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Towards Establishing a Ghana Multi-Stakeholder Fertiliser Platform: Insights from Stakeholder and Network Analyses

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IFDC

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LIST OF ABBREVIATIONS

AFAP	African Fertilizer and Agribusiness Partnership
AGRA	Alliance for a Green Revolution in Africa
CIAT	International Center for Tropical Agriculture
COCOBOD	Cocoa Board Ghana
CSD	Crop Service Directorate MOFA Ghana
CSO	Civil Society Organisation
DAES	Directorate of Agriculture Extension Services MOFA Ghana
ECOWAS	Economic Community of West African States
EPA	Environmental Protection Agency Ghana
FAO	Food and Agriculture Organization of the United Nations
FASDEP	Food and Agriculture Sector Development Project
FERARI	Fertilizer Research and Responsible Implementation
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GFEP	Ghana Fertiliser Expansion Programme
GIRSAL	Ghana Incentive-based Risk Sharing System for Agricultural Lending
GRA	Ghana Revenue Authority
GSA	Ghana Standards Authority
IFDC	International Fertilizer Development Center
IP	Innovation Platform
KFERT	Kenyan Fertiliser Platform
KII	Key Informant Interview
METASIP	Medium Term Agriculture Sector Development Plan
MOFA	Ministry of Food and Agriculture Ghana
MOU	Memorandum of Understanding
MSI	Multi-Stakeholder Initiative
MSP	Multi-Stakeholder Platform

MT	Metric Tonne
NASTAG	National Seed Trade Association of Ghana
NFC	National Fertiliser Council Ghana
OPRE	Oversight, Policy, Regulations and Enforcement
PFJ	Planting for Food and Jobs
PIBWR	Production, Blending, Importation, Warehousing and Retailing
PPMED	Policy, Planning, Monitoring and Evaluation Directorate MOFA Ghana
PPP	Public Private Partnership
PPPRSD	Plant Protection and Regulatory Services Directorate MOFA Ghana
RDTA	Research and Development and Technical Advisory
SA	Stakeholder Analysis
SARI	Savanna Agriculture Research Institute
SDGs	Sustainable Development Goals
SNA	Social Network Analysis
SRID	Statistics, Research and Information Directorate MOFA Ghana
SSAT	Strategic Support, Advocacy and Training
UNDESA	United Nations Department for Economic and Social Affairs
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
VC	Value Chain

ABSTRACT

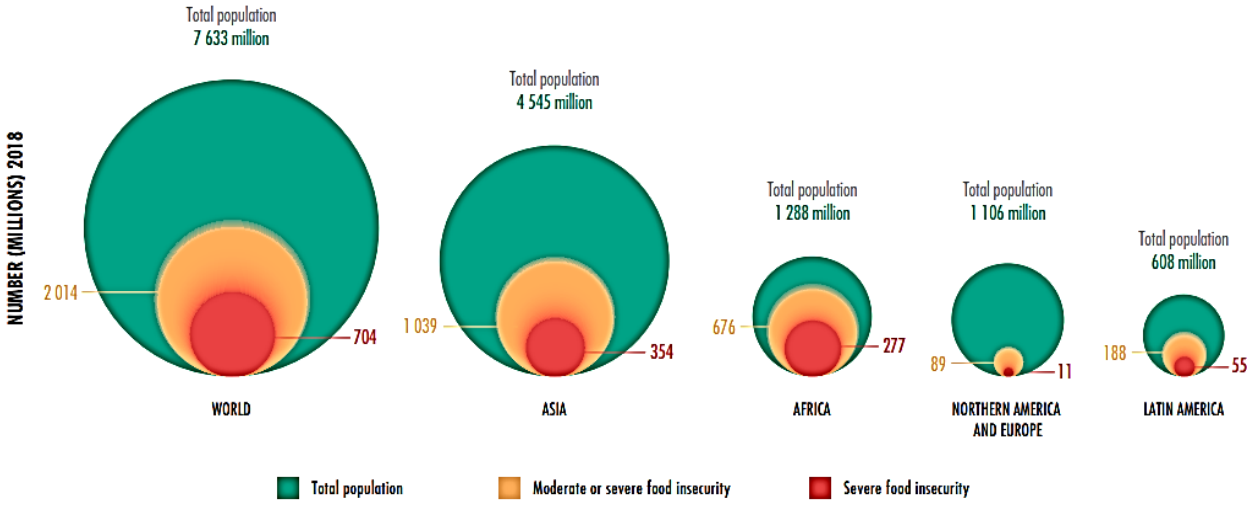
Sustainable intensification achieved through an increase in fertiliser use is critical for the achievement of increase in food production and improvement of food security. However, Ghana's fertiliser value chain faces several challenges that limit this potential and affects the activities of the stakeholders involved in the value chain. This study aimed to provide a background on the fertiliser value chain in preparation for the establishment of a fertiliser multi-stakeholder platform that aligns all the relevant stakeholders to address existing challenges. Using a mixed method approach involving stakeholder analysis and social network analysis carried out with 36 key informant interviews, paired interviews and a focus group discussion, this study identified and classified stakeholders according to their power and interest. Similarly, the study identified the critical stakeholders who can highly influence the initial planning and success of the platform. The fertiliser value chain was sub-divided into five management categories and critical stakeholders in these categories were also presented. The study also identified challenges that the platform could face and the conditions to put in place to avoid these. Overall, the study concludes that if the identified critical stakeholders are involved and the platform clearly outlines its objectives and vision, it can address the challenges in the fertiliser sector, catalyse the development of the general agriculture sector and improve food production and food security in Ghana.

Keywords: *Social Network Analysis, Stakeholder Analysis, Multi-stakeholder Platform, Fertiliser Value Chain, Ghana*

CHAPTER 1: INTRODUCTION

1.1 Background

Countries under the umbrella of the United Nations in 2015 agreed to 17 Sustainable Development Goals (SDGs) as a collective development strategy to achieve global prosperity and reduce widening inequality. First amongst these global goals are the commitments to achieve zero hunger and end poverty in all their forms by 2030 (UNDP, undated). This has become important given the current challenges with the global food system that is unable to meet the food security needs of a continuously growing world population. The United Nations Food and Agriculture Organisation estimates that up to 2 billion people are facing moderate to severe food insecurity worldwide (FAO, 2019). In Africa, this is about 52% of the 1.2 billion people living on the continent (Figure 1). In Ghana, poverty and food insecurity are a common challenge in both urban and rural areas although those in the rural areas are more affected (Anang, 2017).



Source: FAO (2019).

Figure 1. Global Distribution of Food Insecurity as at 2018

Agriculture, especially crop intensification through the adoption of modern technologies, has been suggested as a way of producing more food to end hunger (Bindraban *et al.*, 2018) and poverty (Wossen *et al.*, 2017; Christiaensen *et al.*, 2011). It is known that mineral fertilisers contribute to higher crop yield. For instance, nitrogen-based fertilisers alone contribute about half of the food produced globally (Erisman *et al.* 2008). Without synthetic fertilisers, crop yield will only feed about 2 – 3 billion people (Bindraban *et al.*, 2018). This shows that inorganic fertilisers will play a pivotal role in achieving sustainable intensification (Jayne *et al.*, 2019) to increase food production, achieve food security, and reduce poverty. However, existing unsustainable farming practices (Morris *et al.*, 2007), nutrient mining, leaching, and erosion (AGRA, 2019) are barriers to achieving this.

While the government of Ghana has put various programmes in place to stimulate agricultural development, certain challenges continue to exist. Thus, the Fertiliser Research and Responsible Implementation (FERARI) programme by the International Fertiliser Development Centre (IFDC) seeks to link research with implementation to support Ghana's fertiliser value chain development. One of the objectives of FERARI is to facilitate the setting up of a Fertiliser Multi-stakeholder Platform that can serve as a space to address immediate, medium- and long-term issues affecting the fertiliser value chain. This research therefore seeks to provide, using stakeholder and social network analyses, the necessary empirical information to aid the process of setting up the fertiliser platform in Ghana.

1.2 Problem Statement

Although the Government of Ghana implements many policies to develop its agriculture, the sector has not achieved food self-sufficiency and export potentials. The fertiliser value chain, which plays a major role in crop production, particularly faces challenges. Fertiliser recommendations are blanket i.e. not site-specific (AGRA, 2019; Tetteh *et al.*, 2018) and do not consider micronutrients mined from the soil (Bindraban *et al.*, 2018).

Moreover, Bindraban *et al.* (2018) noted that efforts of governments and civil societies are not enough to drive transformation in the fertiliser sector. Subsidy programmes meant to stimulate fertiliser use and increase crop yield fall short of these due to, among others, political influence in distribution of subsidised fertilisers (Mustapha *et al.*, 2016), subsidy targeting problems (Baltzer and Hansen 2012), late arrival, poor extension services (Yawson *et al.*, 2010), high cost of offering subsidies and their impact on distorting markets (Mabe *et al.*, 2018). The fertiliser industry also invests little, with only about 0.2% of its revenue in research compared to 10% in the seed industry (Bindraban *et al.*, 2018) which may lead to the lack of appropriate, location specific fertilizer products in the market. These challenges have made fertiliser use to remain far below the 50 kg/ha recommendation of the Abuja Declaration, at about 20 kg/ha in Ghana.

Although government-, private sector- and civil society-led efforts exist, many of them run separately with no current joint initiative that brings all the stakeholders across the fertiliser value chain together to discuss the value chain challenges and provide solutions to them. As a result, the opportunity to produce enough food locally through crop intensification to feed the population of Ghana or meet export needs can be missed. There is a threat to food security and development since agriculture is key to development and a significant employer of labour in Ghana (MOFA, 2018).

1.3 Justification of Study/Proposed Strategy

Multi-stakeholder platforms (MSPs) have been developed as a way to solve complex challenges by bringing stakeholders influenced by such challenges together to find common solutions. They have been used to address issues in agriculture, aviation, governance and the textile industry. In agriculture, MSPs can be used to mobilise and organise actors including smallholders, agricultural entrepreneurs, researchers and policymakers for collective action. These platforms have been suggested for driving innovation in the agriculture sector (Francis and van Huis, 2016).

By using a multi-stakeholder approach for Ghana's fertiliser sector, all stakeholders within this sector can be identified as well as the challenges that they face. Then, solutions can be jointly proposed through sharing of knowledge and resources to put the fertiliser sector on a path of sustainable growth. This can catalyse the development of the fertiliser sector through an increase in the use of appropriate, location-specific fertilisers among farmers in the country, increase food production and contribute to ending poverty, solving hunger and reducing (youth) unemployment.

1.4 Research Objectives

The main objective of this research is to provide understanding of the fertiliser value chain in Ghana in preparation for the establishment of a fertiliser multi-stakeholder platform. The specific objectives are:

1. To identify key stakeholders in Ghana's fertiliser value chain, their roles and relations.
2. To make an inventory of the key challenges facing the fertiliser value chain in Ghana.
3. To understand the entry points to addressing the fertiliser value chain challenges by means of a Multi-stakeholder Platform (MSP) approach that addresses issues raised.

1.5 Research Questions

This research work will answer each of the following questions:

1. Who are the key stakeholders in Ghana's fertiliser value chain, what roles do they play and how are they linked to one another?
2. What challenges are the stakeholders in the fertiliser vale chain in Ghana facing?
3. What are the entry points to addressing these challenges through an MSP approach?

CHAPTER 2: LITERATURE REVIEW

2.1 Review of Conceptual Issues

2.1.1 Multi-stakeholder Platforms (MSPs)

Several development projects have been launched in the past to eradicate poverty and achieve food security. Nevertheless, their performance has been poor because, according to Ragasa *et al.* (2016), many of them did not involve key stakeholders in their planning, governance and implementation. To address this ineffective approach, participatory governance was introduced few decades ago as a sustainable alternative. This approach, now described in various terms like multi-stakeholder processes, interactive policymaking, social learning, and cross-sector partnerships (Brouwer *et al.*, 2015), ensures that all the stakeholders who can influence or could be influenced by a decision are involved in the decision making and implementation processes.

Before defining what a Multi-Stakeholder Platform (MSP) or Multi-stakeholder Initiative (MSI) is, it is important to first clarify who stakeholders are. Stakeholders are the actors in a system who could be individuals, groups, or organizations that can affect or be affected by decisions made in the system (Ahmadi *et al.*, 2019; Reed *et al.*, 2009; Chevalier 2008a). According to Mayers (2005), stakeholders can be categorised into two groups – primary and secondary – depending on whether the decisions to be made directly affects or is directly affected by the stakeholders or not. The author also proposed that stakeholders can be grouped as internal, interface and external. Internal stakeholders operate within an organisation, external stakeholders operate from the outside and interface stakeholders operate between the two phases.

With the above definition of a stakeholder in mind, an MSI is defined as a "structured collaborative action between multiple actors from different sectors with inherently different interests, through which stakeholders come together to address an issue that is common to all, typically delivering collective good" (Winter *et al.*, 2017). This definition recognises that while individual actors have their own interest, there is usually an overall goal that all parties in the process are jointly interested in and that such goal can be effectively met when they work together.

Likewise, USAID (2018) described MSPs as "voluntary partnerships between governments, civil society, and the private sector… to address development challenges collaboratively, entrench democratic practices, and strengthen regulatory frameworks." This points out that MSPs bring actors together from different sectors of society and that participating is voluntary. Even though participation is optional, doing so can deliver a collective good to all participants (Winter *et al.*, 2017). Similarly, the concept of innovation platform has been described as a 'multi-stakeholder group of committed individuals seeking purposeful socio-technical and institutional change at a range of levels through diagnostic studies, experimentation and strategic actions to bring joint learning into use' (Hounkonnou *et al.*, 2016 quoted in Adu-Acheampong *et al*. 2017). In this study, MSP and Innovation Platforms (IP) are considered as the same concepts since, like MSP, IP also promotes interactions amongst stakeholders, fosters institutional changes and makes the best use of available resources (Davies *et al.*, 2017; Adekunle and Fatunbi, 2014).

2.1.2 Fertiliser Value Chain

Donovan *et al.* (2015) categorised the variants of value chain (VC) definitions into three. These definitions see a value chain as (i) "a set of activities", (ii) "a set of actors" or (iii) "a strategic network". In line with these categories, the World Bank's description of a VC as "the full range of value adding activities required to bring a product or service through the different phases of production, including procurement of raw materials and other inputs" fits into Donovan *et al.'s* (2015) first category above. However, while the definition recognises the activities performed in the value chain and the creation of value, it does not recognise the actors in the chain such as the producer of the raw materials or the consumer of the finished product.

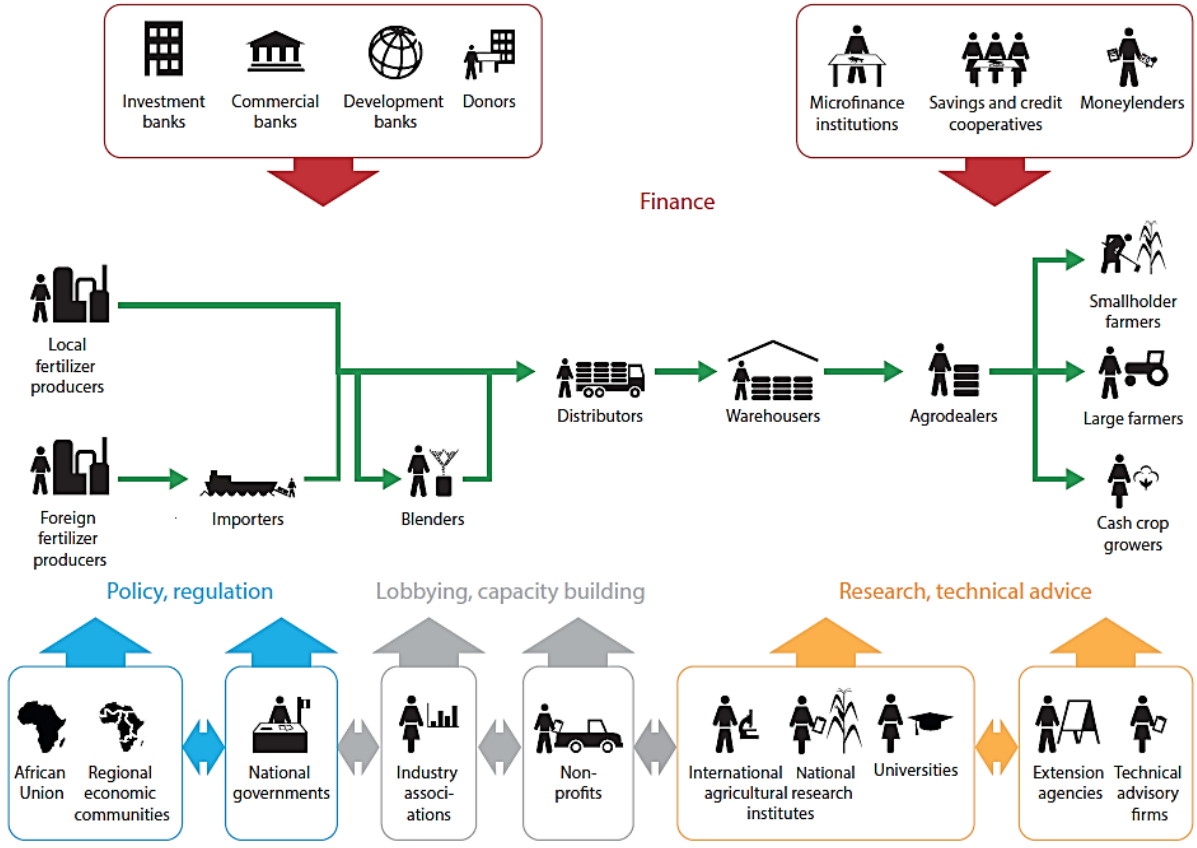
Similarly, as an example of the second category of definitions, the International Potato Centre defined a VC as a set of "actors connected along a chain producing, transforming, and bringing goods and services to end consumers through a sequenced set of activities" (Donovan *et al.*, 2015). This definition addresses what was missing in the previous one, recognising both the persons and the activities that they perform in the chain and the idea of creating value through 'transforming' goods and services. Lastly for the third category, VC was defined by the International Centre for Tropical Agriculture (CIAT) as "a strategic network among a number of independent business organizations, where network members engage in extensive collaboration" (Donovan *et al.*, 2015). CIAT's definition recognises VC as a network of actors that collaborate for their activities.

Earlier, Brown (1997) had defined VC as "a tool to disaggregate a business into strategically relevant activities" which conforms to the first category from Donovan *et al.* (2015). Brown (1997) argued that VC helps to identify "source of competitive advantage by performing these activities more cheaply or better than its competitors." Brown's definition projects the value chain as being "disaggregated" into smaller activities which suggest that while the idea of a value chain may be to produce a final product, there are different actors involved in different but related set of activities to achieve this. Also, Walters and Lancaster (2000) defined VC as "a business system which creates end-user satisfaction (i.e. value) and realises the objectives of other member stakeholders". This definition is a recognition of the importance of value creation for the satisfaction of an end user in the value chain. So, whether defined as a set of activities, a set of actors, a network, a system or a tool, the idea of the value chain is to align actors who are engaged in specialised roles to produce a result that satisfies the need of a user at the end of the chain.

Lending from this background, the fertiliser value chain can then be defined as a system/network of stakeholders that collaborate and engage in the production, transformation, and distribution of fertilisers or support these activities to meet the needs of the end users (usually farmers) who are also actors in the chain. GFEP (2019) identified fertiliser manufacturers, importers, distributors, agro-dealers, agro-processors and farmers as the stakeholders in Ghana's fertiliser value chain. In the case of Kenya, identified stakeholders for the Kenya Fertiliser Platform (KeFERT) included fertilizer and lime suppliers, policymakers, fertilizer regulatory bodies, laboratory services, experts in geostatistical information collection and mapping, research entities, and government and private extension service providers (IFDC, 2019b).

AGRA (2019) grouped activities of actors in the fertiliser value chain into five: (a) oversight, policies, regulations and enforcement; (b) production, blending, importation, warehousing and retail; (c) research and development, technical advisory, advocacy and policy support;

(d) commercial financing; and (e) strategic support. As shown in Figure 2, all the actors/ institutions involved in the fertiliser value chain are public sector, private sector, non-profit organisations, and banks and donors.



Source: AGRA (2019).

Figure 2. Fertiliser Value Chain and Supporting Institutions

2.2 Review of Empirical Issues

2.2.1 Agriculture in Ghana

Agriculture is an important sector in Ghana's economy. The Ministry of Food and Agriculture, operating with the vision of modernising Ghana's agriculture and transforming the economy to reduce food insecurity, unemployment and poverty (MOFA, 2018), is charged with formulating agricultural policies, coordinating planning, developing and managing of agricultural programmes and projects, advancing agricultural technology and advisory, and monitoring and evaluating performance. Agriculture in the country is divided into crops, livestock, fisheries, cocoa, and forestry/logging. Excluding cocoa, the crops subsector (roots and tubers; cereals; legumes; fruits and vegetables; and tree crops) contributed 67.7% to agriculture GDP in 2016. Ghana is said to be food self-sufficient in all its major staple crops except for rice and millet (MOFA, 2018).

