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Informing the Design of a Multistakeholder Platform Using Stakeholder Analysis and Social Network Analysis --Manuscript Draft--

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Abstract:	<p>The fertiliser value chain in Ghana faces many challenges that limit its potential contribution to food production and food security in the country. This has necessitated discussions on the need to establish a multi-stakeholder platform to address extant value chain challenges. In preparation for this platform, this study conducted 31 interviews and identified 24 stakeholder groups in the fertiliser value chain using stakeholder analysis and social network analysis. We found that while many of the public sector stakeholders have high levels of power and show high interest in the value chain, they usually face resource constraints in exercising their duties. Conversely, most of the private sector stakeholders have high interest in fertilisers, but do not have much power to influence decisions. Also, development partners are very powerful and resourceful, but practically have temporary presence in the value chain. The study subsequently combined the results from stakeholder analysis and social network analysis and identified 19 critical stakeholders out of the initial 24 who can highly influence the initial planning and subsequent success of the platform. Lastly, the study identified challenges that the platform may face and the conditions to put in place to avoid/address these challenges. Overall, the study concludes that if the identified critical stakeholders are engaged and the platform clearly outlines its objectives and vision, it can address the challenges in the fertiliser value chain, contribute to the development of the general agriculture sector and improve food production and food security in Ghana.</p>

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Informing the Design of a Multistakeholder Platform Using Stakeholder Analysis and Social Network Analysis

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Abstract

The fertiliser value chain in Ghana faces many challenges that limit its potential contribution to food production and food security in the country. This has necessitated discussions on the need to establish a multi-stakeholder platform to address extant value chain challenges. In preparation for this platform, this study conducted 31 interviews and identified 24 stakeholder groups in the fertiliser value chain using stakeholder analysis and social network analysis. We found that while many of the public sector stakeholders have high levels of power and show high interest in the value chain, they usually face resource constraints in exercising their duties. Conversely, most of the private sector stakeholders have high interest in fertilisers, but do not have much power to influence decisions. Also, development partners are very powerful and resourceful, but practically have temporary presence in the value chain. The study subsequently combined the results from stakeholder analysis and social network analysis and identified 19 critical stakeholders out of the initial 24 who can highly influence the initial planning and subsequent success of the platform. Lastly, the study identified challenges that the platform may face and the conditions to put in place to avoid/address these challenges. Overall, the study concludes that if the identified critical stakeholders are engaged and the platform clearly outlines its objectives and vision, it can address the challenges in the fertiliser value chain, contribute to the development of the general agriculture sector and improve food production and food security in Ghana.

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

Declaration of Competing Interests

None.

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Authors' contributions

Aremu, Toyib B.: Writing - original draft; Data collection; Data analysis; Conceptualization, Methodology. *Freeman, Comfort Yomle*: Conceptualization; Methodology; Writing-Reviewing. *Laamari, Abdelaali*: Conceptualization; Methodology; Writing-Reviewing. *Iddrisu, Yakubu*: Data collection. *Atakora, Williams K.*: Data collection. *Bindraban, Prem S.*: Conceptualization; Writing-Reviewing.

1. Introduction

Mineral fertilisers contribute greatly to increasing food production globally (Erisman *et al.* 2008). Without them, normal crop yield would feed only about 2 – 3 billion people (Bindraban *et al.*, 2018). Despite this importance, the fertiliser value chain in Africa faces challenges that limit its contribution to sustainably feeding the continent. These challenges cut across different stages of and involve different stakeholders in the value chain. For example, fertiliser recommendations to farmers are often not site-specific (AGRA, 2019; Tetteh *et al.*, 2018), government interventions are expensive, cumbersome to implement and result in market distortion (Mabe *et al.*, 2018), and investment in research is insufficient (Bindraban *et al.*, 2018). Fertiliser use in Ghana, currently at 20.88 kg/ha according to World Bank (2020), remains below the 50 kg/ha recommendation of the Abuja Declaration and partly contributes to the low crop yield experienced in the country.

The limited impacts of past agricultural development efforts to improve food security and reduce poverty have been attributed to the lack of involvement of important stakeholders (Ragasa *et al.*, 2016). To correct this kind of issues, starting in the 1980s in West Africa (Struik *et al.*, 2014), more participatory approaches like multi-stakeholder platforms (MSPs) have been introduced as alternatives for engaging stakeholders to solve complex issues (Achyar *et al.*, 2017; Hermans *et al.*, 2017; Sumberg *et al.*, 2013). According to Hermans *et al.* (2017), engaging stakeholders is important for three reasons: (i) to provide complementary views on a problem and ensures that the technical, economic, social, cultural and political appropriateness of suggested solutions are properly discussed, (ii) to help stakeholders identify their individual interests as well as the need to work together to achieve the group's aim, and (iii) to ensure that developed solutions are well received since all stakeholders have been involved in their development. Given its potentials, an MSP is being proposed in Ghana to address the fertiliser sector challenges. The International Fertiliser Development Centre had prepared a concept for such a platform that can help develop a competitive private sector-led fertiliser market, increase fertiliser use, and achieve a shift from blanket to balanced fertiliser use, among other objectives (IFDC, 2017).

To set the stage for establishing the MSP, this paper identifies all the stakeholders involved in the fertiliser value chain of Ghana and those most critical to engage at the planning stage based on their power, interest, and legitimacy and results from social network analysis. It is important to avoid, among other things, an over- or under-representation of certain stakeholders in decision making (Brouwer *et al.*, 2015) which may hinder the MSP from achieving the objectives that it is set to achieve. Hermans *et al.* (2017) had found that such representation issues affected the capacity of MSPs in Rwanda, the Democratic Republic of Congo, and Burundi to innovate or scale up innovation. Similarly, Davies *et al.* (2017) studied nine cases of agricultural/pastoral platforms in five west and central African countries, finding that limited participation of some important stakeholders like agro-dealers and financial institution representatives challenged outcomes in some of the platforms. As far as we know, this is the first study using stakeholder analysis (SA) and social network analysis (SNA) to identify stakeholders in the fertiliser value chain and quantifying their power, interest, and legitimacy across different management categories ahead of establishing a fertiliser MSP. While some fertiliser MSPs have previously been established in Mozambique

and Kenya, there is no recorded systematic approach on how the stakeholders were identified, selected, and engaged.

The remainder of the paper is structured as follows: in the next section we explain how we used SA and SNA for our analysis; then we discussed our results (including the list of critical stakeholders and possible challenges the platform may face) before drawing conclusions from the study findings.

