philosophy and Paradigm

Every research is done based on beliefs and approaches (Creswell, 2014). Like Mary, (2014.), put it, it is important to consider the philosophy underpinning one's research where the values of roles in the research are explicit on the methodology. Paradigm refers to a type of proof and an illustration of similar occurrences originated from the Greek word *paradeigma* which means *pattern* and was first used by Thomas Kuhn (1962). He defined it as; "an integrated cluster of substantive concepts, variables and problems attached with corresponding methodological approaches and tools". Paradigms serves as pillars and belief systems for all categories of research including this one.

The philosophy underpinning this research is the ***interpretive paradigm***. Interpretive philosophy and paradigm is associated with qualitative research. Interpretive is used to obtain an understanding of the word from an individual perspective. People cannot be studied using models developed for the physical sciences because humans are qualitatively different from natural events. The interpretive paradigm supports the belief that reality is constructed by a subjective perception and predictions that cannot be made. Hence researchers like me who agree with this paradigm are more interested in the social construction of meanings other than the non-social aspect of actors in CFF.

Interpretive researchers see themselves as part of the studied and researched and with the participants interpreting the world around them. The epistemological position for this paradigm is linked to knowledge creation and sharing as well as creating relationships for furthering acceptance of different perspectives. Since it

is typically a qualitative approach, the research data is normally subjective and being influenced by the opinions of the researcher.

The paradigm is premised on the following beliefs as espoused by Carballo, 2003;

- "People make decisions and act in accordance with their subjective understanding of the situations in which they find themselves.
- Social life consists of interaction processes rather than structures and is therefore constantly changing.
- People understand their experience through the meanings found in the symbols of their primary groups, and language is an essential part of social life.
- The world is made up of social objects that are named and have socially determined meanings.
- People's actions are based on their interpretations, in which the relevant objects and actions in the situation are considered and defined.
- One's self is a significant object and like all the social objects is defined through social interaction with others".

The researcher used this *interpretive paradigm* (Table 3.1) because of the nature of the research objects and main subject of study which is centred on how scientists interact across disciplines and observation of the scientists in CFF that requires an ethnographic study. Events and situations are understood through the mental processes of interpretation that is influenced by interaction with social contexts constructed by experiencing the real life or natural settings. Moreover, the interpretation of the social language and discourse of the scientists and how

they attribute meaning to their actions and activities in a network of each programme and theme are important in studies like this.

Table 3.1. Features of Interpretive Paradigm for this Study

Category	Features
Research Purpose	Understand the complexity of research projects and organisations and its challenges on cross disciplinary (transdisciplinary) communication for better interactions.
Ontology (nature of reality of this study)	There are multiple realities to peoples' interactions and collaboration;
	The realities observed can be explored, and constructed through researcher's interactions, and other meaningful actions.
	Brings out how participants make sense of their social worlds in the natural setting by means of daily routines, interactions and knowledge sharing.
	The social reality part of people exists as a result of varying cultural and human experiences, including peoples' knowledge, views and interpretations
Epistemology (nature of knowledge and the relation between the researcher and the researched)	It considers events and situations as well understood through the mental processes of interpretation of people influenced by interaction within social contexts.
	Those active in the research process socially produce knowledge by experiencing the real life or natural settings.
	Inquirer and the inquired-into are interlocked in an interactive process of talking and listening, reading and writing.
	More personal, interactive mode of data collection.
Methodology	

	Data collected by interactions, observations, interviews, and reflective sessions with field notes and feedback
	Use of ethnography
	Inductive approach
	Grounded theory approach

(Source: Modified from: Cantrell, 2001 and Gora Andrea, 2007)

3.3. The Research Approach

The research deals with texts, verbal and nonverbal utterances which are the products of reflexive processes among actors of CFF. As an approach for the study, participant observation and ethnographic perspectives helps to account for the observed phenomena better than some other approaches because it focuses on actual events as they happen rather than through opinions and perceptions of the objects. Understanding real-life situation of scientists at CFF in an exploratory research like this requires that the researcher gets closer to the objects, be with them and share in their values, beliefs, trust and ethics through participant observation. Participant observation normally focuses on person's life, life experiences, behaviours, emotions, and feeling as well as about organizational functioning, knowledge generation and management, social movements, cultural phenomena and interaction between nations.

Anselm Strauss & Juliet Corbin, (1998) argue that qualitative research is any type of research that produces findings not derived from statistical procedures or quantification. Qualitative research which is also called naturalistic inquiry, developed within the social and human sciences, and refers to theories on interpretation (hermeneutics) and human experience (phenomenology).

Qualitative research is especially effective in obtaining culturally specific information about the values, opinions, behaviours, and social contexts of working groups like research institutions.

Use of overt and covert methods to observe and collect data are common practices in ethnography according to Li, (2008). In the case of covert research is research undertaken without the consent or knowledge of respondents or participants. This category of social research is most strongly associated with participant observational work where a researcher joins a group or an organization assuming a covert role to observe first-hand the functioning and daily life of the researchers. Advocates have argued that covert methods offer researchers access to information that is otherwise denied to them (Lugosi, 2006). According to Davidson, (2006), covert research has a strong tradition in sociological and criminological work.

Li, (2008), captured her experience with the use of covert and overt in her ethnographic research as;

"By making my study overt, I was able to fulfil ethical obligations as a researcher but unable to get female gamblers to speak their minds. By assuming a covert research role, I was able to observe natural occurrences of female gambling activities but unable to make peace with disturbing feelings of my research concealment".

For this study, the overt approach was used in accessing the data and relating with actors in CFF as issues required (research objectives) never required hidden

identity form to generating the data. Hence, as a researcher, every actor in CFF knew the research mission which was to observe, interact, interview and review official documents methodologically (Table 3.2).

Table 3.2. Data Gathering and Analysis Framework

Researcher's desk in Participants' Organisation (CFF)	
Observe	Interact
Interview	Participate
Scrutinize Participant Organisation official documents	
Take notes or Record events	
Input and code data on Nvivo	
Analyse and Interpret using grounded theory	
Proposed Framework Developed	

3.4. Data Collection Processes and Methods

Unlike surveys that a single structured questionnaire can be used to collect data for research or a test in the laboratory that produces results. This study uses the realist approach where events and scenarios are captured based on how they occurred (Yin, 2011). Generally in qualitative research use of fixed data collection instruments and procedures or samples in data collection processes are not entrenched, as the research is the research instrument (Yin, 2011). Table 3.2 shows the summarised data gathering process developed and used in the study. Embedded within, interaction and building trust was the first major milestone for this research. The study used multiple data collection methods including; observation of actors and their networks as well as interviews and reviewing the

public official documents of the organisation which significantly complimented each other. Some aspects of information gathered from interviews and observations were compared to the official reports and policy documents to ascertain some level of reliability and variances. Yin, (2011) and Creswell, (2003) argue that, multiple data collection method is ideal for if the study is complex and requires various processes of collection and confirmation of sources and the data itself. Use of audio recorder to record interactions with respondents, use of field note to write comments and short memos were also done to help in the data gathering process.

3.4.1. Participant Observation

Participant observation is a data collection tool that has been used in a variety of disciplines for collecting data about groups, people, processes, and cultures and organizations in a qualitative research for sociological and anthropological research (Kawulich, 2015). It is believed to be used as a method on the Zuni Pueblo people in 1879 by Fran Hamilton Cushing to gather data about their culture and way of life. From then, researchers have used it as one of the most important qualitative data collection method especially for real-life natural settings. Participant observation focuses on natural setting, way of life, social and daily normal activities of the objects observed to generate data. Technically, an observation can be explained as the 'systematic description of events, behaviours, and artefacts in the social setting or environment used for study" (Marchall and Rossman, 1989: 79). It is also known as *people ethnography* according to Fine, (2003), because it provides a theoretical underpinning on issues based on trends, interviews and field notes.

As a research method, participant observation requires very strict adherence to ethics and professionalism. It requires the researcher to be non-judgemental or with prejudice mind set and attitude. As a character, the observer should be a good listener, should expect indifferent attitude from participants, cultural shocks and curious regarding participants' behaviours and actions (Dewalt and Dewalt, 1998: 3). To get closer to each actor within the organisation, the researcher had to listen to almost everyone; answer to everyone who cared to ask me questions and tried to get the attention of everybody. Few actors were indifferent and felt I evaded their space. Kawulich, (2005) opined that, documenting the data in participant observation is very challenging, thus 'it is hard to write down everything that is important while you are in the act of participating in the research process. Based on the scenarios and participants under study, the approach is relatively unstructured as events cannot be predicted well by the researcher. The challenges and weaknesses of this method are much easier for researchers who already possess a solid base of cultural awareness and are better able to concentrate on the research question itself (Mack et al. 2005).

As McNeill & Chapman, (2005) and Li, (2008), explained earlier on earning the trust of participants, the researcher had to participate in some of the organisations activities and meetings such that the researcher will not only be there to observe and collect data, but to contribute and be part of the system. This approach of participation leveraged the researcher's interaction with the participants on several issues relating to personal and technical issues. Participants' names and positions were captioned as actors, respondents (R) or participants (P), employees, staff and members. CFF as an international agricultural research

organisation have their internal regulations, rules, values and ethical guidelines that needed to be followed. Ethics of participant observation should be addressed in relation to the sensitivity of the research content, the vulnerability of the researched individuals or objects and the plasticity of field membership roles as well as the researcher should all be considered (Li, 2008). Although covert participant observation is more likely to provide detailed portraits of contextualized social realities and natural setting, it stirs much controversy and debate on ethical considerations, mainly on the absence of the consent agreement from the people being studied (Li, 2008).

Mindful of this phenomenon, this research adopted the overt method where scientists at CFF accepts and opens to the researcher as a member of the research family with the purpose and intent of professionally and ethically studying the interactive trends within. Since all actors within CFF know the researcher's status and purpose, the overt observation research approach was challenging because some actors tried hiding certain realities by reverting to use of strange signs and language being careful while interacting with the researcher.

Participants were largely the academics (postdocs, directors and professors) and non academics (administrative and supporting staff and farm workers in the fields) who were anonymised using 'Respondents' (R) in the study.

3.4.2. Interviews

The study used interviews as a complimentary method to participant observation to seek their perspectives on critical issues regarding scientific communication and

interaction amongst scientists in CFF. Interviews are in the form of structured and unstructured depending on the participants and context of study. This approach tries to measure the hypothesis and the objectives of the study.

As Mcneill & Chapman, (2005) and Gill et al, (2008) espoused, interviews are structured in to structured, semi structured and unstructured interviews. Structured interviews are, essentially, verbally administered questionnaires, in which lists of predetermined questions are asked, with little or no variation and with no scope for follow-up questions to responses that warrant further elaboration. In the case of this research using ethnographic approach as the overall method in collecting data and carrying out research in real-life at CFF, use of both structured and unstructured interviews can unearth detailed data from participants under observation.

Due to the tight schedules and nature of the observed groups within CFF, proper interview and interactive schedules were made to allow them select appropriate dates and time for the interviews. Hence each participant received an email soliciting for time and space with them. Aside this formal and structured form, little interactions and interviews ensued at certain joints like the pantries, wash rooms, cafeterias, corridors and meeting rooms where opportunities provided for the interactions. Every participant was explained to or given an overview about the research with assurance about ethical principles and considerations at hand before the start of each session. This gives participants some idea of what to expect from the interview, increases the likelihood of honesty and is also a fundamental aspect of the informed consent process. Reja at al., (2003); Gill et

al., (2008) maintain that wherever possible, interviews should be conducted in areas free from distractions and at times and locations that are most suitable for participants. However, interviews conducted on this study were just based on the choice location of participants. Once they were comfortable to speak on every issue with me, the researcher had no issues with the location.

3.4.3. Official Document Review

Document review and analysis has been one of the key staple data source for organisational research over many years now (Bowen, 2009). It takes away the subjective aspect and interactional effects and helps to keep up with the growth and changing patterns of organisations (Bowen, 1997) such as CFF. CFF is in its developmental stages of growth as an institution after its establishment in 2011. There existed several official public documents of CFF, published, unpublished, hard and electronic ones. These documents were reviewed to pick out relevant information and narratives that served to clarify and add on to the objectives of the study. Specifically, this aspect of document review focused on the internal policies, regulations, external communications and research outputs of the organisation and corroborating such information with feedback from actors captured in the form of reports, presentations from seminars, project and funding proposals, research publications, meeting minutes, newsletters, memorandum of understandings (MoUs) and other materials. In particular, this method was more useful in situations where actors were more inaccessible to the researcher for observation and interactions.

3.5. Data Analysis and Interpretation

The data generated from the research comprised of observational and interactive or interview data. These were scripted on a field note book during the process of data collection and audio data through consented recording. Additionally, secondary data from the organisation was used including official documents and existing public audio files. Transcription and coding of the data was done and categorised with the help of NVivo qualitative software and then analysed based on the objective and research questions of the study. From axial coding of the data these themes emerged; collaboration and interactions through the research value chain (RVC), knowledge management and contributions from knowledge groups through formal and informal structures for transdisciplinary research, data policy issues etc. A further breakdown of the themes and categories into sub categories was also done to relate and cross these variables to established communication patterns under such conditions. Use of content analysis to compliment the grounded theory approach was done. Trends, patterns, themes and subcategories can be established in a data through transcription and axial coding (Creswell, 2003) and Glaser, 2002).

Analyses of the statement from participants were denoted to be respondents instead of their identities, positions and names. In the text, use of (R1..... Rn) represents actual actors the researcher interacted with, for which the alphabets are attributed to in the study.

3.5.1. Grounded Theory

Grounded the approach is the process where theory is discovered and analysed from data gathered. It is an inductive process and a qualitative research method

through a rigorous and systematic procedure to gather and analyse data (Cho & Lee, 2014). However, (Lotrecchiano, 2013) of the Grounded Theory Institute, argue that the theory can be used for both qualitative and quantitative research methods. According to Suddaby (2006), Glaser and Strauss discovered that researchers could achieve a theory that is very meaningful and relevant in certain contexts and situations from observations and the observers' consensus. Cuban and Spiliopoulos, (2010) explains that, when data is complex from complex groups, and when many issues are hidden and needed exploration, grounded theory analysis and method is ideal, whilst Charmaz, (2006) argue that it is the most salient form of analysis method to use for research. Again, she added that social interaction and the researcher's involvement with participants in constructing the theory as in the case of the research is ideal for grounded theory. The author used grounded theory to understand the structure and nature, trend and properties of the data gathered and to make analysis relevant to the objective with a framework and concept set out to achieve.

3.6. Ethical Consideration and Approach

In research and in academics, ethical processes, considerations and standards are critical to the integrity of research works, knowledge management, the researcher and the researched as well as the results. As the University of Nottingham-UoN, (2010) put it: 'Researchers must be honest and lawful in respect of their own actions in research and in their responses to the actions of other researchers'. An application to the Faculty of Arts and Social Sciences (FASS) Ethics committee was made for approval (FASS Ref dated 28-05-2015). The committee examined the

research scope, design, categories of participants or objects of study, the duration of the study, rational for the study and the research strategy within the ethical limits. The approval process took more than six months from the day of application because of bureaucratic processes and changes to the nature and structure of the questions and the method of data collection stipulated in the application.

3.6.1. Anonymity and Confidentiality

As a requirement for maintaining ethical standards, anonymity of participants was done to avoid disclosure of identity and their shared perspectives about the organisation. However, there are few instances where participants' positions are fully mentioned in the study because the knowledge shared represented the official public information shared by the organisation.

Maintaining participant's confidentiality and trust, protection of identity, letting participants voluntarily agree to participate in the research were some of the very critical issues considered by the committee for this research. The information given including their identity and opinions were all strictly confidential as stipulated in the consent form prior to the start of the study.

3.6.2. The Consent Form

The researcher related well with participants and sympathetically shared with in the process of the interactions. An overview of the study was always explained to participants before the start of any interaction process. Consent forms were prepared for each participant to fill before an interaction or interview took place as a sign of willingness to participate in the research process.

A small recorder was also used to record interactions and interviews with the consent approval by each participant. Others refused to be recorded and only allowed writing down on my field note book. On the part of the observations, a guideline to the research was developed on boundaries and limits of observations within the organisation. Very personal issues of individuals outside of the organisation and issues outside the objectives of this research were not part of the elements of observation. Participant observation normally takes some time to unravel, as such, repeated processes of observations and interactions were done not only to validate the data collected but also to ensure accuracy and consistency in the process of the research for reliability.

3.7. Gaining Access into CFF for Ethnography as part of the Methodology

3.7.1. Audience Mapping /Target Respondents

Learning about each participant and how to approach them for interaction and be accepted was a task ahead after gaining entry in to CFF. Generally, people observation is seen to be a very challenging task because of realities and constant changes of behaviours and un-predictableness. The critical issue was getting in to the inner circle of the participants because of the nature and calibre of staff in CFF. Majority of the employees had advance level of education and good research standing.

The diversity of the employees through different nationalities (Figure 3.1), culture, beliefs and most importantly disciplinary specialisation made the task and data from the lens of transdisciplinary interactions reliable and encompassing.

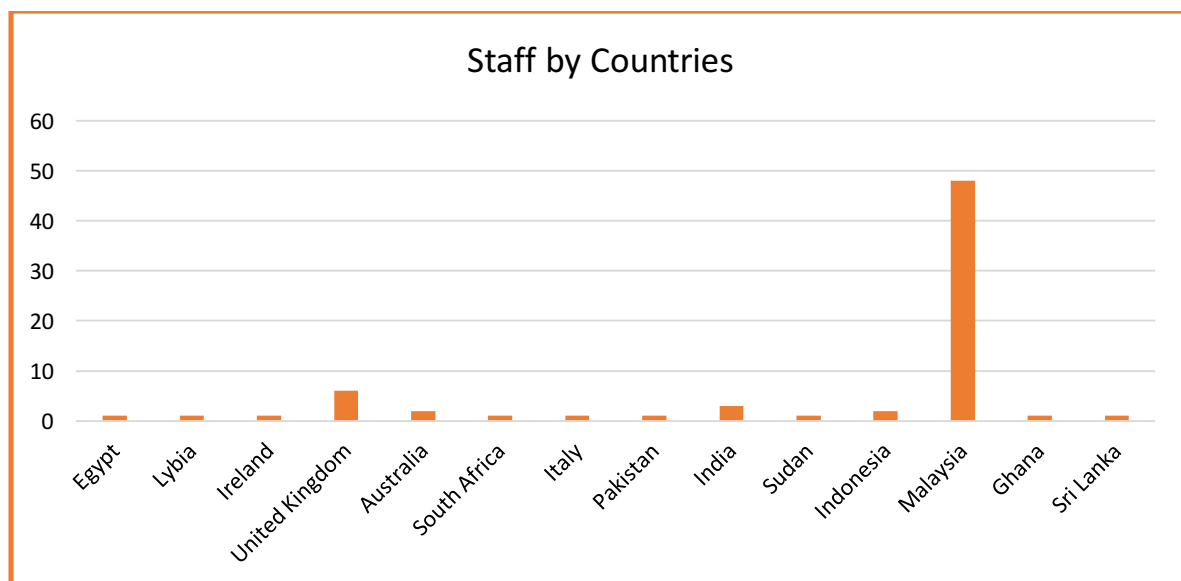


Figure 3.1. Nationalities of CFF Employees (2014-2015)

Mapping and outlining areas of focus, strategy for engagement and areas of concentration was quickly done for adjustment and better access. Another important aspect of the access strategy was the introductory email sent to the entire organisation with a short biography about me as a student researcher and the reasons for being there by the human resource. Issues of getting an institutional email came up and authorised persons in charge of that got divided especially based on the roles the researcher was coming to play as a researcher and not a permanent staff, albeit others wanted me to get the email address. Ultimately, the researcher had the email address which got me closer to the institution by way of institutional means of communication. The institutional email revealed how crucial and important the emailing system was within CFF for communication. Almost every correspondence and communication from top down and bottom up was through emails (Figure 3.2). Interestingly, face to face interaction/informal meetings were some of the most used mediums of researchers communicating with each other especially at the theme and programme levels.

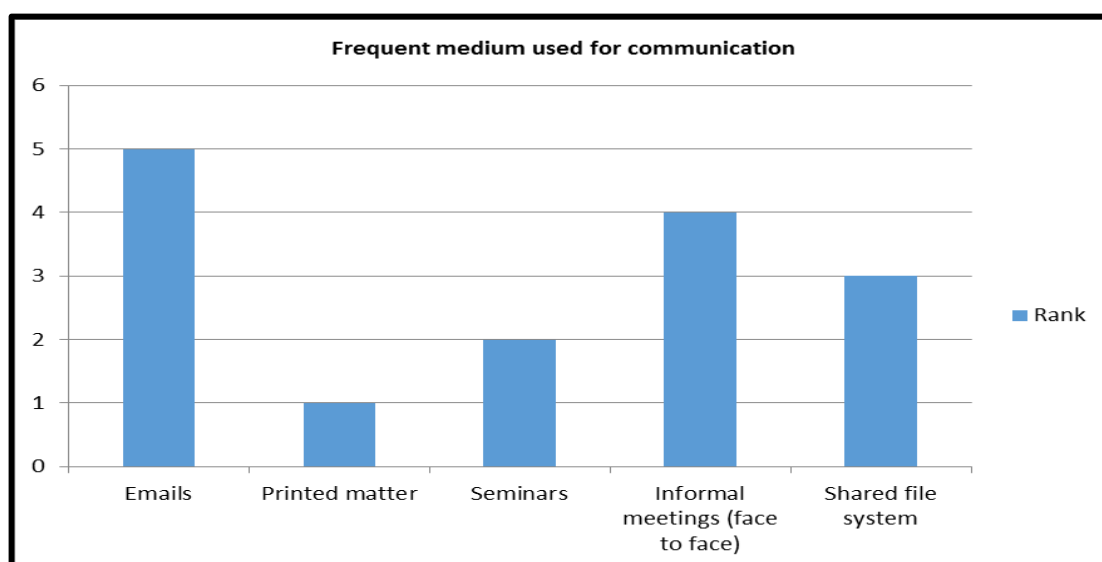


Figure 3.2. Most frequently used medium for interactions within CFF

It was observed that short minutes of discussions which happen several times a day was the trend for the informal or face to face meetings. This aspect of the email element was very essential to the methodology of this study as it brought out some issues of organisational structures and bureaucracy.

Members who used this approach were seen to have good rapport and networking that goes with serious and mutual commitment to execute any assigned task. Computer network and file sharing system was also observed to be a good source of information sharing amongst all knowledge communities within CFF.