Ghana's agriculture employs about 4 out of 10 economically active Ghanaians (GFEP, 2019). A large part of this labour (75.25%) is predominantly in rural areas (Mabe *et al.*, 2018). However, rural poverty is at 37.9% (MOFA, 2018) possibly due to the smallholding nature of farms (Mabe

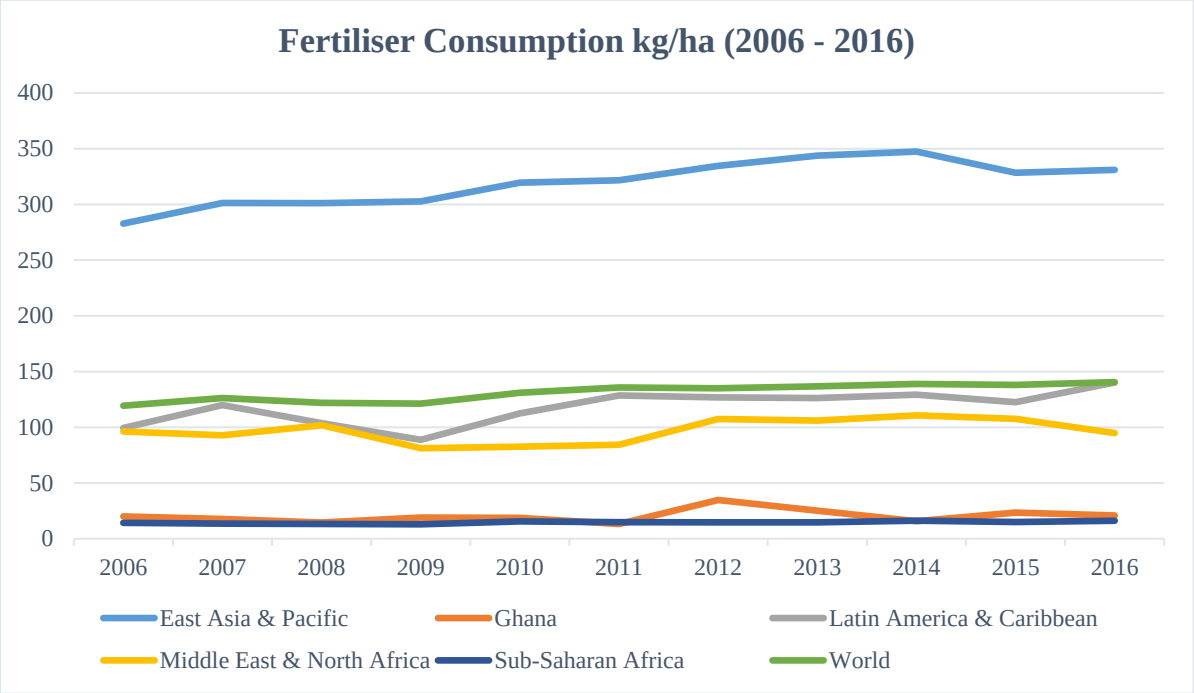
et al., 2018) and declining opportunities in farming and non-farming activities in the rural areas (Anang, 2017). The contribution of agriculture to GDP decreased from 31.8% in 2009 to 20.2% in 2015 (ISSER, 2017) due to low total factor productivity (MOFA, 2018) but witnessed a growth of 8.4% in 2017 (GFEP, 2019). Amidst all these realities, Ghana's population continues to grow and is expected to reach 52 million in 2050 (UNDESA, 2019). This necessitates an increase in food production to feed the population (Mabe *et al.*, 2018).

The need for transforming Ghana's agriculture lies in its potential to contribute to increasing productivity and transforming the mainstream economy. This increase in productivity which is vital to attaining food security and reducing rural poverty can be achieved through increase in the use of appropriate fertilisers (GFEP 2019; MOFA, 2017). More so, agriculture can contribute to increasing access of women and youth to employment, reducing poverty and food insecurity, and ensuring access to safe and nutritious food amongst others. Realising these possibilities, Ghana at different times has introduced policies and programmes to develop its agriculture sector.

The Accelerated Agricultural Growth and Development Strategy of 1996, for example, sought to link Ghana's agricultural value chain. This was followed by the Food and Agricultural Sector Development Policy (FASDEP) in 2002 to modernise Ghana's agriculture. Impact assessment of FASDEP I showed that the policy did not meet all expectations due to conceptualisation and implementation issues. A second FASDEP was introduced in 2008 that incorporated lessons from FASDEP I. In FASDEP II, Ghana introduced the Medium-Term Agricultural Sector Investment Plan (METASIP) (2011-2017) to align its agriculture with the African Union's Maputo and Malabo declarations. By planning to spend 10% of its budget on agriculture and attain 6% annual GDP growth, Ghana set the ambitious goal of achieving food security and rural development by 2015. The government ran state farms and irrigation scheme, provided input subsidies and controlled agricultural output market. Through these, particularly the fertiliser subsidy, maize and rice production witnessed an area increase of 32% and 74%, respectively, as well as production increase of 60% and 160% between 2008 and 2012.[1]

While some of these efforts yielded results, Ghana's fertiliser consumption remains low and dampens crop yield. The Ministry of Food and Agriculture (MOFA) in Ghana acknowledged that insufficient fertiliser use, lack of sufficient farm extension services, and poor market linkages are some of the major impediments to agriculture growth in the country (MOFA, 2017 cited in Mabe *et al.*, 2018). The soil fertility challenge could have been greatly ameliorated with fertiliser application, but current rate of fertiliser use is low compared to the rest of the world (Figure 3).

[1] This paragraph on agricultural policies in Ghana are based on a review of Mabe *et al.* (2018)



Source: Computed from World Bank data.[2]

Figure 3. Average Fertiliser Use in Various Sub-Continents and the World

2.2.2 The Fertiliser Sector in Ghana

Most of the fertilisers consumed in Ghana are imported as compound fertilisers or as raw materials that are blended locally since there is no in-country mineral fertiliser production. There is no tax on imported fertiliser raw materials although there is a 5% on compound fertilisers (IFDC, 2019a) and shipper and council levies (AGRA, 2019). As of 2018, there were 15 importers, up to 6 blending plants, almost 90 wholesale distributors and 3,500 agro-input retailers in the country (GFEP, 2019). The blending plants presently operate at 20-25% of their capacities (IFDC, 2019a). Additionally, there is local production of organic fertilisers in Ghana even though the quantity is low (AFO, 2020a). By the end of 2019, apparent fertiliser consumption was 423,603 MT for solid fertilisers and 1,669,986 litres for liquid ones (AFO, 2020a) – highest since 2010 (appendix B1). Total fertiliser consumption is projected to reach 500,000 – 760,000 MT in five years although this can be further increased through the right policy and technical improvements (IFDC, 2019a).

Across West Africa, Ghana currently runs the most expensive subsidy programme (IFDC, 2019a). In 2008, the country reintroduced fertiliser subsidy post-Structural Adjustment Programme era to increase fertiliser use among farmers. After a break in 2014, a new subsidy programme was again unveiled in 2015 that involved about 23% and 20% reduction in the cost of compound and urea fertilisers, respectively. Subsequently since 2017, Ghana has been implementing a new MOFA-run fertiliser subsidy programme known as the Planting for Food and Jobs programme (PFJ) (IFDC, 2019a). Fifty percent of the prices of urea and NPK 15-15-15 are subsidised under PFJ

[2] Source https://data.worldbank.org/indicator/AG.CON.FERT.ZS?locations=ZG-1W&view=chart

which make them cheaper compared to other countries within ECOWAS. Apart from this, there is also a fertiliser subsidy for cocoa farmers.

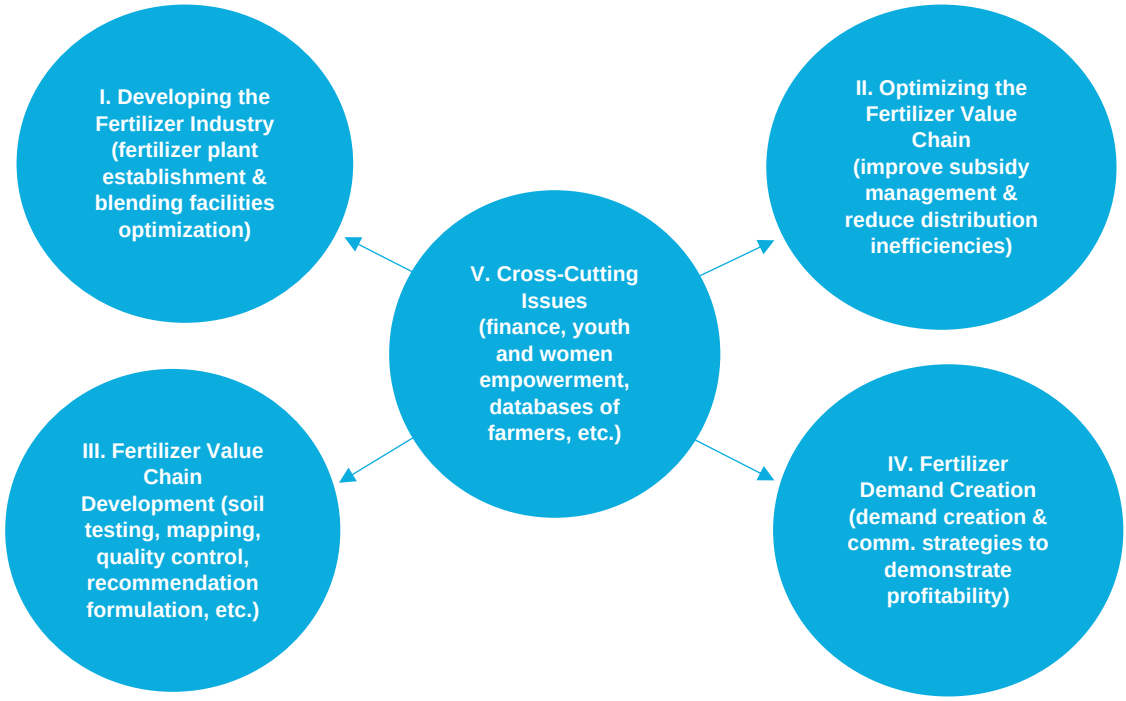
Thus, sixty percent of fertiliser consumed in Ghana goes to MOFA for PFJ targeting food crops, 20% to COCOBOD for cocoa (IFDC, 2019a) so that about 80% of the fertiliser market is captured by subsidy. Out of the remaining, 10% goes to commercial agribusinesses involved in fruits, rubber and oil palm production, and the rest goes to distributors to be sold at open market price. In 2019, according to AFO (2020b), 330,416 MT and 957,795 litres of solid and liquid fertilisers were distributed as subsidised fertilisers for food crops under PFJ. Similarly, in the same year, COCOBOD distributed 142,500 MT and 446,400 litres of subsidised fertilisers to cocoa farmers.

Nonetheless, the fertiliser value chain in Ghana still faces different kinds of challenges. As of 2016, fertiliser application rate in Ghana is only 20.88 kg/ha (World Bank, 2020) increasing from about 13 kg/ha in 2008 when fertiliser subsidy was re-introduced (Figure 3). The resulting nutrient deficiency is contributing to a yield gap of about 30 – 80% (Mabe *et al.*, 2018). Several factors are responsible for the low application rate of fertilizer among which are unavailability of the fertilisers (Mabe *et al.*, 2018), high cost (Mokwunye, 2012), farmers' inability to see the benefits (Druilhe and Barreiro-Hurlé, 2012), poor agronomic knowledge (Liverpool-Tasie *et al.*, 2015) and poorly developed fertiliser markets (Jayne *et al.*, 2019). MOFA contends that although production of crops like maize, sorghum and rice in Ghana has steadily increased over the years, this increase has been due to expansion of cultivated areas (GFEP 2019; MOFA, 2017) rather than increase in productivity.

Likewise, the subsidy programmes have not fully achieved their aims due to political influence and targeting issues (Baltzer and Hansen 2012), smuggling of subsidised fertilisers to neighbouring countries (IFDC, 2019a), late arrival and poor complementary extension services (Yawson *et al.*, 2010) as well as the high cost of maintaining subsidies and their impact on distorting markets (Mabe *et al.*, 2018). It is only recently that some crop-specific recommendations for maize, rice, soybeans and cassava were introduced in Ghana under the subsidy programme (Debrah, 2019) since blanket application is the common practice. Mabe *et al.* (2018) reviewed PFJ after its first year and reported that while yield of maize, rice and soybean increased by 3.6, 8.5 and 7.5% respectively, the programme faces many challenges such as late supply of inputs, complex payment system, inadequate fertiliser quantity, political interference, smuggling and reselling, long distance for farmers to access subsidised fertilisers, lack of support from some MOFA and district assembly staff, and poor engagement of stakeholders before PFJ implementation began.

Consistent with the recognised contribution of fertiliser to food production and food security (GFEP 2019; MOFA, 2017; MOFA, 2013), a USD 2.2 billion Ghana Fertiliser Expansion Programme (GFEP) was launched to create a five year plan (2019-2023) that holistically integrates fertiliser initiatives to stimulate agribusiness development and industrial growth, promote environmental management, and reduce poverty in Ghana (GFEP, 2019). GFEP sets to reach 3.5 million beneficiaries and attain 800,000 MT fertiliser consumption by 2023 in line with the Abuja Declaration. The programme has five strategic pillars that will see to developing the fertiliser industry and value chain, optimising the fertiliser value chain and creating demand for fertilisers among others (Figure 4). It is expected to be financed by: (i) the government through the Fertilizer

Inspection Fund and the Plants and Fertilizer Funds (40%), (ii) private sector (35%) and (iii) development partners (25%). GFEP, which is still in the planning stage, seeks to establish a National Fertiliser Council, Ghana Fertiliser Advisory Commission, a limited liability Ghana National Fertiliser Company and the National Fertiliser Stakeholder Platform in accordance with the Ghana Plants and Fertilizer Act 2010 and Ghana Fertilizer Policy 2013 (GFEP, 2019; Debrah, 2019).[3]



Source: GFEP (2019).

Figure 4. Five Pillars of the GFEP Strategic Plan

2.2.3 Multi-Stakeholder Platforms

Multi-stakeholder platforms are useful in solving complex challenges as they bring stakeholders together to find solutions through dialogue, consultation, forum, networks, partnerships, etc. (Achyar *et al.*, 2017) and foster institutional changes to make the best use of available resources (Davies *et al.*, 2017). Since previous approaches targeting input system use in agriculture have not yielded much result because of their linear nature and limited interaction among stakeholders (Adekunle and Fatunbi, 2012), a new approach became necessary. The use of participatory approach in smallholder agricultural systems started in West Africa in the 1980s (Struik *et al.*, 2014; Agwu *et al.*, 2008). This approach encourages interactions amongst actors.

MSPs have been applied to address issues across many fields including agriculture (Brouwer *et al.*, 2015) and in the management of land, fisheries, wetland and forestry resources (Adekunle and

[3] See appendix B3 for an explanation of the roles of these structures and their compositions.

Fatunbi, 2012). There is no one-size-fits-all guide for establishing effective MSPs (Van Paassen *et al.*, 2014) but context, members' interaction, contributions (Nokoe *et al.*, 2013), capacity and motivation (Ragasa *et al.*, 2016) are key drivers of success. In addition, MSPs are not always the right solution for every situation and can be difficult to start and sustain due to the running costs and operating challenges (Winter *et al.*, 2017). Stakeholders to be involved in an MSP should be identified meticulously to avoid producing a long list than is needed or a short one that misses out important participants (Brouwer *et al.*, 2015).

Davies *et al.* (2017) studied nine innovation platforms in five West and Central African countries to highlight the benefits of stakeholder collaborations.[4] The IPs focused on developing pastoral and/or agricultural value chains. They found that 5703 members from seven of these platforms generated additional USD 680,793 income after 6 – 18 months of creating them. To address limited finance that caused delay in planting and poor production, input dealers in an IP in Ghana supplied farmers in the IP with inputs on credit. Also, through the IPs, trained seed dealers and livestock mineral salt market emerged which, respectively, facilitated sale of certified seeds and ensured that the livestock abandoned the consumption of plastics. In Benin even though conflict resolution was originally not part of the plan, the IP facilitated reduction in conflicts between pastoralists and agriculturalists, reduced the number of injured animals and increased trade and social relations among these actors. Also, participants in other IPs noted an increase in access to research and extension as well as involvement in setting research agendas (Davies *et al.*, 2017).

However, there were mixed results in some cases such as in Ghana where crop destruction by cattle was reduced in one IP but not in another. The authors explained that such can happen when there is limited participation of some important stakeholders. They identified trust among stakeholders involved in these IPs as critical to the success recorded. This trust, they explained, was built through previously working together, positive feedback from members, cultural norms, previous influence of facilitating in the communities, efforts of facilitators and managers to bring people together and encourage communication, and well established IP structures.

Some identified challenges associated with sustaining activities of the IPs were cost of meetings, heavy dependence on project team, and limited participation by some actors. However, Davies *et al.* (2017) explained that trust, social capital, member commitment and newly learned skills can sustain progress. The authors concluded that to achieve systems change and to scale impacts, it is important to involve individuals and organisations that can drive inter-organisational exchanges in terms of knowledge and interdependence.

Multi-Stakeholder Platform in the Fertiliser Sector

IFDC in 2017 developed a road map which made a case for public-private partnerships (PPPs) to develop national fertiliser sector in sub-Saharan Africa. The road map identified constraints and opportunities in the sector that makes establishing PPPs necessary. It proposed that the partnership would intervene in key areas such as soil fertility management, policy and government capacity building, fertiliser and seed market development, agro-dealer development, and market

[4] These countries are Ghana, Senegal, Burkina Faso, Cameroon, and Benin.

information, monitoring, evaluation, learning and sharing systems. This road map is to develop competitive private sector-led fertiliser market, increase fertiliser use, and achieve a shift from blanket to balanced fertiliser use among others. It planned to bring private, public, and research institutions together to promote interactions amongst these groups, conduct value chain analysis and make a case for national fertiliser associations (IFDC, 2017).

Till date, however, there is only two of such platforms established in SSA which are in Kenya and Mozambique. Some of the contextual factors among stakeholders in the Kenya's fertiliser value chain that necessitated creating the fertiliser platform were soil acidity and the lack of liming to correct this, low or no nutrient use among farmers, and lack of micronutrients (balanced fertilisers) in the available products (IFDC, 2019b). The Ministry of Agriculture, Livestock, Fisheries and Irrigation held a multi-stakeholder round table in October 2018 with attendance of over 300 fertiliser sector stakeholders to review these challenges and agree on the need to establish a multi-disciplinary Kenya Fertilizer Platform to address them. The roundtable identified priority issues, agreed on a need to establish a representative platform, developed a joint communique and established a committee to develop a white paper that defined the next step (i.e. platform's mission, goals, structure and governance). The white paper proposed having two chairmen for the platform (representing both private sector and the agriculture ministry), steering committee of voting members, non-voting members, ad-hoc members, sub-committee, and a secretariat managed by a full-time coordinator (IFDC, 2019b).

In Ghana, there is also a plan to establish a national fertiliser platform as part of GFEP activities. Unlike in Kenya, the proposed National Fertiliser Council (NFC) is to be chaired by MOFA minister and function as "a National fertilizer Platform to be responsible for policy direction and public-private stakeholder dialogues on fertilizer issues" (GFEP, 2019). The NFC, as proposed, will also be composed of the Director of Plant Protection and Regulatory Services, Director of Crop Services, the Director-General of the Council for Scientific and Industrial Research, a representative of fertiliser manufacturers and importers, a representative of national farmers associations and the executive director of the Environmental Protection Agency (Debrah, 2019; appendices A2 and B3).

2.3 Review of Methodological Issues

Social network analysis (SNA) and stakeholder analysis (SA) are popular methods used to identify stakeholders and their interests. In the past, SA was done separate from SNA. Both methods are now combined to study a number of issues in politics, human resource, institutional management, business, science and resource governance (Ahmadi *et al.*, 2019).While SA identifies stakeholders and their level of significance, SNA expresses how these stakeholders are connected to one another (Ahmadi *et al.*, 2019). They have complementary roles and can be used to explain complex systems and improve decision making when stakeholders are diverse and have varying interests and goals (Ahmadi *et al.*, 2019; Yang, 2014).

2.3.1 Stakeholder Analysis

SA was first used as a strategic management tool in late 20th century (Xu *et al.*, 2016) and is now used to develop and monitor strategies, reform institutions or businesses, design and evaluate programmes or projects, and navigate the consequences of decisions (Mayers, 2005). The analysis involves: (i) identifying stakeholders, (ii) categorising and prioritising them based on their decision-making influence and (iii) investigating the relationship among the stakeholders (Ahmadi *et al.*, 2019; Reed *et al.*, 2009). It involves determining a stakeholders' relationship, legitimacy, interest as well as power (Chevalier, 2008b). Interest means the net gain or loss experienced due to a certain intervention – current or proposed. Power is a stakeholder's ability to use wealth, authority, information access, and other resources to influence decisions and legitimacy is the recognition of a stakeholder's rights and responsibilities by others (Chevalier, 2008b).

Ahmadi *et al.* (2019) conducted stakeholder analysis for Kan watershed in Iran's Western Tehran Metropolitan City. The authors asked stakeholders to describe how their organisation is involved in the watershed management, the power they wield and their interest in the system, their satisfaction with current dynamics in the system, and how much information their organisations are able to access with respect to the watershed. They argued that organisations with higher power were the most capable in making changes to current situations in the system. Likewise, Xu *et al.* (2016) used interest, power, attitude knowledge, satisfaction and access of information to profile stakeholders in their study of the potential of a food waste recycling and composting project in China. They found that only few (governmental) organisations who have higher power had interest in the food waste recycling programme. On the other hand, only few of those with higher interest in the programme had power to influence changes. This situation resulted in limited support from the governmental organisations to promote the food waste recycling programme.

2.3.2 Social Network Analysis

The introduction of social network analysis to understanding how individuals in a system interact may have been introduced in 1932 by the psychiatrist Jacob Moreno when he studied, alongside his colleague, Helen Jennings, the reasons behind the running away of students of Hudson School for Girls in New York., United States (Borgatti *et al.*, 2009). At the time, Moreno used a concept called "sociometry" to graphically represent how each of the girls was connected to the other through social influence and found that where the girls were residing (i.e. their location in the network – which was sometimes in the same house) and the interaction amongst all of them could explain if and when they ran. Following this came advances in the use of the technique such as the introduction of matrices and graph theory to construct groups (Borgatti *et al.*, 2009) and incorporation of the technique into computers in the 1990s (Xu *et al.*, 2016).

Chiesi (2001) defined network analysis as "a set of integrated techniques to depict relations among actors and to analyse the social structures that emerge from the recurrence of these relations" using graph theory, matrices and relational algebra. The aim is to better understand a system by analysing the actors that make up that system. While it was developed by mathematicians and statisticians, SNA continues to find use among sociologists, anthropologists, social psychologists, historians and political scientists (Chiesi, 2001). In SNA, respondents (or egos) are required to identify the

other people (alters) whom they interact with in a particular system and the relationships between the other actors within the system (Borgatti *et al.*, 2009).

Social network research has been criticised for lacking theoretical understanding and being only a descriptive method. Some critics argued that asking respondents who they interact with and recording this through surveys is more prone to errors compared to observing the actors to know who they interact with. However, Borgatti *et al.* (2009) disagreed and provided theoretical bases for doing social network research. The authors used the differences in the ways of conducting research in the physical sciences and social sciences (and the difference between social network research and other types of social science research) to prove their point.