2. Method

Study setting and design

This study was conducted in the Republic of Ghana with data collection starting in Elmina (Central region) during a technical workshop involving fertiliser stakeholders in February 2020 and continued in May – June 2020 in the Upper East, Upper West, and Greater Accra regions. Ghana was a country of focus because there are already discussions among some stakeholders on establishing a national multistakeholder fertiliser platform. Stakeholders in the fertiliser value chain were identified through literature review, self-identification, and snowballing (Chevalier, 2008a; Mayers, 2005). A final stakeholder list was generated containing 24 groups of stakeholders involved in the fertiliser value chain in Ghana.

Respondents were chosen purposively based on their ability to respond to research questions (Creswell and Creswell, 2018). A total of 31 stakeholder interviews were conducted including 24 key informant interviews, 6 paired interviews and 1 focus group discussion. An interview guide was developed (see Supplementary Material S01) following Creswell and Creswell (2018). Interview data were recorded using an audio recorder as well as through note taking. Interview data were manually synthesised and analysed.

We followed the grouping approaching done by Ahmadi *et al.* (2019), Xu *et al.* (2016) and Lienert *et al.* (2013) and adopted the following five fertiliser value chain management categories from AGRA (2019) with slight modification: (a) Production, blending, importation, warehousing, and retail, (b) Research and development & technical advisory, (c) Financing, (d) Oversight, policies, regulations, and enforcement, (e) Strategic support, advocacy, and training

Stakeholder Analysis

Stakeholder analysis involves determining a stakeholders' relationship, legitimacy, interest as well as power (Chevalier, 2008b). Power is a stakeholder's ability to use wealth, authority, information access, and other resources to influence decisions. Interest means the net gain or loss experienced due to a certain intervention – current or proposed. And legitimacy is the recognition of a stakeholder's rights and responsibilities by others (Chevalier, 2008b).

Stakeholder power, interest and legitimacy were computed as the average value of each of these three characteristics assigned by the 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 interviewed. The averages were then used to compute a power-interest grid. Similar to how AGRA (2019) categorised the stakeholders in the fertiliser value chain into five groups, identified stakeholders were categorised into the following modified six groups:

- (a) *Private sector*: importers and blenders; wholesale distributors; retailers; organic fertiliser producers; professional associations; farmers/farmer groups; and private extension service providers.
- (b) *Public sector*: Crop Services Directorate; Plant Protection and Regulatory Services Directorate; Policy Planning Monitoring and Evaluation Directorate; Environmental Protection Agency; Directorate of Agriculture Extension Services; district and regional departments of agriculture; Cocoa Board; Ghana Standards Authority; Ghana Customs; Ghana Revenue Authority; and 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.

In addition to the power-interest grid, stakeholders' relevance in solving issues in the value chain were also obtained. To quantify stakeholder's relevance, respondents were asked to rate all the 24 identified groups of value chain stakeholders on degree of relevance 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)

Following Lienert et al. (2013), an average value was then computed for all stakeholders for each of the five management categories.

Social Network Analysis

In social network analysis (SNA), the measure of significance at the node i.e., individual level is centrality (Borgatti et al., 2009). The influence of a stakeholder within a network can be analysed through their connection to other stakeholders in the network 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 a stakeholder) 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).

To conduct SNA, the list of stakeholders was reduced from 24 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 – i.e., the people who consume the food produced – was excluded due to their limited role in the network (none of the respondents identified that they work with them). In addition, although the Environmental Protection Agency (EPA) and transporters were not contacted for interviews, they were included in the network analyses using descriptions by other stakeholders. Moreover, stakeholder groups rather than individual organisations were used in the analysis. This is to simplify the network and because members in each stakeholder group perform similar functions. So even if, for example, five fertiliser importers were interviewed, they are one group and the stakeholders that they each reported working with were altogether noted as the stakeholders that fertiliser importers work with. Similarly, stakeholder-stakeholder interactions within the same group (like an importer and another importer) was not recognised even though such interactions may exist (e.g., importers reported sharing vessels for imports, and importers and distributors reported getting more fertiliser products from others when their subsidy quota finishes).

Lastly, the network matrixes are symmetrised meaning that 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).

Data analysis

Power-interest grid was constructed with MS Excel (2013). Social network analysis was done 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. The third quartiles for obtaining the critical stakeholders in the fertiliser value chain were also computed using MS Excel (2013).

3. Results

3.1 Stakeholder Identification

A total of 24 groups of stakeholders were identified (Table 1) from which 31 interviews were conducted for the stakeholder and social network analyses. Representatives from all these groups were interviewed except for the EPA, Ghana Revenue Authority, fertiliser transporters and food consumers.

Table 1 List of stakeholder groups in Ghana's fertiliser value chain

Stakeholder	Abbreviation	Type of Interview (No. of interview)
MOFA – Crop Services Directorate	CSD	KII (1)
MOFA – Plant Protection and Regulatory Services Directorate	PPRSD	FGD (1)
MOFA – Directorate of Agricultural Extension Services	DAES	KII (1)
MOFA – Policy Planning, Monitoring and Evaluation Directorate	PPMED	PI (1)
MOFA - District & Regional Departments of Agriculture	DRDA	PI (1); KII (1)
Private Extension Services	PES	KII (1)
Environmental Protection Agency	EPA	Nil
Research & Universities	R&U	PI (2)
Importers & Blenders	I&B	KII (5)
Distributors & Wholesalers	DISTR	KII (3)
Retailers and Agro-dealers	RET	PI (1)
Organic Fertiliser Producers	ORGFERT	KII (1)
Cocoa Board	COCOBOD	PI (1)
Ghana Revenue Authority	GRA	Nil
Ghana Customs	CUST	KII (1)
Ghana Standards Authority	GSA	KII (1)
Statistics Organisations	STAT	PI (1)
Financial Institutions	FIN	KII (1)
Professional Associations	ASS.	KII (1)
Development Partners (AGRA, AFAP, IFDC, etc.)	DEVPART	KII (2)
Transporters	TRANS	Nil
Farmers/ Farmer Associations	FARM	KII (3)
Food consumers	CONS	Nil
Parliamentary Select Committee on Agriculture	PARL	KII (1)

Source: Authors' compilation. KII = Key Informant Interview, FGD = Focus Group Discussion, PI = paired interviews MOFA = Ministry of Food and Agriculture

3.2 Stakeholder Analysis

After computing the averages of stakeholders' power, interest and legitimacy, a power-interest grid was generated for stakeholder analysis which put the stakeholders into four groups (figure 1)¹.

- a) *Players* – on the top right side of the grid, they are the stakeholders who have both high power and high interest in the fertiliser value chain. Apart from the crowd quadrant, many of the public sector actors are in this quadrant. The Crop Services Directorate is MOFA's technical directorate in charge of implementing government's policies (it is currently implementing the Planting for Food and Jobs subsidy programme) so they have high interest and high power. The pesticide and fertiliser regulatory division of MOFA's Plant Protection and Regulatory Services Directorate (PPRSD) registers and trains fertiliser dealers and applicators, enforces fertiliser laws and regulations, and supervises fertiliser bio-efficacy trials while Ghana Standard Authority develops fertiliser standards. Although many stakeholders identified that PPRSD possesses high power as a regulator, respondents interviewed from PPRSD expressed that they lack the resources needed to carry out their duties. Ghana Cocoa Board, the government's institution facilitating the production, processing, and trade of cocoa, was identified by most respondents as being a powerful, well-structured institution.