'We have network folders in different forms for use and access. Those that are open to management or some key people and those are general. We do access a lot of information on the file sharing platform with restricted access depending on who wants that information. Same as the email, we have grouped in programmes, projects, management, all staff and others, so that we can manage and handle our information very well'.....R25.

Brockman et al., (2001) makes a critical argument that, not only is the use of emails, shared online files and virtual networks are the results or effect of collaboration, but as well the cause too in organisations such as CFF. There were technical and non-technical folders that actors could access and update any data required especially reports on projects and other presentations made. Seminars were often the formal meetings that ensued but that were done fortnightly unless there were other programmes that required external stakeholder involvement. Many cases of printed materials were observed as one of the medium of communication in CFF.

3.8. Chapter Conclusion

The chapter examined the philosophical nexus of this study, with an overview of the data collection process, the approaches and tools used and how it was analysed. In particular, it explored how interviews, document reviews and participant observations were all critical to examine how actors in CFF interacts to produce underutilized knowledge and whether in the process, there were issues of fluid or challenged communication. As a chapter contribution, it described the strategy used to gain entry into CFF and the challenges thereof for data collection which deepens the methodology discourse for ethnography.

CHAPTER FOUR

THE RESEARCH VALUE CHAIN (RVC) STRATEGY OF CFF: A MEDIUM FOR RESEARCH COLLABORATION

4.1. Introduction

The previous chapter explored the methodological processes and approaches used in the data collection and analysis. This chapter looks at one significant internal procedure and policy of CFF-thus the '*Research Value Chain*' (RVC) as a concept adopted by CFF to collaborate, improve and add value to their research processes and activities along the chain. It tries to examines the formal structure of the RVC and the perspectives of researchers and how such narratives and descriptions contributes to communication amongst actors in CFF.

Crops for the Future defined the Research Value Chain (RVC) as:

"It is a tool and process that is used to cross and integrate themes, programmes and projects of the organisation by mimicking the supply chain concept from the farmer to the consumer in research. It helps to guide the research process of the organisation by linking the genetics and breeding of selected underutilised crops to the secondary output stage for consumption through the research themes" (Profile and Plan, 2014: 5-12).

4.2. Understanding the 'Value Chain' (VC) Concept

Value chain (VC) as a concept has been used over the last 30 or more years as a management tool to understand industries and organisations and how they are

linked to the final consumer through value addition processes and value enhancement activities (Peppard and Rylander, 2006; Porter, 1979; 1985). According to (Trienekens, 2011), it is a vehicle by which new forms of production, technologies, logistics, labour processes and organizational relations and networks are introduced. Most organisations use the value chain (VC) concepts as a market oriented tool to cut cost, optimise efficiency, meeting the demand and taste of the sophisticated customers, competitors and return on investment saw the promotion of the concept. The principle of value chains is not only to add value to the outputs produced at each stage of the chain, but also to ensure that every actor along the horizontal and vertical part of the chain mutually benefit with value for money services. However, often times, corporations who are mostly on the vertical part of the chain benefit more than other actors on the horizontal lines who are primary service providers or final consumers.

Industries have used the value concepts (VC) as diagnostic tools and policy driven elements to help manage their organisations just like CFF. It has been used as constraints identifying tool as well as to help identify weakness, strength and opportunities within and outside of the organisations in the larger view point.

The value chain (VC) concepts of agriculture start generally from the field and ends up in the shelves of supermarkets where farmers produce the food and the middle men, traders, retailers and transporters who are all part of the value chain system, will at each stage add value to the produce until it ends in the shelves of the supermarkets. The idea of this concept in the agricultural arena considers that industries will be the ultimate beneficiary of the whole chain and farmers and other downstream actors only get the trickle-down effect. With this a-priori state,

farmers and all actors in the production level of the chain do not have the required power and influence to negotiate for better benefits. The chain consists of vertical and horizontal actors where the vertical actors are the farmers, retailers, 'middle men' input dealers, processors. While the horizontal actors are the service providers, the financial institutions and general business environment. The vertical and horizontal integration and value upgrading becomes likely ways of bridging the gap in the chains (Trienekens, 2011).

For policy effectiveness, collaboration amongst all actors is very important in the value chain system. This type of collaboration is argued to offer equal level of benefits, power and strong participation of every actor in the chain. One other approach of enhancing this policy tool as defined by CFF is the use of it to improve better participation, coordination, power and capacities of all actors. Scholars argue that other ways of improving on these challenges include the use of value chain analysis (VCA). Value chain analysis aims to enhance the understanding of competition and the challenges that it brings. The analysis helps in identifying and coordinating relationships and engagement of actors in relationship to power control and governance within the chain. It ensures that every actor within the chain and network benefits and has improved access to market for their products. (Wood, 2001) argues that, it provides a common meeting point for both actors on the chain, institutions and policy makers.

4.3. The CFF Model of VC into 'Research Value Chain' (RVC)

Despite the significant technical data generated, barriers exist to the more widespread adoption of these crops amongst farmers, consumers and other actors in the potential value chain. These barriers include not only the practical problems associated with disseminating information on techniques and nutritional values to growers and consumers, but also the socio-cultural issues concerning the existing perceptions of stakeholders and knowledge communities including agronomists, agricultural development workers, agribusinesses concerning these exemplar crops.

CFF added the research dimension to the value chain concept by arguing that cost and time, intellectual human capital development, output maximisation, effective and efficient processes, and critical challenges of research organisational development can only be fully achieved and enhanced if the principle of *value chains* is adopted in their operations.

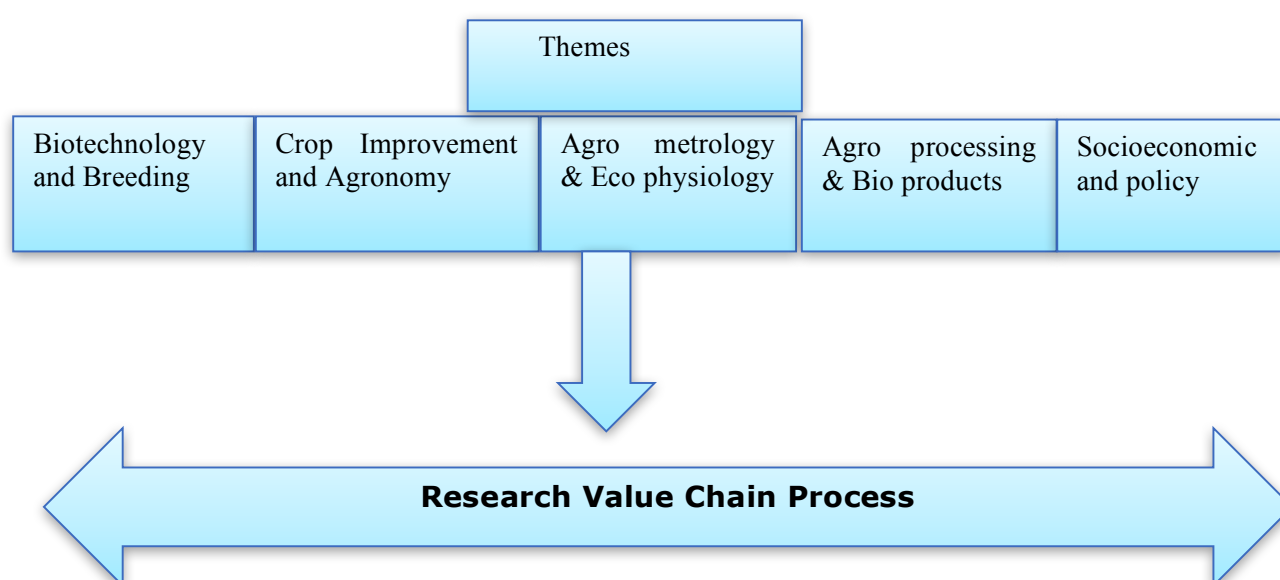


Figure 4.1. CFF Research Value Chain through Research Themes

CFF argues that, it developed RVC from the value chain concept on the principle that, research has to move along the agricultural supply chain from the issues and needs of the farm as an agency to the final consumer or end user by adding research value to each link of the chain. This became practical from the operationalization of the concept RVC through '*themes and programmes*'. CFF believe that the quality and efficiency of their outputs and mission can be better achieved if the concept of RVC is routed through the five (5) themes of the organisation (Figure 4.1).

The argument claims that, conventional research practice exposes some level of difficulty in working with farmers, agro processors, agricultural input dealers, consumers and other end users because of current existing knowledge production process and institutional structures that supports non-interdisciplinary and transdisciplinary integrative research.

With the conventional value chain approach, the integration of the vertical and horizontal actors is challenging due to different levels of interest, roles and strength. However, with the RVC, integration of actors at the horizontal and vertical chains require the adoption of transdisciplinary elements (involvement of researchers and non-researchers). The integration or collaboration of actors on the research chain allows actors in CFF to develop projects involving relevant actors. The projects developed from each of these themes and programmes have their own unique outputs whilst at the same time drawing immensely from the available knowledge produced by other actors from other programmes and themes.

For example, as an agricultural research organisation, CFF focuses on providing detailed biotechnology and crop genetics based knowledge for its exemplar underutilised crop species (example: Bambara nuts). The hybridization or breeding of the new species under the best agronomic practices of different climate variability and geolocations for its research value chains is the first primary step of the RVC as captured by some of the themes and programmes (Figure 4.1 and 4.2). Figure 4.1 explains the structural arrangement of the themes and how it feeds into each other along the research chain process. Figure 4.2 indicates the linkages of programmes and how each programme compliment and feed into others with specific research projects and outputs to complete the chain. For example, Bambara groundnut as an exemplar crop for CFF is being explored from the breeding stage of the crop, to the final consumer as a form and approach of practising RVC (Figure 4.2). It further developed the research catalogue of the nutritional properties of some of the crops (Bambara, Moringa, wing bean) and its bio products.

With this process developed by CFF, it claims such a process will contribute to farmer's stake of improving not only the yields of their crops but also the nutritional component and ultimately their farm incomes. The catalogue is not only a critical convincing tool for the industries on why such underutilised species should be commercialised and with high return on their investments, but also to encourage farmers engage in large scale production of these orphan crops.

Other activities such as linking activities of projects from feasibility studies and research on the need for a project, who the beneficiaries of the research project, will be, the consumers' preference, the policy makers' involvement and engaging

the communities are considered as the roles and responsibilities of the social, economic and policy theme of CFF as seen in Figure 4.2. Several projects were developed with all the themes to add value to the Bambara nut. The socio economic and policy dimension adds the social and a sense of human touch to the biological and physical science research engaged by the institution. Though the projects were at different stages of completion, some were at the conceptual and planned stage, which gives an indication such model was been operationalised

Bambara Exemplar Research Value Chain

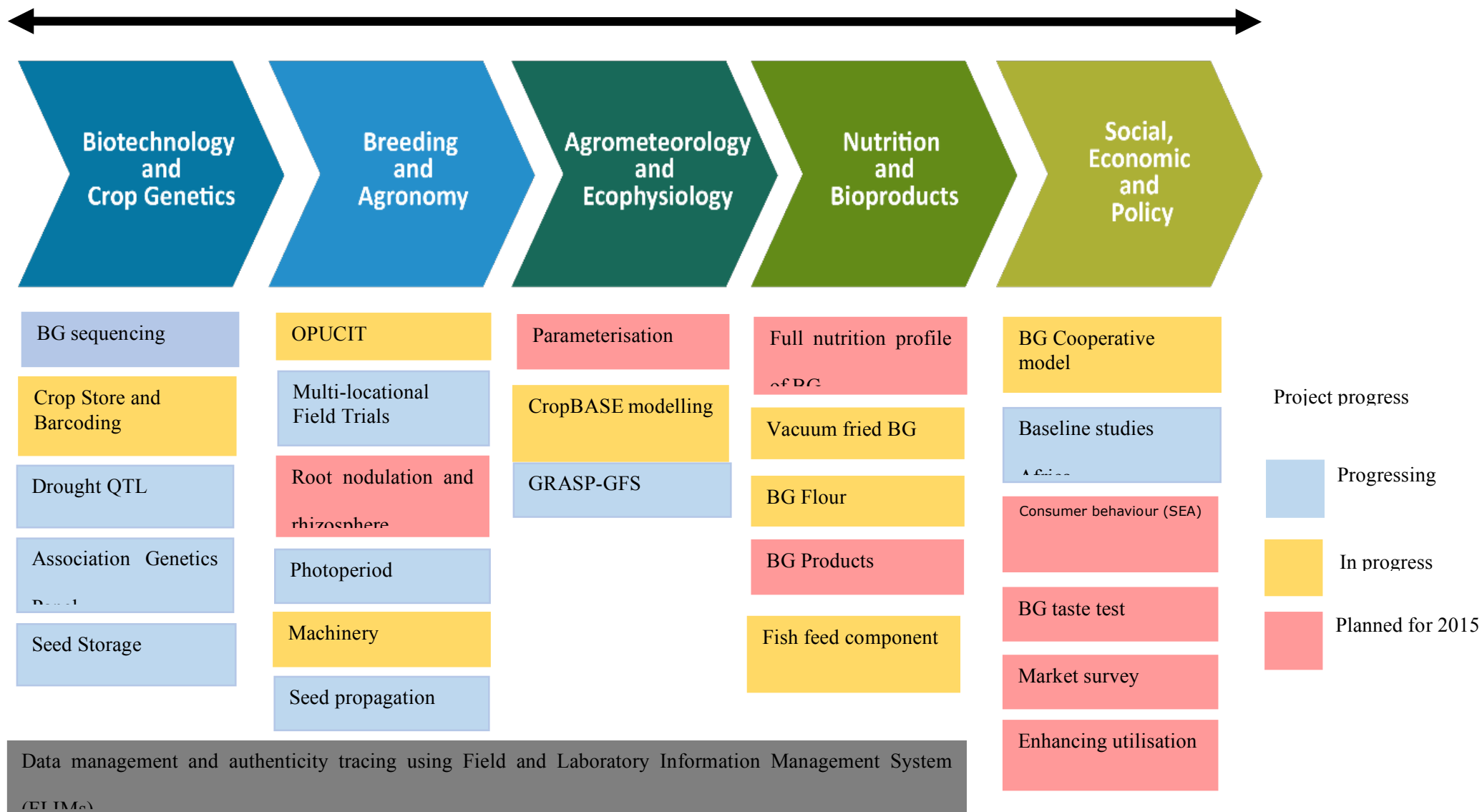


Figure 4.2. Bambara nuts Exemplar Research Value Chain Approach- CFF, 2015

Affirming this perspective, a statement from one of the actors (R3) during a programme stated that;

“We as CFF pride ourselves as an organisation with realistic demand driven base research approaches from communities and beneficiaries aimed to solve real life challenges and not just the usual theoretical research approaches that fits in to box ticking. For instance, our socio-economic policy theme and genetics must link up and feed in to each other realistically. Going forward, it is clear and not possible to work alone in single disciplines as that will not offer any significant impact on society. Importantly so is the shift by funding bodies for a more agreed proposal that are multidisciplinary and interdisciplinary based instead of single silo disciplines”R3.

Through the research structure of CFF, the themes directly contribute (guides) the research programmes. Developed with unique and niche words like ‘YIELD’, PLUS and BASE, the five ‘programmes’ seeks to feed in to the themes that serves as the research wing of the organisation. It is also with the objective of providing integrity and practical solutions to the research developed by CFF. All the programmes are designed and operated based on the Logical Framework Approach (LFA)¹ which helps to identify where researchable development gap

¹ Logical Framework (LFA), known as a log frame or project framework is a tool for planning and managing development and complex projects. It outlines information about the key components of projects with clarity, concise, logical and systematic way. The log frame model was developed in the United States and has

exists for redress through research. The assumption therefore is that, the concept explained intends to compliment the research value chain approach by addressing the gaps identified along the chain and facilitating the working together of members in all the themes and programmes to deliver the required outcomes.

Elaborating further, the YIELD programmes (BAMYIELD) are crop specific tailored programmes whilst the PLUS (proving links to utilised species) (SAGEPLUS, FoodPLUS and FishPLUS) are end user driven or system diversification programmes. The PLUS addresses real life consumer focused research issues from bioenergy at the farmers and community level, providing plant feed that could sustain and improve the aquaculture sector, and to providing and developing plant balanced food and food products for humanity. With all these, the BASE (CropBASE) programme serves as the information hub and support system to CFF activities. CropBASE interfaces with the knowledge coproduced by all the programmes, themes and other auxiliary units within CFF and disseminates it to the wider global audience. Every project must be subjected to problem analysis, stakeholder analysis, focusing on the objective and alternative arrangement. These programmes are expected to address the multidimensional and complex challenges faced by CFF in a holistic form.

since been adopted and adapted by many donor organisations including IFAD, DFID, FAO, UNDP and the World Bank use LFA as a monitoring and planning tool for projects (Taylor, T., Thin, N., and Sartain, J., 2003).

Whilst the programmes provide the practical approach to the research strategy of the organisation as explained, the '*THEMES*' provides research leadership; academic control and guide to the programmes which cut across each other in terms of research with the RVC concept. In effect, the programmes drive much of its strength and direction from the themes (Figure 4.3). The themes are ongoing research strategy and policy that aims to provide the capacity to programmes to carry out a high class and a niche of disciplinary research across the various knowledge communities within CFF with the astute academics.

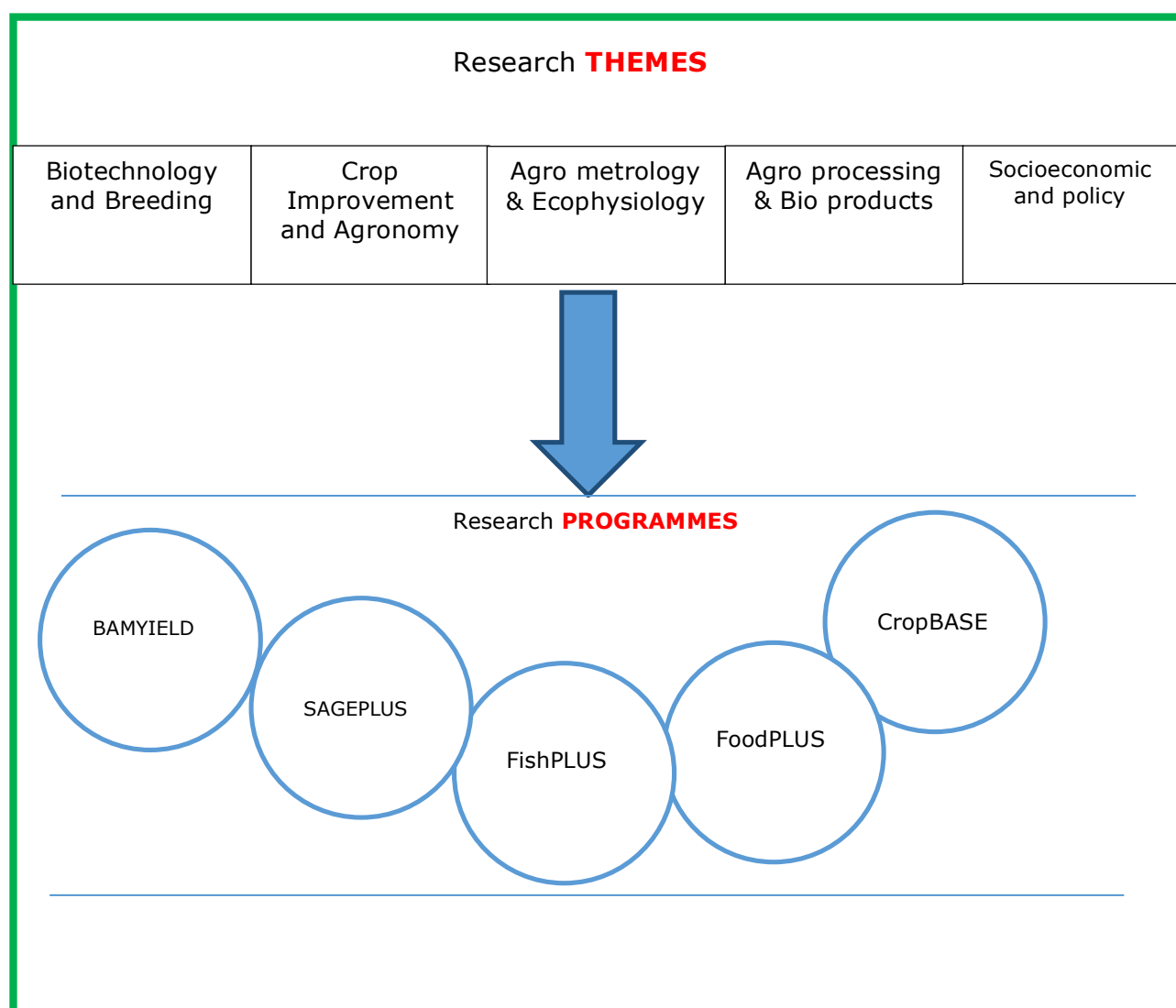


Figure 4.3. Themes and Programmes Relationship

CFF Profile Plan, (2014), argues that, project developed by the organisation are premised on the principle of shared knowledge, rooted on the values and aims of the themes and programmes with transdisciplinary links of crossing boundaries between research and industry. The symmetry from the themes and the programmes provides the basis and support for the research value chain (RVC) concept to succeed.

Aside the 'themes' and 'programmes' with these distinctive structuring with catchall terms with BASE, PLUS and YIELD of CFF was the FRC which added to the research value chain process. The Field Research Centre (FRC) which is a huge facility occupying a land space of eight (8) acre size, was one of the themes established to develop the strategic approaches and expertise in experimental laboratory works on fauna and flora related to underutilised species. This was with the view to carry out experiments that brings together different fields of research and disciplines by creating interdisciplinary and transdisciplinary experts and facilities that can serve the tropics and South East Asia. However, with growth and changes in the organisation, the research facility only serves as a facility and conduit for field and laboratory work that aims to push the underutilised narratives and deepening research collaboration.

It seems clear from the discussion that, the RVC is one of the critical internal policy tools for research collaboration and interaction in CFF. The concept allowed members according to the participants to lobby and negotiate with each other to develop proposals and projects for funding. For example, the Biotechnology and Genetics theme as well as the BAMYIELD programme, developed extensive

collaborative projects on Bambara groundnut value chains that deals with researchers and actors within CFF and other stakeholders nationally and globally (Figure 4.2). Some of the RVC projects developed include; Root nodulation and rhizosphere in Bambara groundnut with partners in South Africa, Multi locational field trials with partners (Malaysia, Ghana, Indonesia, Tanzania and South Africa), photoperiods in Bambara groundnut (South Africa and Malaysia), Seed propagation and multiplication and Machinery in Malaysia. These projects require the expertise of different and multiple disciplines allowing CFF and the theme to engage partners outside of Malaysia through memoranda of understanding (MOUs) to enhance and complete the value for Bambara breeding and commercialisation. Kedondong and Moringa plants are other exemplar underutilised plant species CFF focuses on aside from the Bambara groundnut. These underutilised species are plants with good potential benefits (nutrition and household incomes) that can impact on the livelihoods of small holder farmers in Malaysia, South East Asia and in Africa. Actors on these projects revealed that, the arrangements and operations of these global collaborations brought several stakeholders and specialists together to work on many aspects of the underutilised crops utilising the concept of the RVC.