They argued, for example, that unlike other social science methods which explain an individual's characteristics using other characteristics of this individual (like explaining income with gender and/or age), network analysis explains an individual's outcomes based on how their environment has influenced them or how they have leveraged on the surrounding to achieve an outcome. This is because in social network research, the location of a node (or an actor) in a network affects their opportunities and constraints and ultimately their outcome/characteristics (Borgatti *et al.*, 2009). The authors concluded that what physical and social scientists who conduct network research look for differ and this is the reason for divergent opinion between the two groups on whose approach is "merely descriptive" or which has theoretical grounding.

CHAPTER 3: METHODOLOGY

3.1 Location and Respondents

This study was conducted in the Republic of Ghana starting in February and continued in May – June 2020. Stakeholders in the fertiliser value chain were identified through literature review, self-identification, and identification by other stakeholders (Chevalier, 2008a; Mayers, 2005). After primary stakeholder identification through literature review, initially identified stakeholders were contacted for further suggestion of other actors in the fertiliser value chain. This is similar to what was adopted in Ahmadi *et al.* (2019), Xu *et al.* (2016) and Caniato *et al.* (2014). Sample size is not as big as is in quantitative studies, and questions asked were semi-structured. A final stakeholder list was generated containing 25 groups of stakeholders involved in the fertiliser value chain (see Appendix 3 Section B).

3.2 Research Design and Data Collection Tools

Respondents were identified using a purposive rather than random method based on the ability of respondents to be most resourceful (Creswell and Creswell, 2018). The research used both quantitative and qualitative design in data collection. Quantitative data were collected by asking respondent to rank other stakeholders on a Likert scale in order to compute averages for each of the characteristics measured (such as power, interest, legitimacy, etc.). Qualitative method was used to obtain information on the issues in the fertiliser value chain, which may be difficult to obtain using quantitative surveys. This is due to the need for extensive explanation for proper understanding. The qualitative method allows for answering research questions through respondents in the 'real world' using a flexible research design while ensuring that neutrality in the interpretation of results is maintained (Ritchie *et al.*, 2013).

A total of 36 stakeholder interviews were conducted. This is considered within the range after which saturation is reached (Ritchie *et al.*, 2013) i.e. when more data collection does not provide much additional insights to the research objectives (Creswell and Creswell, 2018). In 26 of these interviews, single-person key informant interviews (KII) were conducted. In others, 9 paired interviews and 1 focus group discussion (FGD) were conducted. An interview guide was developed (appendix A3) to answer all research questions. Procedures provided in Creswell and Creswell (2018) on interview protocol development and data recording were followed. Interview data were recorded using an audio recorder as well as through note taking.

The validity of data was ensured through the number of stakeholders interviewed across the value chain, the extensive amount of time spent on the field and by clarifying responses with participants (e.g. asking other participants if the interview is paired or with a group or by comparing responses with other stakeholders within the same stakeholder group). Triangulation was ensured by using complementary methods (stakeholder and social network analyses) and by briefing supervisors for reviews on how to narrate results to resonate with target audience. A summary of objectives, data collection and data analysis tools is presented in Table 1.

Table 1. Analytical Logic of Research Objectives

Objectives	Data Required	Source of Data	Analytical Method
(1) To identify all key stakeholders in Ghana fertiliser value chain, their roles and relations.	Identify all key stakeholder groups in the fertiliser value chain; role in the value chain. Who are the most important? Who has implementation means?	Primary data from interviews (power, interest and legitimacy)	Discussion and Stakeholder Analysis (power-interest grid)
	Who has contact with whom? Nature of the relationship amongst actors.	Primary data from stakeholder network symmetric matrices.	Social Network Analysis (centrality measures) using UCINET and NETDraw
(2) To establish the key constraints facing Ghana fertiliser value chain	Understand the key challenges facing the Ghana fertiliser value chain; the actors affected; how the challenges affect the performance of the fertiliser value chain? What are the existing/ previous approaches to solve the challenges?	Primary data from interviews	Discussion and Thematic analysis
(3) To establish entry points to addressing these constraints through a multi-stakeholder platform that meets set objectives and issues to be addressed.	Who should spearhead/ host platform? Who should fund platform? How often should meetings hold? Who are the important stakeholders to be represented on the platform? Envisaged conflicts/ challenges and how to address these.	Primary data from interviews and secondary data from reference materials	Discussion

Following the grouping approach as done by Ahmadi *et al.* (2019), Xu *et al.* (2016) and Lienert *et al.* (2013), in this research we adopted the following five management categories for Ghana fertiliser value chain from AGRA (2019), although slightly modified, to identify stakeholders that are most influential to address issues in each category:

I. Production, blending, importation, warehousing and retail
II. Research and development & technical advisory
III. Financing
IV. Oversight, policies, regulations, and enforcement
V. Strategic support, advocacy, and training

3.3 Data Analysis Tools

Recorded interviews were summarised in texts and analysed following Creswell and Creswell (2018). Social network analysis was conducted using UCINET version 6.704 (Borgatti *et al.*, 2002) to compute densities and centralities (total and betweenness) for each stakeholder. NETDRAW version 2.158 (Borgatti, 2002) was used to present the network diagrams. UCINET is a qualitative analysis software for analysing social networks while NETDRAW is the accompanying software to present the relationship among the stakeholders in a network.

In social network analysis, the measure of significance at the node level is centrality (Borgatti *et al.*, 2009). The influence of a stakeholder within such network can be analysed through their connection to other stakeholders using the Freeman centrality measures (Lienert *et al.*, 2013). Total Degree Centrality, also called the Freeman Degree Centrality, is a measure of the number of direct connections that a node (or an actor) has in a system (SSRL, 2018). Betweenness centrality on the other hand measures who the 'gatekeepers' are in a system i.e. how many times a node is located on a geodesic path (SSRL, 2018) and indicates stakeholders who can act as intermediaries. It is also an indication of how much power a node (or an actor) in a system has (Borgatti *et al.*, 2009). In the UCINET software, this centrality is calculated for nodes in binary adjacency matrices (Ahmadi *et al.*, 2019).

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Fertiliser Value Chain Stakeholder Identification and Their Interactions

4.1.1 Stakeholders Analysis of Ghana's Fertiliser Value Chain

After the identification of stakeholders in the fertiliser value chain (following Chevalier, 2008a; Mayers, 2005), 36 total interviews were conducted using the guide in Appendix A3. All the stakeholder groups (Table 2) were interviewed except EPA, transporters and food consumers.

Table 2. List of Stakeholder Groups in Ghana's Fertiliser Value Chain

S/No	Stakeholder	Abbreviation
1	MOFA – Crop Service Directorate	CSD
2	MOFA – Plant Protection and Regulation Services Directorate	PPRSD
3	MOFA – Directorate of Agriculture Extension Services	DAES
4	MOFA – Policy Planning, Monitoring and Evaluation Directorate	PPMED
5	MOFA – District & Regional Departments of Agriculture	DRDA
6	Private Extension	PES
7	Environmental Protection Agency	EPA
8	Research and Universities	R&U
9	Importers and Blenders	I&B
10	Distributors and Wholesalers	DISTR
11	Retailers and Agro-Dealers	RET
12	Organic Fertiliser Producers	ORGFERT
13	Cocoa Board	COCOBOD
14	Ghana Revenue Authority	GRA
15	Ghana Customs	CUST
16	Ghana Standards Authority	GSA
17	Statistics Orgs	STAT
18	Financial Institutions	FIN
19	Professional Associations	ASS.
20	Development Partners (AGRA, AFAP, IFDC, FAO, USAID, etc.)	DEVPART
21	Transporters	TRANS
22	Farmers/Farmer Associations	FARM
23	Food Consumers	CONS
24	Parliamentary Select Committee on Agriculture	PARL

Similar to how AGRA (2019) put fertiliser value chain stakeholders into five groups (described earlier in page 6), identified stakeholders were categorised into six groups:

(a) *Private sector*: importers and blenders; distributors; retailers; organic fertiliser producers; professional associations; farmers/farmer groups; and private extension service providers.
(b) *Public sector*: CSD; PPRSD; DAES; PPMED; district and regional departments of agriculture; EPA, Cocoa Board; GSA; Ghana Customs; GRA and the Parliamentary Select Committee on Agriculture
(c) *Academia and research*: research institutions and universities
(d) *Banks*: Financial institutions
(e) *Non-profit actors*: development partners
(f) *Others*: statistical organisations (private and public); transporters and food consumers.

Stakeholder power, interest and legitimacy were computed as the average value of each of these three characteristics assigned by respondents. For example, the average power of a stakeholder is the average of the values (from 0 to 3; 0 being none, 1 being low, 2 being moderate and 3 being high) assigned for the stakeholder by all the respondents. After computing the averages, a power-interest grid was generated grouping stakeholders into four groups (Figure 5)[5]. The result is similar to that obtained by dos Muchangos *et al.* (2017), who analysed stakeholders in a municipal solid waste management system in Maputo, in terms of public sector stakeholders largely represented in the player group.

a) *Crowd* – On the bottom left of the power-interest grid, these stakeholders have low power and low interest in fertiliser. Those within the group are food consumers (with the overall lowest power, interest and legitimacy in the value chain), fertiliser transporters, financial institutions, Ghana Customs, Ghana Revenue Authority, PPMED, and EPA.[6] Many of the interviewed stakeholders viewed food consumers as not being concerned about fertiliser, so they assigned low values for power, interest and legitimacy to them. Some respondents used phrases like "this is Ghana" to stress that food consumers are less concerned about fertilisers used in producing their food; that their interest is to consume the food. However, some others think that there is a growing interest among consumers about how their food is produced. The transporters also have low interest and power since many of them are not specifically into fertiliser transportation except in the case of some importers who have their own trucks. According to one of the respondents, these transporters do not care if the product is fertiliser or not, they would transport anything taken to them. As for the financial institutions, some respondents viewed them as not being interested in financing agriculture. Importers particularly complained about high interest (about 25%) and collateral demanded by these institutions. An importer said a reason why banks hesitate to fund agriculture is because of the risk associated with it. Generally, even though this group has low power and low interest, dos Muchangos *et al.* (2017) argued that mishandling them could cause strong opposition in a system. Therefore, they should be carried along in discussions.

[5] Descriptive statistics of power, interest and legitimacy are shown in Appendices C1-C3. The number of stakeholders for this and social network analysis is 31. Those exempted are already well-represented in the 31.
[6] EPA has a moderate power but interest that is just slightly above moderate, so it could either be in the crowd or in the context setter group.

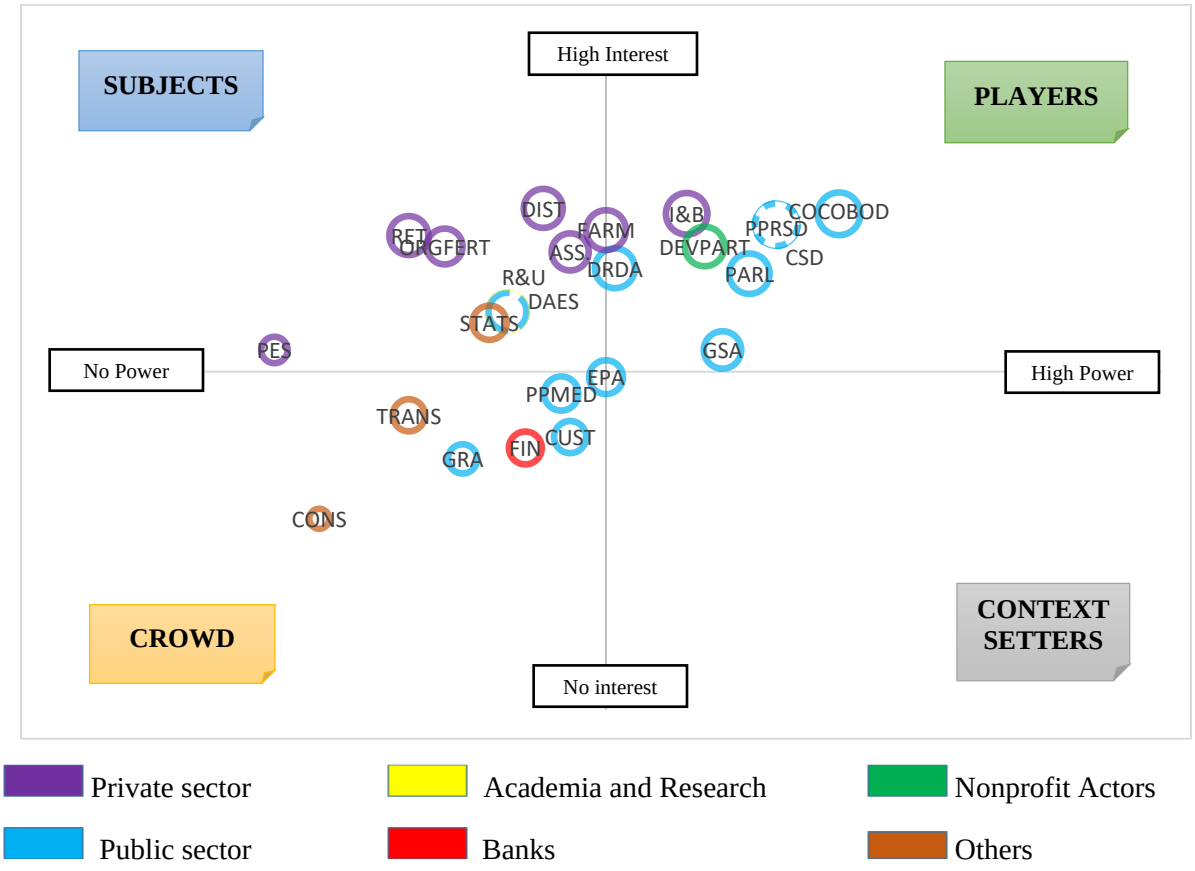


Figure 5. Power-Interest Grid of Stakeholders in Ghana's Fertiliser Value Chain

Note: Stakeholders 1 and 2 and 3 and 8 has similar power and interest thereby falling in the same location on the grid. To indicate that there are two different stakeholders, dotted lines were used for 1 and 8. Numbers (as in Table 2) were used to represent stakeholders to not clog the grid with names. Sizes of the circles denote stakeholder legitimacies.

Ghana Customs Division is under the Ghana Revenue Authority. While the former is the first point of contact for imported fertilisers and raw materials (as well as the last point of contact for fertilisers to be exported), the latter is in charge of collecting taxes. Although it is surprising that these two bodies were assigned low values for power given that Customs should have the power to stop fertiliser products from being imported and GRA should have the power to enforce tax compliance, their low interest could be attributed to their limited activities in the fertiliser value chain. Some respondents noted that the Revenue Authority is not particularly interested in fertiliser but are in the fertiliser value chain "for the money" (i.e. to collect tax).

b) *Subjects* – These stakeholders are those with high interest in the fertiliser value chain but low power. Most of the private sector actors are in this group, such as private extension, fertiliser distributors, retailers, organic fertiliser producers and professional associations. Other stakeholders within this group are DAES, research institutions and universities and statistical organisations (private and public). For the organic fertiliser producers, although they have the products to sell, the representative of a company that was interviewed noted

that demand is low. It is worth noting that for the distributors, some are expanding their businesses to become importers and are at the same time involved in fertiliser retailing. However, some of the distributors complained that they are not involved in key decision making. For the farmers, they have very high interest but moderate power which places them in-between being players and being subjects in the value chain. The stakeholders in this group, given their high interest, have the potential for more power and need to be included in decision making (dos Muchangos *et al.*, 2017).

c) *Players* – on the top right side of the grid, they have both high power and high interest. Apart from the crowd group, the rest of the public sector stakeholders are in this group including CSD, PPRSD, COCOBOD, GSA and the parliamentary select committee on agriculture. Other stakeholders within this group are fertiliser importers and blenders (the only private sector stakeholder in this group) and development partners. CSD is MOFA's technical directorate in charge of implementing government's policies (it is currently implementing PFJ) so they have high interest and high power. The pesticide and fertiliser regulatory division of PPRSD registers and trains fertiliser dealers and applicators, enforces fertiliser laws and regulations, and supervises fertiliser bio-efficacy trials while GSA develops fertiliser standards. COCOBOD was regarded by most respondent as a powerful, well-structured institution.

d) *Context Setters* – these are stakeholders who possess high power but low interest. In this study, there is no stakeholder in this group except for EPA which is in-between being in this group and being in the crowd.

4.1.2 Social Network Analysis of Ghana's Fertiliser Value Chain

For SNA, the list of stakeholders was reduced from 24 (Table 2) to 22. This was because, firstly, Ghana Customs is under Ghana Revenue Authority, so only the former was interviewed then both were merged as GRA-CUST. Secondly, the food consumer group was excluded due to their limited role in the network (none of the respondents identified that they work with them). Although EPA and transporters were not contacted for interviews, they were included in the network analyses using descriptions by other stakeholders. Moreover, stakeholder groups as in Table 2 rather than individuals/individual organisation were used in the analysis. This is to simplify the network and also since members in each stakeholder group perform similar functions. So even if, for example, five importers were interviewed, they are one group and the stakeholders that they each reported working with were together noted as the stakeholders that importers work with.

In addition, stakeholder-stakeholder interaction in same group (like an importer and another importer) was not recognised even though they may exist (e.g. importers reported sharing vessels for imports, and importers and distributors reported getting more fertiliser products from others when their quota finishes). Lastly, the network matrixes are symmetrised meaning stakeholder relationships were taken as two-way such that if a stakeholder A indicates that they relate with stakeholder 'B', stakeholder 'B' automatically works with 'A' (Franco-Trigo *et al.*, 2019).

A network diagram of the entire value chain (density = 0.714) is presented in Figure 6.[7] The network indicates how stakeholders interact and who is most connected to other stakeholders (total degree centrality). The most connected in the network are development partners (20/22) followed by farmers (19/22); importers and blenders (18/22); distributors (18/22); PPRSD (18/22); district and regional departments of agriculture (18/22); retailers (17/22); research institutions and universities (17/22), etc. According to Lienert *et al.* (2013), stakeholders with high degree centrality tend to have more access to direct information and have the potential to shape policy planning. The entire value chain network in terms of betweenness centralities (appendix E1) is similar to the network represented by the total degree centralities.

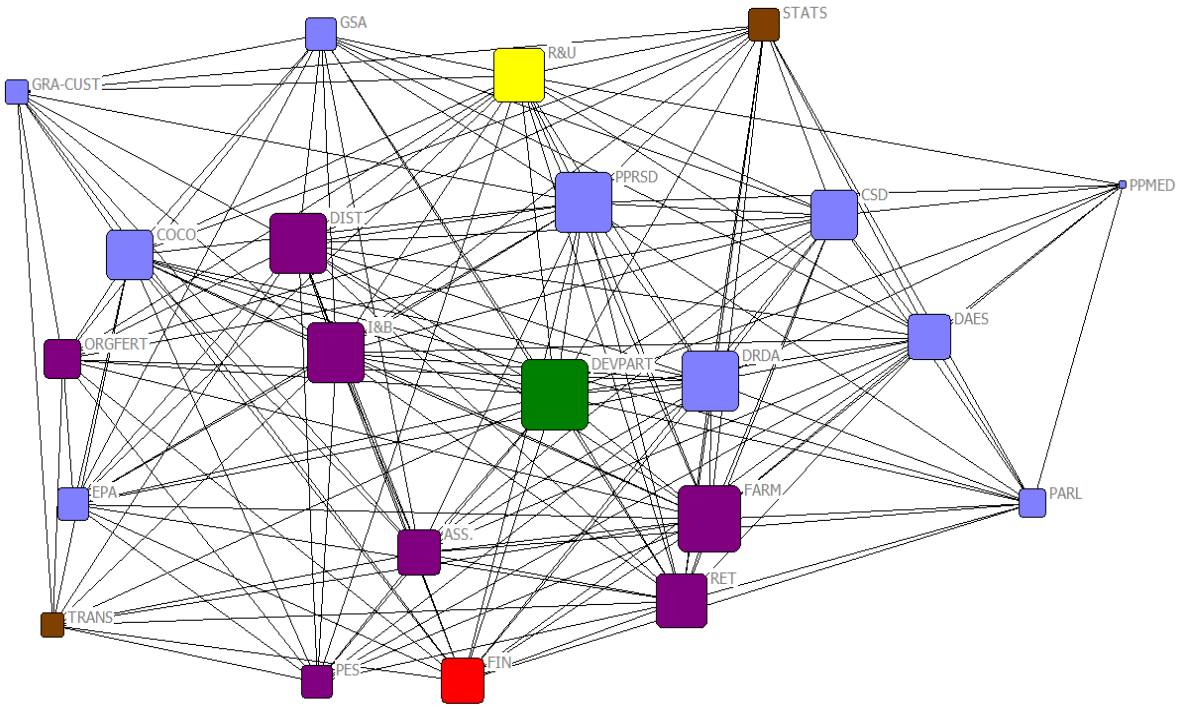


Figure 6. Total Degree Centralities for the Whole Network of Ghana Fertiliser Value Chain[8]

Network Structures based on Five Management Categories

By looking at only the entire value chain network, the most powerful stakeholders would be as is represented in appendix E1. However, when the value chain is decoupled into the five management categories, stakeholders' power changes depending on the category. The networks by management categories are presented below:

a) Production, blending, importation, warehousing and retailing

Although development partners in the overall network had the highest connections and highest power of connecting other stakeholders based on their total degree and betweenness centralities, on issues of production, blending, importation, warehousing and retailing (PIBWR), they do not.

[7] The density of a network indicates the relative connectedness of that network.
[8] For this and the rest of fertilizer value chain network diagrams, box sizes represent stakeholder centralities.

For PBIWR network (density = 0.420), stakeholders with the highest connection to other stakeholders are importers and blenders (15/22), distributors (15/22), CSD (14/22), retailers (13/22), statistics organisation (13/22), district and regional departments of agriculture (12/22), organic fertiliser producers (11/22), development partners (11/22), etc. (appendix E2).