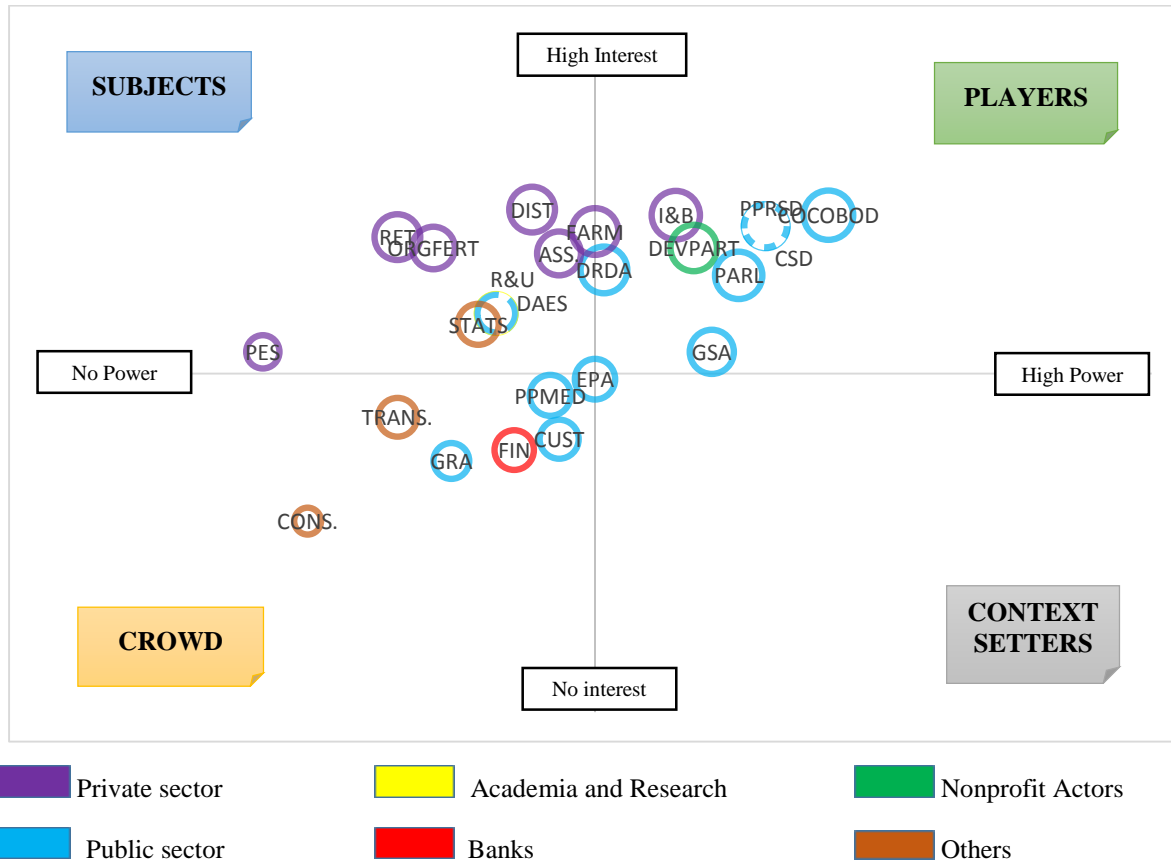


Figure 1 Power-Interest Grid of Stakeholders in Ghana's Fertiliser Value Chain

Note: CSD and PPRSD as well as DAES and R&U have similar power and interest thereby falling in the same location on the grid. To differentiate these stakeholders, dotted lines were used for CSD and DAES. Sizes of the circles denote stakeholder legitimacies.

- b) *Subjects* – These stakeholders (nine groups in total) are those with high interest in the fertiliser value chain but low power. Most of the private sector actors are found in this quadrant. For the organic fertiliser producers, although they have products to sell, the representative of a company that was interviewed noted that demand is currently low for organic fertiliser in the country. 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 such as fertiliser price determination. The professional associations also have high interest, such as the industry player lobby group interviewed that comprises majorly importers but with representation of distributors. 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 quadrant, given their

high interest, have the potential for more power and need to also be included in decision making (dos Muchangos *et al.*, 2017).

- c) *Context Setters* – these are stakeholders who possess high power but low interest. Based on the result of the power-interest grid for Ghana’s fertiliser value chain, there is no stakeholder in this quadrant except for EPA which falls in-between being in this group and being in the crowd.
- d) *Crowd*: on the bottom left of the power-interest grid, these stakeholders have low power and low interest in fertiliser. There are seven groups of stakeholders in this quadrant, four of which are from the public sector.² Many of the interviewed stakeholders viewed food consumers (with the overall lowest interest and legitimacy in the value chain) as not being concerned about fertiliser. 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 mainly to consume the food. However, some others expressed that there is a growing interest among consumers about how their food is produced. The fertiliser transporters also have low power and interest since most of them are not specifically involved with 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 financial institutions, some respondents viewed them as not interested in financing agriculture. Importers particularly complained about the high interest rate (about 25%) and collateral requested 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 the ‘crowd’ group of stakeholders has low power and low interest, mishandling them (dos Muchangos *et al.*, 2017) or wrong communication (Caniato *et al.*, 2014) could cause strong opposition in a system. Therefore, stakeholders in this group should also be carried along in fertiliser value chain discussions.

Ghana Customs Division is under the Ghana Revenue Authority. While the former is the first point of contact for imported fertilisers and raw materials coming into (and the last point of contact for fertilisers that are to be exported outside) the country, the latter oversees collecting taxes. Although it is surprising that these two bodies have low average 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. Also, 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).

3.3 Social Network Analysis

Figure 2 is the network diagram for the whole fertiliser value chain (density = 0.714) based on betweenness centrality i.e., who is most influential in the network.³ The most influential in the whole fertiliser value chain

network are development partners (betweenness centrality = 6.725) followed by farmers (5.8); PPRSD (5.259); research institutions and universities (4.635); district and regional departments of agriculture (4.318); distributors (4.064) etc. Similarly, the most connected/popular stakeholders in the network are development partners (total degree centrality = 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.^{4,5} 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.