A respondent (R1) opined that, they as a programme have made and are making conscious effort in developing the research value chain for Kedondong and Moringa apart from the Bambara crop that will involve everyone in CFF. R1 explained the level of collaboration to achieve the RVC of these underutilised crops as;

“We are working on Kedondong drink which involves the demand need, the production of kedondong, drink processing, quality requirement and the

drink product. All these stages require different knowledge groups and actors to collaborate and make the Kedondong value a success”R1.

“On Moringa, we are collaborating with the Field Research Center (FRC) and SAGEPLUS to develop the Moringa value chain for utilisation in Malaysia. It is a good nutritious plant and classified as an underutilised. We are assisting to develop Moringa Soap for use and Moringa Dry Leaves for consumption as well. This project came from SAGEPLUS team on the need to develop a good research value chain for this plant. Hence there is a strong partnership and collaborative initiatives. As a team, we will have to secure funding for the project”R1.

Some actors further reiterated on how they have extended the culture of collaboration from within CFF to other institutions to complement the research value chain process. Qin et al. (1996), argued that the value of research or knowledge co-produced to some extent can be determined by the level and type of collaboration at the individual, department and the institutional level. It reflected from an interaction with R1 who pointed out that, it was important to engaging the University of Nottingham on agronomy and crop physiology through field and laboratory works, thus;

“As a programme working in line with the RVC policy of CFF, we brought in Biotechnology and Crop Genetics Theme for research collaboration especially around flowering and maturing phase of the fruit. We also engaged the School of Bioscience (University Nottingham) for collaboration on working with Kedondong as well as the socio economic and policy theme.

All these knowledge communities form part of an interdisciplinary research team and a proposal drafted for funding"...R1.

The formal structures (i.e. themes and programmes) were observed to facilitate researchers to support each other through projects and events they were involved in. Such events developed into bigger projects that are fed into research gaps identified along the RVC. The collaboration processes within CFF were observed to concentrate around the RVC concept. Meaning that, where ever there was a strong level of collaboration indicated a strong level of RVC amongst actors. To fulfil the research approach, and to cash in funds to run the organisation, every other form of working together fitted in to the RVC system. Some flagship projects worked on were not critically related or knitted to the core themes and programmes focus, but rather to ensure that the general overhead expenditures were met. Nonetheless, the process served as push factors towards making the RVC approach real.

The level of collaboration differed from different themes and programmes depending on the actors' levels of motivation and engagements. Availability and access to funding, attracting more local and international partners through MOUs for research, developing collective goals, guaranteeing job security/promotion for subordinates, good leadership, more social interaction and networking and 'speak your mind' culture are some important elements that may likely be helping some programmes and themes in collaborating better than others.

Whilst some knowledge communities (themes and programmes) had some flexible and more relaxed culture of embracing ideas from support managers and interns,

allowing flexible communication and promoting self-initiatives that were within their area of focus, others were still using the traditional system of working from boss to subordinate processes. The two scenarios depended on the level of motivation and support offered by the agents. For instance, it was observed that the FoodPLUS team members came from two countries between 2014 and 2015. This group appeared conservative with high regard to hierarchical reporting, contributions and interactions with high power distance as espoused by Hofstede, (2010). The BAMYIELD and CropBASE programmes from observation had team members from countries considered to be of low power distance with reduced team bureaucracy, flexibility, open interactions and communication than other programmes which could be linked to cultural orientation and management approaches and styles.

To enhance the collaborative process, a participant (R8) revealed that in the next growth phase of CFF, the organisation intends to make it obligatory and binding on members to collaborate and work in teams.

'On our next round of flagship projects, we can only fund projects that are interdisciplinary that cut through the programmes and themes. With this, it will help us in working together well.... everybody should be aware of this going forward'.....R8.

This gives an indication that, the concept of using transdisciplinary models and pushing forward the RVC policy by CFF is linked to funding. This decision of only funding interdisciplinary projects may seem appropriate for RVC especially as

donors/funders are now tailored towards team work and inter-transdisciplinary approach to research and project executions. The essential aspect worth noting, is whether these collaborations, initiatives and actions are for their personal interest and consolidating power hold or professionals working towards the collective good of CFF. For others, such collaborative projects aim largely to achieve their individual set targets as professionals other than towards the main goal of the organisation.

Another critical element of RVC observed apart from actors' collaboration was the transdisciplinary link between research and the industry, through building partnerships, participation, negotiation and joint problem representation. CFF signed several MOUs with partner research organisations and industry players to strengthen their operations. Transdisciplinarity acknowledges that each key stakeholder is an expert in different aspects of knowledge and hence may provide an essential contribution to understanding and solving the problems. The longer the collaborative process of team members in projects, the lower the cost of doing research with efficiency (Chenhall, Hall, & Smith, 2010) and (Njorog et al., 2015), a view that the suggest that CFF could reduce project and operational cost by developing long term projects for sustained collaboration.

Matthew further adds that, when actors on projects collaborate with each other for a long time, the social spaces of team members gets closed with a dense network and they are comfortable with each other. Longer collaboration amongst actors indicates that employees are given long term contracts as against the short-term agreements (Figure 4.4) that usually burdens staff and take away a lot of

their commitment and sense of belonging to blend and bond for long term goals of CFF. The essence of RVC embedded in the structure of CFF shows that, it tries to achieve a long term professional and social cohesion of members that will make it easier to work together as espoused by some attributes of SC. The participation of all actors within the organisation (technical and non-technical members) of RVC embedded projects were observed to create better value addition (Figure 4.4) in terms of support provided to the research scientists from the support managers and the corporate communication unit where the outputs are put out there to the public.

A respondent (R13) interacted with revealed that, collaboration and cooperation of scientists in a project or organization hinges on several other factors including;

“Job or employment security, social environment, good and effective leadership, team members, motivation and collective goals of every actor enhances their level of collaboration in project execution”R13.

These factors (Figure 4.4) are observed to play an important role in encouraging and demotivating actors within CFF as team of researchers. Other researchers recounted the ideal situation that facilitated the effectiveness in working together to achieve the overall organizational goals and intimate the existing elements that they think constituted barriers to working together as teams in projects and programmes.

“Individualism and personal interest of actors, short contracts, competition and feeling insecure about their jobs, poor leadership and poorly designed

programmes and themes appeared to be barriers to effective collaboration that derailed the effort of the research value approach”R6.

Either way, the dimensions of effectively working on and improving the RVC and the technical projects of CFF appeared linked to how motivated the staffs are with members who are ready to cooperate in the interest of CFF. The theory of SC affirmed this by arguing that social cohesion, bonding and networking contributes to peoples’ motivation, commitment and performance in a group (Bourdieu, 1986) as revealed from actors’ perspectives (Figure 4.4). Again, the findings affirms Weber’s, (1978) position of the theory of bureaucratic management, that, the hierarchical and bureaucratic reporting systems contributes to reduce the level of collaborations and networking in CFF which is the medium through which communication and interaction takes place.

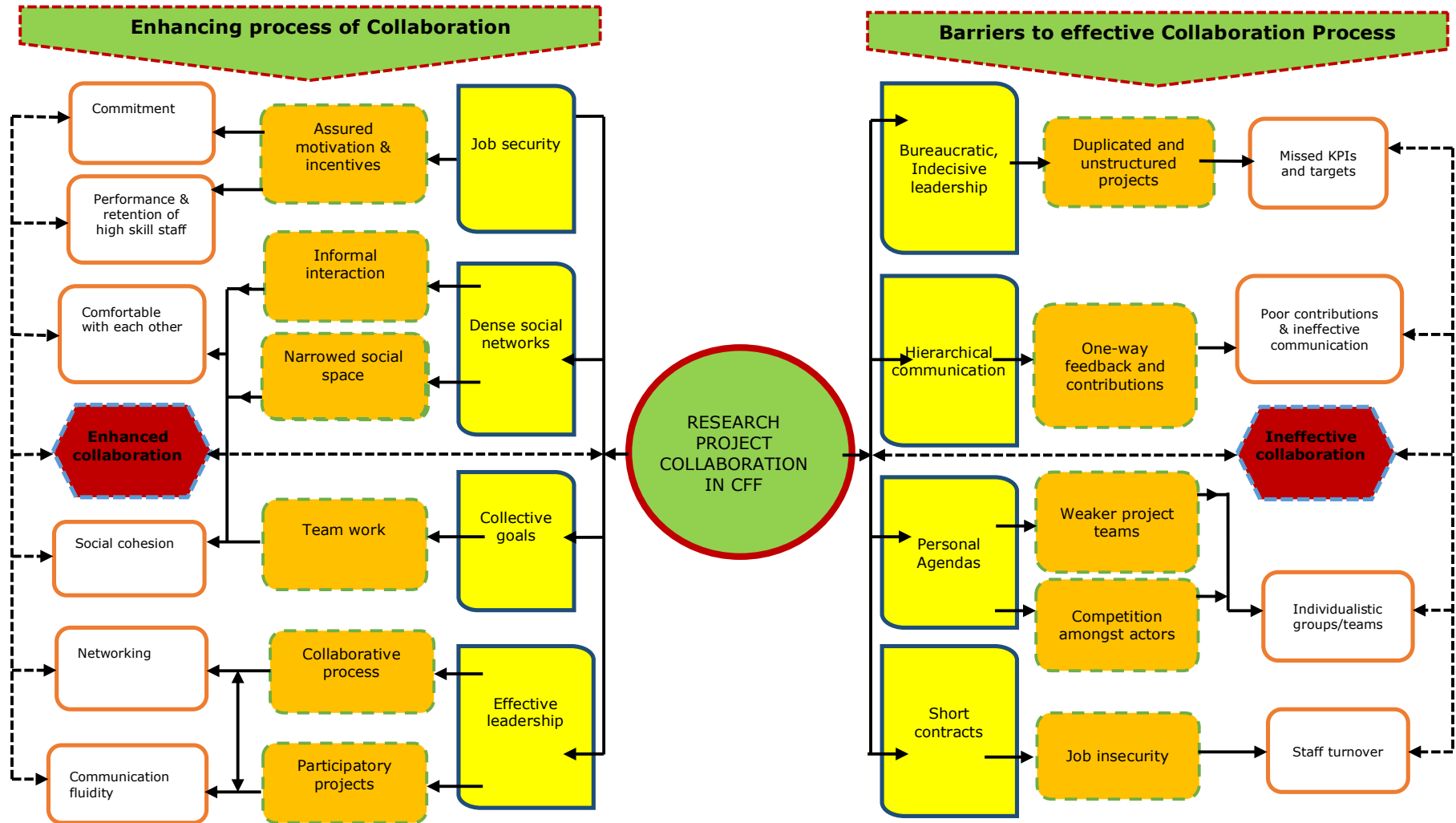


Figure 4.4. Collaborations in the Research Value Chain of CFF

4.4. Communication in RVC Projects

From the narrative, it is established that the RVC is the center of collaboration through which most projects and activities are carried out. Communication process within the RVC appeared in the normal structured bureaucratic reporting system (ie. From the project leader to the Theme Directors/CEO). Hardani-Widhiastut, (2012) reveals that, in structured formal organisation like CFF, communication is always hierarchical and exchanged from top down fashion. Some members revealed that almost every instructive feedback came from the CEO, the theme leaders and programme directors, to members in their own units and sometimes to others depending on the content and objective.

“Our communication process has always been from the top-down approach to us, as support managers and coordinators”R5.

“Major decisions and communications comes to us from programme and theme directors normally sanctioned by the CEO. For projects, the CEO is not involved in the daily operations but he is always briefed by programme directors. R4

Formal interactions in RVC were revealed to be from frequent email exchange, short meetings, seminars and presentations, as well as short memos with all other members and knowledge communities involved. This is very important as Hirokawa et al., (1990) and Katz (1998) posits strongly that, hierarchical communication is always a medium used to transmit and gain legitimate power in the workplace.

Issues of legitimate power² are relevant in such projects as more of the responsibilities of the projects ultimately rest on the project leader. Though members often have their own opinions and perspectives on issues being discussed in such projects, the final decision rest on the project leader who mostly are the directors. Some of the project teams relied on collective participation of every team member (Global Action Plan for Agricultural Diversification- GAPAD Project) to deliver as theory of SC argues for. Other project teams adopted the two-way communication system (interactive) instead of the top down process. To them, allowing a two-way communication in their projects and programmes represents a mark of good leadership which confirms Johansson et al. (2011) position that elements of communicative leadership theory in organizations creates effective communication, self belonging, and positive competition amongst actors which enhances better decision making process. Some of the postdocs or programme coordinators and the support managers saw the two-way communication process as an empowering process and enhancement of their commitments and active involvements in delivering project outputs. Some members confirmed that in cases where this method of collective participation ensued, timely completion and better deliverables were said to be produced by team members.

² Legitimate power is based on the supervisor or manager's position in the organisation and validated by the members of the organisation by virtue of their positions (Gioia & Sims: 10).

As a challenge in the communication process, some of the postdocs and support managers revealed that, impromptu messages and instructions from the leaders sometimes during weekends and late at night were often experienced.

“The only problem is that we are always informed of issues and meetings on very short notices. That is very bad and we suspect its coming from the leadership who gives the instructions on short notice”R5

R5 expressed not only discomforted them but made them unprepared for the said tasks. Giving ample time and prior information on any assignment and responsibility achieves better and effective communication amongst team members and offers them the freedom space to work in such projects (Hardani Widhiastuti, 2012).

4.5. The Informal Perspectives of Actors on RVC in CFF

Members of CFF accepted the research value chain concept as an organisational policy issue of which collaboration is required, an indication that, some level of goodwill and willingness of the researchers to practice or implement the RVC as explained before existed.

There were four categories of observed stakeholders in the research value chain process; namely the research group (programmes and themes), the administrative support group (CEO, Finance, HR, Facilities & Lab and Communication), funding partners and research partners with the availability of funds. These groups have the responsibility of working together irrespective of the type of project that is initiated. Considering the different critical roles each group contributes, understanding the group dynamics of members for research is

essential. On this, Scholz and Stauffacher (2009) underscored the importance of accepting and understanding each other, respecting other members and bonding in transdisciplinary projects.

Some members view of the whole process was that they collaborated with other groups only based on their choice and how that contributes to their key performance indicators (KPIs). In addition, and perhaps because of this perspective, a participant (R3) expressed mixed feeling of how policies are formulated in CFF including of RVC.

“Many of the discrete and programme projects appeared never to have lasted nor made any significant impact or resonate with the overall goal of the organisation but rather to get budget and have something at hand to do”... R3

Concerns, such as this, seem to undermine the roles and purpose of the Exco Committee. The “Scientific or Executive Committee (Exco)³” comprising of theme and programme leaders as well as the Senior Management Group (SMG) discusses research ideas and projects that are considered by programmes. Members of this group are considered influential and powerful and they make the final and critical decisions. This meeting is representing the collective ideas of all knowledge communities within CFF. Hence, realistic cuts across projects could be initiated and worked on by all programmes if the ‘*Scientific or Exco Meeting*’ meet to cover

³ Scientific or Executive Committee (Exco) are some selected senior management staff who are responsible for the operations and functioning of their units and departments under which all activities are carried out chaired normally by the Chief Research Officer and answerable to the CEO of CFF.

the interest of all parties involved other than a few as suggested. Again, much as RVC is a formal organisational policy and used as a strategy to fully develop the research of underutilise crops, issues raised by (R3) tends to contradict CFF view point that, projects and policies such as RVC are linked to the overall goal and vision of the organisation.

Knowledge and information sharing is important to solving complex problems and developing projects to solve. From interacting with members, it came clear that information or any form of knowledge in CFF, should be considered *'ripe', 'well thought through' and 'strategic'*, before deciding on whether to share with other programmes/themes or not. Respondent (R12) explains;

"I tell you, sharing every technical information and ideas with others are not good and strategic. You know here, if others give you an idea on a project, it becomes like their intellectual property (IP). There, you are scooped. So, it's all about personal achievements and goals and not programmes and themes or CFF. Though from a public relations angle, we will say it's CFF but amongst ourselves and at personal levels, it is ours and we capture them in our CVs,..laughed. We all protect our ideas and not share for a broader programme and theme linkage using that RVC thing"...R 12.

Whereas some of the researchers see knowledge and idea sharing as being prone to scooping, many others believed that sharing and working together to make the RVC and all other policies better are part of their agreed mandate as researchers. Many argued that in working for the interest of CFF, there is nothing like being scooped or a personal intellectual property when they are paid to coproduce

knowledge. Some (R18) maintain that it is not something new but rather a common-sense approach that working together has always produced better and good results than working alone.

'RVC is also a good policy for CFF as it tries cut across all programmes and themes to develop projects and add value to the NUCs chain. Other than these, all programmes have their own way of working'.....R18

"Yes, I think the concept is helping us to work together for underutilised species from all the themes to programmes. We use the RVC for that. Even the studentships, some of the student projects cut across some of the programmes and themes. So, by the structure of the organisation, we are transdisciplinary or interdisciplinary. Different backgrounds, specialisations, responsibilities, mixed gender, religion, language and race. We are very mixed in everything here and we work well I think"..... R18

Whilst many acknowledged how well they know and share in the value of the research value chain concept as explained in the organisation plan and prolife document including;

"Covers genetics to products".....R5

"It is a description of all the researchable technologies and sciences from farmer to user"..... R9

"It is looking at a crop from all stages - from genetics right up to marketing as a product"..... R4

"A set of activities that firm operating in a specific industry performs in order to deliver a valuable product or service for the market".....R7

“Activities required bringing a product from concept to consumer”.....R23

Others had a rather different and generic understanding from what CFF claims RVC was.

“Knowledge of underutilised crops for food and non-food usage”.....R2

“Complete delivery of NUC knowledge”.....R5

“Research in the disciplines and also research gaps between the disciplines and themes”..... R7

“A set of activities that firm operating in a specific industry performs to deliver a valuable product or service for the market”..... R9

Despite the events described above, researchers’ accounts of these approaches by CFF continued to reflect the technocratic features of the policy implementation discourse of actors believing that, it is the usual box ticking exercise and part of the structured process of doing things. The RVC working process appeared same and normal just like any other research project in organisations i.e. from conceptual stage to the implementation and publication of findings stages. These processes require lot of team work, effort and collaboration from the actors (Figure 4.5). The flow and working process (Figure 4.5) revealed that, the RVC starts with problem identification and framing, developing concept notes/proposals and ultimately forming teams from other themes and programmes depending on the project focus where responsibilities are assigned. After such thorough processes, funding is sourced and the actual implementation starts, which could be by only CFF researchers or involving doctoral students for the task through the Doctoral Training Partnership (DTP). CFF expectations are that, for actors to collaborate to this level, some level of interactions, friendship building and understanding of each

other would have ensued thereby improving the informal communication processes.

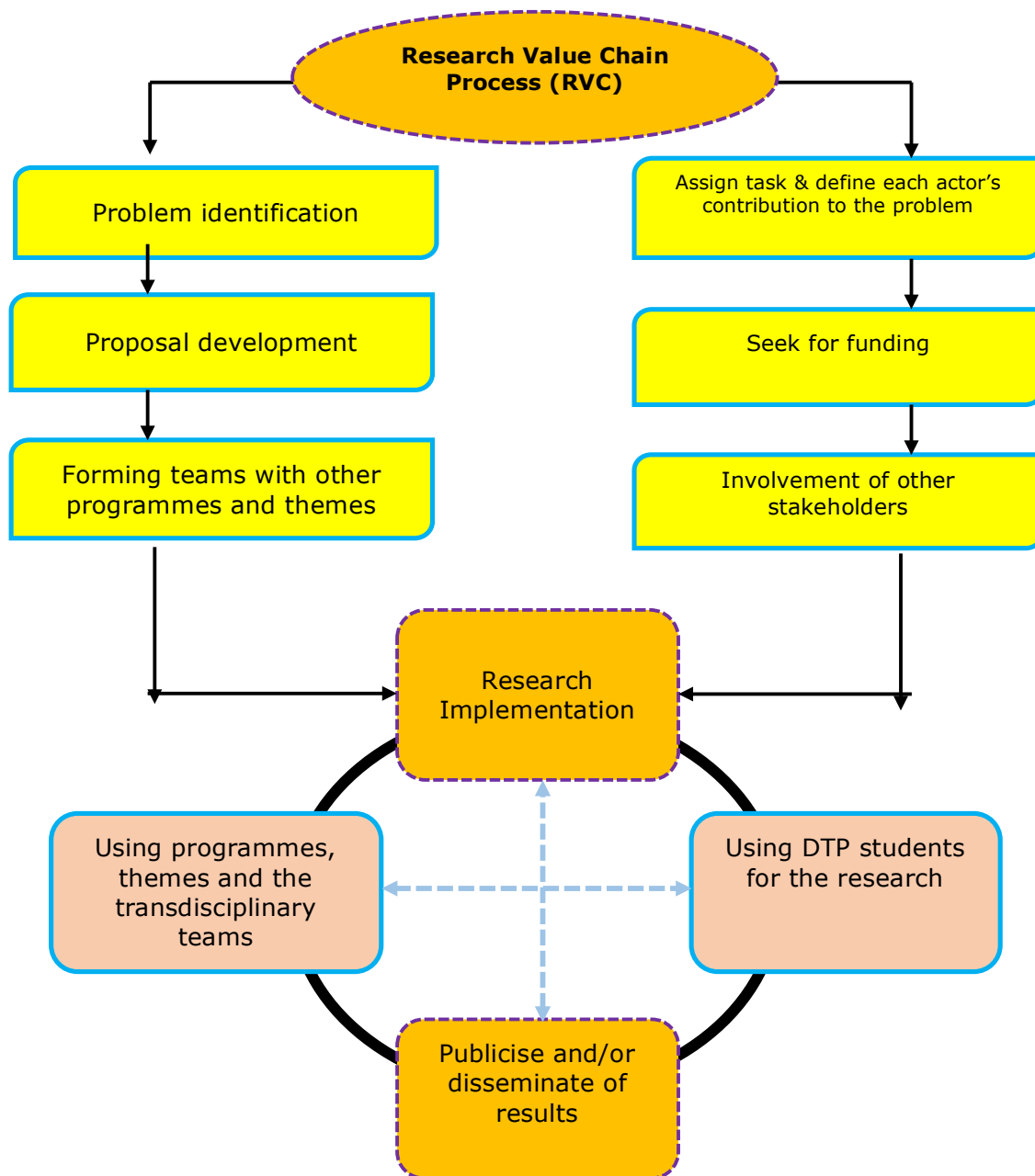


Figure 4.5. The Flow and working process of RVC in CFF

4.6. Challenges of the Implementation Process of RVC

Every organisational policy comes with challenges no matter the benefits expected. When several actors of different networks had to come together to

work, different opinions and perspectives were expected. Robert and Mark (2005) observes that the differences among actors are traced to the constraints and opportunities that arise from how they are embedded in the network, how they understand and view the activities of the network, how they are connected to the network and the nature of their network. The network within the themes and programmes defines the way work gets done. It was observed that a denser and collaborative network provides quite minimal challenges in the implementation of their activities and the research value chain.