With betweenness centralities (Figure 7), CSD is the most powerful stakeholder in the PBIWR management category since it has the highest betweenness centrality value (17.954). This is followed by importers and blenders (13.283), district and regional departments of agriculture (11.089), distributors (11.089), statistical organisations (10.453), etc. The high betweenness centrality of CSD can be attributed to its role as the implementer of the PFJ. Importers have to get quotas from CSD on the amount of fertilisers that they can supply for the PFJ subsidy programme. It can also be explained that the importers, distributors, and retailers intending to connect with and sell fertilisers to farmers do so through CSD that manages the government's subsidy programme.

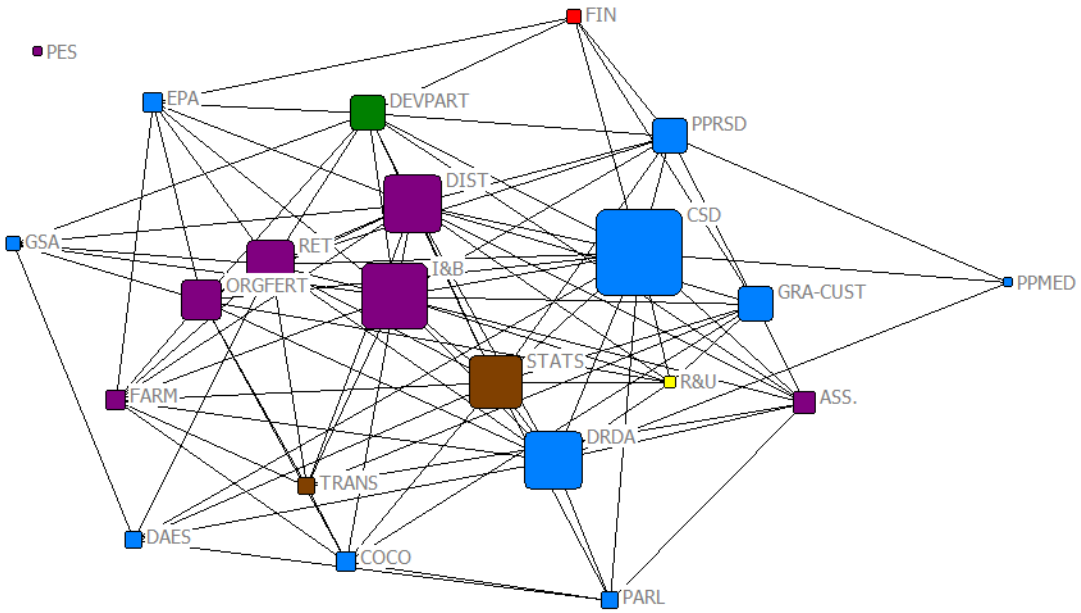


Figure 7. Betweenness centralities of PBIWR Network

Similarly, the high betweenness centralities of importers, distributors and retailers in this category is understandable since the category is about activities in the value chain that get fertiliser from where it is produced to where the farmer picks it up or buys it, and these are the key stakeholders involved. None of the respondents indicated that they work with private extension agents in this the PBIWR category[9]. Some of the stakeholders stated that they were not sure private extension agents are involved in the whole value chain.

[9] Stakeholders not involved in the interactions in a network appear separately in the network, like PES in this case.

b) Research and development and technical advisory

In terms of research and development and technical advisory (RDTA), the network becomes less dense (i.e. fewer overall connections among stakeholders, density = 0.216) compared to PBIWR. The most connected stakeholder group is the development partners (14/22) followed by research institutions and universities (12/22), district and regional departments of agriculture (10/22), CSD (8/22), importers (8/22), PPRSD (6/22), etc. (appendix E3). GRA, Customs Division, financial institutions and fertiliser transporters are not involved in RDTA and this is why the three stand alone away from the rest of the network.

Looking at the RDTA network with stakeholders' betweenness centralities (Figure 8), development partners and research institutions and universities are the two powerful stakeholders connecting different actors on issues of RDTA. These two are followed by district and regional departments of agriculture and importers. This could be because development partners provide funding for researchers to conduct research. Also, extension officers at DRDA attend extension-research linkage meetings where they indicate to researchers the kind of research problems they would like to be addressed.

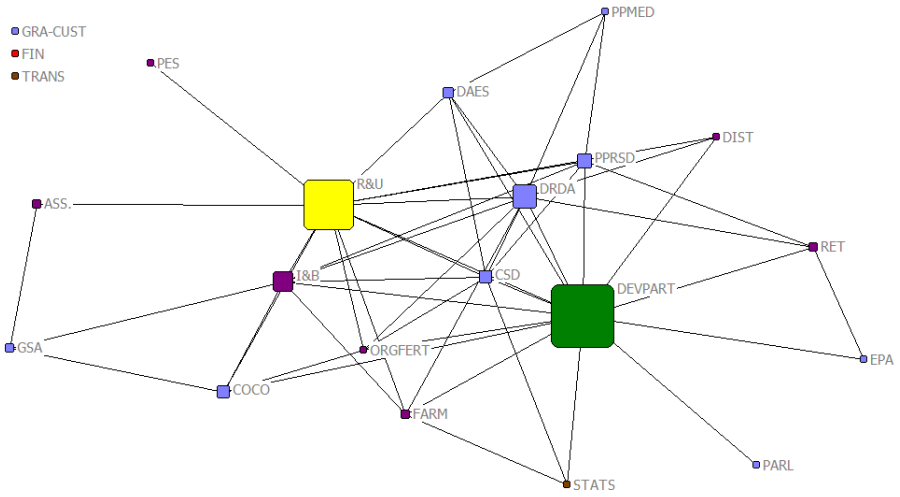


Figure 8. Betweenness Centralities of RDTA Network

c) Financing

In terms of financing (density = 0.208), the most connected stakeholder in the value chain are the development partners (18/22) followed by financial institutions (11/22), importers and blenders (7/22), etc. (Appendix E4). In terms of which stakeholder group has higher power and connects other stakeholders in the network more (betweenness centrality), development partners (126.792), are the highest and only followed by financial institutions (15.375), CSD (11.917) and importers and blenders (11.208) (Figure 9). It is interesting to see that the development partners work with more stakeholders and are more powerful in connecting the value chain on financing than the financial institutions. Development partners in several ways provide financing in the fertiliser value chain. USAID, for example, was reported to provide financing for AGRA which in turn

provides financing for AFAP. AGRA also provides funding for research institutions and universities to conduct research and to host farmer education programmes on radio. It has also provided funding to PPRSD in the past to conduct fertiliser quality studies. Similarly, AFAP offers credit guarantee and business development support to private sector stakeholders.

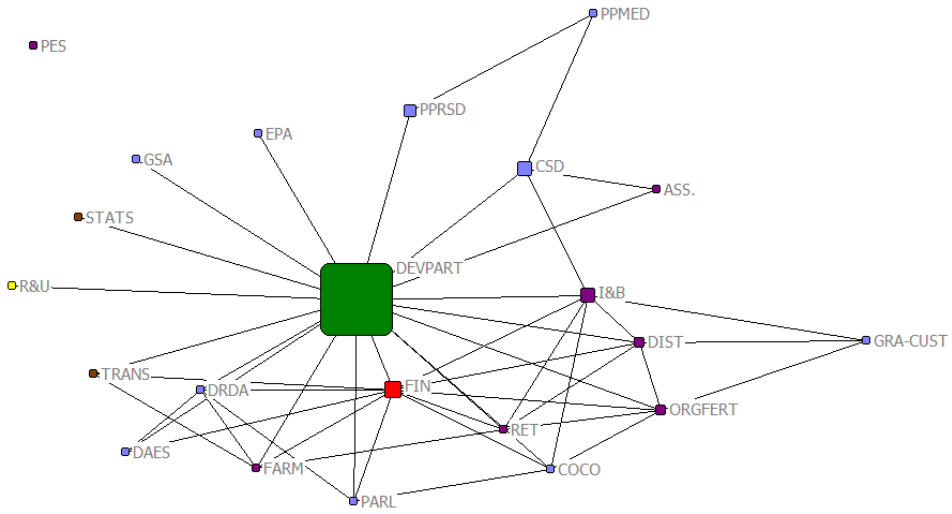


Figure 9. Betweenness Centrality of Financing Network

d) Oversight, policies, regulations and enforcement

With respect to issues of oversight, policies, regulations and enforcement of laws (OPRE, density = 0.225), the highest connected stakeholder is PPRSD (15/22), EPA (11/22), CSD (10/22), GSA (9/22), DEVPART (9/22), DRDA (7/22), etc. (Appendix E5). Similarly, the OPRE in terms of betweenness centralities (Figure 10) also show that PPRSD is the most powerful stakeholder connecting other stakeholders in this network followed by EPA, district and regional department of agriculture, CSD and GSA. Statistics organisations, financial institutions and transporters are not involved in OPRE. The high total degree and betweenness centralities of PPRSD can be attributed to its role as a regulator in the value chain. Similar explanation can be made for EPA and GSA since the former grants permit to locate warehouses and the latter sets standards on fertilisers. It is interesting however to see that compared to the public sector, the private sector actors have little power/participation in this domain which could be because they are more involved in complying with set rules than in setting them.

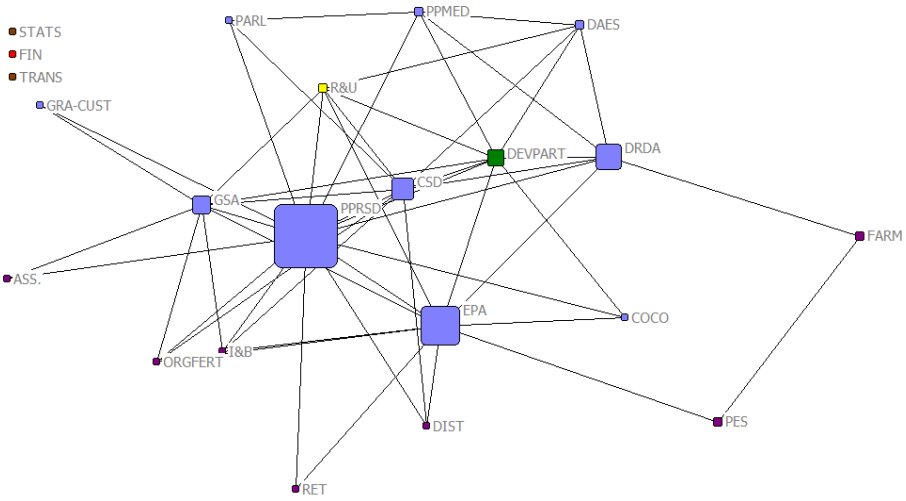


Figure 10. Betweenness Centralities of OPRE Network

e) Strategic support, advocacy and training

On the last management category in the value chain – strategic support, advocacy and training (SSAT, density = 0.398), the stakeholder working with the highest number of other stakeholders is development partners (18/22) followed by farmers (17/22), district and regional departments of agriculture (15/22), CSD (13/22), importers and blenders (12/22), etc. (appendix E6). GRA and Customs Division are not involved in this aspect of the value chain. Likewise, financial institutions and statistics organisations, while interacting together also standalone from the rest of the network. With respect to the betweenness centralities, the development partners are the most powerful stakeholder followed by farmers and district and regional departments of agriculture (Figure 11).

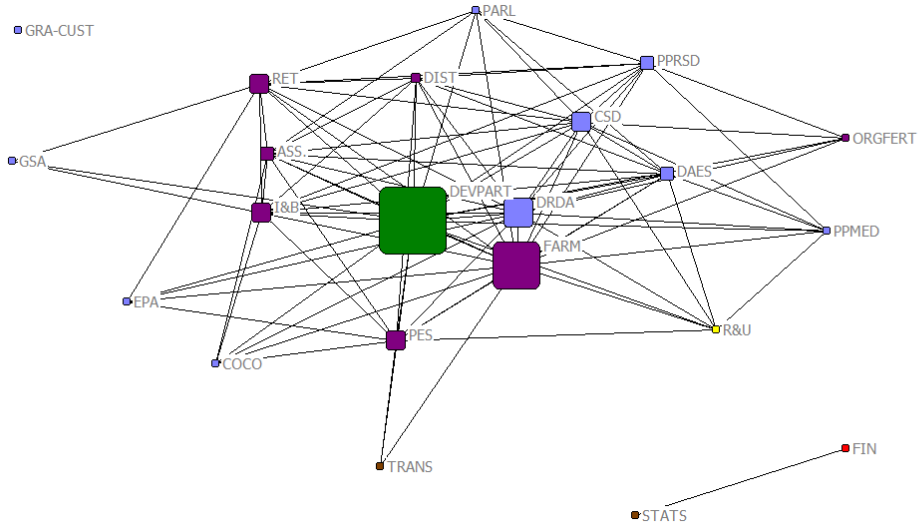


Figure 11. Betweenness centralities of SSAT Network

4.2 Ghana Fertiliser Value Chain: Challenges, Approaches and Limitations

4.2.1 Fertiliser Value Chain Challenges in Ghana

From the 36 interviews conducted, a total of 170 challenges were raised by respondents as facing the fertiliser value chain in Ghana. These challenges were grouped into 18 based on their similarities. In terms of the frequency of how these challenges were raised by respondents, issues of subsidy/quota (32) and product type, quality and responsiveness (32) were the highest as shown in Table 3.

Table 3. Fertiliser Value Chain Challenges

Challenges	Frequency	Rank
Subsidy/quota	32	1st
Product type, quality and responsiveness	32	1st
Financing/funding	22	2nd
Affordability	12	3rd
Soil testing/recommendation	10	4th
Smuggling	8	5th
Extension services/farmer knowledge	7	6th
Unavailability	6	7th
Pricing and profitability	6	7th
Low application rate	6	7th
Tax and levies	5	8th
Security agents	5	8th
Data	4	9th
Proximity	4	9th
Transportation	3	10th
Business/technical knowledge	3	10th
Warehousing	2	11th
Delays	2	11th
Fertiliser act	1	12th
Total responses on challenges	**170**	

Source: Author's compilation from interviews

For ease of discussion, the 18 challenges were further grouped into five and discussed below:

a) Fertiliser quality, use and responsiveness

This section discusses the challenges of product type, quality and responsiveness; affordability; unavailability; soil testing and recommendation; low application rate; and extension/farmer knowledge raised by the respondents.

On fertiliser type, quality and responsiveness, a farmer, among other respondents, complained that there are too many fertiliser brands. On the other hand, an importer noted that farmers are used to certain fertiliser products and it is "difficult to convince [them] to adopt new products and new fertiliser formulas." These two challenges could be a result of the "fake and adulterated fertilisers" in the market that lead to "poor efficacy" or "poor response of crops to fertilisers" which were raised by many respondents. Interviewed members of the fertiliser retailer association noted this challenge and added that "farmers come back to complain when the fertiliser does not give desired result" on their farms. Because of this, farmers have made it a habit to state specific brand names that they prefer or even go with used bags of these fertiliser brands to retail points.

> *"…farmers come back to complain about fertilisers they applied on maize and rice that it made their crops go yellow. [It is because] the nitrogen in NPK 12-30-17 is low. I stopped taking [buying] it and I am now selling different ones (25-10-10 and 23-10-5) that have higher N and the farmers do not complain about these."* – Fertiliser distributor and retailer, Upper East Region

An advocacy association that works with private sector stakeholders in the agro-chemical industry and farmers noted that fertilisers are sometimes re-bagged to be sold in the name of a brand and farmers sometimes complain that sand is packed as urea in these bags. To avoid this compromise to quality, an importer explained that his company spends extra money on foot-to-foot surveillance when transporting fertilisers. A farmer leader who noted that he does not face the challenge of low fertiliser response on his rice farm suggested that the low response could be because some farmers do not know how to apply the fertilisers. This concern – of farmers having little knowledge about how to apply fertiliser – as well as knowing little about their soil needs and receiving little extension support to guide them were raised separately as part of the challenges in the value chain. Another respondent who owns a seed and fertiliser company noted that fertiliser packaging is poor and causes fertilisers to deteriorate before arriving at the intended location.

Responding to why there are quality issues, a senior agriculture officer at MOFA noted that though PPRSD is charged with taking fertiliser samples from the port and conducting tests, the directorate does not have the resources to do so. IFDC (2019) reported that this challenge is connected to the under-resourced PPRSD that is unable to perform its regulatory and enforcement duties. The study added that adulterated fertilisers on the market has made farmers to lose confidence in applying fertilisers. Related to low response of fertilisers is the issues of soil testing and fertiliser recommendation. A senior extension officer at the Directorate of Agriculture Extension Services noted that specific recommendations exist only for certain crops like cocoa and oil palm and application rate for other crops are not based on soil testing. Another extension officer in the Upper East region noted that the cost of soil testing is high and unaffordable for farmers.

Many of the respondents, from both the private and public sector, also highlighted that farmers (especially women, according to the district extension officer) still cannot afford to buy fertiliser at subsidised prices let alone at open market which was considered "exorbitant" by a farmer. Nonetheless, the senior extension officer at the Directorate of Agricultural Extension Service hinted that "farmers will always complain." Fertiliser unavailability is also an issue as farmers do not get fertilisers when they need it which affects their planting plans. The private sector advocacy organisation interviewed explained that this is due to "bureaucracy in importation and transporting from the port to where the farmer buys the fertiliser as well as delays in seeking waiver and

approval to import at MOFA." A similar challenge is said to be faced at COCOBOD in seeking procurement approval to award contracts to importers.

> *"[There are] bottlenecks in port operation [causing] delays in vessel arrival and number of days to clear product which sometimes lead to payment of demurrages. This [delay] depends on the number of vessels at the harbour but can take one week on average…" –* Fertiliser Importer and Blender.

According to a senior researcher at SARI, straight fertilisers are also not available in the market which is because they are not covered in the subsidy programme. Moreover, the product from a briquetting project which the IFDC managed, despite being a success according to interviewed district extension agents, is no more in the market and farmers are "returning to granular urea even though the super granules (briquettes) are more effective." This, as stated by a university researcher aware of this project, is because the briquette applicators are unavailable.

> *"[The] urea briquette project for rice supported by IFDC worked so well, [it] improved yield that farmers liked it. We made a local name for the briquette ('nubine', meaning finger). Even when applied to maize, it still improved yield. [However], the urea briquette is no more in the market and farmers are back to their old practice." –* Extension officer, Bongo District, Upper East Region

Another challenge raised by respondents is low fertiliser use by farmers generally and organic fertilisers specifically. The organic fertiliser company noted that the issue of low adoption of organic fertiliser is because "the market is used to chemical fertilisers".

b) Subsidy, quota, smuggling and security agents

The government through the Planting for Food and Jobs programme offers 50% fertiliser subsidy to farmers. From the interviews, almost all the importers raised concern about quota/allocation system which determines how much fertiliser they import for the programme. According to one importer, "it is not clear how the government arrives at the [quota] figures for importers." Another added that "some people who want to benefit from the subsidy quota claim that they are importers when they are not" and "get allocated quantities that they do not have the capacity to import while those who can import more get smaller quotas." This, they said, results in "supplier's quota under subsidy finishing before demands [of farmers] are met". Similarly, the senior extension officer hinted that because the subsidy programme is not available all-year-round, farmers engaging in minor (dry) season planting do not have access to the subsidised fertiliser.

The importers complained that government's control of the market through its subsidy programme and its fixing of price for subsidised fertiliser "hinders the sale of fertiliser at open market price" since "farmers are expecting to buy fertilisers at subsidised prices". They added that this "makes the market not open to competition and discourages marketing and product development" since the dealers are "only interested in selling their quota" and not in "[looking] for their own innovative ways to get their products to the market". This challenge was also previously stated in IFDC's (2019) study of the value chain.

The interviewed member of the parliament's agriculture committee noted that there is a "lack of accountability on distributed fertilisers under the subsidy". Also, the extension officers interviewed

in a district at the Upper East region complained that "smallholder farmers do not get access to the subsidies – [the] bigger farmers do," and "agro-dealers hoard subsidised fertilisers till subsidy programme for the year ends, then sell at commercial price or smuggle to neighbouring country."[10]

> *"At the retailer level, there is challenge with proper record of subsidised fertilisers distributed to farmers. Some are dishonest – they connive with some farmers and record more fertilisers than they have distributed to the farmers in order to claim more money from the government."* – Senior agriculture officer, MOFA Crop Service Directorate

Some of the respondents who raised the issue of smuggling argue that the subsidy gives those who smuggle fertilisers the incentive since they take the cheaper fertilisers from Ghana to sell at higher prices in the neighbouring countries. According to the parliamentarian, security agents at the borders are compromised and this is aiding smuggling. An importer also shared this concern:

> *"Fertiliser is smuggled to Cote D'Ivoire, Burkina Faso and Togo due to incentive to sell at higher profit margins [there]… if security personnel are at the borders, how do fertilisers get smuggled out? Who watches the watchman?"* – Fertiliser importer and blender

Also, fertiliser distributors complained that policemen stop their transporters asking for licence of the distributor. Although a list of the names of approved distributors and retailers has been prepared by MOFA and the drivers have waybills on them, distributors complained that the policemen still demand for licences. These distributors are concerned that if they give the transporters copies of their licence, it could be used to transport products that are not theirs.

c) Funding, profitability, tax and business/technical knowledge

Financing of businesses was an issue commonly raised by stakeholders in the private sector while funding to carry out responsibilities was raised by respondents from the public sector. With regard to financing, importers, distributors and retailers remarked that they do not have enough finance to run their businesses and that it is difficult to get loans from the banks due to collateral condition and high interest rate. This, the distributors mentioned, limits the size of stock they can take at a time even if they have the demand. In order to assist the distributors, some importers had tried giving fertilisers on credit to them; however, importers said that some of the distributors defaulted at the time of payment and so they stopped giving their products on credit.

> *"…banks are hesitant to give out loans because of concerns about repayment default. Their loans [also] do not come with an insurance package. The banks are not ready to provide insurance for farming - they refuse to give loans because there is no insurance. They insure the loans instead of providing farmers with insurance"* – Importer and blender

Importers also mentioned the challenge with fluctuating foreign exchange which increases their cost of doing business. Another issue raised by importers was the late payment by the government

[10] This district shares border with another country.

for supplied subsidised fertilisers.[11] A senior agricultural officer at MOFA noted that late payment by government sometimes result in late importation for the next cycle by the importers.