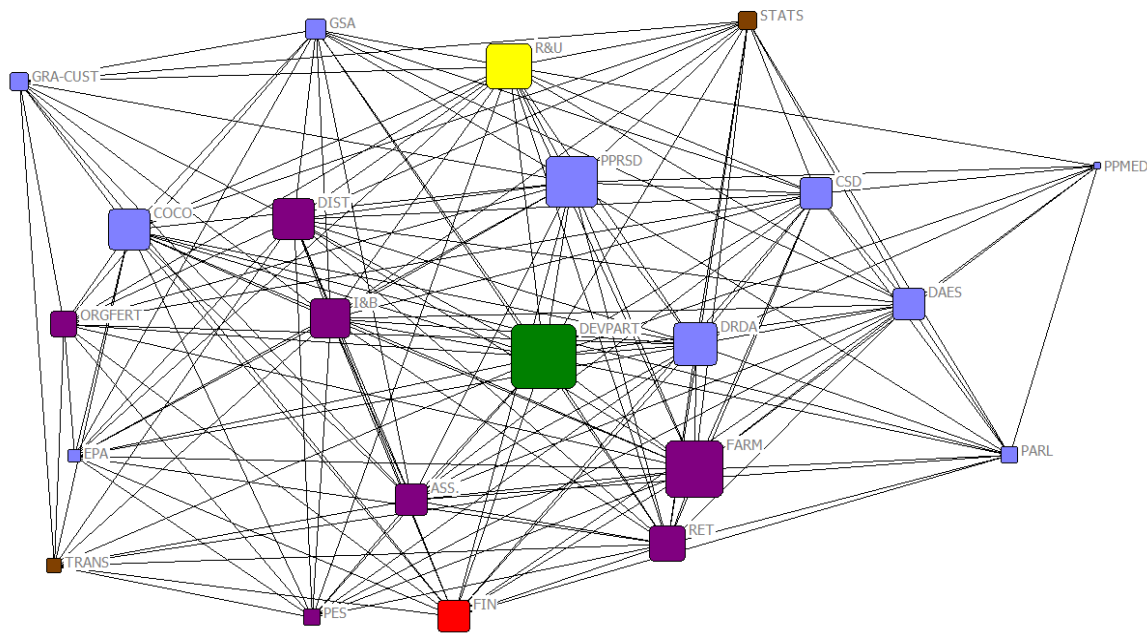


Figure 2 Betweenness Centralities for the Whole Network of Ghana Fertiliser Value Chain⁶

By looking at stakeholder interactions only from the whole value chain level, the most influential stakeholders would be as is represented in figure 2. However, when the value chain is divided into the five management categories, stakeholders' influence changes depending on the category. The networks by management categories are presented below:

a) *Production, blending, importation, warehousing, and retailing (PIBWR)*

Although development partners had the highest connections/popularity (total degree centrality) and highest influence/power among other stakeholders (betweenness centrality) in the overall network, on PIBWR they do not. For PIBWR network (density = 0.420), stakeholder group with the highest influence (figure 3) is Crop Service Directorate (17.954) 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 may be attributed to its role as the implementer of the Planting for Food and Jobs (PFJ) subsidy programme since about 80% of the market is covered by subsidy (IFDC 2019). Importers get their quotas from CSD on the amount of

fertilisers that they can supply for PFJ. So, the influence can also be explained by the fact 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.

Similarly, the high betweenness centralities of importers, distributors and retailers in this category is understandable since this category involves activities in the value chain that get fertiliser from where it is produced to where the farmer picks it up or buys it to use, and they are key stakeholders in this. None of the respondents indicated that they work with private extension agents in the PBIWR category.⁷ Some of the respondents even stated that they were not sure private extension agents are involved in value chain activities to show the unpopularity of this group of stakeholders.

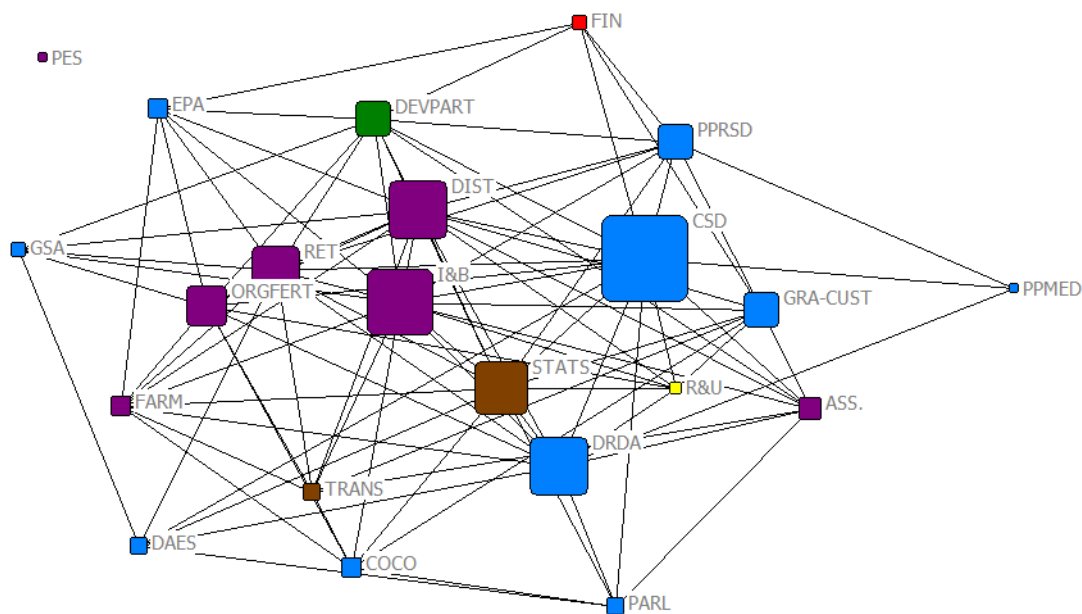


Figure 3 Betweenness centralities of PBIWR Network

b) Research and development and technical advisory (RDTA)

In terms of RDTA, the network is less dense (i.e., fewer connections among stakeholders, density = 0.216) compared to PBIWR. This could be because fewer groups of stakeholders collaborate in the value chain on research, as Bindraban *et al.* (2018) earlier noted on the low investment in fertiliser research. The most connected stakeholder group are development partners (14/22) followed by research institutions and universities (12/22), district and regional departments of agriculture (10/22), Crop Service Directorate (8/22), importers (8/22), PPRSD (6/22) etc. Ghana Revenue Authority, Customs Division, financial institutions, and fertiliser transporters are not involved in RDTA and therefore they stand alone, away from the rest of the network.

RDTA with respect to stakeholders' betweenness centralities (figure 4) shows development partners and research institutions and universities are the two most influential stakeholders connecting different actors on issues in this value chain category. 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 help researchers set agenda on the kind of research problems they would like to see addressed. However, despite the recognition of research institutions as important stakeholders in the value chain, researchers report not having enough funding support to conduct research.