It becomes a challenge then, when the same output and collaborative processes are expected from all programmes and themes for better implementation of RVC. Networking and informal relationships of employees as attributes of SC are argued to enhance a better implementation of agreed milestones because the act facilitates the understanding of each actor's perspectives (Benavides et al, 2012; Scholz and Stauffacher, 2009). Lowell Bryan et al. (2007) argue that based on how humans behave and interact in networks, social informalities tend to create mutual self-interest which leads people to share ideas and work together even when no one requires them to do so. Knowledge is well shared and coproduced when networks are built which leads to better collaboration.

Some actors collaborating on projects through the RVC claim it helped improved on their informal network and communication as discussed, others had different views.

A participant revealed that RVC is;

“ A management cycle procedure⁴ and a marketing tool to foster working collaborations but it seems not real and quite difficult working with, partly due to personalities and people with fixated ideas⁵ and thinking. The way the programmes are structured makes it challenging to follow through with this concept. There are issues with personalities, entrenching personal goals agendas”.....R3

This challenges the RVC principle and the core values of the organisation. Whereas the mission, the values and the vision are tended to motivate staff to contribute to activities outside of their programmes and themes in the interest of the organisation and not based on personal goals. As the operational guide of CFF, 2015 put it, “RVC will help improve on the transferable skills making the organisation to become more than its parts”.

“Some of our colleagues are obsessed to their ideas and line of knowledge and never want to think outside the box or change. They think collaboration is a waste of time and they only need to meet their KPIs (key performance indicators) and attract funding. Working in places like this does not require such behaviours as it undermines the collectiveness of the institution, more so it does not help the RVC concept you are asking about. Again, the obsession to one’s self and beliefs makes us compete unnecessarily” R3.

⁴ ‘With cycle management, I mean people, paper work, managing information and use of support systems within the organisation serving as a management tool as usual’...R3.

Another challenge revealed was the competition for funding, influence and relevance which had the propensity of hampering effective collaboration for a sustainable RVC. Knowledge management and sharing is critical in research collaboration process(Tan & Noor, 2013) and (Small and Sage, 2005), and the feeling of being scooped, protecting information available to a section of members as a strategy to guide their themes and programmes in order that they do not lose their power and control were issues raised. Sharing information to other programmes or individuals who are considered as predatory colleagues was not only challenging effective networking, collaboration and communication, but also the sustained research value chain implementation process.

Each of the groups and actors employed some elements that strategically supported their own interest and projects which often differed from the bigger picture of CFF. This interest tends to enhance their power and influence over other programmes and themes rather than produce a research chain of cross disciplines for diversified agriculture. Actors appeared to work towards RVC largely on interest grounds that, it aligns to their programmes and themes targets and may solidify their individual power grips if they collaborate on several projects in the name of such policy.

“There are some of us who are benefiting from the politics of CFF. I am telling you, they really don’t care of anything other than their interest. Not about food security or climate future or diversity. It’s about their funding and KPIs and to let people know and think they are working. But we just stay out of some of the politics and challenges”R4

Respondent 3 explained that, one of the challenges facing the RVC concept that affects their reporting and communication process as team members was the structuring of the programmes, insisting that;

“I think our main challenge as organisation is the structuring process of the themes and programmes which is not allowing the RVC concept to work well and rather looks perfect on paper but the communication process is poor”R3

Whilst these narratives from this chapter provided a mixed form of opinions from the RVC on the account of respondents and from CFF official documents, issues on how the concept as a policy tool helped members to communicate and collaborate remains divided. However, the discourse affirms the theoretical framework view of this study that, the level of functioning of the RVC till now could be attributed to the adoption of some SC attributes as well as that of leadership communicative theory.

4.7. Chapter Conclusion

Issues of the research value chain as a policy shows that each knowledge community had their own view and approach on how the policy works and implemented towards the general underutilised agenda. From the actors, own views, RVC is a good policy and serves as a bigger medium for them work together as researchers. From observations and the narrations provided, CFF tried to make the policy work, not only to deepen the research chain of the selected underutilised crops, but also to ensure that researchers actively and cohesively work together. Whilst this approach may garner some level of collaborative research and projects within CFF, the long-term sustainability of the concept may be challenged. Conditions that facilitate easy integration and use of the policy tend to be hinged

on the choice and discretion of the theme and programme leaders other than the overall need and research direction of the organisation. Again, it appeared to be tailored to the needs of industry and government as funders of some of the projects they execute.

Some members interacted with, considered some of these as discrete and flagship projects which normally involve fewer programmes for implementation. One critical part of the one-off projects (short projects) is the funding component that constantly lubricates and serves as the additional stream of revenue to manage the operational expenditures of the organisation. The expiration of such projects implies the closure of the collaboration and the value chain of the research object in question. Another issue of the one-off projects which drives the RVC is the issue of maintaining team members who developed better and effective way of interrelating and interacting with one another during the periods of those projects. The skills set developed over the period of the project for those specific problem base, can be lost if there is no outlined policy issue to harness and ensure continuity for the public good of the organisation.

The long-term improvement and embedding of the RVC into the daily research activity of CFF can be done with long term projects that share the value and vision of the organisation. Equally, the improvement in the social relations and networking of scientists is important to reduce miscommunication and misunderstanding between each stakeholder in the chain. Many of the researchers intimated on how poorly structured some of the programmes are and how that affects the smooth process of collaboration and communication which becomes one barrier to the RVC implementation process.

Since the RVC has been identified by members as the medium through which they collaborate, the need to create a process that binds all actors within the network for inter-transdisciplinary projects is critical and imperative, so that it does not rely on individual choice but on the collective demand and need of CFF. All themes and programmes should appreciate the contribution of each discipline or knowledge community. The contribution of each group/programme should serve as the product and service upon which other themes and programmes can rely on to complete the entire the chain of research.

Again, scientists within CFF view the research value (RVC) as a model and concept that promotes the agenda of transdisciplinary research on underutilised crops. Many journals are now all tailored towards interdisciplinary knowledge production for publication and are gradually breaking the disciplinary walls (Azam-Ali, 2010). CFF must fit in to these paradigms and use the RVC as the driving vehicle. New ways of doing research are more interactive, involving, collaborative and productive form for efficient outputs. Since the world challenges and problems are driven by multiple causes, it requires multiple solutions as well to solve it.

CHAPTER FIVE

THE FORMAL AND INFORMAL CROPS FOR THE FUTURE

5.1. Introduction

The previous chapter explained one critical formal policy programme (Research Value Chain-RVC) of CFF and how that tries to shape the research strategy of the organisation. This chapter goes further to explore how such policies including others help to shape the formal and informal CFF and link that to how that facilitate communication. It examines the purpose of establishment of CFF, how it works and the networking of the researchers as well as the power of influence within.

5.2. The Hope and Need for Underutilised Crops by CFF

As explained in previous chapters, CFF is the world's first centre dedicated to research on underutilised crops for food and non-food uses. An interaction with the CEO of CFF revealed some important reasons for which CFF was established to focus on underutilised crops alone unlike other agricultural research institutions as;

"Is the world not at risk of depending on these few crops? Why are others consuming some food stuff or plant species in some parts of the world for their daily nutritional and food security requirements than others? What could be the alternatives to these challenges and vulnerabilities? Providing some answers to these questions led to the establishment of an organization dedicated to underutilised crops globally. With a name that shows a stronger alternative to the conventional crop call underutilised crops"CEO, CFF.

From the CEO's explanation, the passion to push for food security issues coupled with strong drive for research made ideas and thoughts became real through the establishment of a research company⁶ that provides a common and public good output for the public and scientific community. A researcher explained that, underutilised crops are crops;

"That are orphaned, not extensively researched on, not popularised globally for its commercial value and usage, not well documented but with high nutritional value, good commercial value, a food security contributor that can largely improve the livelihoods of small holder farmers and commercial actors on the agricultural value chain, are considered as underutilised crop"

.....R8

The fifteen (15) global Consultative Group on International Agricultural Research (CGAIR) centres are largely focusing on the main and conventional crops that feeds the world. With about 7000 underutilised plant species available (Garn and Leonard, 1989; Azam-Ali, 2010), CFF tries to direct its focus and resources towards some of these plant species as alternatives to the main crops that exist towards community, household food and nutrition security. Crops for the Future, a member of the Association of International Research and Development Centres for Agriculture (AIRCA) evolved from a union of the International Centre for

⁶ 'Registered as a company because we need the flexibility to explore deeper on NUCs through our RVC concept without limits and restrictions from both the government and Nottingham as well. It is also a company because, that status offers us a 200% tax rebate or relief on investments in CFF for public good' CEO, CFF-Prof Azam Ali Sayed.

Underutilised Crops (ICUC) and the Global Facilitation Unit for Underutilized Species (GFU). Looking back from the initial stage of CFF formation till now, the CEO further explained that the research organisation/company has made significant progress towards the mission of;

“Developing solutions for diversifying future agriculture using underutilised crops to improve food and nutritional security and livelihoods of the poor”..... CEO, CFF.

Several underutilised plant species including Bambara groundnut, Kedondong fruit, Moringa, Wing bean, Napier grass, Brassica, Dabai fruit are being worked on from the genetics aspect of the chain, along to the final processed part for consumption. These fruits, vegetables and bioenergy property grasses have the strongest propensity to contribute to the livelihoods and food security status of several smallholder farmers even at the early stage of research. With these developments, actors within CFF believe they are working fervently towards a sustainable solution of diversify future agriculture.

In the establishment process, the aim of becoming a global agricultural research player sounds interesting, expectant and hopeful of CFF by the researchers as some of them tout the achievements made till now. One actor (R8) commented that;

“We have come a long way to this present magnificent iconic structure from a small office space with a handful of staff to operate within UNMC. Today, we have more than 12 nationalities working with us, several highly-qualified scientists and academics, experienced postdocs, an incredible administrative support staff, over 34 global partners through MOUs and a host of postgraduate students whose research works will feed into our RVC

through the programmes within 5 years. This is a remarkable achievement and experience for us”R8.

These achievements are significant in the view of researchers because not only is the organisation young (established, 2011), but that research work on underutilised crops hardly attracts funding and experienced human resource in the sciences and other technical fields. Nonetheless with this effort by CFF, it is considered that underutilised crops have had a boost which in the future some of the selected crops may become major crops like maize, rice and wheat.

5.2.1. The Iconic Domes and Symbol of CFF

Office buildings are integral part of the corporate image of organisations. Beyond issues of corporate image, issues of privacy, acoustic control, office space for staff, healthy and personally receptive environments are significant values of office infrastructure (CABE, 2005) CFF considers the iconic domes as one formal element of the organisation because of its purpose and the value they share with it. From 2011 of its establishment in Malaysia, CFF operated from within the University of Nottingham Malaysia Campus. The office facility was quite small with limited office space for staff. There was not much privacy for staff due to the number of people within the available space, an environment that had the "one stock shop model" because of the size and convenience. As the organisation expanded, a new bigger office was required to accommodate everybody, provide comfort and enhance effective research and collaboration for the staff. In September 2015, CFF moved in to their own building-the domes, which serve as the headquarters of the organisation.

The three iconic domes (occupied 3.18 ha of land space) were constructed to offer comfort and conducive working environment for agents of the organisation. The domes have a living laboratory dome, researchers dome and the administrative dome (Dome A, B and C) surrounded by botanical gardens of alternative plants with environmentally efficient technology and materials such as the glulam and the hard/red woods. As the new HQ office (Figure 5.1), many of the staff developed the attachment to the DOMES as the new symbol and image of the organisation. The layout of the building, the design and the location of the facility close to the University of Nottingham, added more to the growing presence of CFF in Malaysia and on the global space.

“The organisation believes that the domes will not only pay for itself in terms of cost but will also serve as a tourist reference point within Malaysia with time. Many dignitaries, Ministers, government officers and researchers from the UK and within Malaysia usually visit the HQ” ... (CEO, CFF-2015 on the research strategy of CFF).

The structure per some of the briefing sessions of the organisation, was set out to be environmentally sustainable with a higher level of green certification with the building receiving a silver rating certification award for design assessment by the Green Building Index of Malaysia. According to the facilities management, the assessment was based on energy efficiency, indoor air quality, sustainable site planning and management, water efficiency and innovation.



Figure 5.1. CFF Head Quarters- The Domes

In addition to this niche, the facility used high quality available timber in Malaysia, with natural light and energy saving fittings and equipment. All these added to the unique quality of the HQ and why it is significant to CFF and its underutilized canticle or hymn.

"With the landscape garden, underutilised plant species planted as landscape and beautification plants represents the very existence of the CFF and it's over all mission statement, revealing the beauty of dominance of the facility"R8

The assumption of a better environment to facilitate the development of higher social capital through team-work and sense of attachment and belonging, underscores the essence and importance of creating such edifice. Knorr-Centina

(1983; 1981) believes, environment or surroundings of scientists/people, coupled with their day to day interactions with one another affects the scientific knowledge produced and its dissemination.

5.2.2. The Office Landscape arrangements and Researchers Interactions

It is argued that by having an open office system, where employees sit close to each other, facilitate information sharing and communicating about agents of activities for better collaboration (Wolf, Lindenthal, Szerencsits, Holbrook, & Heß, 2013) and (Holbrook et al., 2007; LU, 2014). Again, Lu, (2014) and Holbrook et al, (2007) argue that, transparent glasses of offices allow staff to see each other with the aim to enhance an open and transparent culture of the organisation where activities and daily interactions from management and the lower rank officers are seen and emulated. This normative view of Lu, mirrors the approach of CFF and the purpose of its office landscape arrangement as it claims that,

'The seating allocation at the HQ is designed to facilitate communication, interaction and productive personal relationships between staff where trust develops'.⁷

The DOMES (Figure 5.1 and 5.2), the botanical garden and the open office system are tended to help build on networks, close gaps amongst researchers, facilitate knowledge sharing and ultimately contribute to the organisational culture. For

⁷ CFF Operational Guide, 2015: 54

Holbrook et al., (2007), office landscapes help in actor networks and collaborations.

'Such systems and structures encourage research collaborations, the connection of researchers and users (and other stakeholders) and building multidisciplinary research agendas' (Holbrook et al 2007).

However, some actors within were dissatisfied with all the arrangements and open office landscape method of CFF. They believed it is good to be together, share ideas and interact more; nonetheless, the mixture of all categories of employees within one space hedged their privacy and comfort in terms of visual, acoustical and territorial. Whilst chatting during lunch time with some officers (R4 and R6), this is what ensued;

"I don't understand issues with regards to the office chairs, sitting arrangements and everything. Another participant commented on why mixing up PhD holders and others like students, interns together? At our level, we should not be in this type of open environment with everybody...R6.



Figure 5.2. Open office Landscape System of CFF

"Another one laughed out, for sure you are not important and powerful like the others"R4

Some of the concerns appeared genuine as they seem stressed and distracted by the arrangement. Others from observation had the concern that they could not control any information either on their screens, discussions or even on phone without anyone listening or trying to watch. Interactions and networking amongst them may have to go beyond office arrangement to deliberate regulations and policies that support collaboration and cooperation of scientists in projects. Konnikova (2014), found that, adaptation and increase in productivity and networking to open office systems differed from age level, working experience and culture from many studies in Canada and the United States of America. The study according to Konnikova, revealed that, the younger ones could adapt well to open office systems and they valued the time spent socializing with co-workers, whom

they often saw as friends but are always distracted whilst the grown ones are often stressed psychologically and feel deprived.

Grabbing a cup of coffee and snacks requires going to a well-structured pantry in the administrative Dome (A). Actors see it as convenient and nice to hang around but having to walk to that place from the researchers Dome (B) for just a coffee is an issue. Some members often announce;

“Who is going for milo or coffee? I need some but I feel lazy to walk all the way to that place, anyone to help”?.....R10

The pantry and place to eat within the facility encouraged eating together as members of CFF. This social bonding is expected to consolidate friendship and networking of participants, where they understand each other more for better communication (Bourdieu, 1986). During lunch time, staff who came to office with lunch boxes will all gather at the pantry to eat, share, relax and network amongst each other, whilst others move out to nearby food joints and restaurants. The place is always full if there is any activity or programme organised with food and snacks. The sitting arrangements of mixing actors of different programmes and together appeared cohesive. Actors were seen talking to each other, share information and knowledge by virtue of their sits close to each other.

“I sit very close to three other colleagues and we are very free and we share a lot. We listen to each other communication, hear each other secretes, bond, we laugh and joke because we have come to understand each. Its good”.....R10

Others insisted and were choosy and prioritized their relationship more with their own knowledge community members than colleagues sitting around them. To such actors, interactions and networking should be more from their programmes and themes.

"I relate more to my programme colleagues and superiors than with other members of different programmes. This is normal in groups and teams and that makes our level of friendship stronger for effective working relationship" R9.

Whilst the entire edifice was to contribute to ensure comfort for staff and facilitate closer networking and effective interaction as aimed by CFF and from views of employees, others had issues with the structure and the sitting arrangements. Some lamented about the slippery nature of the domes when it rained and that discomforted them. Moving into the new HQ coincided with the raining season of Malaysia where there were daily rains. Per the design of the iconic domes and how they are linked to each other with minimal rain guards at the tops, the entire walk ways and stair case of the buildings were always wet and very slippery.

"We are always careful of the floor and staircase when walking anytime it rains.R5

"Its always dangerous because of the level of slippery we are exposed to whilst walking. We all do not like it here when it rains, it's a discomfort. But we hope that it improves soon."R6.

Again, the few management staff (Theme Directors and CEO) who had their own enclosed cubicles (research directors) were considered as the powerful groups and game changers in CFF, whilst those in the open office saw their privacies evaded with junior colleagues including students, when in effect, from CFF official policy point of view, it was to facilitate face to face interactions and build closer networks.

“Power within the organisation at the level of management is seen as ‘those who call the shots’, those who make the decisions at the programme and theme levels, those whose privacies are intact and those who determine which grant or funding to seek and projects to develop within the organisation and those who has the most funding for their projects and themes” R4.

For actors (R4), the sitting arrangements rather evaded their privacy and social space rather than help them to interact and bond more. More so, they claim, to separate the few management staff into small cubicles was meant to show power and class differences which could not fit into the narrative of improving communication between superiors and subordinates.

5.2.3. The Reporting Processes and Flow in CFF

CFF is in its second phase of research and development, having established the institutional structures and facilities. It has significant global partners in all parts of the continent with very strong team members who are the core human resource for the organisation. The organisation’s claims that most of its projects and research are expected to produce tangible and intangible outputs by end of 2017 (CFF Strategic Plan 2014).

Procedurally, members of CFF report through the themes, programmes and through projects. For example, all themes and programme directors and other administrative directors report directly to the CEO quarterly and annually through the chief research officer (CRO) and chief corporate services (CCS) who in turn report to the board together with CFF Exco for critical policy decisions. The research unit (themes and programmes), the corporate services unit (human resource, information technology, finance and facilities) and the organisational strategy units (business development, advisory and consulting services, global partnerships and liaison units), uses the traditional system of management and reporting. Ultimately, the CEO is responsible for the overall performance, functioning and growth of CFF with the expectations that a proactive leadership direction is provided to help achieve its stated objectives. This reporting process and structure affirms Weber's theory on bureaucratic structures and reporting which argues that;

"Organisations tend to have bureaucratic structures if these conditions exist. That is, when there is formal hierarchical structure with class and a clear reporting system and decision making processes; when the principles of organisations are managed by rules to make decisions at the higher levels..." (Weber, 1921: 1978).

These bureaucratic processes of reporting within CFF tend to enhance the procedures, orderliness and control of its activities and people to authority. Again, being considered as a complex institution with multiple actors, stakeholders and partners, a vertical bureaucratic process often tends to enhance the management

process. Khanifar, (2013); Trondal, (2014); Claver-Corte's et al, (2007); Hang Yan-Ming, (1993) argued that, whilst institutions need to relax their rigidity and authority in the management processes, using elements of an apex command that integrates the activities from all actors through laid down procedures is still crucial to complex organisations. In corroborating this, R4 revealed that;

"There exist a functional and a hierarchical structure at the higher level of management of CFF, but at the bottom level of the organisation, we are all same. No hierarchy. There are 3 levels of staff within CFF. One is the boss, second are the leaders and the third are the junior staff which include everybody. So, that's the structure".....R4

Normatively, since employees usually condition their mind-set of reporting to their superiors, the bureaucratic process appeared normal to them unlike the contemporary methods (project, matrix and functional). Nonetheless, despite the use of hierarchies as explained, many senior actors including management claim the use of bottom up interactive and communicative tendencies that allows their junior colleague researchers to be more flexible, proactive and participative in decision making. To this, Jokela, (2011) added that, bottom-up communication within a hierarchical organisation tend to assist employees to integrate well into the organization which enhances better decision-making processes. On whether participants allow and uses hierarchical approach with colleagues in CFF, R2 explained;

"Laughed..., no I don't do that. I am a bit relaxed about it. You should have seen how frequent I visit that office to see my other colleagues instead of

them walking to me to take instruction. I want my colleagues and everybody to feel comfortable working with me and CFF. It seems some other guys to do that too. Laughed....I am relaxed about these things”
.....R2

Meanwhile, when it comes to research projects (programme projects, core-funded projects, one-off projects and keystone projects), CFF often tend to use the functional and the matrix reporting structures. As projects are developed for execution, primary investigators or project team leads take direct responsibilities of the project and expect to lead other researchers from other programmes or perhaps partners from outside of CFF. Deliverables and other updates from such projects are reported (Figure 5.3) from the team lead to the management and relevant partners. Project team members (theme and programmes) do cross functional and matrix system of reporting during the project implementation process. Depending on the need, the cross functional process of formal reporting usually involves the finance and administration unit and others whose critical skills and experiences are required in the project delivery processes.