The importers also raised issues of different taxes and levies they have to pay. According to one importer, his company pays 25% corporate tax; another importer said that he pays 9% of the total cost of product as tax and yet another mentioned that he pays a 10 Cedis per tonnage for PPRSD to conduct test on imported fertiliser products. Because the government determines the price at which fertiliser is sold, importers also complained that there is only a small profit margin left after paying commission to the transporter, distributor and retailers especially if the product is supplied to the northern part of Ghana. Similarly, an importer noted that the directive by the government to switch from the 50 kg bag to 25 kg packaging is increasing his cost:

> *"…the 25 kg bagging introduced under PFJ is increasing the cost of production; producing the [25 kg] sacks, sack filling, packing, loading and offloading costs more compared to the 50 kg bag. Producing a 50 kg bag costs about 1.80 Cedis while producing a 25 kg is about 3.20 Cedis."* – Fertiliser Importer and distributor

In terms of funding, the MOFA Statistics Research and Information Directorate respondents explained that the directorate lacks the needed resources to go on the field to collect and manage data. Similarly, PPRSD also does not have the resources to carry out its inspection responsibilities. The members of staff interviewed noted that due to funding and logistics challenges, they are unable to carry out post-registration monitoring because they do not have the resources to go on the field to inspect fertiliser products. Although PPRSD generates funds from the private sector, only 13% of this is retained for use by the directorate which is too small according to respondents from the directorate. Likewise, they noted that the current fertiliser act is outdated and they have not been able to review it. According to a deputy director in the directorate, the current act "does not take into account issues like blending, composting, bio-stimulants and enhancers, smuggling, obsolete fertiliser disposing, and advertising of fertiliser products." Similarly, the research institution representative interviewed noted that they do not have funding to conduct research.

Respondents also highlighted the dearth of fertiliser knowledge among some of the stakeholders. A senior revenue officer at the Customs Division noted that even though they have chemists who conduct fertiliser tests in their laboratories, some officers at the port may not be able to identify which products are fertilisers or which ones are not when they are being imported into the country. Likewise, according to an importer, "many of the people marketing fertilisers to farmers do not have the technical knowledge of the products, [and] they cannot tell farmers which product to apply and how to apply it." Similarly, a senior standards officer at the Ghana Standard Authority explained that many of the fertiliser stakeholders have limited knowledge of fertiliser standards.

d) Others – data, proximity, transportation, and warehousing

The limited availability of fertiliser data to influence decision and formulate policies was also raised. Linking this to fertiliser demand, a member of the Ghana Fertiliser Expansion Programme

[11] One of the importers noted that there is still outstanding payment from the previous government's subsidy programme and another said that only half of the 2019 payment had been made as of May 2020 when the interview was conducted.

team said that "fertiliser is not demand-driven; farmer groups are not able to forecast their fertiliser need for the next season so that they can request ahead. This is why calculation on fertiliser need in the country is based on figures from the previous year." A statistics officer at SRID added that "obtaining fertiliser use by crop is difficult because farmers do not keep this record."

> *"…the retailers and distributors do not run a structured business which makes working with them difficult. They are unable to provide a forecast of how much fertiliser they need which can assist the importer's decision when planning importation"* – Importer

Respondents raised that retailers are not located close to the farmers which means that fertilisers must be transported over long distances to get to the farmer and vice versa. Furthermore, since most fertilisers in the country are imported, some importers complained that it can be "difficult to get a vehicle to transport fertilisers from Tema to the Upper West Region." Even when the fertiliser gets transported finally, a lack of warehousing or storage at the destination "limits capacity of dealers to take large volumes".

4.2.2 Current Approaches to Solving Challenges

Stakeholders in the value chain have some means of addressing their challenges and these are highlighted below under four groups according to responses from interviews.

a) Private Sector

The most common approach for the private sector is to hold meetings and discussions with other actors in the value chain to make their challenges known. The importers and distributors often meet with the Ministry of Food and Agriculture to discuss challenges. The retailers' association met with some stakeholders (EPA, PPRSD, Customs, and the Parliamentary Select Committee on Agriculture) and signed an MOU in February 2019 to address the issue of adulterated fertiliser.

To address smuggling, one of the importers require their distributors to sign an undertaking that is also signed by the district chief executive that the fertilisers they receive would be sold in the district and not smuggled. Importers are exploring "alternative markets" to sell unsubsidised fertiliser for example to oil palm and rubber plantations. Organic fertiliser producers are also marketing their products to increase its acceptance in the market.

Some distributors get additional product from other distributors when their quota finishes. They also invite farmers to demonstration clubs to see the performance of different fertiliser products. One distributor created a virtual platform on WhatsApp where importers and distributors raise and discuss issues affecting the fertiliser value chain. To strengthen the distribution network, distributors work closely with their retail agents who supply fertilisers to farmers.

On the farmers' side, some of them come together as a group to buy fertilisers in bulk to reduce transportation cost. One of the farmers mentioned that through a nucleus farmers' group, they discuss their challenges and forward to the district assembly. Also, through a farmer-based organisation, farmers met with the MOFA minister to discuss their challenges.

b) Public Sector

The government has a subsidy programme to support farmers to afford fertilisers. But these subsidised fertilisers find their way to neighbouring countries. To address smuggling of subsidised fertilisers, MOFA produced a list of recognised fertiliser distributors and retailers. In border towns, it also selected between 5 and 7 retailers recognised to distribute subsidised fertilisers. In other towns, retailers were allowed to distribute these fertilisers except the district departments of agriculture. Similarly, subsidised fertilisers are required to be branded with 'Planting for Food and Jobs' to indicate they are subsidised and deter them from being smuggled outside.

To strengthen the distribution network, PPRSD works with the Crop Services Directorate to spread out fertiliser dealers in areas where they are concentrated so that they can reach farmers in farther areas. On quality, the PPRSD is to take samples of all imported fertilisers for testing while the importers bears the cost and Standards Authority trains stakeholders on fertiliser standards. On recommendations, the PFJ programme now has specific recommendations for maize, cassava, soybean and other crops and there are now fertilisers in the market containing micronutrients.

Extension officers at the district level meet weekly with the district director to highlight the challenges they face whilst working with farmers. Likewise, they attend a quarterly district-level Research-Extension Linkage meeting which is also attended by researchers to present their challenges. Due to the unavailability and cost of soil testing, extension officers use the soil history to recommend fertilisers to farmers. COCOBOD has also recently recruited more extension officers to support cocoa farmers.

c) Research Institutions and Universities

Through funding from development partners, research institutions educate farmers about fertilisers through radio programmes. For example, the Savannah Agriculture Research Institute through funding from AGRA formed a "listening club" radio programme where explanations are provided to farmers on the process of farming, from land preparation to fertiliser application. Farmers are also provided call credits to call in and ask specific questions.

Researchers from the University of Development Studies are engaged in research combining organic and inorganic fertilisers together as well as trying biochar and different cropping systems to see if this can reduce cost of fertilisers. Similarly, through funding from AGRA, SARI conducted research on soil fertility and another on inoculants to increase crop yield.

d) Development Partners

Development partners fund many activities in the value chain including research. AFAP provides business development, credit guarantee and capacity building support for private sector actors and shares fertiliser data with other development partners as well as with government bodies. Similarly, AGRA works with research institutions and blenders to produce specific blends of fertiliser.

4.2.3 Limitation of Current Approaches

The fertiliser subsidy programme was reportedly fraught with many challenges which limits the achievement of its purpose. Although the programme is for farmers with 5 or less acres of land,

those with more areas of land are said to have access. According to an extension officer, since there is no way to confirm the acreage of a farmer, some farmers would get subsidised fertilisers for 5 acres and present their relatives to access more fertilisers. Another issue raised was hoarding subsidised fertilisers until the season is over and then selling at commercial prices to farmers or smuggling to neighbouring countries. Subsidised fertiliser also reportedly get late to farmers. Although the subsidy programme aims to make fertiliser affordable to farmers, many respondents said that farmers still find subsidised fertiliser unaffordable.

Regarding the different meetings that stakeholders have, these are said to have little to no effect as they sometimes end at "we will look at it". According to a distributor, financing is a limitation to progress in the value chain. "Everything is linked to financing," he said. "Even when the scientists are ready to conduct research as requested, the question that remains unanswered is who finances such research?" Many importers and distributors noted also that subsidy is distorting the market since farmers are unwilling to buy fertiliser at commercial prices.

Researchers noted that the adoption of mixing organic fertiliser with inorganic has been low because the former is "expensive, far from farmers and bulky." Some development projects also face sustainability issues like the briquette project for rice farmers. Although the project was reportedly a success, it could not continue due to the absence of the equipment to apply the super-granules. "Even when super granules (briquettes) are more effective as source of nitrogen, applicators are unavailable." Due to this, the briquettes are no more produced, and farmers have returned to old practice.

> *"Once, a research was conducted to study yield impact of single superphosphate and inoculant on groundnut and it gave good results. However, now there is no SSP in the market to introduce such [an] approach to farmers."* – Researcher

4.2.4 Suggested Solutions to Challenges in the Fertiliser Value Chain

While recognising that subsidy is a "political subject", respondents suggested that fertiliser subsidy should be removed, reduced or reviewed. Many of those who suggested that it should be removed argue that it will create less incentive for it to be smuggled and "allow competition in the market". One of the respondents who suggested that the subsidy should be reviewed also suggested that the price of transportation should be at low or no cost to the distributors. Others suggested removing/ reducing tax in place of providing subsidy. Another respondent suggested that instead of subsidy, government should provide an off-take market opportunity for farmers. Lastly, one other respondent proposed that the fund from reducing the amount of the subsidy could be directed into research or other activities to develop the value chain. A senior extension officer noted that the subsidy is not available during off-farm season and suggested that the subsidy programme should be made available all-year-round.

On financing, respondents indicated the need for banks to offer more flexible, low-interest and insurance-based loans. However, the banker interviewed noted that for the interest rate to come down, there has to be "a deliberate proposition to get cheaper interest rates through guarantees from platforms like GIRSAL" to reduce banks' risk of lending these actors money. He added that the importers need to get necessary business support to prepare their documents to be ready and eligible for financing. Importers advocated for an increase in quota allocated to them under the

subsidy programme as well as government's early call for tenders and early repayment for supplied fertilisers. Similarly, to address the bureaucracy involved in seeking import permits, an importer suggested that this process should be digitised. An assistant director at PPRSD suggested that development partner financing and retaining more of the revenues generated in the directorate are needed to address their funding challenges.

Stakeholders also mentioned the need to solve fertiliser quality issues and recommend appropriate fertilisers by crop and location. They suggested that PPRSD should intensify efforts on identifying substandard and adulterated fertilisers and penalising those in possession of them. They also proposed educating stakeholders about adulterated fertilisers, establishing soil testing centres to conduct soil tests, and blending and recommending appropriate fertilisers for crops. Similarly, stakeholders pointed to the need for political will to be "more proactive and reinforce laws to curb smuggling" using law enforcement.

Furthermore, the need for involving relevant stakeholders in key decision-making process was also raised. Importer and distributors mentioned the need to be involved in consultations before prices are fixed. The organic fertiliser producer respondent suggested the need for public-private partnerships particularly with respect to organic fertiliser to encourage its adoption. The need for more extension officers to teach farmers good agriculture practices including the right fertiliser type to use was mentioned as well as the need for retailers and distributors to develop their business to ease forecasting fertiliser needs. Similarly, the government was advised to conduct an agriculture census and digitise farmers' information to ease forecasting fertiliser needs based on farmers' biodata. Respondents also mentioned the need to strengthen distribution networks by repairing bad roads, linking agro-dealers directly and closely to farmers and using a cooperative/ group approach in supplying fertilisers to farmers.

4.3 Addressing the Fertiliser Value Chain Challenges through an MSP

4.3.1 Opinion of Stakeholders about Establishing Fertiliser MSP

While there are some ongoing efforts to develop Ghana's fertiliser value chain and consequently increase food production to achieve food security in the country, there are still many challenges which have been discussed in section 4.21. The current approaches that are applied to solve the challenges have limitations: average fertiliser use in Ghana is still about 20 kg/ha, subsidised fertilisers are smuggled to be sold in neighbouring countries, private sector actors complain about low profitability and lack of finance to run business while key government agencies and research institutions do not have the resources to carry out their duties. All these combined, limit the potential of the fertiliser value chain to contribute to sustainable intensification and food security.

With the value chain currently faced with these challenges and some private sector stakeholders feeling left out in key decision making, such an environment makes it appropriate for a multi-stakeholder platform approach to address existing challenges. However, there is currently no multi-stakeholder structure that brings all the stakeholders together for this purpose. Respondents were asked about what they think of establishing an MSP for the fertiliser sector in Ghana. All the interviewed stakeholders received the idea well, with their responses ranging from 'good', 'very good', 'very necessary' to 'a fantastic idea', 'a welcome news', and 'long overdue', etc. They foresee such a platform as becoming 'a one-stop place to attend to issues' pertaining to fertilisers

and as ‘an opportunity for all the stakeholders in the value chain to present their challenges and have them addressed’.

With respect to who should host the platform, respondents’ suggestions ranged from ‘MOFA’, ‘co-hosting by private and public sectors’, ‘civil society organisation or grassroots organisation’ to ‘independent, unbiased organisation like AFAP or IFDC’ (Figure 12).

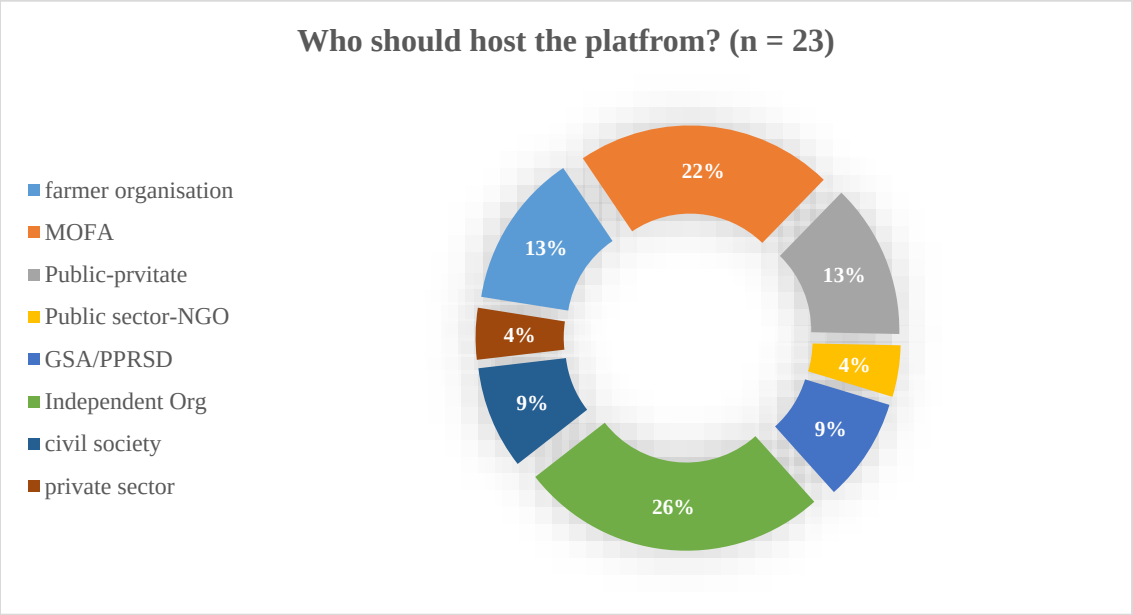


Figure 12. Ghana Fertiliser Platform Hosting

On funding, respondents suggested government, private sector, development partner funding or a combination of these three. In addition, they noted that some stakeholders may make non-monetary contribution to the platform such as offering trainings or providing venues for meetings. It is worthy of note that many respondents expressed that if the responsibility of hosting or funding the platform is expressly left to the government, there could be sustainability challenges.

Timing of the meeting was also important to the stakeholders (Figure 13). Respondents added that the frequency depends on the issues to be addressed although such meetings should be in line with the crop calendar. A stakeholder who suggested having meetings thrice in a year said that these should hold before, during and after the planting season. Another respondent who suggested meeting twice in a year added that if there are other issues, they could be addressed remotely using online means. Another suggestion was for a first meeting to be held before the season to plan ahead and a second one after to review the season.

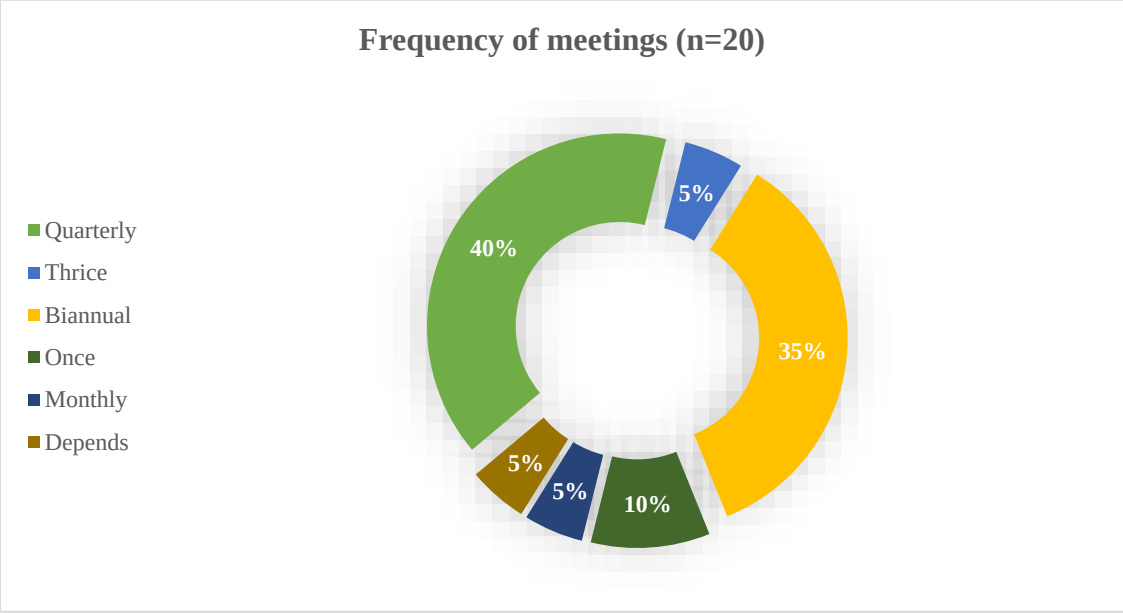


Figure 13. Frequency of Meetings

4.3.2 Stakeholders to Include on the Platform

Each respondent was asked to suggest five most important stakeholder to include on the Fertiliser Multi-stakeholder Platform. The different stakeholders (32 in total) suggested to be represented on the platform are illustrated in Figure 14. In addition to the initial list of identified key stakeholders in the fertiliser value chain, port authorities, security agents, policymakers, Ministry of Finance, civil society organisation (CSOs), local government service (district), think-tanks, regional bodies (ECOWAS), Ministry of Trade and Industries, and the media (press) were identified as key stakeholders to include on the fertiliser platform.

Although in few cases respondents specifically mentioned names of development partners to be on the platform, these were merged under 'development partners'. 'Security' on the word cloud represents suggestions for the Ghana Police Service and Customs Division. 'District' indicates Local Government Service and district-level administration. 'NASTAG' is the National Seed Trade Association of Ghana. The stakeholder who suggested including regional bodies specifically mentioned ECOWAS. Based on the frequencies of these suggestions, importers are the most highly suggested group (28) followed by farmers/farmer representative groups (27), distributors (22), MOFA (18), retailers (16), research (14), development partners/donor (10), etc.

Figure 14. Stakeholders to include on the Fertiliser Platform[12]

Although the above graphical representation was generated from asking stakeholders about who to include in the platform, the resulting list is long for an initial planning of the platform. By combining the results from SA and SNA, it is possible to get a list of the critical stakeholders who can be involved in the steering committee that will drive the initial planning of the platform (Franco-Trigo *et al.*, 2019). In Table 3, the third quartiles of the degree and betweenness centralities of actors (appendix D1) are presented alongside the result from asking respondents which stakeholders are the most relevant in solving specific issues in the value chain (appendix D2) to obtain the list of critical stakeholders.

To get the values in appendix D2, respondents were asked to rate all the value chain stakeholders on how relevant they are in solving issues in each of the five management categories. Each stakeholder was asked to assign one of the following:

- *3 if essential (without the stakeholder/group, solving this problem is impossible);*
- *2 if important (without the stakeholder/group, solving this problem is difficult);*
- *1 if desirable (without the stakeholder/group, solving this problem is still possible), and*
- *0 if "not significant" (the stakeholder/group do not contribute to solving the problem)*

After this, an average value was computed for all stakeholders for each of the five management categories (appendix D2). A similar approach has been used by Lienert *et al.* (2013) who asked

[12] Word cloud generated online using https://www.wordclouds.com/

stakeholders involved in a water planning process to rate the requirements for good planning using the same 'essential', 'important', 'desirable' and 'not significant' classification.

For the critical stakeholder list, using only the whole value chain network, 11 critical stakeholders are identified as shown in row 1 column 5 in Table 4. Franco-Trigo *et al.* (2019) obtained critical stakeholder list for a community pharmacy service project this way. However, the five management categories were included so that stakeholders who are not recognised as critical in the overall value chain but are critical in specific management categories can also be included. By considering this, a total of 19 critical stakeholders were identified.