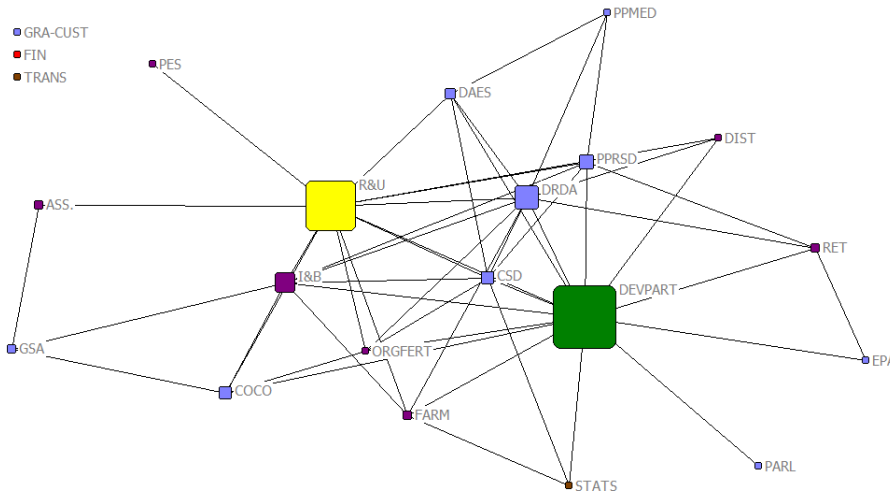


Figure 4 Betweenness centralities of RDTA Network

c) Financing

For financing (density = 0.208), the most connected stakeholder are the development partners (18/22) followed by financial institutions (11/22), importers and blenders (7/22) etc. In terms of which stakeholder groups have higher influence and connect the value chain network more, development partners (126.792) are the highest followed by financial institutions (15.375), CSD (11.917) and importers and blenders (11.208) (figure 5). It is interesting that development partners work with more stakeholders and are more highly powerful in value chain 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 a development partner, 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.⁸

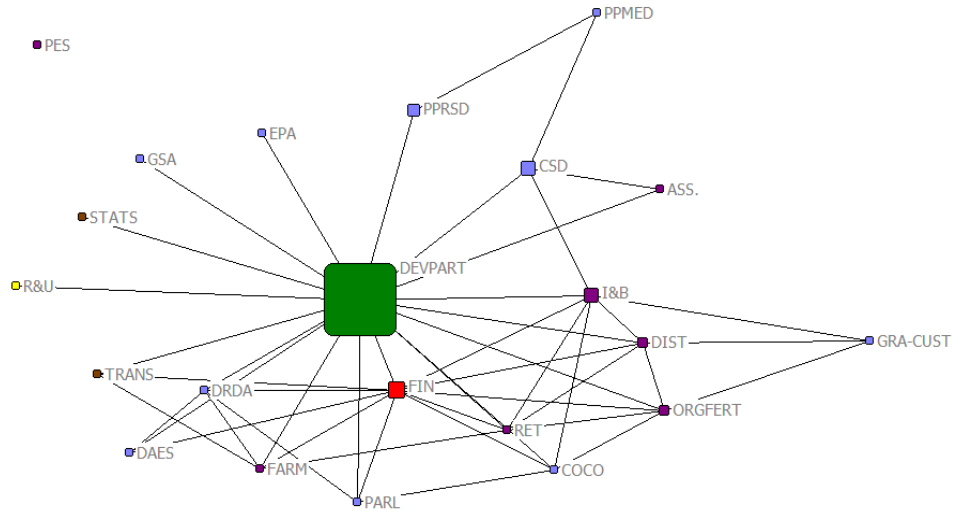


Figure 5 Betweenness centrality of Financing Network

d) Oversight, policies, regulations, and enforcement (OPRE)

For OPRE (density = 0.225), the highest connected stakeholders are PPRSD (15/22), EPA (11/22), CSD (10/22), GSA (9/22), DEVPART (9/22), DRDA (7/22) etc. Similarly, OPRE in terms of betweenness centralities (figure 6) also show that PPRSD is the most influential stakeholder connecting 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 fertiliser value chain. Similar explanation can be made for EPA and GSA since the former grants permit to locate warehouses and the latter sets fertiliser standards. 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 rather than in setting them.

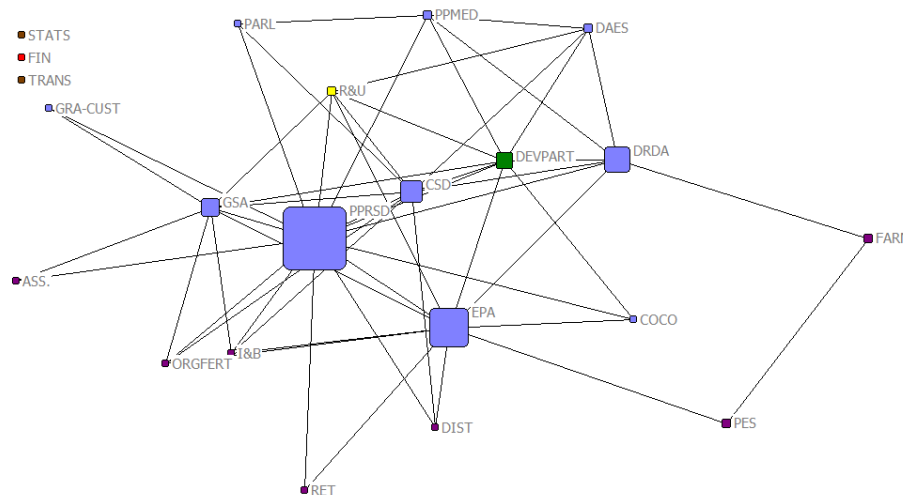


Figure 6 Betweenness centralities of OPRE Network

e) Strategic support, advocacy, and training SSAT

On the last management category in the value chain, 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. Our analysis shows that GRA and Customs Division are not involved in this management category. 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 7).