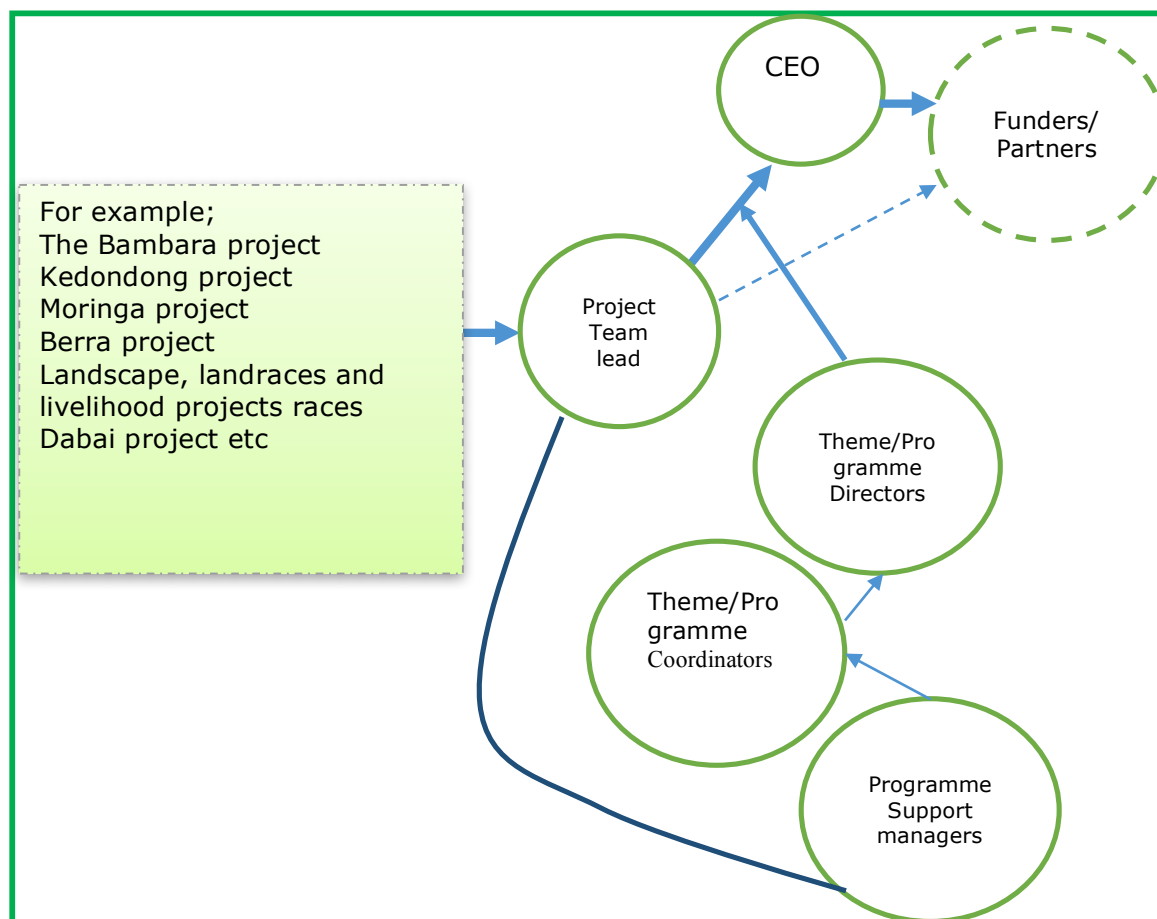


Figure 5.3. Example of Functional/Matrix Reporting Processes

While team members functionally contribute, their skills set to these projects (Figure 5.3), they also report to multiple lines of authorities who hitherto are not their immediate superior officers for reporting but rather due to the matrix structure embedded in executing their projects. One of the actors revealed that though the functional and matrix system of handling projects appeared effective, it had some challenges in relation to reporting and commitment of members.

“Reporting to a colleague who is not your supervisor is challenging, it requires patience when such projects come up. Commitment is often lacking because of other responsibilities for members. Multiple conflict of interest and loyalty issues do pop up often unlike if we are working on our themes

and programmes. Of course, my programme comes first before any other collaborative project”.....R20.

The existence of competitive feeling amongst colleagues is considered normal (Hooker, 2008) and the belief that, it boosts performance if the competition is positive and can achieve targets and deliverables, which even makes such opinion stronger. Consequently, whilst these management processes are to facilitate the coordination and implementation of interactive activities for CFF, issues such as loyalty and commitments to project efforts can slow the collaborative effort.

5.2.4. Motivation and Rewards to Collaborate in CFF

Passion and expected benefits often serve as the reasons people are motivated to do what they do. Every actor in CFF came with a set of motivation to work for it as a research company. With varying levels and reasons for motivation, it appeared through interactions that and just like many others that, actors in CFF work for it as an organisation not because of its domes and its underutilise jargon praise, but for a livelihood, personal satisfaction and fulfilment and for career advancement drive that impacts their life. In achieving these personal goals as actors for CFF, they directly and indirectly contribute to the food security, climate future and agricultural diversification advocacy with underutilised crops drive of the organisation. Many of the actors revealed that the motivation and drive to work for CFF differed from the motivation they have now working for it due to realities on ground. The realities much more linked to the core corporate values, informal relationship with colleagues, the leadership style and approach, the diversity of members, the international exposure and all that CFF represents are considered added reasons for which actors are motivated. Some actors (R9, R11,

R12, R17 and R19) shared their perspectives on what motivates them as members of CFF.

'It is an international organisation with lots of cultural diversity. The pay is not that bad too hahaha and the people are awesome. So far, I have enjoyed working here. So growing or advancing in my career line with good remuneration is some motivating factors to be here'.....R9

'My motivation for working with CFFRC is linked to my microbiology background with one and half laboratory experience in plant biotechnology and microbiology. Aside that, CFFRC is an international organisation with many nationalities and multi-location research partners and collaborations. So, it offers some of us several opportunities to have broader networks. This place offers a very conducive environment for work and research as compared to several institutions in Malaysia here. The remuneration is also that bad and I am learning many things from the technical to the non-technical viewpoints'.....R11

'Though I am on this programme, I have a different background all together. I studied Plant Biotechnology focusing on Genetics and Plant Improvement at the university and not food science as you may think. So, I had serious challenges settling in to my roles when I joined in 2013. I was a bit tailored to the laboratory and now must work with scientists, farmers, industries and food vendors. So, what is motivating me is the new responsibilities. I like challenges and I am curious. Not about money or anything because I am content with whatever I have or get. My bosses are so kind to me. They guide and assist me a lot. They have patience for me

and we are like family. Our team is very complete as one is more of industry and public service person and the other is academic and I am assisting them. They guide and nature me well and its good for my personal growth. Now my work and contribution are targeting real people, communities and farmers and not for me to get PhD or publications. I love what am doing'..... R12

'There was an opportunity that came up which was this job. I took it. I needed to have new adventures outside of my comfort and training from the educational fields to typical agriculture and rural development. And this was just a good fit for my interest and passion. Also on working with my boss, I am very loyal to have increased my motivation in working for the theme and CFF. It was definitely not finance as the remuneration was only to survive me and nothing else compared to what I was earning'.... R17

'It is an international organisation and what I am doing is also my passion. My background is related to my work'.....R19

From the account of some of the actors, issues of motivation resonated well with the passion and social relationships they shared and believed in, rather than the economic or financial gains albeit an underlining factor. This appeared to be the choice of actors and seem not related to formal structures put in place by CFF. The feeling of content, strong urge to work for CFF and sense of belonging by some of the members interacted was a motivation enough. The diversity of staff from all parts of the continent brought the world to them in that small environment and however little that was, some of the researchers believe is the strength of CFF

multinational character. In their view point, the style of leadership gave some of them a mentoring and capacity building support from management.

As the CFF operational guideline put it, *The values of CFF requires that senior colleagues work together beyond their own network and responsibilities and must mentor their staff on the importance of collegiality for best performance and behaviours*⁸.

Some other senior category of members considered the contribution of their vast and extensive research experience to the underutilised development for CFF as a form and reason in working for CFF, especially from members who were engaged after their retirement and those with many years of working experience. With the same responsibilities of managing and working for programmes and themes, the basis of interests and what motivates each actor differed. While career progression and the zeal to publish with recognition resonated much with the postdocs and support managers, consolidating and securing their grip on power and influence and advancing the course of science on the part of some of the directors appeared important.

'I am not to build my career from here. I have been here to help build CFF and support them. I have lots of things to attend to from family, to research'.....R3

'I have had an extensive experience in both academic and industries from many different countries and even with some voluntary works in the EU,

⁸ CFF operational guideline, (2015: 20)

Africa and Asia related to the food sector. As a motivation in working with CFF and I have a strong background in Food science for my PhD and with practical and academic experience on that also. This strengthened my interest for the job when I saw it and here I am. Like I said, I worked for 7 years in these countries including top global brands. Another reason is because CFF is an international brand and a place where I can put my industry knowledge on food science in to practice. Critical also is the goal of CFF to develop our local foods using local underutilised plant species. In effect, I share strongly in the value of CFF'.....R2.

The basic principle of collaboration and effective participation is when there are shared values, mutual benefit and existing motivation or push to do it. Although as explained, actors revealed generally that their personal motivation and interest regarding CFF is to offer their services through committed discharge of responsibilities in exchange for good condition of service, better welfare and career advancements, it tended to seem the perpetuation of that claim tailored much more to their self-benefit other than the collective good of CFF. Considering the collaborative challenges espoused in previous chapters on RVC and programme to programme based collaboration, this assertion may likely be the case. In disagreement, a participant claim, such overriding interest do not exist in CFF and hence for the organisations interest that motivates them largely.

'I don't think so, but we all have our goals in life. That could be money or project funding, more power and influence, publish more and get more promotions or bonuses. Yeah, it could be any. But here in CFF I don't think

we have that. Everybody is working hard to develop our programmes and themes and the company at the end’.....R19.

In attempting to agree with the latter part of his argument, the former position on their self-goals are not out of place either. The alignment of actors’ personal interest to that of the organisation is considered ideal. As O’Reilly, (2012) argued, when actors encounter with the realities of practice and existence with different understanding of established interest on the part of organisations or intervention processes, an agreed base and concept of the meaning of the practice is established, presumably in a form that suits them.

5.2.5. Measuring Performance and Funding in CFF

CFF claims it is different, not only from its underutilised/marginalised research focus, but a move away from how conventional research is done where research is carried out in mono disciplinary terms and published, hence it aims to use inter-disciplinary approaches to carrying out their research. As such, they want to be research partners to funders instead of just being recipients of funds for their work, carrying out a huge capacity building initiative/model (Doctoral Training Partnership, DTP⁹) to speed up their research whilst developing the next generation of scientists and using the research value chain (RVC) concept to

⁹ DTP, a research model between CFF and the University of Nottingham Malaysia that is offering over 300 years of postgraduate studentships in different disciplines having a contribution to make on underutilized crops and Crops for the Future as an Organisation (CFF Operational Guide, 2015: 12-13).

conduct a collaborative research focusing on all parts of the issues identified. In as much as these claims exist and seem real, it still plays out to the wider interest of stakeholders and partners including actors within. Aside that, meeting the requirements of being a corporate entity may likely come with its influence and demands that could alter such valid policy position.

Again, the expectation of actors to account for their responsibilities through agreed key performance indicators (KPIs) in the form of outputs, attracting considerable funding not only from the reliable source of the government of Malaysia (GoM) but from other existing funding bodies for their programme and theme activities and publications in high impact scientific journals, appears to challenge CFF's position on being different. This seem not to be different from what the conventional and mainstream agricultural research organisations such as the CGAIR¹⁰ centres and AIRCA¹¹ members do, because use of KPIs as a measure of researchers' output, publish or perish attitude and bring in the money or you are out syndrome seem characteristic of CFF too. The propensity of these things building up actors' interest just to be in the 'game' for the sake of maintaining their jobs in the name of meeting these responsibilities may be high. Some members shared their views;

'They, I am telling you, they really don't care other than their interest. Not about food security or climate future or diversity. It's about their funding

¹⁰ CGAIR, Consultative Consortium of International Agricultural Research Centers

¹¹ AIRCA, Association of International Research and Development Centers for Agriculture (CFF is a member of AIRCA)

and KPIs and to let people know and think they are working. But we just stay out of some of the politics and challenges'...R4

'The KPIs? What about it? It's a good thing for us because of the bonuses. It will also help us in renewing our contracts and even if we are leaving CFFRC, it can help us'.... R12.

'We have many targets to achieve. If such collaboration or working together does not fit in to our KPIs, I do not think we may be part of such project. However, do not get me wrong, we accept and want the RVC thing to succeed and we want to work with everybody'.....R25.

If activities or projects from other groups (themes, programmes and corporate services) demands collaboration from others to which it does not serve their group or network interests and targets, some actors revealed they will not cooperate. These revelations by actors indicate how the use of targets/KPIs/deliverables of their programmes and themes enforces their drive to achieve them even if it contravenes the collective goal of working together as an organisation. It tends to bring pressure on actors to consider more of 'self' driven activities other than the bigger collective aim.

One such source of pressure observed was the issue of funding of projects. CFF needed a constant flow of financial support aside the support from the government of Malaysia to expand its horizon and the sustainability of its activities and projects. Sponsors often demand difficult and tight milestones and deliverables that openly suites their interest in the process that allows for limited innovation

and risk mitigation which does often not favour long term focused research (Azam-Ali, 2010). With underutilised crops as the focus, the expectations of getting low funding response from agencies and governments appeared real as actors and management consistently lobbied and advocated to attract funding even under circumstances that required a change of narrative.

5.2.6. Engagements and Contracts of Actors in CFF

CFF is a knowledge base organisation. It produces knowledge from the physical, biological and social science arenas related to agriculture for public use. Sustaining the tacit and explicit knowledge available to it is important if CFF is to exist in to the foreseeable future. This demands that, capable people are engaged in all departments to help in the knowledge coproduction process. Members from the Theme and Programme Coordinators level to the CEO are not only required to be highly academic with minimum of PhD to the Professorship level, but also with very substantial industry and development experience. Actors are engaged on contractual (short and long term) basis and renewed based on satisfactory performances. Whilst this is good and expects to put employees focused on delivering on agreed targets for which they are engaged and the new norm in employee recruitments by corporations and bigger organisations, it offers a challenge of retaining staff, building cohesive teams, sharing knowledge (Aziri, Veseli, & Ibraimi, 2009) by the organisations and putting excessive burden, uncertainties and pressure on employees.

Several members complained of the challenge of going through several processes to renew their contracts when it expires and the huge amount of uncertainties that clouds them when the contract is about to end. Issues of visa application especially

for other internationals to the Malaysian Immigration which takes an unknown length of time to process burdens almost all the participants which is much linked to short term contract of engagement with CFF. As observed in the research value chain (RVC) concept in chapter (4), one critical challenge for building good teams and long term collaborations in CFF was the issue of short term contracts and staff turnover issue. Sustaining RVC and research projects from actors' point of view required actors who over the period accumulated and developed critical knowledge on what CFF does now and for its future. On a question on contract, job security and responsibilities in CFF, some actors believe the contract system never correlated to their job performance.

'For employment security I don't think we are. We are all on contract and there is no guarantee you will be at post after your contract expires. I am yet to be convinced it is linked to performance and you can see a lot of people leaving CFF'.....R5.

'Yea, we have had some staff leaving the place including the directors. Some just left and others contracts were not renewed. So I tell you that job insecurity is high. You can see that we have many retired senior researchers who are the leaders. It could be linked to CFF trying to cut budget by employing more retired staff or depend on their vast experience which I doubt it's not happening. We have two extreme cases with much older generation against young researchers as postdocs. The synergy should have been there and a growth pattern within clearly mapped out. But I am afraid it is not. In the next five years I don't see myself growing from my current position in this organisation likewise my other colleagues. Referring

to others sitting close by; don't you agree with me? Yea you are right'.....R5.

"These days' organisations give employment contracts subject to meeting targets instead of full permanent jobs. On that I will say am not and everyone here may not be secured too. You have to bring in funds, you have to publish and you have to meet targets. You always have to have an open mind that your next contract may not renew and be prepared for that" R7.

Hence, whilst it is imperative to cut cost and boost organisational performance, it is equally important that such formal policies are guided to maximise the fullest potential of members while dealing with staff attrition, motivation and knowledge management issues.

5.3. The Informal Crops for the Future

As CFF structures its formal management process, the informal part evolves from the day to day interactions between the members of various knowledge communities. Lu, (2014) adds that, when the informal structure becomes more organized and embedded in policy and operations, management often tend to adapt the informal structure into the formal process of running the organisation. As espoused in the formal structuring of CFF, the perspective of actors within CFF on how it operates through the informal eye is important for this study.

5.3.1. Information Sharing and Social Networking in CFF

Use of IT and the internet in CFF revealed a significant adoption of how collaboration and networking is done on projects and with other programmes and themes. Researchers were seen mostly behind their desks most of the times, however vast amount of information was always being shared. It was observed that, use of share point (for different categories of users), emails, skype to share data and information to all stakeholders and use of UMNC online resource platform were common and considered as significant tools for an effective communication collaboration without meeting face to face. Laura and Arbuckle, (2015) argued that, use of these IT related platforms have facilitated an immense transdisciplinary effort and push for project execution and functioning organizations.

Sharing information and knowledge to all actors within any scientific organisation is critical and important (Talja, 2002). Whilst for research organisations, Allen, (1977) and Sonnenwald et al., (1997), argue that, a higher frequency of contacts of scholars with other researchers offers the strongest predictor of their research and publication efficiencies. They postulate that communication and information sharing behaviour and success in project teams, correlates positively and enhances individual effectiveness and project performance. The nature of knowledge and how it is shared depends largely on organisational policies, structures and shared values. Again, issues of the culture of trust in organisations are argued to serve as an underlining foundation for knowledge and information amongst actors in the same in different networks (Kankanhalli, Tan, & Wei, 2005; Wang & Noe, 2010).

As a driver of directives and policy issues in CFF, it was observed that information was shared through informally established culture, which is through lunch and coffee time interactions, visiting each other's desk during leisure times and through friendship aside the formal seminars, project briefings, directives from management and staff monthly forums. Relative to these methods, the level of social interaction, networking and sharing information amongst researchers were dense at the various knowledge community levels than from crossed themes and programmes. More personal and bureaucratic barriers appeared reduced, allowing for communication and sharing of personal stories and experiences other than the usual official responsibilities.

Another medium observed with participants was the social stratum classification where informal relationship is done along with the research grades of researchers. Since it is much easier to make friends at the colleague or same grade level (senior and junior), members were relating in social and hearty interactions either as directors, coordinators or support managers. Such personal social interactions according to Krauss and Chi- Chiu, (2008), often results in sharing lots of official information that some members are exposed to by virtue of their status and closeness to power. Apart from what is demonstrated, gender and age formed a layer of social and informal relationship within CFF. The Programme Support Managers and other actors at the administrative wing of the organisation had more women which allow them to socially relate and interact with each other thereby building a network.

"Apart from the Support Manager for FishPLUS who is a man, all of us in the remaining programmes are women. Also, most of the staff in Dome A (administrative wing) are also women" R9.

On age level interactions, there was a wider age gap observed between the senior research directors and the early career researchers (postdocs) and support managers which offered its own form of interaction and relationships. Many, except for a few of the senior research group members were engaged after retirement.

"You can see that apart from two of the Theme/Programme Directors, the rest of them are retired and being engaged now" R7.

As a strategy by the leadership, the essence of such engagements was to ensure that the early career group and support managers, could benefit greatly from the many years of field, research and academic experiences of the engaged retired research directors. However, over time, most of these experienced research directors could not stay for longer periods. As such, building a network and having an informal relationship with the senior members appeared not as expected from some of the staff. In affirming such conundrums, Neumeier, (2011) suggested that, a social innovative way which offers an overarching social networking and interaction to generate a collaborative action amongst members of different age, background, gender, age and disciplines can be adopted. Stressing further, Neumeier states that, actors in this light, need to change attitudes and perceptions about each other and other groups who are either or not aligned to their interest, camp, status or network for a better collaboration within and beyond their groups.

Some actors linked the state of knowledge sharing and social interaction to leadership in their research process within CFF.

"The informal social networks help, but I think some leadership styles and approaches generates more fun in some programmes for better cohesion and communication and others don't".....R10

"This system will only be very effective if the social interaction and good relations exist amongst us as researchers. If the pure top down leadership approach is changed to horizontal/flat as what the organisation claims. I just wait for my boss to tell me what to do and what will be our next task. We follow the winds and the moods of our bosses. It makes us just sit there waiting for them. It's a challenge".....R4

Leadership as argued occurs through the process of interaction and communication in organisations (Hirokawa,1989), and respondent 10 view on leadership can be linked to collaborative and communicative leadership, where collective participation, cohesiveness and bonding of team members are encouraged to improve on performance in teams. Though information and general knowledge in CFF are shared mainly; face to face, through emails, meetings and seminars, projects and briefing sessions, the request, speed and access of the information depends on the leadership cum the formal structural support

5.3.2. Monthly Staff forum

Every month, management through the human resource unit and the communications wing of CFF organises a monthly staff forum to take account of

the month, make announcements, celebrate birthdays of staff for the month, and communicate important decisions to everybody. It is an opportunity for everybody to attend including drivers, technicians, interns and even students who hitherto would not have had such opportunity to be part. Each staff gets the chance of seeing or meeting everybody and it deepens staff awareness of issues around the organisation. This interactive platform intended to share updates and information and shore up networking and informal relationship building albeit discussing official issues. Members usually will chat, laugh, take selfies and quietly wait for birthday cake and refreshment for the day whilst management communicate to them of any available information.

As important as it is viewed from management perspective to interact and communicate to members in the forum, most participants preferred rather to go and idle without interacting, contributing or asking the questions that are relevant to CFF because of they consider it '*business as usual*'. A participant explained regarding the importance of such a meeting that;

"We just go and sit down. Clearing throat.... to listen to the communication of the CEO and the other heavy weights so that they tell us what they want to do. We normally don't have regular contacts with the CEO directly, so this is one chance to listen to them".....R4

For researchers like R4 and others, there was no extension of any form of communication or interaction to the meeting, but rather to just attend because they needed to. The culture of some members of not talking in meetings was not only because of the business as usual views, but that some lacked the confidence

and deeper proficiency to speak the English language in meetings which is the official communication language. Whilst most of the researchers have high English language proficiency and understanding whether as first or second language speakers, some of them preferred not to talk in meetings for the reason of fear, making mistakes and self-ridiculing. A member explained that;

“For me I don’t talk much in meetings because sometimes I fear to say the wrong things and feel disgraced, unless I am asked a question or to make a presentation to the house, I will not talk. Most issues discussed are normally beyond my level. I can always contribute at programme levels”....