Table 4. Critical Stakeholders in Ghana's Fertiliser Value Chain

	Degree Centrality (3rd Quartile)	**Betweenness Centrality (3rd Quartile)**	**Relevance in Solving Challenges (3rd Quartile)[13]**	**Critical Stakeholders**
Whole Value Chain	DEVPART (20) FARM (19) PPRSD (18) I&B (18) DRDA (18) DISTR (18)	DEVPART (6.725) FARM (5.8) PPRSD (5.259) R&U (4.635) DRDA (4.318) DISTR (4.064)	COCOBOD CSD PPRSD DRDA I&B GSA DEVPART PARL FARM	DEVPART (+++) FARM (+++) PPRSD (+++) DRDA (+++) I&B (++) DISTR (++) R&U COCOBOD CSD GSA PARL
			Total	**11**
Production Blending Importation Warehousing and Retailing	I&B (15) DIST (15) RET (15) CSD (14) STAT (13) DRDA (12)	CSD (17.954) I&B (13.283) DRDA (11.572) DIST (11.089) STAT (10.453) RET (9.154)	I&B (2.935) PPRSD (2.581) ORGFERT (2.516) COCOBOD (2.516) GSA (2.452) DIST (2.419)	I&B (+++) DISTR (+++) DRDA (++) CSD (++) STAT (++) RET (++) PPRSD OGFERT COCOBOD GSA
			Total	**10**
Research and Development and Technical Advisory	DEVPART (14) R&U (12) DRDA (10) I&B (8) CSD (8) PPRSD (6)	DEVPART (50.798) R&U (39.245) DRDA (15.233) I&B (11.827) PPRSD (6.436) CSD (5.438)	COCOBOD (2.742) R&U (2.677) DEVPART (2.645) PPRSD (2.452) ASS (2.323) I&B (2.258)	DEVPART (+++) R&U (+++) PPRSD (+++) I&B (+++) CSD (++) DRDA (++) COCOBOD ASS.
			Total	**8**

[13] The stakeholders indicated under 'whole value chain' are those classified as players (high power and interest) in the power-interest grid

	Degree Centrality (3rd Quartile)	Betweenness Centrality (3rd Quartile)	Relevance in Solving Challenges (3rd Quartile)[13]	Critical Stakeholders
Financing	DEVPART (18) FIN (11) I&B (7) RET (6) DISTR (6) ORGFERT (6)	DEVPART (126.792) FIN (15.375) CSD (11.917) I&B (11.208) PPRSD (6.833) ORGFERT (5.625)	FIN (2.871) I&B (2.516) COCOBOD (2.484) DEVPART (2.290) PARL (2.233) DISTR (2.065)	DEVPART (+++) FIN (+++) I&B (+++) ORGFERT (++) DISTR (++) RET CSD PPRSD COCOBOD PARL
			Total	**10**
Oversight, Policies, Regulation and Enforcement	PPRSD (15) EPA (11) CSD (10) GSA (9) DEVPART (9) DRDA (7)	PPRSD (51.294) EPA (29.531) DRDA (16.714 CSD (13.642) GSA (9.736) DEVPART (7.786)	PPRSD (2.839) COCOBOD (2.548) GSA (2.548) PARL (2.433) CSD (2.419) EPA 2.387)	PPRSD (+++) EPA (+++) CSD (+++) GSA (+++) DEVPART (++) DRDA (++) COCOBOD PARL
			Total	**8**
Strategic Support, Advocacy and Training	DEVPART (18) FARM (17) DRDA (15) CSD (13) I&B (12) PES (11) DAES (11) RET (11) ASS (11)	DEVPART (25.328) FARM (16.738) DRDA (9.026) I&B (5.326) PES (5.100) RET (4.987)	PPRSD (2.742) COCOBOD 2.742) GSA (2.548) PARL (2.484) CSD (2.484) EPA (2.452)	DEVPART (++) FARM (++) DRDA (++) CSD (++) I&B (++) PES (++) DAES RET (++) ASS PPRSD COCOBOD GSA PARL EPA
			Total	**14**
All critical stakeholders: DEVPART; FARM; DRDA; CSD; I&B; PES; DAES; RET; ASS.; PPRSD; COCOBOD; GSA; PARL; EPA; DISTR; R&U; STAT; OGFERT; FIN (Total = 19). [This excludes PPMED, GRA, Customs, transporters and food consumers ('not critical stakeholders')]				

Source: Author's computation from third quartiles of stakeholders' total and betweenness centralities as well as third quartiles of relevant stakeholders in solving value chain challenges.

Note: (+++) indicate stakeholders that are critical (i.e. appear) in the three methods while (++) signify those that are critical in two of the three methods.

However, there are a total of 11 stakeholders that appear in the three methods i.e. the quartiles of betweenness and degree centralities and stakeholder relevance: PPRSD, EPA, CSD, GSA, DEVPART, FARM, DRDA, I&B, DISTR, R&U and FIN. These 11 can be regarded as the 'most critical stakeholders' who should be included in initial planning processes of the fertiliser platform. Similarly, five other stakeholders are identified in two out of the three methods (RET, PES, FARM,

ORGFERT and STAT) and can be regarded as 'more critical stakeholders'. Therefore, taking the approach by Franco-Trigo *et al.* (2019) further, stakeholders in the fertiliser value chain can be classified into 'most critical' (11), 'more critical' (5), 'critical' (3) and 'not critical' (5).

Apart from being able to know who to involve at the planning stage of the platform, the five management categories can serve as sub-committees for the platform and the critical stakeholders in each of these five management categories in Table 4 can be members of the sub-committees.

4.3.3 Foreseen Challenges and Solutions

While none of the respondents was in opposition to the idea of having a multi-stakeholder platform, they however raised concerns about issues that could make the platform not function as intended. Most prominent among these is the differences in the interests of members of the platform. These challenges and the suggested conditions to put in place to avoid them are summarised in Table 5.

Table 5. Foreseen Challenges for the Fertiliser MSP and Suggested Solutions

Stakeholders' Concerns	Suggested Solutions/Conditions to Put in Place
(1) Differences in interest of members leading to conflicts	(1) Involve relevant stakeholders both during the planning and execution stages of platform/ only involve those who are directly involved in the fertiliser value chain
(2) Difficulty in reaching compromise	(2) inclusive platform with members having equal decision-making power and the opportunity to express views and concerns
(3) Power differences among members/ members suppressing the views of others	(3) Identify stakeholders' needs and expectations
(4) Differences in the background and understanding of members	(4) communicate "plain, simple and open" objectives of the platform and the roles of stakeholders
(5) Misunderstanding of the role of the platform by members of the platform	(5) Have a clear understanding of how to finance the platform.
(6) The platform becoming a 'talk shop' or not meeting stakeholders' expectations or not having the power to drive change or decisions made on the platform not binding.	(6) Use taxes and duties paid to fund platform's activities/fund with contributions from members/Use donor fund to kick-start activities while alternatives are sourced/ have a sub-committee on the platform whose responsibility is sourcing sustainable financing.
(7) if the platform becomes aggressive or antagonistic in approach e.g. in making demands from the government	(7) have a good management team or steering committee
(8) Change in government or its policy	(8) Have sub-groups ('smaller thematic groups') on the platform

Stakeholders' Concerns	Suggested Solutions/Conditions to Put in Place
(9) Difficulty in getting everyone on board/ getting everyone committed to attending meetings/ if senior officers send subordinates who may not have the capacity to make needed decisions to represent them	(9) Decide if the platform's secretariat will be managed by full-time or part-time staff
(10) Politicising the platform i.e. if the platform becomes partisan	(10) build trust amongst platform members
(11) Lack of sustainable means of financing the platform's activities	(11) Maintain professionalism and confidentiality with information obtained through the platform
(12) Members unwillingness to share information due to fear of exposure to competition/ if information shared is not treated with confidentiality	(12) Decisions on the platform to be binding and influence change in the fertiliser sector.
	(13) Platform's management to individually consult with concerned members if there is conflict or disagreement
	(14) Members should be willing to compromise some of their interests for the general objective of the platform.

Source: Authors' compilation from field study.

4.3.4 Next Steps

Winter et al. (2017) had proposed that it is important to identify "pragmatic launch requirements" and "contextual factors" before launching a multi-stakeholder platform. Pragmatic launch requirements are funding and leadership to run the platform while contextual factors are common interest among stakeholders about an issue. The contextual factors, according to Winter et al. (2017), are: (a) the level of awareness and importance of an issue to stakeholders; (b) ownership of the issue and display of leadership to solve it; (c) presence of momentum and alignment among the stakeholders; and (d) presence of trigger or catalysts.

Depending on the magnitude of each of the four contextual factors, Winter et al. (2017) grouped MSPs into three categories: natural progression, catalyst or call to action. In the case of a natural progression, the awareness about the issue is high, there is broad ownership among relevant stakeholders, momentum is high and there is enough trigger to get action started. A catalyst kind of MSP begins with some awareness and momentum and then it is influenced by an external catalyst such as a change in government or policy. Lastly, a call to action kind of MSP occurs when a gap or a poorly addressed issue is identified by a stakeholder and the stakeholder takes initial step to address this issue.

In the case under study, although the funding and leadership to run the platform are still subject to being discussed by stakeholders, the contextual factor conditions seem to have been satisfied.

Stakeholders are aware that the value chain is not performing well with each person having a challenge that affects their activities in the value chain. Stakeholders have also welcomed the idea of coming together under a platform to solve these challenges. Similarly, with the government of Ghana initiating the Ghana Fertiliser Expansion Programme that includes plan for a platform and IFDC taking up the challenge to initiate discussions about actualising this, this puts the process of establishing the MSP in the catalyst category.

Considering the guide by Brouwer *et al.* (2015), the next line of action should be to hold an initiation meeting of a small group of critical stakeholders/steering committee to clarify objectives as suggested by some of the interviewed stakeholders and develop a shared vision (Franco-Trigo *et al*., 2019), scope and mandate (Brouwer *et al.*, 2015). The 19 stakeholder groups that we have suggested as critical here can be members of the steering committee and the management categories can become the sub-committees of the platform. The challenges highlighted through the study can serve as issues that the platform serves to solve in the short-, medium- and long term. Attention needs to also be paid to the issues raised by stakeholders as possible challenges that can challenge the performance of the platform especially issue of financing, commitment and trust building.

CHAPTER 5:
CONCLUSION AND RECOMMENDATIONS

With a total of 36 combined KIIs, paired interviews and FGD conducted among stakeholders in Ghana's fertiliser value chain using purposive sampling, this study has provided insights into Ghana fertiliser value chain in preparation for the establishment of a fertiliser multi-stakeholder platform. The study identified the stakeholders in the value chain, their linkages, challenges and power and interest (SA). The study also provided visualisations of the interactions amongst stakeholders in the value chain and insights on stakeholders that are more influential in connecting the value chain (SNA). Although the use of SA and SNA is not new, our study will be the first using these approaches to study the fertiliser value chain.

SA result puts all the stakeholders into three main groups (players, subject and crowd) with government organisations and development partners dominating the player group and majority of the private sector stakeholders located in the subject group. While PPRSD is on the player side on the power-interest grid denoted by high power and high interest, the directorate is challenged by limited resources to carry out its regulatory duties in the value chain as farmers complain of poor quality fertilisers in the market. Similarly, extension agents are limited to teach farmers how to properly use fertilisers. Both the government and private extension have limited power putting them in the subject side of the power-interest grid. The private extension agents were not recognised by many of the stakeholders interviewed. The government's directorate at MOFA in charge of obtaining fertiliser statistics (SRID) also have limited resources to obtain data even though data is important in decision making. Financial institutions are in the crowd on the grid with low interest and low power in the value chain. The main challenges with banks are the high interest and collateral demanded before money can be lent. However, the bank representative noted that with credit guarantees, these barriers can be overcome.

While the power-interest grid from SA provided an overview of the power and interest of different stakeholders in the value chain, SNA complemented this by showing who is popular on account of the number of stakeholders they are connected to and who is influential in connecting the value chain network. To understand stakeholders' relevance beyond a whole network approach, five management categories denoting different activities occurring in the value chain were introduced to further show the stakeholders with higher connections and influence at a management category level which cannot be observed through the whole network. Through this, for example, the study identified PPRSD as the most connected and most influential in issues of oversight, policy, regulation and enforcement whereas this cannot be seen if only the entire network is considered. The SNA result also showed that development partners are very powerful in the overall value chain as well as in three of the five management categories (research and development; financing and strategic support) even ahead of actors in these categories that should be the most relevant and powerful (e.g. research institutions for research and financial institutions for finance). This seeming dependence of the value chain on development partners could be an important point for discussion on sustainability when the MSP is launched vis-a-vis Ghana's Beyond Aid plan.

Moreover, SNA also showed that while some stakeholders may have little power in the value chain (as indicated in the SA result), they can still be important. For example, research institutions and

universities were classified under the subject group in SA but are the second most important group of stakeholders after development partners on issues of research and development. Similarly, EPA falls in the crowd in SA although they are the second most important stakeholder after PPRSD on issues of oversight, policy, regulation and enforcement in SNA. Through SNA, it was also seen that the financing management category is the least dense of the five and has development partners more influential in connecting the financing network together more than financial institutions. Therefore, combining SA and SNA provided robustness for the study's results.

Most of the challenges raised by respondents have been noted in previous studies. These challenges have been discussed, for example, in a private sector optimisation study conducted by the International Fertilizer Development Center. Out of the 170 challenges highlighted by respondents that were grouped into 18, subsidy/quota, fertiliser quality and responsiveness, financing, affordability, and soil testing/blanket application stood out as the most referenced challenges by respondents. Respondents noted that the motivation for smuggling subsidised fertilisers is because of their cheap prices due to subsidy and the opportunity to sell at higher prices in neighbouring countries. Also, PPRSD being under-resourced and unable to efficiently conduct its inspection and regulatory roles could influence adulterated fertilisers finding way into the market and farmers losing confidence in the importance of fertilisers. Solving these challenges sustainably requires a holistic approach that involves proper coordination and financing that may not be possible with one agency/one stakeholder.

There are current approaches to address challenges, but some of these approaches have limitations. Even though government provides subsidy, some farmers still complain that the price is high. Some eligible farmers are also said to not get access to these fertilisers either because more established farmers access it or retailers hoard then smuggle them to neighbouring countries. Private sector stakeholders also noted that the quota system is problematic, and subsidy hinders the development of the unsubsidised market. Similarly, importers and distributors complained about low profit margin that result from the government fixing a flat rate for fertilisers to be sold across all the regions in the country. In order to address these challenges sustainably, stakeholders need to be consulted in decision making which currently is missing. So, respondents were asked about establishing a multi-stakeholder platform that brings all the actors together to solve the value chain challenges and none raised objection to this. The study presented challenges that stakeholders suggest could affect the performance of such a multi-stakeholder platform (such as trust, information sharing, power differences and partisanship) and the conditions to put in place to avoid/address these.

Overall going by the SA and SNA results, if identified critical stakeholders are engaged and involved in planning of the MSP and the challenges that stakeholders raised are looked at, this can help in effectively addressing the fertiliser value chain challenges. Stakeholders that are not as influential as others still should be involved later when a management structure and clear objectives are in place. The management categories can serve as sub-committees on the platform where identified challenges can be grouped to efficiently address them. It is vital to deliberate on who takes responsibility of hosting the platform and how to finance activities, putting in mind sustainability. Doing these has the potential to increase fertiliser use and transform the agriculture sector in Ghana through stakeholder collaborations and resource sharing.

CHAPTER 6: PERSPECTIVES

SA and SNA are most popularly used for resources governance studies. They have been used to study water resources management (Ahmadi *et al.*, 2019), solid waste management (dos Muchangos *et al.*, 2017), infectious waste management (Caniato *et al.*, 2014), food waste (Xu *et al*., 2016) and even higher education institutions (Lagoke *et al.*, 2020), collaborative health planning (Franco-Trigo *et al.*, 2019) and breastfeeding policies (Buccini *et al.*, 2020). Although they have been applied in farmer participation and agriculture knowledge diffusion studies (Micha *et al.*, 2020; Ataei *et al.*, 2019; Cadger *et al.*, 2016), to the best of our knowledge this is the first time they are being combined to study fertiliser value chain. The methods are appropriate for this study since they are suitable in explaining complex systems and can be used to improve decision making when stakeholders are diverse and have varying interests and goals (Ahmadi *et al*., 2019; Yang, 2014). Also, since both methods are complementary, combining them serves as a means of data triangulation (Caniato *et al*., 2014) and hence validates the results presented.

Many previous studies combining SA and SNA have been conducted at a city/municipal level although there are also studies done at the national level. Our study collected data in Elmina in the Central region during a technical working group meeting of fertiliser industry actors and later in the Upper East and Upper West regions and in the Greater Accra region following a purposive sampling of key stakeholders who can provide the relevant information for the study. We used 36 respondents for this study similar to previous studies combining SA and SNA where sample sizes range from 11 – 96 (Lienert *et al*., 2013; Caniato *et al*., 2014; Xu *et al*., 2016; Ahmedi *et al*., 2019; Franco-Trigo *et al*., 2019). In fact, Buccini *et al*. (2020) who used SNA to map stakeholders involved in breastfeeding policies in Mexico conducted only 9 key informant interviews. Similarly, Lagoke *et al.*'s (2020) study of university-industry relationship in enhancing curriculum development in Nigeria used 27 key stakeholder interviews. Therefore, our study sample size is within the range used in similar previous studies even for a national level study.

Future studies of this kind however could be conducted more efficiently if stakeholders are brought together in a workshop/meeting rather than individually interviewing them especially for the social network analysis data collection. Lagoke *et al.* (2020) has noted that SNA can either be done as an ego- (individual stakeholder-) level analysis or complete network analysis although adding that the latter can be prone to bias or external influence. In our own case due to the physical distancing requirement necessitated by COVID-19, we could only interview stakeholders individually or in small focus groups. Nonetheless, if limited to SNA, data collection in a group would be less time consuming and efficient in producing whole network symmetric matrices.

Similarly, future study, instead of grouping stakeholders as is done here, could consider representing each of the stakeholder groups used here as individual egos (for example, representing each importer, distributor, retailer, farmer, research institution, universities, etc. as individual stakeholder). Similarly, as plans are being made to set up the platform, it will be useful to conduct an action research observing the activities of the platform to provide empirical data for learning about MSP application in the fertiliser value chain since this is relatively new.

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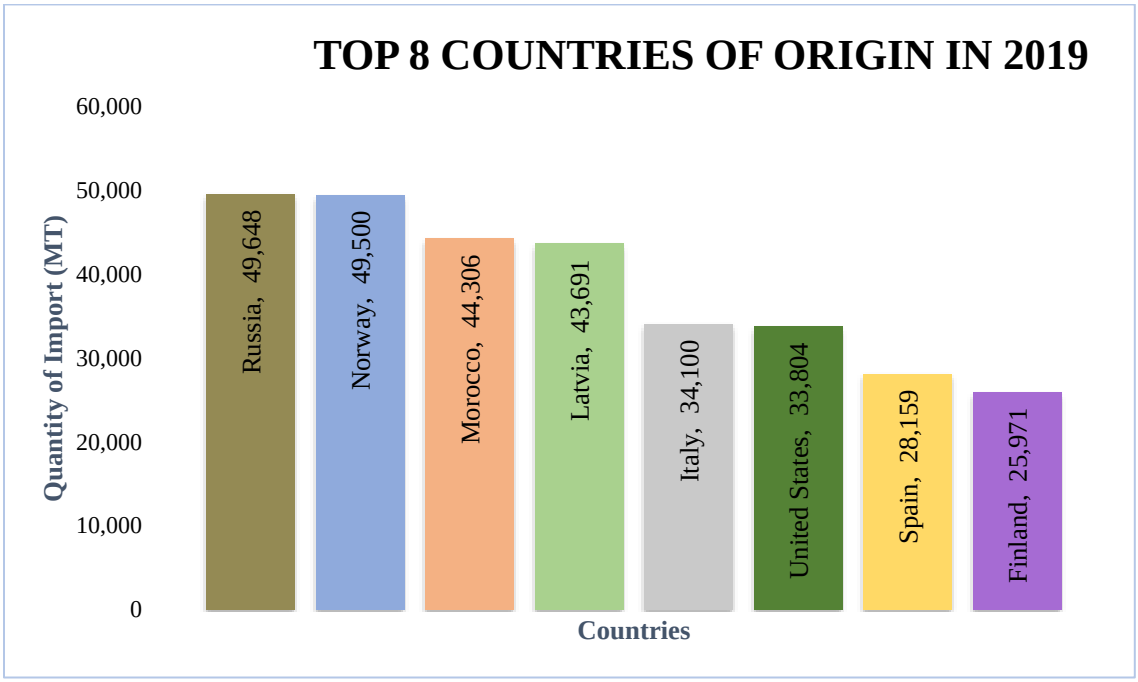
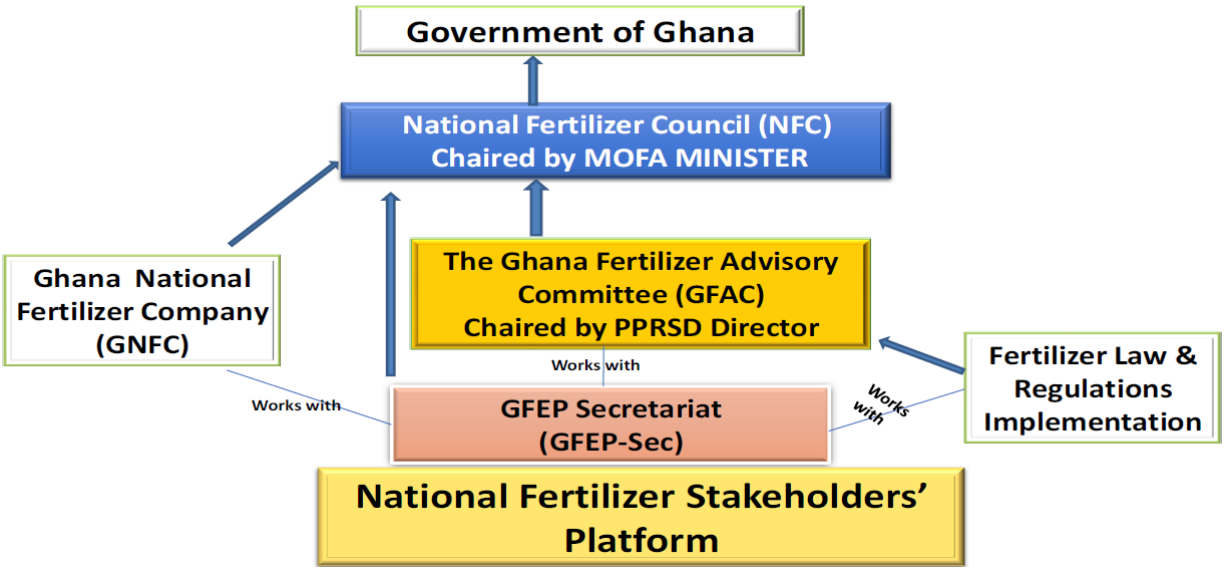
APPENDICES

Appendix A1. Top Countries Where Fertilisers in Ghana Are Sourced



Source: AFO (2020b).