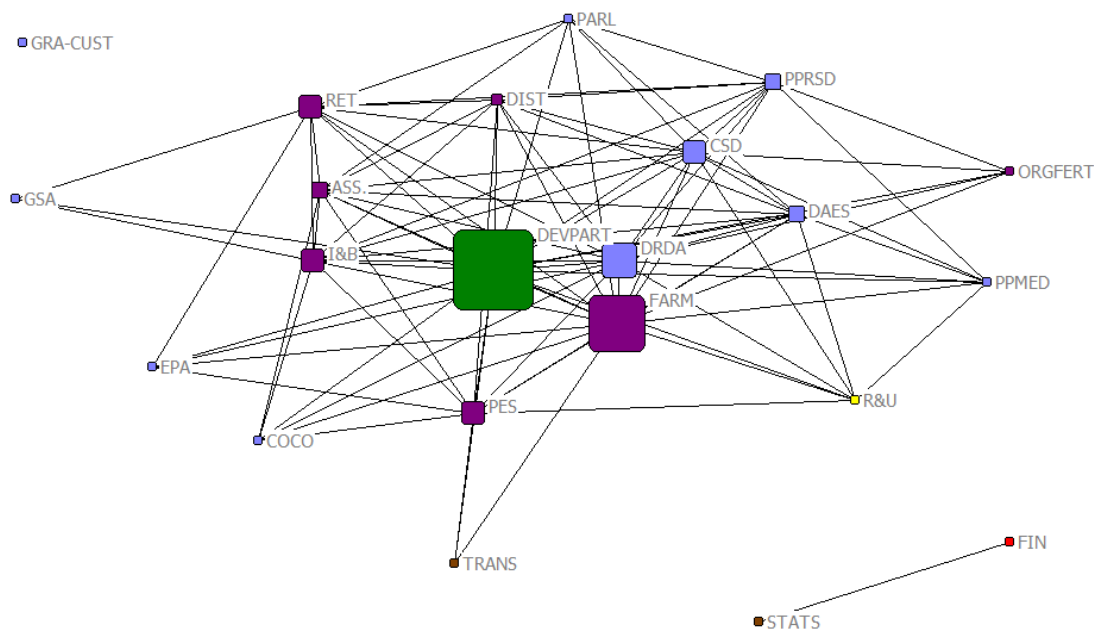


Figure 7 Betweenness centralities of SSAT Network

3.4 Addressing the Fertiliser Value Chain Challenges through an 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, these current efforts 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 limited finance to run business, and key government agencies and research institutions do not have the resources to carry out their duties.⁹ All of these, combined, limit the potential of the fertiliser value chain to contribute to sustainable intensification and food security.

With these challenges in the value chain and some stakeholders perceiving themselves as having less power to influence decisions, such an environment makes it appropriate for the establishment of a multi-stakeholder platform. This would involve bringing stakeholders together to find solutions through dialogue, consultation, forum, networks, partnerships, etc. (Achyar *et al.*, 2017) and fostering institutional changes to make the best use of available resources (Davies *et al.*, 2017). However, setting up an MSP requires a thorough identification of stakeholders to be involved to avoid producing a long list than is needed or a short one that misses out important participants (Brouwer *et al.*, 2015).

By combining the results from SA and SNA, we obtained a list of the critical stakeholders to achieve diversity and inclusive participation in the proposed platform (Franco-Trigo *et al.*, 2019). These stakeholders would be involved in the steering committee to drive the initial planning of the platform. In Table 2, the third quartiles of the degree and betweenness centralities of stakeholders (Supplementary Material S05) are presented with the result from asking respondents which stakeholders are the most relevant in solving specific issues in the value chain (Supplementary Material S06) to obtain the list of critical stakeholders.

For the critical stakeholder list, using only the whole value chain network, 11 critical stakeholders are identified as shown in row 1 column 5 of table 2. 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 stakeholders were identified as critical.

Table 2 Critical Stakeholders in Ghana's Fertiliser Value Chain

	Degree Centrality (3rd Quartile)	Betweenness Centrality (3rd Quartile)	Relevance in Solving Challenges (3rd Quartile)¹⁰	Total critical stakeholders
Whole Value Chain	DEVPART (20)	DEVPART (6.725)	COCOBOD	DEVPART (++++)
	FARM (19)	FARM (5.8)	CSD	FARM (++++)
	PPRSD (18)	PPRSD (5.259)	PPRSD	PPRSD (++++)
	I&B (18)	R&U (4.635)	DRDA	DRDA (++++)
	DRDA (18)	DRDA (4.318)	I&B	I&B (++)
	DISTR (18)	DISTR (4.064)	GSA	DISTR (++)
			DEVPART	R&U
			PARL	COCOBOD
			FARM	CSD
				GSA
				PARL
			Total	11

Production Blending	I&B (15)	CSD (17.954)	I&B (2.935)	I&B (+++)
Importation	DIST (15)	I&B (13.283)	PPRSD (2.581)	DISTR (+++)
Warehousing and	RET (15)	DRDA (11.572)	ORGFERT (2.516)	DRDA (++)
Retailing	CSD (14)	DIST (11.089)	COCOBOD (2.516)	CSD (++)
	STAT (13)	STAT (10.453)	GSA (2.452)	STAT (++)
	DRDA (12)	RET (9.154)	DIST (2.419)	RET (++)
				PPRSD
				OGFERT
				COCOBOD
				GSA
			Total	10
Research and	DEVPART (14)	DEVPART (50.798)	COCOBOD (2.742)	DEVPART (+++)
Development and	R&U (12)	R&U (39.245)	R&U (2.677)	R&U (+++)
Technical Advisory	DRDA (10)	DRDA (15.233)	DEVPART (2.645)	PPRSD (+++)
	I&B (8)	I&B (11.827)	PPRSD (2.452)	I&B (+++)
	CSD (8)	PPRSD (6.436)	ASS (2.323)	CSD (++)
	PPRSD (6)	CSD (5.438)	I&B (2.258)	DRDA (++)
				COCOBOD
				ASS.
			Total	8
Financing	DEVPART (18)	DEVPART (126.792)	FIN (2.871)	DEVPART (+++)
	FIN (11)	FIN (15.375)	I&B (2.516)	FIN (+++)
	I&B (7)	CSD (11.917)	COCOBOD (2.484)	I&B (+++)
	RET (6)	I&B (11.208)	DEVPART (2.290)	ORGFERT (++)
	DISTR (6)	PPRSD (6.833)	PARL (2.233)	DISTR (++)
	ORGFERT (6)	ORGFERT (5.625)	DISTR (2.065)	RET
				CSD
				PPRSD
				COCOBOD
				PARL
			Total	10
Oversight, Policies,	PPRSD (15)	PPRSD (51.294)	PPRSD (2.839)	PPRSD (+++)
Regulation and	EPA (11)	EPA (29.531)	COCOBOD (2.548)	EPA (+++)
Enforcement	CSD (10)	DRDA (16.714)	GSA (2.548)	CSD (+++)
	GSA (9)	CSD (13.642)	PARL (2.433)	GSA (+++)
	DEVPART (9)	GSA (9.736)	CSD (2.419)	DEVPART (++)

	DRDA (7)	DEVPART (7.786)	EPA 2.387)	DRDA (++) COCOBOD PARL
			Total	8
Strategic Support,	DEVPART (18)	DEVPART (25.328)	PPRSD (2.742)	DEVPART (++)
Advocacy and	FARM (17)	FARM (16.738)	COCOBOD 2.742)	FARM (++)
Training	DRDA (15)	DRDA (9.026)	GSA (2.548)	DRDA (++)
	CSD (13)	I&B (5.326)	PARL (2.484)	CSD (++)
	I&B (12)	PES (5.100)	CSD (2.484)	I&B (++)
	PES (11)	RET (4.987)	EPA (2.452)	PES (++)
	DAES (11)			DAES
	RET (11)			RET (++)
	ASS (11)			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.