R7.

The idea of communicating with errors or unable to clearly explain issues at stake to senior colleagues appears to limit diverse opinions during meetings from members. Others also were not frequent contributors at meetings not because of the language expression challenge, but because of the topics or issues discussed in such meetings and its relevance to their personal interest. Again, members viewed that, considering such meetings as one platform to listen to directives from management, never warrants any compulsive talking or expressing views during proceedings. To them such gatherings are to help management fulfil their management functions and they need not be challenged or offered contrary opinions.

5.3.3. Celebrating festivals and family days together

CFF takes these festivities seriously and they try to organise get together for celebration of such festivals. Some of these festivals witnessed includes Edul fitr and Adha, Chinese New Year, Dipavali, Christmas and New Year celebrations which

tended to create a belonging, celebration of diversity, respect for others cultures and beliefs and ultimately entrenching on the corporate value system of the organisation. The 'family days together' aims to foster bonding and unity amongst actors. In that gathering, members can come with their family members to dine, interact, visit parts and offices of CFF and deserving awards given to people who are viewed as outstanding in the discharge of their duties. Such bonding and networking boosts the social capital level of the organisation and tends to gain more commitments from the staff. As an element and platform for interaction and collaboration, it offers the tendencies to enhance better working relationship.

5.3.4. Weekly Social gathering sessions and presentations

CFF instituted a weekly social gathering presentation where members are encouraged to present any topical issue to the house normally on every Thursday of the week. The purpose of these presentations was to enhance interactions and cohesion of staff whilst disseminating technical issues. This cut across the research staff and the administrative staff.

"The Senior HR Manager and the Programme Coordinator for FishPLUS put this weekly meeting session together so that we can always share what we have be it social, personal or technical issue. I think it's helping and I hope we should be able to sustain it"R22.

As an observer, a few of the presentations the researcher attended, showed some level of greater interest amongst staff depending on who was presenting. While it was a social event, emphasis was placed on the talk and knowledge to share to members. It served as an added avenue for programmes to present updates from their projects. However, just like other meetings, attendance started dwindling over time due to lack of interest by members, which some actors attributed to *'not serving interest of some few'*, because the idea and concept came from others. Few enquiries as to the reasons for such low attendance, some members thought it was just one of the structures of the organisations and management effort as being seen of doing something and not necessarily the get together or interactions that is required from it as claimed.

5.3.1. Visits of Important Guests

Another important medium of social interaction yet with technical and critical information dissemination processes was guest visitation to CFF. Underutilised crops due to its unpopular tag from the CEOs perspective;

“requires lots of interest building, lobbying and good public relations to draw more attention, focus and funding to the underutilised research efforts”.

In this effort, CFF attracted very important personalities and dignitaries including directors of MARDI, Ministers within Malaysia, Prime Ministers, Ambassadors and High Commissioners of some countries, development partners and the scientific and research community. The visit of these stakeholders and partners appeared very significant to CFF's existence.

The interactions and knowledge exchange during such visits are important to shaping the policy position and direction of CFF. As Knorr-Centina (1983) opined, the active roles, contributions and presence of every actor, stakeholders and partners in teams and organisations, within and without, influences the knowledge produced. Likening it to quantitative triangulation, Knorr -Centina strongly argues that informal communicative activities and interactions of scientists and researchers, serve as the mediating and moderating roles to productivity.

The visits were much more visible especially coming into the existence of the HQ/Domes of the organisation which offers a better attraction sites (field research centre, the architecture of the domes, the laboratories, the flower garden and the lake). This in addition to the research mandate and relationship with development partners, sought to create a routine schedule where staff will always have to prepare for guests.

Actors within CFF by this initiative are often offered the chance to interact and present updates and their projects to these partners for better and effective partnership. Whilst this positions CFF in the research and policy arena with these important partners, it offers a social interaction and networking of the employees with these important personalities to advance their future research collaborations.

5.4. Power and Leadership at Programme and Theme Levels

There is always a strong sense of belonging to a group, class and other social stratum. This affords members an opportunity to share and benefit from the assets

of the group. The influence of members to direct, dominate and immensely benefit from such groups (Anderson and Kilduff, 2009) like the themes and programmes of CFF reveals the interest of social power relations and general capacities of the its members. The sense of leadership at the programme level attempts to provide a very flexible working relationship for researchers. Most of the leaders of the programmes and themes utilises the informal relationship with colleagues. The programme directors will usually walk in to the dome B to ask, share, give instructions and largely interact with their programme members, which from the postdocs and support managers' perspectives, motivates and commits them, instead of the usual top down approach of engagements. They explained that such engagements create confidence, build a sense of belongingness and allows them to feel valued in terms of the ideas they contribute through meetings and normal social interactions which helps to drive the activities of the programmes.

'At programme and sometimes at the theme levels, our ideas are respected and accepted and the bureaucratic process has been relaxed just to create the efficiency and effectiveness to deliver on our targets'.....R12

'The leadership at the programme level is very flexible and I relate with my boss well. Our working relationship is very good and she brings out the best in me and good sense of belonging. I am always allowed to suggest ideas and it is respected and accepted. We see each other as colleagues, though there might be age, rank and qualification'.....R10

'At the bigger level, am referring to the top management, it is very good and open. We take our motivation from them. They are free to be consulted. The CEO is always okay and his office is open all the time to us. The

leadership scale is seen as exemplary because of the easy access, respect for all and equal treatment of staff. Sometimes, some approvals are sought from the Chief Executive first before the middle level management due to the flexibilities of the leadership qualities of the CEO. We will sometimes seek his buy-in before working it through with ur bosses.R10

This working culture of relaxed operational process and involvement of members by the leaders of CFF appeared to be viewed positively by some actors. Whilst it appears that some leaders allowed for collective participation of members in making the everyday decisions which they considered as better leadership, some postdocs and the support managers' views some of the acts as power play and manipulative by the leaders to get their work done. House, Wright, and Aditya, (1997) affirms such practices and styles of leaders who influence the behaviours of their followers through manipulative tendencies, deliberate socialisation and selective management criteria to advance their targets and that of the organisation.

The social and resource power of leaders to determine which grant application to vie for and which proposal to submit and how meetings are scheduled or who deserve a raise within programmes and themes are argued to be the normative functions and responsibilities of leaders in organisations and thus seen as not unusual. Nonetheless, some of the researchers believe that, the bond, sharing and supposed engagements by their bosses that makes them feel good sapping a commitment from them need to come with sincerity and they as subordinates will need to deconstruct that process to maintain the formal CFF.

The structuring of the programmes and themes in to specific disciplines as knowledge communities allowed some level of autonomy and compartment functioning system which gave a lot more control to the leaders. Hence, aside the individual level of influencing or controlling tendencies of the leaders, the compartment working system consolidated the perceived power of the leadership they have. The process of limited social interaction of members from other programmes, whilst internal policies such as RVC strive to foster such collaboration, the compartment system limits the interactive and good attributes of social capital level of actors. Participant 4 and 8 shed more light on such issues;

'To be frank, I have an excellent working relationship with my boss and my two other colleagues. We have good informal relationship within. But I don't relate like that with others outside of the network'.....R4.

"For the poor networking, outside of programmes and themes, it's all normal and it's like that everywhere because we work in compartments. That's my experience. You can't find real flat/horizontal structured organisation unless you have good leadership. Leadership is key in helping with cross functional working".....R8.

For R4 and R8, their views of leadership at the organizational level appeared weak, trusting their immediate programme leadership than the entire management styles. Communicative leadership theory requires that, all followers are taken along with the leader with the responsibility of sharing, maintaining and ensuring that, the core values, motivation, reward system, sense of belonging and

ultimately effective communication, symbolizes an effective and efficient leader (Johansson et al. 2011; O'Daniel and Rosenstein, 2008).

Meanwhile, for other actors, their programme, theme and the organizational leaderships were doing well and that, it provided them a superlative medium for performance and efficiency (R10). They contend that; they could achieve better metrics and targets because of the direction and support of their leaders. As such, issues of power play appeared downplayed by actors as the focus of the achievements clouded much of the office politics. View of power by participants differed if their group could attract the required funding for their daily activities/operations and whether their programmes are considered powerful than others.

"The feeling in the air is that some people and some programmes are powerful than others. That I agree, but cannot tell you who and which programme. But am sure you may know already. The excuse people always make is that because the CEO is so interested in our exemplar crop, that gives us an advantage in this programme which is not true. But my boss is powerful. That I can tell you. The issue is also that we are hardworking and we are all allowed to think outside of the box and suggest. All the programmes and themes have their uniqueness and different roles and we all believe in our area of work".....R11.

'Hhhhmm, I am not sure about this at our level. But at the directors' level am sure about that. Your boss and their level are different. There is clear scramble for power and control after the CEO. We always gossip about that.

It is also because they are the decision makers. They have to prove to the CEO that they know what they doing and that they need the organisation to approve their plans. So that way, they will have to get favours and influence from the CEO. Doing this means they become powerful. But sometimes they compete sometimes by letting us do unnecessary works. But you know it's all good and positive and its part of how big institutions work. For us we are all equal and that's from my point of view. I don't know of the others. Everyone in CFF wants to be in the good books of the CEO. He is so kind; I mean very kind. We all want him to see our good works. Laughed... That's natural. The funding is a huge problem and am sure CFF will get over that in the future'..... R12.

To such actors (R11), the essence of power and leadership are to get work done and make sure everything progresses as expected and not for the profit of the individual members within.

5.5. Chapter Conclusion

Actors in CFF views the organisation as a bureaucratic organisation but uses matrix and functional structuring in executing its research projects. The formal CFF is largely pushed and strengthened by the informal social structures employees develop over time. The communication, networking and interaction processes by actors are thus boosted with SC attributes serving as glue and appeared enhanced by the open office landscape arrangement and the designs of the programmes and themes, though other actors had issues with that. It can be

inferred therefore that, CFF structured domes and reporting system certainly influenced the behaviors of individuals from respondents account.

It can be inferred that, in programmes and themes with good social capital level, can lead to a better relationship, motivation, information sharing and commitment level of colleagues. The social programmes designed (staff forum weekly meetings, celebration of important days etc.) are important formal processes of bringing out the best informal elements of employees. These arrangements have the propensity to boost collaboration and improve on the level of commitment of staff for better performance.

It emerged from the discussion that, whilst most directors and theme leaders were exhibiting collaborative leadership tendencies with their colleagues within the themes and programmes, some actors viewed such strategies as manipulative with embedded interest to get their work done. Other actors thought the autonomous structure of themes and programmes that do not depend on each other to function, limits their level of interaction, knowledge sharing and general contribution to the organisation. These revelations confirm Mohamed, Stankosky and Murray, (2004:129) argument that, rigid functional silos or compartmentalized departments/units in organisations often generates challenging barriers often collaboration and communication between members.

CHAPTER SIX

THE CONTRIBUTIONS OF KNOWLEDGE COMMUNITIES IN CFF

6.1. Introduction

The previous chapter dealt with what is considered as formal and informal CFF from researchers' perspectives and official policy documents related to the organizational structure and office landscape on views about leadership style, reporting process and how actors socialize and network amongst each other. This chapter looks at the contribution of all knowledge communities within CFF, fitting it in the context of transdisciplinary concepts.

Each knowledge community values what it brings to the table and as Kuhn argued, community of knowledge with their own set of specialisations in a team will make sure that there is a continued growth in the knowledge they generate which they treat with precision and detail. It is significant therefore that, a focus on how each group within CFF contributes to the organisation and its link of dependency and synergy is examined. Knowledge contribution of each member in a team is critical to the collective output and value placed on each actor (Bourdieu. 1970; Kuhn, 1962, 2002). The section will be capped with an overview of the communication processes in coproducing the knowledge in CFF with a nexus of formal and informal and technical and non-technical.

6.2. Knowledge generation and Co-production in CFF

CFF as a research institution carry out research in different forms. From field experimentation, field surveys and feasibilities studies, to laboratory research analysis as well as engineering workshops which mostly relates to bioenergy using

underutilized plants with energy properties. The methodology of generating research data as stated reveals the diversities of disciplines and communities of knowledge in CFF. Per the design and structure of the research programmes and themes, knowledge production is executed through their stated milestone and programme objectives.

The biotechnology and crop genetics, agronomy and breeding themes and BAMYIELD programme produces its data largely from field trials and from laboratories to extract molecular and DNA information from the underutilized plant species. With CFF established to advance the course of underutilized species for the climate future, breeding and genetics remains a critical part of its research direction. In addition to this, such disciplines are capital intensive relative to carrying out empirical research which tends to absorb huge funding and overhead expenditures from the organisation. This position, some actors linked to power play and influence from power bearers of such knowledge communities for getting such attention and funding more than others. As a considered area of focus and serving as the primary base for breeding and producing hybrids and breeds for the underutilized story by members, no serious research work can be done as an agricultural research institution without such primary data and information. Nonetheless, such knowledge and data required tend to connect with people and the environment which surpasses their disciplines. To that effect, the social, economic and policy theme collaboration with the biological programmes/themes to coproduce knowledge that determines the need for a crop variety from farmers and other value chain actors appeared significant and required for any critical molecular work and breeding which could be done if it is to serve the interest of farmers and society other than for publications and disciplinary perpetuation.

Field instrumentation measurement such as sensors, moisture meters, soil and water temperature regulation equipment, control and growth rooms and general agricultural landscapes appeared to provide a base for SAGEPLUS in a linked data generation process with BAMYIELD. The field research centre (FRC) and the DOME C (laboratories) teams were observed to play a significant role in helping these themes and programmes carry out their research works both in the field and at the laboratories by making sure that the appropriate protocol setups, logistics and maintenance required are offered to the researchers. Data produced from laboratories and field experiments is argued to be influenced by the internal and external environments and cannot be argued on lines of scientific purity without influence (Knorr-Cetina, 1992). Knorr-Cetina, (1992:128) further explains that, laboratory based system of knowledge production would be exhibiting a socio-political character of leaders and senior scientists promoting their careers. As such, data generated through these processes of several networks had the mutual collaborative element and influence that takes away the disciplinary purity claim by researchers.

The CropBASE programme produces data that is an output from all programmes and themes by taking empirical and metadata from these groups for processing. Actors in this programme views the collaboration and data sharing with other communities of knowledge to be critical of the success of the underutilised research and progress of their programme. Underscoring the essence of such collaboration, participant (R7) revealed the use of social relationships aside the formal processes enhances their work amid challenges they face as a knowledge management base programme.

'We are making significant contributions to CFF though slowly. We have created a database now and we are bringing everybody on board. The platform is serving as a glue and source of information and knowledge management base for the organisation. We are developing formats now to collect the metadata from each of the themes and programmes. We now have servers that host the data we are developing. But we have a lot more to do. We have not done much due to serious challenges'.....R7.

'Networking is okay. You need to have some level of social relationship here to function very well. So, that things can be easy for you and you will not have setbacks. I flow very well with my boss and the PSMs within our programme and I also have some good relationship with almost everybody. Sometimes we argue or disagree on issues as employees or scientists, but it should always be quick for us to come together or move beyond the disagreement. If you only follow procedures, nothing will work for you. That's my opinion'..... R7.

Whilst actors acknowledged the need for collaborative knowledge production which resonate the use of RVC policy as discussed in the previous chapters. Most of the publications generated which represents the knowledge produced within the period of the establishment of CFF, produced disciplinary silo focused research with few joint publications. A check on the official website of CFF, google scholar pages of researchers and research gate publication lists of actors revealed that. Azam-Ali, (2010) argued that, when research and knowledge production is driven by formal investigations and scientific research alone without consideration of the

local vocabulary (peoples' perspectives) and contributions from other disciplines, it tends to organize scientific knowledge into hierarchies, schematically defeating the very need for joint and collaborative knowledge production. Some actors tend to hold the view that, their disciplines and programmes appeared more scientific and prestigious than others in CFF.

An actor revealed that;

'Not all of us researchers are scientists. Social science people are not scientists and I do not see them as such, but we work together'.... R11.

Working together with this actor's view may seem challenging considering that, the knowledge contribution from other team members are considered not to be in their disciplinary genre, as such has no technical mind to contribute on scientific discourse. This demotivates and reduces the value contribution of other members with different specialisation in a team relative to Azam-Ali, (2010) proposition. Since all the communities of knowledge in CFF are clustered on a genre of disciplines, it reflects on how the themes and programmes are structured and viewed by each other. Actors viewed and appreciated their own programme and theme contributions and what it represents to them.

"I think when a programme publishes more, get more projects and funding and delivers, we respect such programmes and its actors more. But I must add that all the programmes are at different levels of growth" ...R12.

In addition, programmes within the period that attracted good funding either within or outside of CFF and having more functional projects were considered better, highly ranked and seen as powerful programmes with high value.

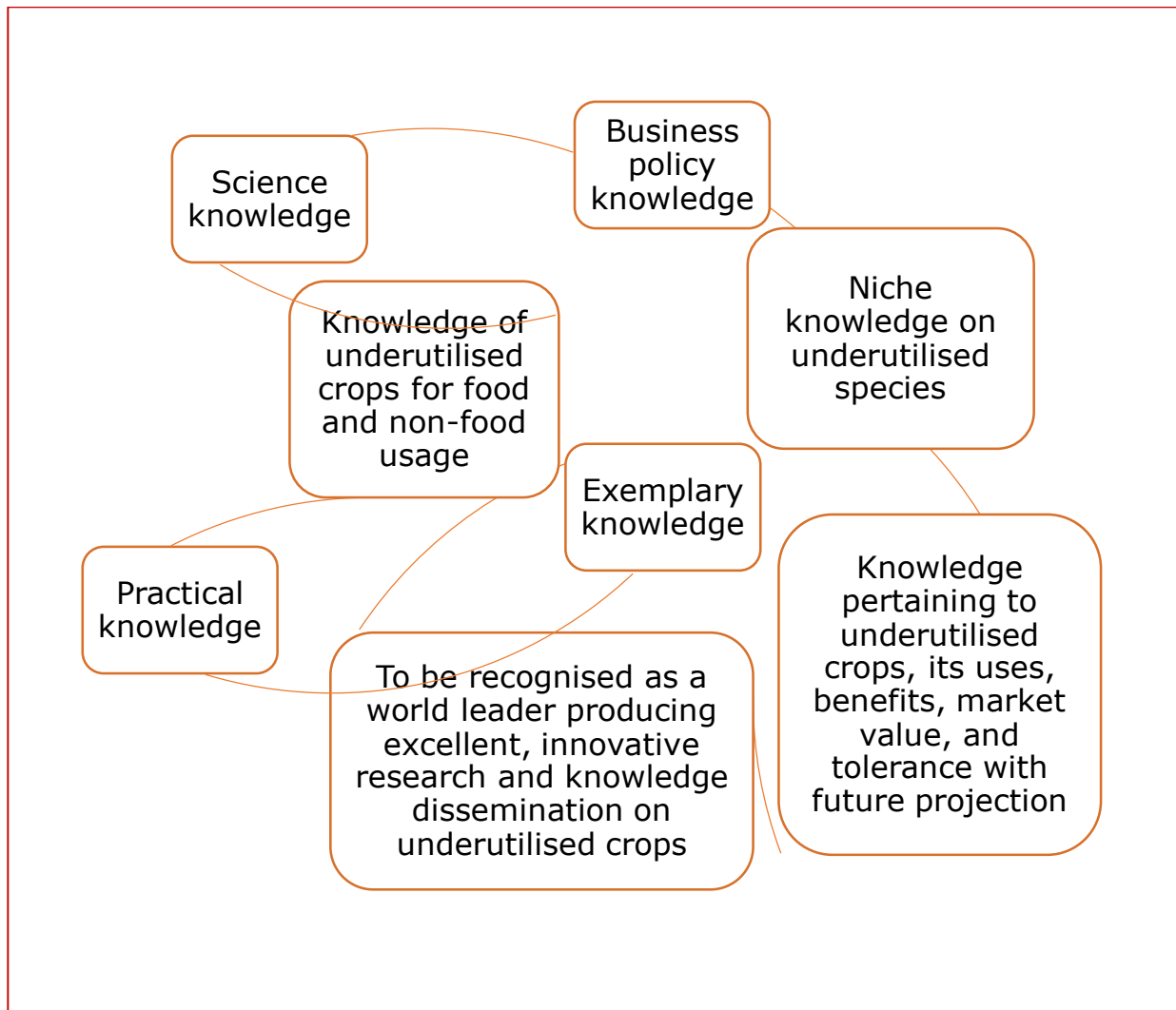


Figure 6.1. Actors Perspective on the Types of knowledge CFF produces

Issues of knowledge production CFF appeared more simplified to actors, though in different perspectives. Whilst others considered the knowledge produced as scientific research knowledge on underutilised crops/species, others opined completely that, it is purely and entirely business policy knowledge produced by the collective irrespective of where the knowledge is generated (Figure 6.1). Admittedly, just like the perspective on scientific knowledge produced, the view point of business oriented knowledge appears synchronised with the CFF business

model¹² concept that aims to make CFF financially sustainable with the going concern approach of business as a research company. Figure 6.1 presents a mix of actors' views of what categories of knowledge CFF produces.

As such, from policy development perspective, institutionalizing different knowledge paradigms from different actors appeared not only challenging, but from Fisher & Holland, (2003) point of view, received minimal attention within the policy process. Researchers from biological, economic and social, physical and engineering arenas in CFF need to appreciate that, whilst it is critical to produce purity of knowledge in their specialisations, mainstreaming and commercialising this category of knowledge is already challenged considering its 'orphaned' status and long term financial unstableness. Hence a bridged divide between various communities of knowledge within the organisation to consolidate what it set out to do in a competitive global knowledge environment is of no bargain for the researchers.

Having established the link with laboratory and field experimental knowledge as well as the field survey and observational knowledge generated in CFF, and how

¹² A model underpinned by a fundraising strategy by producing excellent scientific research outputs with the involvement of partners and end users and doing business. With a Malaysian government grant of an estimated US \$ 36.3million involving land, development and operational grant which is phasing out, a mix of fund raising, consultancies and delivering of prototypes and proof of concepts with scale up and commercialization propensities will enhance the sustainability of the funding strategy-(CFF Strategic Plan, 2015 :38).

actors perceived the importance of these contributions to their programmes and themes and CFF in general, it may be relevant to touch on the nexus of knowledge production in CFF and its funding influence. In the phase one or early stage of its establishment as an organisation, exposure and vulnerability to funding conditions may likely be abound considering the current challenges in sourcing funding for research and underutilised. Actors revealed that several projects along the line got abandoned not because of funding availability but presumably the non-relevance of such research initiatives to the funders, the interest of some key actors within CFF and in fairness, the non-feasible aspects. A participant (R3) expressed concern on funding model and how that affects the research progress and agenda of some themes and programmes.