Appendix A2. GFEP Implementation and Coordination Structure (adapted from GFEP, 2019)



Appendix A3

FERARI PROJECT

INTERNATIONAL FERTILIZER DEVELOPMENT CENTER (IFDC)

GHANA NATIONAL FERTILISER MULTI-STAKEHOLDER PLATFORM RESEARCH

SECTION A: Introduction and Interview Guide

Dear Respondent,

This research is being conducted as part of the Fertilizer Research & Responsible Implementation (FERARI) project of IFDC. The overall aim of the study is to improve the efficient use of fertilizer in Ghana through identification and optimal organisation of the main stakeholders in the fertiliser value chain, characterisation of challenges in the value chain and proposition of solutions that work. A letter to this effect has been communicated to you earlier through an email.

Throughout this research, responses obtained from the interview will be recorded with an audio recorder for the purpose of proper transcription and analysis at a later time. The only personal information that will be requested are your name, place of work and role. However, this and all other information obtained will be kept with utmost confidentiality. The ultimate goal is to make the result from this exercise public in a research paper. Your personal data will however be withheld, and responses will not be matched with your name or organisation.

Should you not understand any of the questions we ask, kindly feel free to seek clarification. Completing the interview would take about an hour. We plead with you to provide as much important information as you can.

By proceeding with this interview, you agree to the conditions above and promise to respond to the questions truthfully. We will ensure that we share the outcome of the research when the whole process is completed. Thank you for your time.

QUESTIONS:

1. Your name, where you work and what you do exactly with respect to fertiliser in Ghana.
2. What, in your opinion, are the challenges that affect the functioning of the fertiliser value chain in Ghana?
3. How do the challenges you mentioned affect the performance of the fertiliser value chain?
4. If any, list existing/ previous approaches (whether private, public or public-private) put in place to solve these challenges in the Ghana fertiliser value chain and those spearheading them
5. Please explain how these existing/ previous approaches were set up and coordinated.
6. Which of the fertiliser value chain challenges are these approaches addressing? Are they being addressed effectively?
7. In your opinion, what are the limitations of these approaches?
8. In your opinion, what lessons can be learned from these existing/ previous approaches?
9. What, in your opinion, at this time needs to be done to effectively address the challenges that still exist in the fertiliser value chain?
10. What is your opinion about establishing a multi-stakeholder platform that brings all the stakeholders in Ghana fertilizer value chain together to address the challenges in the value chain?
11. Can you suggest your five most important stakeholders/ groups of stakeholders that should be included in a national multi-stakeholder fertiliser platform?
12. What kind of challenges do you foresee regarding setting up this kind of a platform?
13. What in your opinion can prevent such a platform from achieving its aims?
14. What are the necessary conditions to put in place for the platform to address the challenges it is meant to address effectively?
15. List five priority issues that you would like a national fertiliser multi-stakeholder platform to address if set up
16. Any other thing that you would like to add which has not been covered?

SECTION B: Stakeholder Analysis

Part 1

*In this section, you are asked to provide an assessment (**by choosing between 0 and 3**) of the power, interest and legitimacy of each of the stakeholders/ group of stakeholders in the fertiliser value chain listed below. For each of the three characteristics (the meanings are explained below), **0 indicates none, 1 is low, 2 is medium and 3 is the high**.*

***Power** is defined as the relative amount of influence and resources that a stakeholder can exercise to promote or oppose solutions to the issues identified in the fertiliser value chain based on their economic wealth, political influence, use of force or threats, or access to information. **Stakeholder interest** is how much a stakeholder is willing to be involved in addressing issues related to the value chain. **Legitimacy** however is how important other actors in the value chain regard a particular stakeholder i.e. how much such a stakeholder is recognized by law or by local customs.*

S/No	Stakeholders	Power	Interest	Legitimacy
1.	MOFA – Crop Services Directorate			
2.	MOFA – Plant Protection and Regulatory Services Directorate			
3.	MOFA – Directorate of Agricultural Extension Services			
4.	MOFA – Policy, Planning & Monitoring & Evaluation Directorate			
5.	MOFA – District & Regional Departments of Agriculture			
6.	Extension Service Providers (Private)			
7.	Environmental Protection Agency			
8.	Research Institutions & Universities			
9.	Fertilizer Importers & Blenders			
10.	Distributors & Wholesalers			
11.	Fertiliser Retailers and Agro-Dealers			
12.	Organic Fertiliser Producers			

S/No	Stakeholders	Power	Interest	Legitimacy
13.	COCOBOD			
14.	Ghana Revenue Authority			
15.	Ghana Customs			
16.	Ghana Standards Authority			
17.	Statistics agencies (Ghana Statistical Services, MOFA Statistical Research & Information Directorate; AfricaFertilizer.Org, Development Gateways)			
18.	Financial Institutions			
19.	Professional Associations (WAFA, Crop Life, GAIDA, etc.)			
20.	Development Partners (IFDC, FAO, USAID, etc.)			
21.	Transporters			
22.	Farmers/ Farmer Associations/ Seed Companies			
23.	Food Produce end users/ consumers			
24.	Parliamentary Select Committee on Agriculture			
25.	Ghana Fertiliser Expansion Programme Secretariat			

Choose only one of the groups from 1 – 25 above that best describe where you work in the fertiliser value chain _____ (*write only a number e.g. choose 7 if you are a private extension service provider*)

Part 2: In this section, indicate who is important in solving a problem according to 5 identified groups in the fertiliser value chain: (a) production, blending, importation, warehousing and retail; (b) Research and development & technical advisory; (c) Financing; (d) Oversight, policies, regulations & enforcement; and (e) Strategic support, policy support advocacy. For example, if there is a problem that needs to be solved and this issue relates to "Production, blending, importation, warehousing and retail", how important is MOFA going to be?

- 3 is essential (without the stakeholder/group, solving this problem is impossible);
- 2 is important (without the stakeholder/group, solving this problem is difficult);
- 1 is desirable (without the stakeholder/group, solving this problem is still possible), and
- 0 is "not significant" (the stakeholder/group do not contribute to solving the problem)

Stakeholders	**Production, Blending, Importation, Warehousing and Retail**	**Research & Development and Technical Advisory**	**Finance**	**Oversight, Policies, Regulations and Enforcement**	**Strategic Support, Policy Support Advocacy**
Ghana Fertiliser Expansion Programme Secretariat					
MOFA – Crop Services Directorate					
MOFA – Plant Protection and Regulatory Services Directorate					
MOFA – Directorate of Agricultural Extension Services					
MOFA – Policy, Planning & Monitoring & Evaluation Directorate					
MOFA – District & Regional Departments of Agriculture					
Extension Service Providers (Private)					
Environmental Protection Agency					
Research Institutions & Universities					
Fertilizer Importers & Blenders					

Stakeholders	**Production, Blending, Importation, Warehousing and Retail**	**Research & Development and Technical Advisory**	**Finance**	**Oversight, Policies, Regulations and Enforcement**	**Strategic Support, Policy Support Advocacy**
Distributors & Wholesalers					
Fertiliser Retailers and Agro-dealers					
Organic Fertiliser Producers					
COCOBOD					
Ghana Revenue Authority					
Ghana Customs					
Ghana Standards Authority					
Statistics Agencies					
Financial Institutions					
Professional Associations (WAFA, Crop Life, GAIDA, etc.)					
Development Partners (IFDC, FAO, USAID, etc.)					
Transporters					
Farmers/ Farmer Associations					
Food Produce end users/ consumers					
Parliamentary Select Committee on Agriculture					

SECTION C: Social Network Analysis

In this section, show your interaction with each of the stakeholders. There are five groups of activities in the value chain and you are to indicate if you relate with a stakeholder for each of the five groups. There are 2 columns for each group. The first column establishes how often you interact/relate in the fertiliser value chain (0 means never, 1 sometimes, 2 regular, and 3 frequent). Also, show if your relationship with the stakeholder is +ve (collaboration) or -ve (conflict).

Note: Statistics organisations include Ghana Statistical Services, MOFA Statistical Research & Information Directorate; AfricaFertilizer.Org, Development Gateways.

Table 1. Magnitude and Nature of Stakeholder Relationships

Stakeholders	**Relationships between Stakeholders in Production, Blending Importation, Warehousing and Retail**	**Nature of Relationships between Stakeholders in Production, Blending Importation, Warehousing and Retail**	**Relationships between Stakeholders in Research and Development. & Technical Advisory**	**Nature of Relationships between Stakeholders in Research and Development & Technical Advisory**	**Relationship between Stakeholders in Financing**	**Nature of Relationship between Stakeholders in Financing**	**Relationships between Stakeholders in Oversight, Policies, Regulations & Enforcement**	**Nature of Relationships between Stakeholders in Oversight, Policies, Regulations & Enforcement**	**Relationships between Stakeholders in Strategic Support, Policy Support Advocacy**	**Nature of Relationships between Stakeholders in Strategic Support, Policy Support Advocacy**
GFEP										
MOFA Crop Services Directorate										
MOFA – PPRSD										
MOFA – Directorate of Agricultural Extension Services										
MOFA – PPMED										
MOFA – District & Regional D. of Agric										

Stakeholders	**Relationships between Stakeholders in Production, Blending Importation, Warehousing and Retail**	**Nature of Relationships between Stakeholders in Production, Blending Importation, Warehousing and Retail**	**Relationships between Stakeholders in Research and Development. & Technical Advisory**	**Nature of Relationships between Stakeholders in Research and Development & Technical Advisory**	**Relationship between Stakeholders in Financing**	**Nature of Relationship between Stakeholders in Financing**	**Relationships between Stakeholders in Oversight, Policies, Regulations & Enforcement**	**Nature of Relationships between Stakeholders in Oversight, Policies, Regulations & Enforcement**	**Relationships between Stakeholders in Strategic Support, Policy Support Advocacy**	**Nature of Relationships between Stakeholders in Strategic Support, Policy Support Advocacy**
Extension Service Provider (Private)										
EPA										
Research Institutions & Universities										
Importers and Blenders										
Distributors & Wholesalers										
Fertiliser Retailers and Agro-dealers										
Organic Fertiliser Producers										
COCOBOD										
Ghana Revenue Authority										
Ghana Customs										
Ghana Standards Authority										

Stakeholders	Relationships between Stakeholders in Production, Blending Importation, Warehousing and Retail	Nature of Relationships between Stakeholders in Production, Blending Importation, Warehousing and Retail	Relationships between Stakeholders in Research and Development. & Technical Advisory	Nature of Relationships between Stakeholders in Research and Development & Technical Advisory	Relationship between Stakeholders in Financing	Nature of Relationship between Stakeholders in Financing	Relationships between Stakeholders in Oversight, Policies, Regulations & Enforcement	Nature of Relationships between Stakeholders in Oversight, Policies, Regulations & Enforcement	Relationships between Stakeholders in Strategic Support, Policy Support Advocacy	Nature of Relationships between Stakeholders in Strategic Support, Policy Support Advocacy
Statistics orgs.										
Financial Institutions										
Professional Associations (WAFA, CropLife, GAIDA, etc.)										
Development Partners (IFDC, FAO, USAID, etc.)										
Transporters										
Farmers/ Farmer Associations										
Food produce end users										
Parliament Committee on Agriculture										

Please share any important information regarding your interaction with any of the stakeholder group in any of the activities listed above.

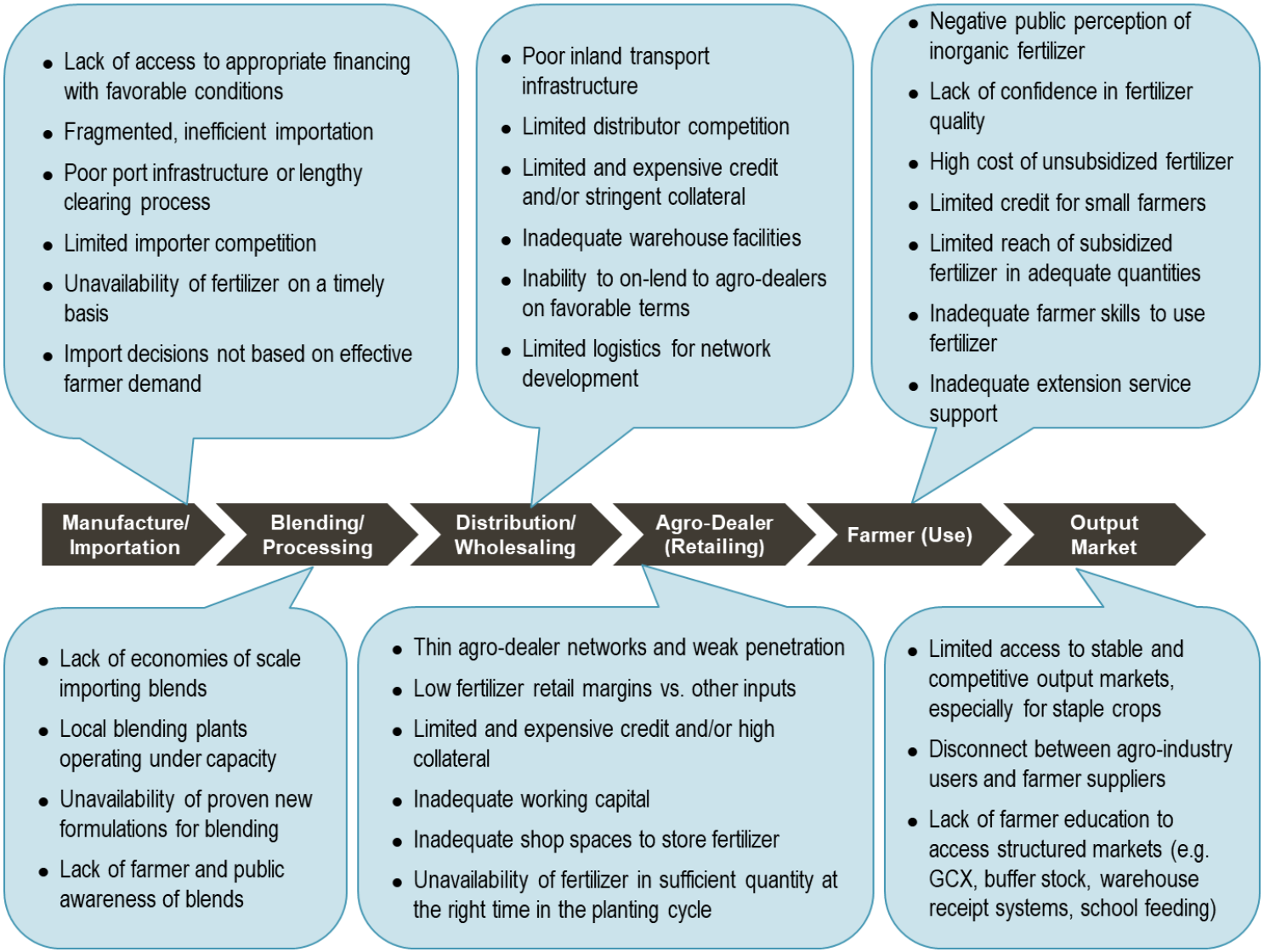
Appendix B1. Apparent Fertilizer Consumption in Ghana in MT (2010-2017)

Fertilizer Name	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
NPK	65,783	46,273	126,968	113,812	39,344	137,902	132,632	210,387	220,176	215,617
Urea	13,994	2,431	17,603	36,104	-	18,253	39,035	88,259	42,002	76,921
Ammonium sulphate	39,531	1,052	61,585	54,863	6,282	64,015	23,268	43,865	10,084	17,326
Organic fertilizers	88	13	275	6,465	5,523	7,818	8,747	37,568	5,868	4,663
TSP	79,042	22,149	92,456	47,173	19,613	32,052	13,802	26,766	9,460	29,300
MOP	37,332	25,884	43,403	19,801	22,702	18,707	13,842	24,235	15,712	42,235
Other Fertilizers	29,014	28,113	31,735	16,287	10,223	11,077	8,532	9,582	7,564	37,542
Total (MT)	**264,784**	**125,915**	**374,025**	**294,505**	**103,688**	**289,822**	**239,858**	**440,661**	**310,866**	**423,603**[14]

Source: Adapted from GFEP (2019) and AFO (2020).

[14] This figure excludes 1,669,986 liters of liquid fertilizer consumed in 2019,

Appendix B2. Summary of Challenges Faced by Actors in the Fertilizer Value Chain



Source: GFEP (2019).

Appendix B3. GFEP Implementation and Coordination Structures and Their Roles

GFEP Implementation and Coordination Structures and Roles

National Fertiliser Council

Function: advise the MOFA Minister on fertiliser policies regarding fertiliser manufacture, registration, accreditation, inspection, testing and marketing; monitor fertiliser distribution in the country etc.

Membership: MOFA Minister or a representative (head); Directors of PPRSD and CSD; Director General of CSIR and Executive Director of EPA; representative of Fertiliser Manufacturers and Importers; and representative of National Farmers' Association.

Ghana Fertiliser Advisory Council

Function: make recommendations on fertiliser related matters such as enforcement of the Plants and Fertilizer Act 2010 etc.

Membership: Director of PPRSD (chairperson); Director of CSD; representative of CSIR; 2 reps of "fertiliser industry association of Ghana", 1 rep each of analytical laboratories, EPA, Universities, Minister of Justice and National Association of farmers and fishermen

GFEP Secretariat

Function: hosted by the National Fertiliser Stakeholder Platform, the secretariat is proposed to ensure day-to-day running of GFEP and facilitate discussions of fertiliser issues among actors and development of joint solutions.

Membership: core members of the national fertiliser task team, public and private sector reps, fertiliser industry reps, research and development institutions, specialised institutions, civil societies, farmer organisations, agro-input dealers, and development partners.

Ghana National Fertilizer Company

Function: a proposed joint-venture, limited liability company with capacity to locally manufacture 1 Million tons per year ammonia, a 1.5 Million tons per year Urea and 0.7 Million tons per year DAP.

Membership: composed of a board of directors at the top management level, the company is to be headed by a managing director and have production, commercial, economic and development departments.

Appendix C1. Descriptive Statistics for Stakeholder Power

Variable	N	N*	Mean	StDev	Minimum	Median	Maximum	Mode	N for Mode
MOFA – CSD	31	0	2.613	0.615	1.000	3.000	3.000	3	21
MOFA – PPRSD	31	0	2.613	0.803	0.000	3.000	3.000	3	24
MOFA – DAES	31	0	1.645	0.877	0.000	2.000	3.000	2	13
MOFA – PPMED	31	0	1.839	0.898	0.000	2.000	3.000	2	12
MOFA – District & Regional Dept	31	0	2.032	0.983	0.000	2.000	3.000	3	12
Private Extension	31	0	0.806	0.980	0.000	1.000	3.000	0	15
EPA	31	0	2.000	1.125	0.000	2.000	3.000	3	14
Research and Universities	31	0	1.645	1.018	0.000	2.000	3.000	1	11
Importers and Blenders	31	0	2.290	0.902	0.000	3.000	3.000	3	16
Distributors and Wholesalers	31	0	1.774	0.990	0.000	2.000	3.000	2	12
Retailers and Agro-Dealers	31	0	1.290	0.902	0.000	1.000	3.000	1	13
Organic Fertiliser Producers	31	0	1.419	0.564	1.000	1.000	3.000	1	19
COCOBOD	31	0	2.8387	0.4544	1.0000	3.0000	3.0000	3	27
Ghana Revenue Authority	31	0	1.484	1.061	0.000	1.000	3.000	1	11
Ghana Customs	31	0	1.871	0.991	0.000	2.000	3.000	2, 3	10
Standards Authority	31	0	2.419	0.886	0.000	3.000	3.000	3	19
Statistics Organisations	31	0	1.581	0.886	0.000	1.000	3.000	1	15
Financial Institutions	31	0	1.710	0.938	0.000	2.000	3.000	2	11
Professional Associations	31	0	1.871	0.922	0.000	2.000	3.000	2	11
Development Partners (IFDC, FAO, USAID)	31	0	2.355	0.709	1.000	2.000	3.000	3	15
Transporters	31	0	1.290	1.071	0.000	1.000	3.000	1	12
Farmers/Farmer Associations	31	0	2.000	0.966	0.000	2.000	3.000	2	12
Food End Users/Consumers	31	0	0.968	0.948	0.000	1.000	3.000	1	13
Parliamentary Select Committee on Agriculture	31	0	2.516	0.677	1.000	3.000	3.000	3	19

Appendix C2. Descriptive Statistics for Stakeholder Interest

Variable	N	Mean	StDev	Minimum	Median	Maximum	Mode	N for Mode
MOFA – CSD	31	2.8710	0.3408	2.0000	3.0000	3.0000	3	27
MOFA – PPRSD	31	2.8710	0.3408	2.0000	3.0000	3.0000	3	27
MOFA – DAES	31	2.355	0.755	1.000	3.000	3.000	3	16
MOFA – PPMED	31	1.871	0.718	1.000	2.000	3.000	2	15
MOFA – District & Regional Dept	31	2.613	0.558	1.000	3.000	3.000	3	20
Private Extension	31	2.129	0.806	0.000	2.000	3.000	2	14
EPA	31	1.968	0.875	0.000	2.000	3.000	2	14
Research and Universities	31	2.355	0.661	1.000	2.000	3.000	2, 3	14
Importers and Blenders	31	2.9355	0.2497	2.0000	3.0000	3.0000	3	29
Distributors and Wholesalers	31	2.9677	0.1796	2.0000	3.0000	3.0000	3	30
Retailers and Agro-Dealers	31	2.8065	0.4016	2.0000	3.0000	3.0000	3	25
Organic Fertiliser Producers	31	2.7419	0.5143	1.0000	3.0000	3.0000	3	24
COCOBOD	31	2.9355	0.3592	1.0000	3.0000	3.0000	3	30
Ghana Revenue Authority	31	1.484	0.962	0.000	1.000	3.000	1	11
Ghana Customs	31	1.613	0.919	0.000	2.000	3.000	1	12
Standards Authority	31	2.129	0.806	0.000	2.000	3.000	2	14
Statistics Organisations	31	2.290	0.783	1.000	2.000	3.000	3	15
Financial Institutions	31	1.548	0.810	0.000	2.000	3.000	2	14
Professional Associations	31	2.710	0.588	1.000	3.000	3.000	3	24
Development Partners	31	2.742	0.575	1.000	3.000	3.000	3	25
Transporters	31	1.742	0.815	0.000	2.000	3.000	1, 2	12
Farmers/Farmer Associations	31	2.8387	0.4544	1.0000	3.0000	3.0000	3	27
Food End Users/Consumers	31	1.129	0.846	0.000	1.000	3.000	1	12
Parliamentary Select Committee on Agriculture	31	2.581	0.564	1.000	3.000	3.000	3	19