Likewise, there are a total of 11 stakeholders that appear in the three methods used for the critical stakeholder analysis 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, critical stakeholders can be classified into 'most critical' (11), 'more critical' (5), 'critical' (3) and 'not critical' (5).

3.5 Foreseen Challenges and Solutions

While none of the respondents was in opposition to the idea of having a multi-stakeholder platform, they raised concerns about issues that may make the platform not function as intended. Most prominent among these is the differences in the interests of members who would be joining the platform. These challenges and the suggested conditions to put in place to avoid them, according to respondents, are summarised in table 3.

Table 3 Foreseen Challenges for the Fertiliser MSP and Suggested Solutions

Stakeholders' Concerns	Suggested Solutions/ Conditions to Put in Place
(1) Differences in interest of members which may lead to conflicts on the platform	(1) communicate "plain, simple and open" objectives of the platform and the roles of stakeholders
(2) Difficulty in reaching compromise	(2) have a good management team or steering committee
(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) Inclusive platform with members having equal decision-making power and the opportunity to express views and concerns.
(5) Misunderstanding of the role of the platform by members	(5) Have a clear understanding of how to finance the platform.
(6) The platform could become aggressive or antagonistic in approach e.g., in making demands from the government.	(6) Involve relevant stakeholders both during the planning and execution stages of platform/ only involve those who are directly involved in the fertiliser value chain.
(7) 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.	(7) Decide if the platform's secretariat will be managed by full-time or part-time staff
(8) Change in government or its policy	(8) Have sub-groups ('smaller thematic groups') on the platform
(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) 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.
(10) Politicising the platform i.e., if the platform becomes partisan	(10) Build trust amongst platform members
(11) Members' unwillingness to share information due to fear of exposure to competition/ if information shared is not treated with confidentiality	(11) Maintain professionalism and confidentiality with information obtained through the platform

(12) lack of sustainable means of financing the platform's activities

(12) Members should be willing to compromise some of their interests for the general objective of the platform.

(13) Platform's management to individually consult with concerned members to resolve any conflict or disagreement

(14) Decisions on the platform should be binding and influence change in the fertiliser sector.

Source: Authors' own compilation from field study

It is not uncommon for an MSP to experience challenges at one point or the other in its journey. Some of these challenges are captured from respondents in the table above. To achieve success, facilitators of the proposed fertiliser platform must realise that the traditional top-down approach where the government defines the problem for the platform and identifies policy solutions to address them (Brouwer *et al.*, 2015) may not work. All stakeholders should be able to share their views and be involved in the change process, instead of only few individuals making decisions. Certainly, therefore, the capacity of the proposed platform to innovate would depend on having diverse group of stakeholders and having powerful and influential stakeholders to support the platform's agenda, provide legitimacy, help mobilise resources and counter opposition to change (Hermans *et al.*, 2017). Such stakeholders are already identified in Table 2.

Moreover, because the issues to address are many and each stakeholder group would approach the platform with the interest of addressing the issues that concern them, there may sometimes be conflicts of interest. Stakeholders may also have expectations on what the platform would do for them. One way of managing these could be adopting a system thinking approach¹¹ that allows platform members to see how they and their challenges are inter-related with others; provides an avenue for stakeholders to share their perspectives on issues and gain shared insights; and helps set a reasonable boundary on what is or is not achievable (Brouwer *et al.*, 2015). This would allow, for instance, discussions on the platform to transcend getting inorganic fertilisers into the hands of farmers, but also involve issues such as use of appropriate fertilisers for different crops, effective and efficient use of fertilisers, addressing policy constraints, improving the adoption of organic fertilisers, and getting markets for farmers to sell their produce.

Furthermore, facilitators and members of the platform also need to understand the importance of adaptive planning (Brouwer *et al.*, 2015) since it can be hard to predict all the possible outcomes of interventions in complex situations where MSPs are applied. While experimenting different ideas, one must know that some might work, and others might fail. Hence, platform collaborators would need to regularly review actions and take all outcomes – whether desired or not – as part of the learning process and adapt plans to new realities. Also, some successes may be achieved immediately while others can only be seen in the future. For instance, changing institutions – i.e., the 'rule of the game' that help society function or 'norms and values that shape how people think and behave' – can sometimes be critical to achieving the objectives of an MSP, yet the institutions are usually rooted in society that

they are difficult to change (Brouwer *et al.*, 2015). Thus, it is vital for platform facilitators to have in mind that MSPs would not always be able to change institutions and identify important stakeholders and factors that can enable or obstruct change and start the process of achieving that change – even if it cannot be realised immediately.

Lastly, Davies and colleagues found that the success achieved in the platforms they studied was due to factors such as trust among stakeholders built from previously working together, cultural norms in some cases, previous influence of facilitating organisation in the communities, efforts of facilitators and managers to bring people together and promote communication, well established platform structures and positive feedback from members. On the other hand, they also found that sustaining activities of the platform was difficult due to the cost of running meetings, heavy dependence on project team, and limited participation by some actors. However, with trust, social capital, member commitment and newly learned, they argue that progress can be sustained (Davies *et al.*, 2017). If these conditions, in addition to those captured in Table 3, can be put into consideration, there is a great potential for the proposed platform to serve as an avenue for addressing long-standing issues in the fertiliser value chain.

4. Conclusion

The challenges that currently limit the performance of the fertiliser value chain in Ghana is prompting discussions on the need to establish a multi-stakeholder platform to foster dialogue and influence change in the value chain. This has motivated this study which identified the stakeholders and their power in the value chain to manage differences, promote diversity and inclusiveness, and manage conflicts on the platform. Analyses of the 24 identified stakeholders in Ghana's fertiliser value chain presented in this study provide insight on their power and influence. SA revealed that many of the public sector actors have a lot of power in the value chain and possess high interest in fertiliser. Conversely, majority of the private sector, while having high interest, do not have much power to influence decisions. SNA showed that development partners/international NGOs are well connected to most stakeholders and influential in almost all the five management categories of the value chain. The high influence of development partners in the value chain, from a sustainability perspective, arouses concerns. It is important to begin to think of sustainable means of financing the fertiliser value chain and the multi-stakeholder platform that does not excessively depend on development partner funding. This can address many of the funding related challenges that the private sector, government regulatory institutions and research bodies currently face.