"Funding has been the main issue wing with all the programmes including BamYIELD and Biotech theme as it trickles in bits' form. For instance, we have had approved budget from MARDI which is not released to us and it's a challenge. Our partners from (Ghana, South Africa, Indonesia, Zimbabwe and Nigeria) require funding for the agreed research projects. And with the 'pay and get your research' attitude and clear message from partners, quicker execution of projects is not being seen. Biotech and crop genetics theme in particular do not have budget allocation or approved for 2015 and that should tell you the level of challenge"R3.

Adding on, the concern that research on Wing bean and other local species had to be initiated to sustain the interest of the local government (MARDI) who are the principal funders whilst maintaining other exemplar crops such as Bambara crops largely known to Africa had to be done. These tendencies according the

participants changed many initial proofs of concepts developed with the long-term vision of impacting a strong scientific knowledge on the underutilised agenda of the organisation.

6.3. Knowledge Management, Data policy and Copy right

Recognition of the knowledge coproduction process can be traced to issues of data policy and how actors manage knowledge produced in CFF. As actors collaborate to coproduce knowledge, how it is managed and utilised in CFF and external stakeholder matters. Having espoused the tacit knowledge¹³ (opinions perspectives, experiences, competencies and commitments) from actors' point of view, the explicit knowledge¹⁴ (data, information, documents, files and records) which enhances the usage and management knowledge was relevant to this narrative. The technical hands on experience and perspectives of the professors, those with industry and development experience and some of the postdocs were

¹³ Tacit knowledge according to [Chisholm and Holifield \(2003\)](#) and [Tagger \(2005\)](#), is the silent knowledge with implicit learning involving expertise within an organisation like CFF which has not been written down or formally expressed with prime expert characteristics, competencies and judgments but nonetheless important for effective and efficient operations of the organisation.

¹⁴ Explicit knowledge according to [Sanchez \(2005\)](#); [Kim \(2000\)](#) and [Tagger \(2005\)](#), refers to the procedure and rule based knowledge that is used to match and guide actions of actors and holders to situations by elucidating appropriate procedures and rules such as files, documents, data etc.

considered as very critical tacit knowledge for CFF which ultimately are scripted and documented as data.

Data management in CFF is considered the major responsibility of the CropBASE programme which is expected to provide a platform for sharing, storage, dissemination, regulation of usage and the appropriate expected protocols. In explaining the concept and principle behind establishment of CropBASE programme as a knowledge management platform, R9 put it as;

“CropBASE was established on the heels of responding to some challenges of gathering, handling, relaying and the utilisation of information within CFFRC, its partners, end users of the information and other stakeholders who may find the information useful. It is a global knowledge base platform. It will integrate and communicate quantitative research on underutilised crops, initially using the other five CFF programmes as exemplars. It uses Social network interfaces facilitate information sharing across the whole Research Value Chain (RVC) on all aspects of underutilised crop research. Again, it uses geospatially-anchored tools to share the knowledge on the interface and platform for our users to use. The prototype platform collates, evaluates and disseminates applicable information to each different user groups using digital tools. The CropBASE programme incorporates three sub programmes which focus on: Husbandry and value chain, modelling and mapping and breeding. Within each theme expertise and approaches are being developed to achieve specific goals through interlinked work packages that will provide information on present status and future scenarios for specific underutilized crops under CFF”..... R9

In making real sense of these technicalities, it was observed that CropBASE as a programme is required to build the underutilise knowledge domain with pre-existing data and literature related to agriculture and underutilise species, local vernacular knowledge and the new knowledge generated by programmes and themes (Meta data, empirical data, published and non-published research data) to be shared on the CropBASE platform as a database for use by the researchers themselves and stakeholders (research institutions, government agencies, farmers, processors, funders, etc.).

Dealing with that means the data policy of the organisation is required to enhance the process. However as at the time of this research, the data policy issues still appeared to be a challenge for the researchers and the organisation in general. Given that CFF is still young in its five years of existence, the expectation of some structural challenges was considered not unusual. That been said, the nonexistence of the data policy to formally regulate and guide the use and handling of data provided a challenge in the knowledge coproduction drive of actors.

"We do not have a data policy. There are no guidelines for us to work with on the data we produce as programmes and themes. It is difficult for us to just give datasets to CropBASE just like that. The last time, CropBASE gave us a format/excel sheet to fill in for data standardisation specifying the type of information each programme require and that is it...nothing much".....R24

"We are told there is a server now as an organisation and other IT tools are being developed. We hope things work"R23.

It appeared then that, the willingness of researchers to share information/data to other programmes including CropBASE for its KBS¹⁵ depends on the assurances of CropBASE to the programmes on the quality of its tools in data handling, the standards being used as per international standards, strict data adhering protocols, timely request and explicit definition of the type of information required. Actors revealed that, they can only be comfortable and trusting if knowing where their metadata and other data generated is going and who is using it to avoid knowledge scooping and copyright issues. Actors further believed that with the current form of data and information available to them as researchers, the lack of data policy existence seem not to be helping if they are to leave CFF now.

“Leaving CFF means, we are going away with so much data and information that are considered as critical knowledge for which CFF spent huge sums of scarce funding to generate”R23.

As Bose, (2004) indicates, the most common and generalized form of knowledge management is the involvement and development of knowledge repository as well as forming and nurturing of communities of practice to ensure sustainability and efficiency (H. Alrøe & Noe, 2010). Wamundila, (2008) further added that when relevant knowledge is well documented for organisations, it helps to mitigate

¹⁵ KBS, knowledge data base, outlines and organises into a structure, the data sets of programmes and themes for easy access and use using Galaxy as a tool with Aqua Crop model, a CropBASE programme.

actors' attrition challenges and thus serve as a strong link to nurturing and training new members with their wealth of experiences.

'All the meta data we are generating including trials of ideas and concepts as researchers are on our desktops and so if we leave, CFF loses'.....R24

While these legitimate concerns appeared to overwhelm actors responsible for the knowledge management of CFF, it revealed the complexity and difficulties in handling different form of data coming from not just the qualitative and quantitative strands, but from spaced disciplines that appears to challenge CropBASE in formatting and ensuring data uniformity on their KBS systems.

"A precision and rigid system of quality control system and tools to pre-process for data quality and uniformity and for synchronisation on the interface seem useful"R9.

Formats to allow varied units of measurements (kilograms, grams, litres, numbers and frequencies, value based text etc.) will show a complex layout to both the researchers and the end users because of methodology differences of the various knowledge communities in CFF.

Data policy should be a broader policy regulation that guides the type of information and knowledge CFF should share with partners, stakeholders and the public. It should also show what is expected of each programme, how they should collaborate with others to generate the metadata/empirical data for the KBS interface for publishing which should suite the interest and purpose of each knowledge community. In describing the seriousness and challenges of data

handling and integration in agencies, USDT,(2007); Ziegler & Dittrich, (2007) put it that, data synchronisation and integration involving huge quantities of variable and lots of heterogeneous data with varying data formats in standalone units might be doubtful to other stakeholders that their needs, interest and data ownership will be supported by the system aside the quality of data and formatting issues.

This leads to knowledge or data ownership tussle by all knowledge communities within CFF on the CropBASE platform. In transdisciplinary knowledge management processes, data ownership and copyright are challenges to a fluid transdisciplinary team. It is expected that the clarity of who owns the knowledge or information allows members to freely contribute their unique perspectives to the projects. As a formally structured programme, CropBASE requires these policies or regulations to enhance fully its transdisciplinary platform for CFF. For all actors to own the knowledge coproduced, it is argued that, all stakeholder have buy-ins and active participation and involvement in the problem phrasing or definitions by all actors (Belcher, Rasmussen, Kemshaw, & Zornes, 2015; Lang et al., 2012; Sonya Dewi Ramadhani Achdiawan, 2006), in this case the theme and programme team members are essential to adducing better claim of legitimacy to the scientific contribution of an organisation such as CFF. Coproduced knowledge under transdisciplinary setting like CFF, requires an integration of various epistemologies and methodologies from the biological, physical and social science actors which appears challenging. Premised on these normative transdisciplinary elements on knowledge production with multiple actors, issues of copyrights and knowledge ownership by actors and knowledge groups in relation to the existence

of data policy and system as observed in CFF, appeared critical to the knowledge management and integration process.

"We claim we have an integrated themes and programmes and that will be supported by the RVC and the studentships (Doctoral Training Programmes). But there is no integration at all. The RVC and the students' projects are not integrated. I hear they said they will improve that with round 2 calls. Its fair I mention fairness and open environment. CFFRC is doing well. No discrimination and all that"R12

"For publications, if it's time we will all put out our names there because we all worked for those findings. If my role is acknowledged, fair enough if not no problem".R2

While such policy may guide how data generated is managed and integrated, the tacit knowledge of actors occurs on issues of reality and social requirements on how everything within the organisation is instituted (interest, power, commitment, respect, equity, motivation and loyalty). It can be considered as important action towards a genuine culture of collaboration and knowledge coproduction.

6.4. Administrative and Non-Technical Contributions to knowledge

As established that knowledge in complex environments such as CFF cannot be produced in isolation but will directly or indirectly have a link to other actors (H. F. Alrøe & Noe, 2014; Callon, 1986; Knorr-Cetina, 1992). The scientific data generated from the field research centre, from the DOME C, from laboratories of Nottingham University, from field surveys and from partners all over, provided disciplinary focused outputs on underutilised crops even with collaboration with

actors from different communities of knowledge, could not have been possible without the pivotal roles and support of the supporting actors in finance, human resources, facilities, communication, monitoring , corporate services unit of the organisation.

“We offer them a lot of support. No proposal or project can be done without our involvement as support staff. The administrative support from finance, facilities, communication and HR are very important to their daily operations”R22

With these elements of heterogeneous practice for knowledge production as a concept of Mode 2 science (Hessels & van Lente, 2008), the appreciation and acknowledgement of these groups (supporting staff) in the production of scientific knowledge may appear relevant in solving team management and organisational complexity in knowledge management.

CFF supporting staff expectedly are not holding advance degrees like PhDs as academic qualifications compared to their counterparts in the research wing. However, that lack of in real sense of actor network concept, negates any roles they play. This tendency appeared to entrench a feeling of apathy in some circumstances towards the researchers especially when their ideas and perspectives are thrown in to their face on disciplinary hierarchical basis. A participant (R23) revealed that;

‘The researchers seem to be difficult people, in meetings, even when we are not talking about their sciences and research work but just general issues required, they think your opinion is not good enough, but I must add

that not all of them. Some of them have that attitude whilst others do not'.
...R23.

Another actor added;

'CFF is a research company and we sell brains by producing technical knowledge'.....R22

so we should all be part and acknowledged in the whole process. In working with technical scientists and with administrators, one senior officer intimated the challenges with the differences in their trainings, specialisations and perspectives whilst working together in CFF which undermines their contributions to the organisation.

'It is very difficult and challenging to be honest. The researchers like working in silos. They do not like working together at all. Also, they are territorial and want to always keep their space. Again, they do not want to share information. If we are not able to brand CFF well and let the world know who we are very well, it means we are well structured and organised. I get worried sometimes'.....R22.

Interactions with farm workers at the field research center who perform the roles as farmers reveals that, their form of involvement is mainly been told what to do. They work based on instructions given, either to establish a trial plot for demonstration, maintain the farms, perform agronomic practices or help research students establish their fields. Opinions and perspectives from these non academics are critical to the transdisciplinary discourse, and in this regard need to be engaged through collaborative communication.

6.5. Knowledge Coproduction and Communication

The purpose of transdisciplinary approach is primarily to cross various disciplines together in order to produce knowledge that can solve complex problems just like CFF does. Actors will have to communicate to coproduce the knowledge. CFF technical and non technical knowledge communities collaborate to produce joint knowledge on underutilised crops. The biological, physical and social science knowledge produced by actors in CFF revealed some challenges as a result of communication issues. Each knowledge community had different view and type of knowledge CFF was producing, revealing their strict disciplinary and methodological differences. The instrumentation, laboratory, field surveys and interview methods the themes and programmes used in generating their knowledge were enhanced by informal relationships supported with the formal structures of CFF. Due to these differences, there were issues of lack of understanding of each other work and contribution and that served as the basis for effective communication. Some respondents recounted the challenging aspect of communication in producing knowledge in CFF.

"I will make a presentation and no one will ask me a single question. This happened several times and I am always told they don't understand my work and our work, that is very technical and they can't follow. This can be awkward la! I don't know how to communicate to them again, even after adopting and using Prezi instead of PowerPoint sides. They always feel like we are not doing anything.....R9.

These intimations show that not all information shared or presented are understood even understood at all. There is always a significant difference

between what is presented or communicated and what is understood by other actors, if the language, the methodology, and perspectives do not resonate well with them. Transdisciplinary narratives beliefs that, there has to be a conscious effort at taking interest in every knowledge or information shared, and that begins with proper communication and listening. Therefore, disregard of knowledge from other actors within the organisation as observed by R9, R17, and R24 defies the objective of working in parts for the whole of CFF.

"Disregard for others due to backgrounds for technical contributions (perceive others as jokers and not important). Ignoring indigenous knowledge other than lab generated data"..... R17.

"Our disciplines really have an influence on how we see things, understand and communicate issues to others. Some team members have poor communication skills and other just don't get it at all, you know. And it burdens one to be in same project with such colleagues because you end up doing all the write-ups and presentations when its should have been done by the team. The communication issue is real".....R24.

"You know my job is to get feedback from and put the information out there to help build the CFF brand. But it's like they want their ideas to be stolen or copied by others, I don't really know. They always hide everything and so getting information is hard for me. Seriously these guys are weird sometimes and they don't like facial interactions so much other than emails which they do not even respond to laughed. So, you see, I don't know. Keeping and controlling their information and knowledge is what they want

whilst we need it to publicize the organization for good corporate branding”.....R22.

These communication challenges influenced their level of collaboration for an effective knowledge coproduction for CFF. Issues of no good feedback, absolute desire to hide or not share information, mimics the challenges of transdisciplinary communications as argued by OECD, (1996) and Wang & Noe, (2010) that, knowledge coproduced under transdisciplinary teams without structured process and policy to allay fears of being scooped and acknowledged or appreciated as authors of the joint knowledge, will always result in lack of contribution and self cossetting by members . The data policy issue in particular contributed to some of the communication challenges at hand as some took the protective posture of not sharing and releasing information to others. Transdisciplinary knowledge claims as output from teamwork has always been the challenge stifling interaction and knowledge sharing. Joint research publications by actors in CFF were not very pronounced on online research platforms (Research Gate, LinkedIn, Google Scholar, Academia etc), an affirmation that, the fluidity of communication, trust of sharing data and collaborative strength of coproducing knowledge had challenges. Others felt their contributions were not respected or appreciated compared to others, leading to a holdback of actors.

6.6. Chapter conclusion

Interactions, information and knowledge sharing are communication forms in general communication epistemology. Individuals, groups and organisation use these forms of communication to enhance effective collaboration and cooperation

for knowledge coproduction and management, so that real life problems can be addressed. Since project implementation requires some level of support, collaboration and stakeholder buy-in, a sense of respect for different opinions and team members specializations or responsibilities remains vital, which exist in CFF, albeit not so pronounce from actors account. Actors recount did not really portray a strong use of the informal elements of SC in coproducing knowledge, resulting in the weaker communication and lack of understanding of each other. Each member's understanding of the others' areas of work and research has a corresponding and positive effect on the general underutilized knowledge, which in effect means that, deeper level of interactions are required than it is now. Consolidating such argument, is even the case of humans and non-humans being considered as equal actors in an integrated network usually sealed in black boxes (Callon, 1986; Nimmo, 2011) in an effort to consider the value of the objects for better output, talk less of humans and colleagues in the same whole network.

CHAPTER SEVEN

PROPOSED FRAMEWORK AND CONCLUSION

7. Introduction

The study set out with an overall aim of assessing how researchers in CFF interact and working together with their disciplinary diversity and differences from a formal policy point on one hand, to the informal organisational aspects of actors' views and approaches to communication on the other. In specifics, it set out to understand the contributions of different knowledge communities to the research mandate of CFF. It discussed formal policies, procedures and internal regulations that exist to enhance or inhibit disciplinary communication. Importantly, it looked at the knowledge coproduction, management and ownerships and how that motivates actors' zeal to working together for effective knowledge generation for CFF.

The real-life issues at CFF regarding the complexity of agricultural and its related issues demands swift and focused research attention to solve, but nonetheless faced with communication and interactive challenges among actors as a result of disciplinary differences, methodologies, approaches and vested interest. As such, understanding these interlace of differences that tends to limit fluid communication in CFF, served as a huge motivation for this study. The chapter further provides an overview of the proposed framework for transdisciplinary communication in agricultural research organisations such as CFF. This framework is specifically generated from the findings of this study.

7.1. Framework for Transdisciplinary Communication in CFF

7.1.1. Formal and Informal Organisations

The framework starts with the structure and support system at the formal organisational level (Figure 7.1). The framework (Figure 7.1) argues that, communication starts from the formal structures and that, organisations and actors influence each other in their relationships. The structure, internal controls, policies and reporting processes influences how actors communicate both at the formal and the informal levels. The types of formal elements in organisations determines the type of and technicalities of communication that exists within. Organisations and projects need to communicate to actors on their values, their purpose and knowledge or product produced, and how they want the engaged actors to function in parts to achieve its mandate. In particular, for CFF, it designed its formal structures around its research programmes, research themes and the administrative support unit supported by hierarchies of leadership structures (Support Managers, Programme and Theme Coordinators, Research and Programme Director/ Leaders and the CEO). Researchers communicate and report through these hierarchical processes with research projects and the RVC as the centre and convergence of collaboration and working together (Figure 7.1) to achieve the goal of CFF. However as revealed in this study, fluid interaction through these convergences appeared not effective because of several factors including researchers networking problems, competition to outwit each other, issues of power and self-interest and the structuring of the policies itself from actors' account. Hence, what appeared to support the process from actors' perspectives within CFF which need to be consolidated and mainstreamed as proposed by this study; are the informal SC elements-informal organisation

(mutual respect, friendship and bonding, social cohesion and networking, reciprocity, teamwork, collective participation etc.) (Figure 7.1) of every actor on issues that matters, helps to shape the reality of how they feel, act communicate. The framework (Figure 7.1) suggest that, the programmes, themes and support units, domes etcetera, alone, appeared not enough to serve the overarching expectation of an effective collective CFF with knitted networks that exactly focuses and works towards CFF goals. The combination, adaptation and modification of some of the best informal traits and practices espoused by members (SC) in their day to day activities may improve their levels of effective interactions. As affirmed by Bourdieu, (1986); Wang and Ahmad, (2002); Soda & Zaheer, (2012); Sarlak, Mohammad Ali, (2014); Cohen, Nelson, & Walsh, (2002), the formal structure cannot function alone without the informal elements of people as it brings together the socio-technical aspect of the organisation (work, technology, people, processes, structures, and information). In both cases, the nature and style of leadership provided by team leads in organisations and specifically CFF may tend to influence and drive both the formal and informal relationship for better communication.

7.1.2. The Knowledge Coproduction and Integration Dimension

The ultimate aim of Transdisciplinarity is knowledge production. CFF is a knowledge base organisation. Producing and managing knowledge in organisations are anchored on collaboration of actors, data policy including handling of intellectual property, copyright issues, knowledge generation and coproduction, dissemination and the usage of the knowledge produced internally and externally. The ease, comfort, commitment and motivation to collaborate in

producing and sharing knowledge from the experience of actors in CFF can be consolidated with communicative leadership supported with some elements of SC. Researchers are more likely to collaborate and share knowledge if they know that, their contribution and effort will be protected and benefit them (OECD, 1996; Wang & Noe, 2010). This may thus serve as an incentive to share and communicate to create knowledge. Actors in CFF knowledge community clearly indicates that, their knowledge contribution should be well acknowledged and supported just like others. When there are issues of developing a uniform format for data gathering and uploads on its technology platforms for use, it automatically indicates serious challenges for integration of the data generated into a single outcome that echoes transdisciplinary principles in solving complexity. Hence a collective defined and established knowledge management policy that takes on board their views can integrate the pluralistic knowledge produced. This the framework (Figure 7.1) suggest can be done through dialogue on data incorporation from all themes and programmes, may likely improve knowledge coproduction and ultimately on integration, with clear communicative processes. The use of explicit and biased terminologies, jargons and peculiar disciplinary language by themes and programmes to convey their messages to members within and outside CFF, may likely be improved through dialogue and common ground search on what is best for all the scientists and CFF. Integrating data from all aspects of exemplar underutilized crops may tend to succeed if actors are willing and ready to collaborate and coproduced knowledge from need base assessment in communities and markets, breeding and production, to utilization and impacts studies. Bhandar, (2010); Mengis, (2007) observes that knowledge is easily understood if communication is well understood from the organisation to the employees and the amongst the employees themselves.

7.1.3. The Integrative Process

Actors using the formal and informal elements to generate transdisciplinary knowledge requires a process of integration to solve the complexity. This means that an agreed simplified process has to be followed in merging the perspectives of actors in the team. Transdisciplinary philosophies argue that, joint problem identification and framing, assigning responsibilities, bonding and understanding each other with streamlined reporting process are ideal in integrating knowledge produced. However, the study reveals some challenges namely; lack of data policy, different data set formats, technical language, hierarchical reporting system and some actors not recognising other disciplines, etcetera. The framework therefore proposes that, collective problem definition, agreed uniform data protocols/format developed, and satisfying knowledge claim and recognition of each actor with a timely simplified reporting process, would have relaxed and encouraged actors to interact and communicate more whilst knowledge outputs are merged.