Appendix C3. Descriptive Statistics for Stakeholder Legitimacy

Variable	N	Mean	StDev	Minimum	Median	Maximum	Mode	N for Mode
MOFA – CSD	31	2.8065	0.4774	1.0000	3.0000	3.0000	3	26
MOFA – PPRSD	31	2.8710	0.3408	2.0000	3.0000	3.0000	3	27
MOFA – DAES	31	2.355	0.839	0.000	3.000	3.000	3	16
MOFA – PPMED	31	1.968	0.795	0.000	2.000	3.000	2	15
MOFA – District & Regional Dept	31	2.548	0.624	1.000	3.000	3.000	3	19
Private Extension	31	1.290	0.783	0.000	1.000	3.000	1	16
EPA	31	1.935	1.031	0.000	2.000	3.000	2, 3	11
Research and Universities	31	2.290	0.739	1.000	2.000	3.000	3	14
Importers and Blenders	31	2.7419	0.4448	2.0000	3.0000	3.0000	3	23
Distributors and Wholesalers	31	2.452	0.723	1.000	3.000	3.000	3	18
Retailers and Agro-Dealers	31	2.452	0.723	1.000	3.000	3.000	3	18
Organic Fertiliser Producers	31	2.129	0.763	1.000	2.000	3.000	2	13
COCOBOD	31	2.8710	0.4275	1.0000	3.0000	3.0000	3	28
Ghana Revenue Authority	31	1.516	1.092	0.000	1.000	3.000	1	11
Ghana Customs	31	1.774	1.087	0.000	2.000	3.000	3	10
Standards Authority	31	2.290	0.973	0.000	3.000	3.000	3	18
Statistics Organisations	31	1.968	0.836	1.000	2.000	3.000	1	11
Financial Institutions	31	1.839	0.969	0.000	2.000	3.000	1	11
Professional Associations	31	2.258	0.773	1.000	2.000	3.000	3	14
Development Partners (IFDC, FAO, USAID)	31	2.516	0.677	1.000	3.000	3.000	3	19
Transporters	31	1.774	0.884	0.000	2.000	3.000	1	13
Farmers/Farmer Associations	31	2.548	0.675	1.000	3.000	3.000	3	20
Food End Users/Consumers	31	0.839	0.969	0.000	1.000	3.000	0	14
Parliamentary Select Committee on Agriculture	31	2.6129	0.4951	2.0000	3.0000	3.0000	3	19

Appendix D1: Centrality Measures for the entire network and the management categories

ID	Whole Net Deg Cent	Whole Net Betw Cent	1 PBIWR Deg Cent	1 PBIWR Betw Cent	2 RDTA Deg Cent	2 RDTA Betw Cent
CSD	16	3.059	14	17.954	8	5.438
PPRSD	18	5.259	9	5.839	6	6.436
DAES	15	2.955	6	1.993	5	2.708
PPMED	8	0.171	3	0.167	3	0.417
DRDA	18	4.318	12	11.572	10	15.233
PES	13	1.31	0	0	1	0.000
EPA	13	0.909	7	2.241	2	0.000
R&U	17	4.635	7	0.809	12	39.245
I&B	18	3.909	15	13.283	8	11.827
DIST	18	4.064	15	11.089	3	0.000
RET	17	3.548	13	9.154	4	1.567
ORGFERT	14	2.31	11	7.082	5	0.611
COCO	16	4.021	7	2.663	5	4.486
GRA-CUST	11	1.407	9	6.043	0	0.000
GSA	13	1.689	6	0.991	3	1.000
STATS	13	1.542	13	10.453	3	0.200
FIN	15	3.037	5	1.178	0	0.000
ASS.	15	3.059	8	3.099	2	0.976
DEVPART	20	6.725	11	6.181	14	50.798
TRANS	11	0.996	8	1.974	0	0.000
FARM	19	5.8	9	2.392	5	2.060
PARL	12	1.263	6	1.843	1	0.000

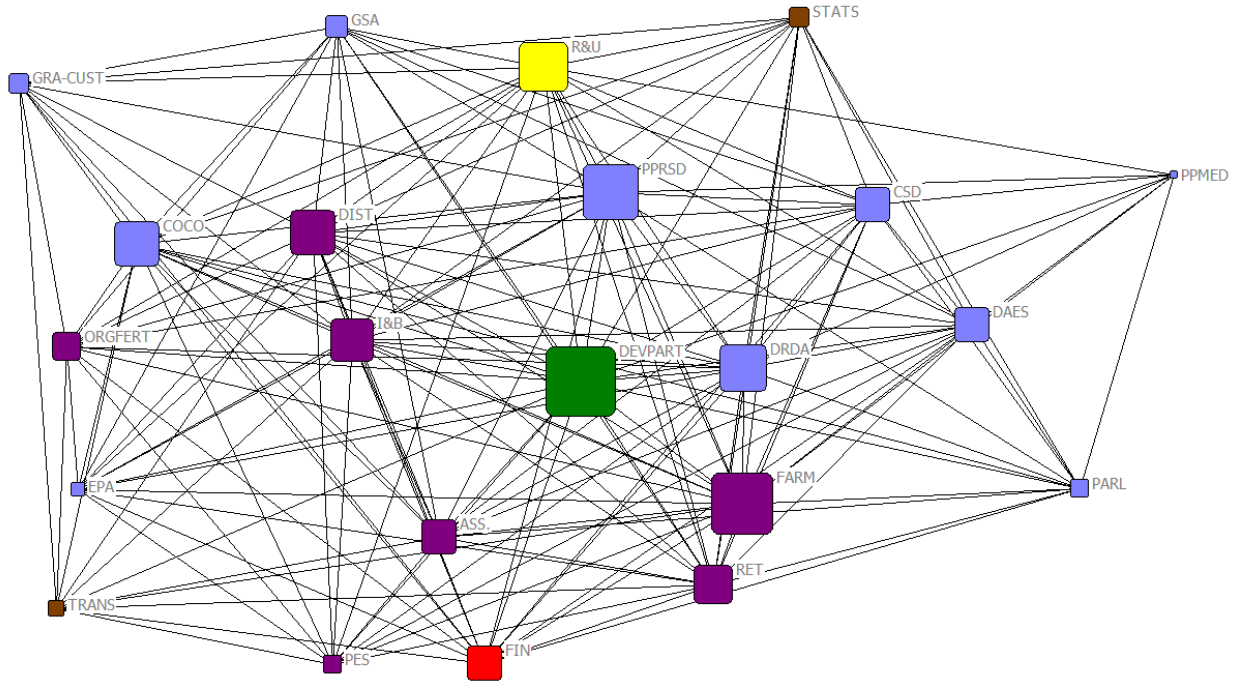
Appendix D1 (cont'd): Centrality Measures for the entire network and the management categories

ID	3 FIN Deg Cent	3 FIN Betw Cent	4 OPRE Deg Cent	4 OPRE Betw Cent	5 SSAT Deg Cent	5 SSAT Betw Cent
CSD	4	11.917	10	13.642	13	4.737
PPRSD	2	6.833	15	51.294	10	2.212
DAES	3	0.000	5	0.900	11	2.487
PPMED	2	0.500	5	2.075	7	0.325
DRDA	5	1.000	7	16.714	15	9.026
PES	0	0.000	2	2.200	11	5.100
EPA	1	0.000	11	29.531	5	0.143
R&U	1	0.000	6	2.103	7	0.325
I&B	7	11.208	4	0.236	12	5.326
DIST	6	4.667	3	0.236	10	0.843
RET	6	1.500	2	0.000	11	4.987
ORGFERT	6	5.625	4	0.236	5	0.000
COCO	5	1.083	3	0.000	6	0.000
GRA-CUST	3	0.167	2	0.000	0	0.000
GSA	1	0.000	9	9.736	3	0.000
STATS	1	0.000	0	0.000	1	0.000
FIN	11	15.375	0	0.000	1	0.000
ASS.	2	0.000	2	0.000	11	2.138
DEVPART	18	126.792	9	7.786	18	25.238
TRANS	3	0.000	0	0.000	3	0.000
FARM	5	1.000	2	1.111	17	16.738
PARL	4	0.333	3	0.200	7	0.375

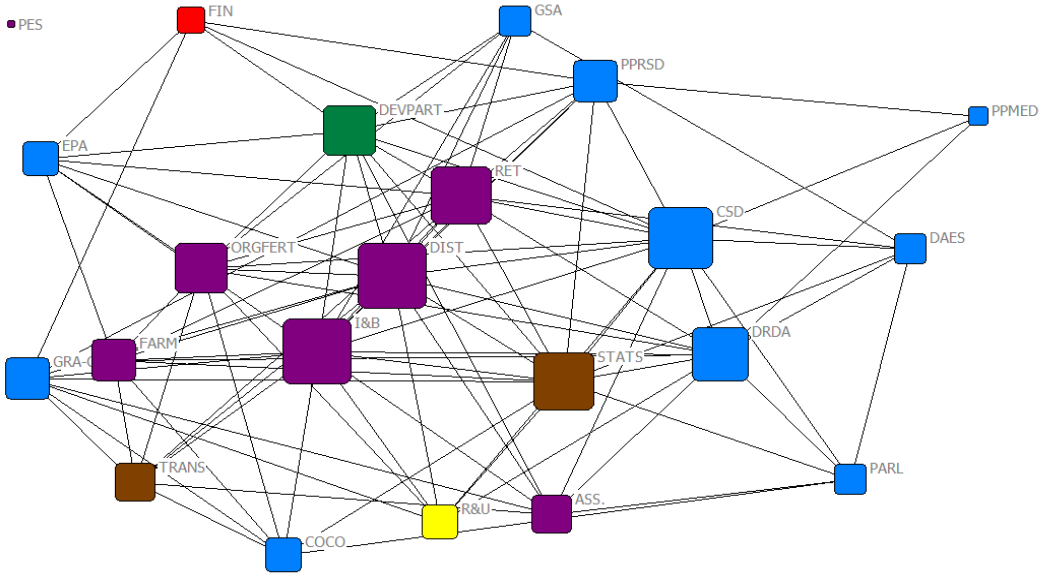
Appendix D2. Power/Relevance of Each Stakeholder in Solving Issues in Each of the Five Management Groups

Production, Blending, Importation, and Warehousing Issues		Research and Dev. and Technical Advisory Issues		Financing Issues		Oversight, Policies, Regulations and Enforcement Issues		Strategic Support, Advocacy and Training Issues	
CONS	0.61	TRANS	0.39	EPA	0.23	CONS	0.74	CONS	0.74
PES	0.74	GRA	0.58	R&U	0.29	TRANS	0.77	TRANS	1.00
GRA	0.94	CONS	0.74	RDDA	0.35	FIN	0.81	GRA	1.23
DAES	1.29	CUST	0.77	PPRSD	0.39	PES	0.97	CUST	1.32
R&U	1.35	RET	1.19	CONS	0.39	R&U	1.10	FIN	1.39
RDDA	1.42	FIN	1.19	DAES	0.42	STATS	1.35	PES	1.52
PPMED	1.48	PES	1.39	PES	0.42	RET	1.42	RET	1.71
CUST	1.77	EPA	1.45	GSA	0.55	DIST	1.45	STATS	1.74
STATS	1.77	DIST	1.55	CSD	0.68	ORGFERT	1.52	EPA	1.81
FARM	1.81	RDDA	1.65	PPMED	0.74	GRA	1.55	ORGFERT	1.94
TRANS	1.84	FARM	1.84	STATS	0.94	I&B	1.74	GSA	1.94
FIN	1.90	PPMED	1.87	TRANS	0.97	DEVPART	1.77	DIST	1.97
PARL	2.17	PARL	1.90	CUST	1.16	ASS.	1.87	FARM	2.03
RET	2.23	DAES	2.10	FARM	1.29	FARM	1.94	R&U	2.06
EPA	2.29	GSA	2.16	ASS.	1.45	DAES	1.97	PARL	2.13
ASS.	2.32	STATS	2.16	RET	1.71	RDDA	2.10	RDDA	2.16
DEVPART	2.32	CSD	2.23	GRA	1.74	CUST	2.10	I&B	2.29
CSD	2.35	ORGFERT	2.23	ORGFERT	1.81	PPMED	2.29	PPMED	2.35
DIST	2.42	I&B	2.26	DIST	2.06	EPA	2.39	PPRSD	2.45
GSA	2.45	ASS.	2.32	PARL	2.23	CSD	2.42	CSD	2.48
ORGFERT	2.52	PPRSD	2.45	DEVPART	2.29	PARL	2.43	DAES	2.48
COCOBOD	2.52	DEVPART	2.65	COCOBOD	2.48	COCOBOD	2.55	ASS.	2.55
PPRSD	2.58	R&U	2.68	I&B	2.52	GSA	2.55	COCOBOD	2.74
I&B	2.94	COCOBOD	2.74	FIN	2.87	PPRSD	2.84	DEVPART	2.74

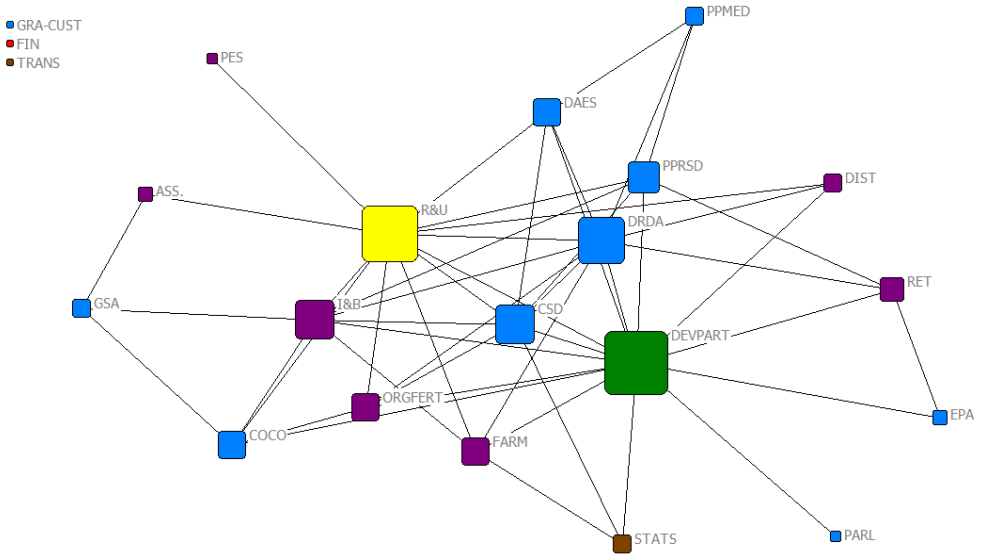
Appendix E1. Entire Fertiliser Value Chain Network (Betweenness Centrality)



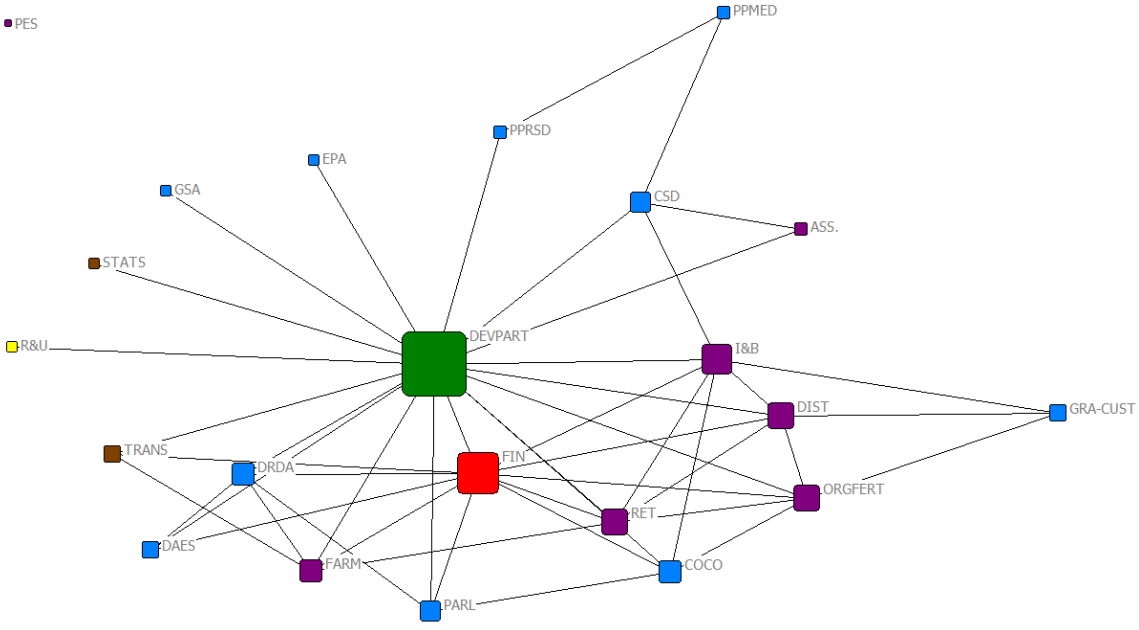
Appendix E2. Network Diagram for Ghana Fertiliser Value Chain in Relation to Production, Blending, Importation, Warehousing and Retailing (Total Degree Centrality)



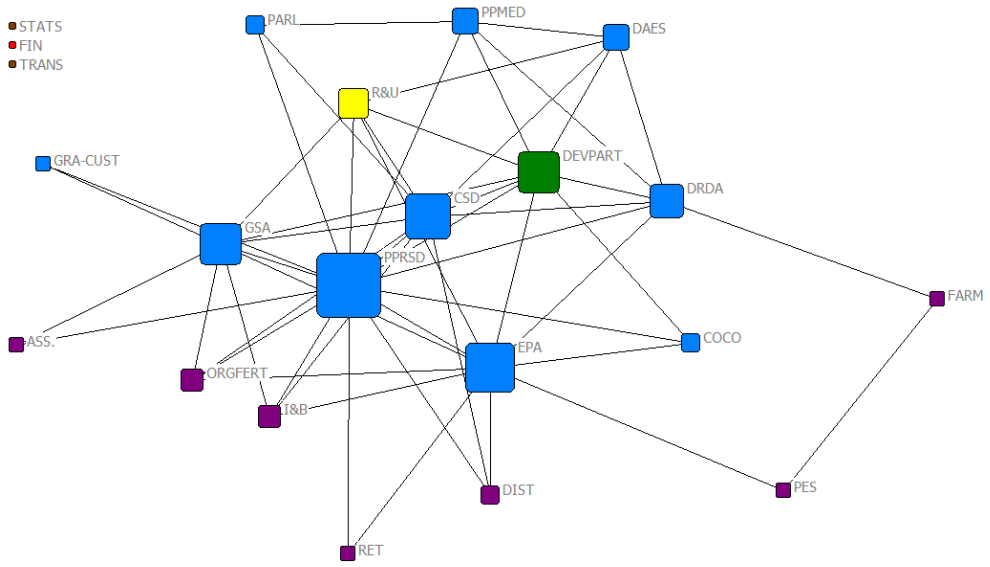
Appendix E3. Network Diagram for Ghana Fertiliser Value Chain in Relation to Research and Development and Technical Advisory (Total Degree Centrality)



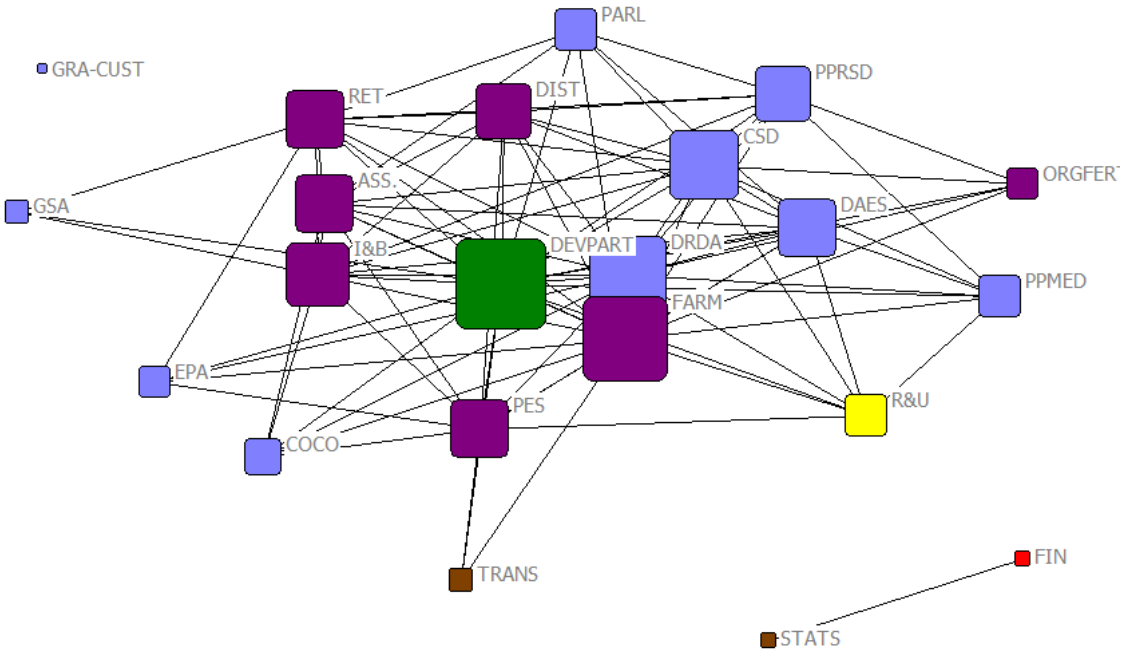
Appendix E4. Network Diagram for Ghana Fertiliser Value Chain in Relation to Financing (Total Degree Centrality)



Appendix E5. Network Diagram for Ghana Fertiliser Value Chain in Relation to Oversight, Policies, Regulations and Enforcement (Total Degree Centrality)



Appendix E6. Network Diagram for Ghana Fertiliser Value Chain in Relation to Strategic Support, Advocacy and Training (Freeman Total Degree Centrality)



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