Following the approach used by Franco-Trigo *et al.* (2019), combining SA and SNA, the study identified critical stakeholders to include in the initial planning of the platform from a whole value chain point of view. Franco-Trigo and colleagues' approach took the following into account to arrive at their list of critical stakeholders: stakeholders with high influence and interest in the process; stakeholders considered most key by other stakeholders; and those stakeholders with higher degree centrality and betweenness centrality in a collaboration network. However, we made a methodological contribution by proposing here that dividing the fertiliser value chain into five management categories reveals other stakeholders who are equally important but are not easily seen at the whole value chain level. By applying this approach, additional critical stakeholders were identified to make 19 total critical

stakeholders. This study also further classified critical stakeholders into ‘most critical’, ‘more critical’, ‘critical’, and ‘not critical’ based on how many times a stakeholder appears in the three combined methods. Apart from being used to identify other critical stakeholders to include when initiating the platform, the five management categories can also serve as sub-committees for the MSP and the critical stakeholders in each of these five management categories can be members of the sub-committees. This means that challenges in the value chain can be effectively addressed by directing them to the appropriate MSP sub-committees.

As plans are put in place to establish the MSP, attention needs to be paid to the issues raised by stakeholders as challenges that can limit the performance of the platform, especially issue of financing, commitment, and trust building among platform members. Lessons also need to be learned from previous public-private partnership platforms that exist or have existed in Ghana and elsewhere, especially those focusing on agriculture, if the proposed platform is to achieve its objectives.

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¹ Descriptive statistics of power, interest and legitimacy are shown in supplementary material S02-04. The number of stakeholders for this and social network analysis is 31. Those exempted are already well-represented in the 31.

² 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.

³ The density of a network indicates the relative connectedness of that network.

⁴ The colour legend is same as is in the power-interest grid.

⁵ See Supplementary Material S05 for the complete list of betweenness and total degree centralities of the whole network and management categories.

⁶ For this and the rest of fertilizer value chain network diagrams, box sizes represent stakeholder centralities.

⁷ Stakeholders not involved in the interactions in a network appear separately in the network, like PES in this case.

⁸ USAID is the United States Agency for International Development; AGRA is Alliance for a Green Revolution in Africa; and AFAP is the African Fertilizer and Agribusiness Partnership

⁹ These are some of the challenges highlighted by respondents during interviews.

¹⁰ The stakeholders indicated under 'whole value chain' are those classified as players (high power and interest) in the power-interest grid.

¹¹ This is done through a soft systems methodology, using different tools such as rich picturing, CATWOE and systems diagram. See Brouwer *et al.* (2015) for description of each tool.

Supplementary Materials

S01: Interview Guide

SECTION A: 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			
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			

Choose only one group from 1 – 24 above that best describe your work in the fertiliser value chain _____

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 and development & technical advisory	Finance	Oversight, policies, regulations & enforcement	Strategic support, policy support advocacy
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					
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).

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

Stakeholders	Relationships between stakeholders in Production, blending importation, warehousing and retail	Relationships between stakeholders in Research and devt. & technical advisory	Relationship between stakeholders in financing	Relationships between stakeholders in Oversight, policies, regulations & enforcement	Relationships between stakeholders in Strategic support, policy support advocacy
MOFA Crop Services Directorate					
MOFA – PPRSD					
MOFA – Directorate of Agricultural Extension Services					
MOFA - PPMED					
MOFA - District & Regional D. of Agric					

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					
Statistics orgs.					
Financial Institutions					
Professional Associations (WAFSA, 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

S02: Descriptive Statistics for Stakeholder Power

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

S03: 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 & Universities	31	2.355	0.661	1.000	2.000	3.000	2, 3	14
Importers & Blenders	31	2.9355	0.2497	2.0000	3.0000	3.0000	3	29
Distributors & 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 Orgs	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
Devt. 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 C_ttee	31	2.581	0.564	1.000	3.000	3.000	3	19

S04: 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 & Universities	31	2.290	0.739	1.000	2.000	3.000	3	14
Importers & Blenders	31	2.7419	0.4448	2.0000	3.0000	3.0000	3	23
Distributors & 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 Orgs	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
Dev. Partners	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 C_ttee on	31	2.6129	0.4951	2.0000	3.0000	3.0000	3	19

S05: Total and Betweenness Centrality Measures for the entire network and management categories

ID	Whole Network Degree Cent	Whole Network Betw Cent	1 PBIWR Degree Cent	1 PBIWR Betw Cent	2 RDTA Degree Cent	2 RDTA Betw Cent	3 FIN Degree Cent	3 FIN Betw Cent	4 OPRE Degree Cent	4 OPRE Betw Cent	5 SSAT Degree Cent	5 SSAT Betw Cent
CSD	16	3.059	14	17.954	8	5.438	4	11.917	10	13.642	13	4.737
PPRSD	18	5.259	9	5.839	6	6.436	2	6.833	15	51.294	10	2.212
DAES	15	2.955	6	1.993	5	2.708	3	0.000	5	0.900	11	2.487
PPMED	8	0.171	3	0.167	3	0.417	2	0.500	5	2.075	7	0.325
DRDA	18	4.318	12	11.572	10	15.233	5	1.000	7	16.714	15	9.026
PES	13	1.31	0	0	1	0.000	0	0.000	2	2.200	11	5.100
EPA	13	0.909	7	2.241	2	0.000	1	0.000	11	29.531	5	0.143
R&U	17	4.635	7	0.809	12	39.245	1	0.000	6	2.103	7	0.325
I&B	18	3.909	15	13.283	8	11.827	7	11.208	4	0.236	12	5.326
DIST	18	4.064	15	11.089	3	0.000	6	4.667	3	0.236	10	0.843
RET	17	3.548	13	9.154	4	1.567	6	1.500	2	0.000	11	4.987
ORGFERT	14	2.31	11	7.082	5	0.611	6	5.625	4	0.236	5	0.000
COCOBOD	16	4.021	7	2.663	5	4.486	5	1.083	3	0.000	6	0.000
GRA-CUST	11	1.407	9	6.043	0	0.000	3	0.167	2	0.000	0	0.000
GSA	13	1.689	6	0.991	3	1.000	1	0.000	9	9.736	3	0.000
STATS	13	1.542	13	10.453	3	0.200	1	0.000	0	0.000	1	0.000
FIN	15	3.037	5	1.178	0	0.000	11	15.375	0	0.000	1	0.000
ASS.	15	3.059	8	3.099	2	0.976	2	0.000	2	0.000	11	2.138
DEVPART	20	6.725	11	6.181	14	50.798	18	126.792	9	7.786	18	25.238
TRANS	11	0.996	8	1.974	0	0.000	3	0.000	0	0.000	3	0.000
FARM	19	5.8	9	2.392	5	2.060	5	1.000	2	1.111	17	16.738
PARL	12	1.263	6	1.843	1	0.000	4	0.333	3	0.200	7	0.375

S06: Power/Relevance of each stakeholder in solving issues in each of the 5 management groups

Prod., 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