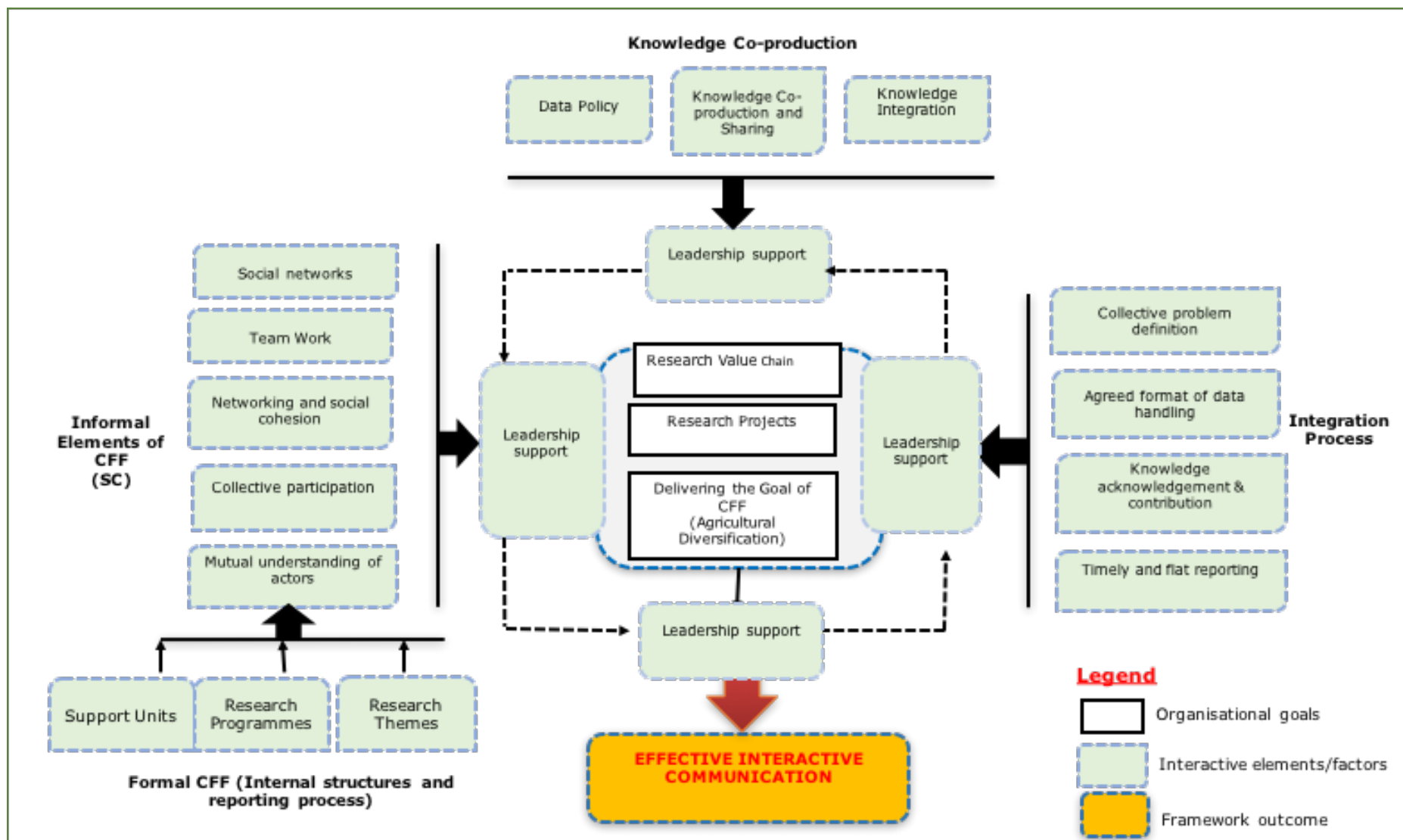


Figure 7.1. Proposed Transdisciplinary Communication Framework

7.1.4. Leadership Support Dimension of the Framework

Communicative leadership from the study revealed that, leaders need to rally their followers along with essential leadership skills that encourages collective contribution, participation, and sense of belonging. The framework assumes that, leadership support through a mix of appropriate styles and support from specific project, theme and programme leadership can serve as the ideal springboard.

These, the framework (Figure 7.1) beliefs can play a significant role to easing the challenges and improve on the structured and unstructured reporting process identified, mainstreamed the informal social network elements (SC) and collaboration for knowledge coproduction process, can effectively enhance a better interactive communication in CFF and research organisations with similar structure alike. Project Management Institute, (2013) argues that, when team members communicate well to each other whilst working on a task/project, the outcome is always a successful project (such as the RVC, specific projects and overall goals of CFF) well delivered to all stakeholders.

7.1.5. Framework Applicability

The framework explained that formal organisations are heavily supported and moderated by informal elements such as the elements of social capital especially regarding interaction or communication. These assertions reflect normatively in almost every social unit or organisation, and thus a point that, it is relevant for consideration whether in research organisations, corporate bodies, public or non governmental organisations. Further to this, knowledge coproduction in organisations is critical essentially for the collective effort of each actor or employee towards the

goals of the organisation. Producing the knowledge, sharing it, managing it, largely depend on the knowledge management and data policy available in every organisation and its ubiquitous requirements for actors to adhere to. Data and knowledge management policies of organisations are argued to allow for better interaction and fluid communication amongst actors of different roles and responsibilities which serves as input and output outcomes along the chain. As such, it is argued that such position of this framework can be applied in organisations that are knowledge production and management inclined such as CFF.

In every organisation where there are transdisciplinary communication challenges, it is required as argued by scholars that integrating technical, social, including different perspectives in the problem and idea generation stage stage in project teams and organisations, reporting process is a must towards a fluid interactive outcome (Hirsch Hadorn, Bradley, Pohl, Rist, & Wiesmann, 2006; Leeuwis, 2000; Nicolescu, 2010; Noe, Alrøe, & Langvad, 2008; Pohl, 2005; Thompson Klein, 2004). Leadership support to managing these determinants (formal organisations, informal organisations, knowledge coproduction and management and the integrative process) towards the goal of the organisation, the framework argues, can consolidate and give the required influence for a better and effective interaction amongst on actors. Hence, such aspect and claim of the framework can be applied in organisations that are technically led for better team work, delivery of outputs through shared communication.

Whilst these may not be encompassing enough to addressing transdisciplinary communication challenges in every organisation, and may require modifications, update, changes and additions to suit, the framework argues to address the essential

communication issues identified in CFF as per the empirical data gathered from this research, though it was not tested. The study therefore posits that; this framework can be applied to similar transdisciplinary research organisations for better communication.

7.2. Contributions to Knowledge

7.2.1. Contribution to the Literature

In digging deeper to understand and answer the research questions on transdisciplinary communication, detailed theoretical reviews of the evolutionary processes of disciplinary science and research (monodisciplinary, multidisciplinary, interdisciplinary and transdisciplinary) that has been used in the past and is currently relevant to address life challenges were done. The reviews suggested that, complexity of real world issues can be dealt with a combination of technical and none-technical perspectives from both academics and non academic approaches. It concentrated the argument on transdisciplinary as advance and upgraded approach of addressing complex multifaceted issues and relating it to real development projects. The review further suggests that, elements of SC are ideal to promoting transdisciplinary approaches which the research identified as gaps. It identified how communication plays significant role for actors to coproduce knowledge in organisations.

Theoretically, the study elaborated on the scientific disciplinary concepts (single, multi, inter and transdisciplinary concepts) (see more at Azam-Ali, 2010; Cassinari et al., 2011; Hirsch Hadorn, Bradley, Pohl, Rist, & Wiesmann, 2006; Leeuwis, 2000; Nicolescu, 2010; Noe, Alrøe, & Langvad, 2008; Pohl, 2005; Recha, Kapukha, Wekesa,

Shames, & Heiner, 2014; Thompson Klein, 2004) on why transdisciplinarity and the need for improved communication in projects, organisations and teams and how it evolved over time to involve academia and non-academia in solving real world problems.

In addition to that, the study argued that actors with different worlds views, interests, and disciplines can work and interact with each other better with the adoption of the principles of social capital and actor networks (Bourdieu, 1977; Bueger & Stockbruegger, 2016; Callon, 1986; Gray, 2009; Latour, 1996; Pohl, 2005; Portes, 1998; Putnam, 1988; Rønning, 2008). It espoused on the relationships between actors and actants and the synergy that emerges from that for effective collaboration, performance and coexistence of actors in projects, teams and organisations.

Again, apart from the SC theory, the study explored the theory of bureaucratic structures in organisations, and communicative leadership theory, which the study underpins. The findings of the thesis observed that, the informal and formal structures and policies in organisations significantly contributes and influences how actors relate, interact and achieve their interest that helps them to contribute to the problem at stake. While the formal structures allow for orderly and expected form of behaviors and routines in delivery of milestones and how to work in organisations, the informal culture- thus, day to day lifestyle and beliefs of actors, influences the formal policy shifts within organisations.

The existence, need, essence and the contribution of Crops for the Future (CFF) to the scientific and research world is much more critical than it is known for. In focus,

it chooses to work on-underutilized/marginalized or orphaned crop species as its contribution to development, food security and the climate future. Doing so around different angles of the sciences (plant biology, nutrition, aquaculture, instrumentation and precision systems, social economic and policy, information technology etcetera), with a deterministic and interpretive systems (mode 1 and mode 2 science) could only reveal the knitted complexity of backgrounds of actors required to solve the complex agricultural related issues in CFF. As such, CFF being used as case study with this distinctive character, indicates a strong and important focus by this study as the least focused underutilise research organisation, yet important category of agriculture, was highly relevant and important for this study.

7.2.2. Methodological Contribution

Methodologically, unearthing the communication complexity requires embedded processes of living with actors as they go about their daily routine activities for a careful and detailed participant observation and in-depth interactive sessions. The study explained in detail, the strategies and techniques used to gain access (role play, profiling of actors and satisfying the ethical requirement) to the research organisation to observe and interact with participants. This the study beliefs are significant contributions to organisational studies using ethnography and participant observation approaches. The study also adopted some multiple data collection methodologies (observation, document review and interviews) for this research. This approach stipulates that, with complex studies such as this research, multiple mix of qualitative data collections methods can be used to address the complexity. These are essential knowledge addition to general qualitative studies.

7.3. Summary of Key findings of the Study

The overriding purpose of this research was to develop a transdisciplinary communication framework in order to address critical communication challenges in CFF. From CFF perspective, cross knowledge community dialogue appeared severely inhibited by the different nature of different disciplines, language and means of communication in CFF. Knowledge generated within CFF on underutilised crops must flow to all participants and knowledge communities including farmers, the researchers themselves, academia, industry and partners. More so, uncertainties and multiple view in teams, projects and organisations often tend to create lack of understanding and communication problems. Challenging enough, CFF at the time of this study was not having a framework or approach that addresses the complexity of transdisciplinary communication within its knowledge community and its research stakeholders. Hence it was essential to examine the underlining issues to these challenges and propose a framework to address that. With these, as the problem statement, the findings drawn from the empirical data generated from participant observations, actors' interactions and from the content analysis of available public records and policy documents of CFF, attempted to accomplish that goal.

The study started by extensively reading official documents of CFF both published and unpolished to understand the formal structure as an organisation. It moved further to friendly interactions with actors as well as profiling them to determine the category of information and observation required from each of the researchers in the organisation. Subsequently, detailed observation and scheduled intensive interviews followed, in order to understand the internal procedures and policies of the

organisation, the formal and informal CFF and how that relate to the researchers interactively, the contribution of different knowledge communities to the over all goal of CFF and the knowledge or output sharing ownership claim of members.

Relative to the first objective of the study of examining the internal procedures, policies, and regulations existing in CFF that addresses the challenges of communication amongst different knowledge groups, an extensive policy and official document reviews, and interviews with actors from management were used as approaches to address this objective. Some of the few questions such as; what are the policies and programmes developed by CFF to improve actors' interactions? What are some of the key internal regulations instituted to improve employees discharge of their responsibilities? How does these factors help improve communication amongst actors? The study identified several procedures, policies and programmes structured (RVC, flagship projects, weekly Thursdays, Festivals and birthday celebrations, DTP, KPIs, Themes and Programmes etc.) to ensure that actors collaborate and work together through these mediums to help achieve the mandate of CFF. These policies and procedures were identified as the medium and avenue through more interactions takes place either through emailing, reports, briefs or with face to face interactions. It was also revealed that, some of these policies and programmes through its social arrangements created a bonding process for actors to formally and informally interact thereby improving the communication lapses within. For example, the birthdays and festival observations were social gatherings that elucidated informal parts of actors to avoid holdbacks and network. The epic of such initiatives the study find, was the acknowledgement process of specific individuals who were considered to have achieved or impacted a great deal within the period of

such celebrations in CFF. Participants revealed that such appreciation by management improved their working relationships, communication and organizational belongingness. Again, the monthly and weekly gathering named the 'staff forum' and weekly social gathering sessions, just like the festivals and birthday celebrations, were observed to generate some significant SC elements including opportunities of junior staff to be briefed on what the organisation was up to from management and any other important information worth sharing to members from the technical and non-technical units. Whilst the DTPs, RVCs, the Programmes, and the Themes remains the technical meeting points through which formal communication takes place, the social programmes enhanced actors level of interactions. In the particular case of the RVC policy, the study identified that, CFF considered it to be a tool or medium that could help address the challenges of knowledge sharing and communication, however from this study, it could not critically serve as the policy antidote to the issue of collective participation and fluid interaction in CFF because of its varied implementation challenges. Open office landscape system adopted by CFF helped shaped how actors related to the organisation either through formal or informal. This appeared to foster some constant interactions amongst all actors even if issues discussed were not related to research and technical issues. The constant face to face way of working together had its own issues of privacy challenges as intimated by some actors, nonetheless, it was observed that, the open system generated some frequent interactions with the Theme and Programmes leaders/directors, coordinators and support managers, who if all were having their own cubicles would have slowed the bonding and networking.

It can therefore be concluded that, some of the internal policies contributed towards the interactive nature and communication of actors in CFF. Again, researchers related very well with both formal and informal CFF through these internal policies or initiatives with SC elements playing the spurring roles as argued in the proposed framework (Figure 7.1). There were indications that actors in some Themes and Programmes related and communicated better due to the programme and Theme leadership support they were receiving. They claim such leadership support offered them the free mind and will to speak, to contribute and be proactive in some relevant decisions, whilst other Programmes and Themes had no such spurs.

On what are the knowledge contribution of every member of each different knowledge community in CFF, the responses appeared very important just as the reasons that got them engaged into the CFF fraternity. Questions in this regard were specifically tailored towards the roles of their disciplines (technical and non technical) to the function process of CFF. As an agricultural led research organisation, researchers' engagement spanned through all the value chain from breeding, agronomy, food, market, to social and policy issues. Each knowledge communities have their set of activities, targets and deliverables that formally are expected to conflate into the overall mission and vision of CFF. Leadership of CFF admonishes its employees for a 'beyond assigned job roles' to activities outside their networks to be more than the sum of their parts. Contributions of each programme and theme in some ways linked to each other but on choice bases of actors and unit heads and not based on a requirement to work together or a policy that strongly mandates them to contribute. It was observed that; a high value is placed on Programmes and Themes that raked in good amount of funding with many projects. Programmes that had its cap fit with

this narrative were considered as very powerful in the view of many participants. Whilst most of the short projects just targeted short term funding, actors believed some were not structured well and not also helping the RVC concept there by not contributed well to the overall objective. Issues of appreciation of the significance and relevance of knowledge produced between laboratory and field experimentation source on one hand, and survey and general social research knowledge, revealed that actors generally were engrossed to disciplinary superiority feelings with some level of disregard to the contribution of 'others' not in their networks. Again, actors appeared ready to share data and information with other members, but needed the data policy to encourage and enhance the communication process. The non-researchers (support unit) viewed the scientists as actors who do not want to work together and are very territorial wanting to always keep to their space and not communicate. All these notwithstanding, revealed a sense of commitment from every Theme, every Programme towards contributing their knowledge in various forms to achieve their individual own goals, the knowledge community they represent and CFF at large.

Regarding the questions of actors claim to knowledge ownership and coproduction in CFF, the findings reveal that, knowledge produced in CFF was largely disciplinary influenced, especially regarding publications. Questions such as, how knowledge is produced, their individual roles and contributions, the acknowledgement process, how knowledge produced are published, copy rights issues, funding allocations, promotions amongst a host were asked to understand the transdisciplinary knowledge claim process in CFF. It came clear that, joint publications from different Themes and Programmes appeared not many considering what RVC tendered to achieve. The process was more of the compartmental or knowledge community base rather than

the move towards inter-transdisciplinary genre of knowledge dissemination. The use of the doctoral training programme (DTP) was considered as a medium for better collaboration and joint publications as most student projects cut through some of the knowledge communities within and other partners of CFF. The knowledge produced came from field experimentation, field surveys and feasibility studies, laboratory research analysis as well as engineering workshops (UNMC) which mostly relates to bioenergy using underutilized plants with energy properties. Whatever that is produced, is considered as an intellectual property belonging to the organisation through the programmes and themes. It came from the findings that, there were no contestations of data produced at the knowledge community level and even at the joint project/RVC led projects. Actors feared to be scooped and not acknowledged for any contribution they make either at the team level or at that organizational level, because of the non existing policy on data handling/policy. Again, there appeared to be no challenges on who leads collaborative projects that will ultimately produce joint knowledge/data for CFF. The team leads were always the themes/programmes heads who will take the initiative and lead in the development of proposals for funding.

The CropBASE programme with the responsibility of knowledge management and dissemination had its own setbacks in terms of logistics and technical issues which data policy views on ownership, copyrights, usage, and handling stood tall. These were considered to influence how actors from all the departments will clearly contribute information and data to the database for integration. As a young organisation in its early phase of development, serious competing interest within CFF and its stakeholders appeared not critical especially regarding knowledge production and management, however, as it gets more complex with transdisciplinarity

approaches more entrenched, stakeholders including researchers within CFF's demand on accountability for any form of data and information produced will be subjected to these current issues. It came clear that, joint publications from different Themes and Programmes appeared not many considering what RVC tendered to achieve. The process was more of the compartmental or knowledge community base rather than the move towards inter-transdisciplinary genre of knowledge dissemination. The study therefore concludes that, knowledge claims of actors which is a serious transdisciplinary challenge causing lack of interest in sharing and interacting amongst actors were hinged on the appreciation levels of contributions of members by management and senior colleagues, credible and available formal data policy, workable knowledge management process and motivation.

Considering that CFF had no framework that deals with transdisciplinary communication challenges as the main reason for this study, the critical thought and data examination process was how the researcher could use the elements identified as informal CFF and that of a formal CFF together, to spur a stronger nexus of interaction amongst actors, whilst dealing with the data and knowledge scooping fear express by researchers. Latuca, (2003); Choi and Pak, (2006); Klein, (2010); Hardon et. al (2008) and Lele and Norgaard, (2005) all argued that, in order to break the barriers to transdisciplinary communication, collective participation, social networking, flexible formal reporting system, knowledge contribution claims and team leadership support need to be integrated into a new outcome that will solve the complexity identified. Ultimately, linking these elements into a framework to help understand how actors communicate in CFF was highly considered as the cynosure and nucleus of this study. From these, it emerged that, issues of how the formal and

informal is structured and viewed by the actors, how actors generate and coproduce knowledge as contributions from their networks and community of practice, the rallying point of collaboration and working together and the leadership support to every act of behaviour in the organisation, mirrored areas of focus for this framework. From that basis and the actors' relationships in CFF, the study proposed a framework (Figure 7.1) that aims to contribute to the fluid interaction and working together in CFF and other similar complex research organizations with diverse disciplines and stakeholders. It tends to provide a reliable account of research and organizational development with communication as the effect and actors working together as the cause.

7.4. Implications and Future Research

7.4.1. Implications of the Findings

Communicating in complex transdisciplinary environments is increasingly challenging as a result of cutting across multiple layers of specialisations and disciplines. The multiple layers of disciplines and perspectives are required because, such assemblies of knowledge offer better and effective methods of addressing the complexities. A key feature of transdisciplinary study argued by this study, communication amongst knowledge communities including agronomy, biotechnology, breeding, and socioeconomic are interactively linked to issues of framing of problems and knowledge production. The framework developed by this study can be used by actors in transdisciplinary agricultural environments to enhance fluid and better communication.

The linkage and integration of formal and informal social elements of actors within organizations can improve the relationship, understanding and interaction of members for better communication. A streamlined data and knowledge management policy may relax and assure actors in research organizations of how their knowledge generated is handled and utilized, so that they can open up more to each other, share information and knowledge without much fear of being scooped.

By exploring leadership roles in organisations and how it influences interactions amongst members, management of these technical agricultural research institutions can utilise some elements of the leadership communicative concepts to support actors' interactions and information sharing for collective problem framing and contributions towards the goals of the organisation. Inline with the difficulties of each actors' contribution been acknowledged from within transdisciplinary teams that allows them to share information and interact fluidly, indicates the significance of a strong internal policy implication on joint publication of outputs from teams, copyright and actors' intellectual property issues.

The revelation and narrative of the RVC policy from the findings also indicates an implication that, management of research organisations need to identify the major points of interaction, collaboration and citadel of its researchers within the organisation such as the RVC of CFF in order to improve on the barriers of communication on such mediums generates. Engaging experienced and retired academics together with early career researchers (postdocs) recognises that, knowledge transfer, sharing as well as mentoring is ideal for staff development, but

requires constant information sharing and communication and long term engagement contracts.

7.4.2. Future Research

As the study developed the framework for transdisciplinary communication, it is important that further research is carried out in similar research organisations to implement and evaluate how actors, relate with the system (formal and informal), leadership and policy inter-linkages of the framework, to communicate effectively in order to generate and coproduce knowledge for real life challenges like climate change and food security issues. The study interacted with the research organisation farm workers who plays the role of farmers, however, it will be important for future research to engage more farmers who are stakeholders or partners but are independent in order to deepen the transdisciplinary discourse. Again, the study recommends for future research, the testing and application of this framework in similar organisations to examine its effectiveness and applicability since the study could not apply and test the use of the framework in CFF as captured in the limitations of the study.

7.5. Conclusion

In concluding remarks, it is worth pointing again to the analogy of Godfry Saxe, (1882) on the use of the blind men and the elephant as captured in the introductory scene of this study. Though each actor was partly in the right, collectively there were in the wrong. A single person learning all parts and making sense of the elephant can be challenging, but a bit in pieces from actors, for a sum in all parts may help

understand the elephant better. Such is the complex world and its challenges that scientists and non-scientists in collective, need an integrative move away from their interests, beliefs, world views, and other differences to a more accommodating, more participatory, sharing and interactive positions to help understand the world and the elephant better and solve the teething problems.

The events narrated in this study shows that not only were some actors exhibiting internal looking tendencies through the elevation and focusing on their networks and responsibilities that will give them the power and rewards they seek; but also, a gesture for collaboration and working together with others in the name of the organisation, still revealed that there were many issues at stake other than diversifying agriculture with underutilized crop species. Communication across disciplines in organisations the study concludes requires the collective effort of actors on participation, informal networks of actors, defined problem, proactive leadership and structured reporting process.

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