# Product flow efficiency and financial benefit in the commercial soybean value chain system in Ghana

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ABSTRACT

*Soybean is an important economic crop in Ghana contributing to poverty reduction and food security. A key challenge in Ghana's soybean sector is enhancing product flow efficiency and adding value along the chain. This paper examines perceived efficiency in product flow, nature of value adding and perceived financial benefits among value chain actors in Ghana. The study combines quantitative and qualitative techniques to investigate product flow efficiency and financial benefits of the soybean value chain. The study was conducted in the Northern, Upper East, Upper West and Brong Ahafo regions of Ghana, between January and April 2013.* The study used a *sample data of 300 value chain actors including input dealers, producers, aggregators, and processors. The data collected were analyzed using descriptive statistics, process map, principal component analysis (PCA) and Analysis of Variance (ANOVA) along the commercial soybean value chain system in the northern part of Ghana. The results show that on average, with the exception of financial institutions, chain actors perceived the soybean product flow along the chain as efficient. Also, the PCA showed two key financial dimensions in the soybean value chain including tangible financial benefit and intangible financial benefit. ANOVA showed that on average, there was no significant difference across stakeholders on the effect of tangible financial benefit on their perception of efficiency of product flow in the value chain. However, there was a significant difference on the effect of intangible financial benefit on their perception of efficiency of product flow efficiency in value chain. The process map mainly showed that the soybean value chain is mainly non-value addition with exception of the input supply level. The findings revealed that there is less value adding along the soybean value chain in Ghana, requiring that strategic efforts be put in place to improve on value addition along the chain to increase employment creation, poverty reduction and food security.*

*Keywords: Soybean value chain, tangible financial benefit, intangible financial benefit, Analysis of variance*

## 1. INTRODUCTION

In Ghana, soybeans have a significance role in the economy by reducing poverty and ensuring food security (Asodina et al., 2021; Anang & Zakariah, 2022).“Dueto the crop's significance, the Ghanaian government works to develop it along the entire value chain, from the supply of inputs to the market. Numerous factors may affect the ability of chain actors' capacity to establish enduring relationships in an agriculture value chain system. Given the strategic importance of business-to-business relationship management and the understanding that strategy implementation requires linkage in two dimensions—both vertical and horizontal”(Rolfe et. al., 2022)such linkages allow business partners and other actors in a value chain system to benefit from maintaining existing partnerships rather than continuously seeking new ones (Manyise&Dentoni, 2021; Akuriba et al., 2021). “Therefore, it is important for managers of agribusiness value chain systems to appreciate the dynamics of information flow throughout the horizontal and vertical linkages, if long term relationships could be built to enhance functional roles of key chain actors. Previous studies” (Manyise&Dentoni, 2021) have shown the need for both vertical and horizontal linkages in such value chains, highlighting the need for actors to consider horizontal collaborations which span across similar levels of the chain in addition to linkages across higher and lower points along the chain. It is important to note here that effectiveness of information flow across these linkages is vital to sustainability. However, there are limited empirical studieson how efficiently the information is transmitted among actors, particularly in underdeveloped regions such as northern Ghana.

Previous studies on value chains in Ghana (Ghartey et. al., 2023; Mensah Bonsu-et al., 2019), have notexamined product flow efficiency and financial benefits, although it is important to note that ineffective information flow decreases value chain performance in relation to production, market access and value addition. Furthermore, these studies have not focused on identifying valuing adding activities along the value chain. This paper, therefore, seeks to fill this knowledge gap by examiningsoybean value chain actors’ perceptions of the efficiency of information flow in northern Ghana, and also link the perceptions with financial gains and overall viability of the value chain in the face of increasing interest in sustainability.

The study uses data gathered from actors on the Agribusiness cluster soybean value chain project. The Agribusiness cluster for soybean value chain project was started in 2007 to link all stakeholders associated with the soybean industry in the Northern parts of Ghana with the goal to improve industry’s performance in market access and value-added activities (Ghartey et. al., 2023), thereby, enhancing the sustainability and viability of the industry in the national economy. Reports from project evaluation studies suggest an asymmetry nature of information flow,whichappears to undermine the dynamic interplay of chain activities essential for sustainable chain management.However, the study's findings reveal that while value chain actors perceive product flow as efficient, there are limited value-adding activities along the soybean value chain. This finding underscores the project's impact on improving product flow efficiency and enhancing the chain's sustainability.

The rest of the paper is as follows. The next section presents the methodology, followed by results and discussion, then conclusion of the study.

## 2. METHODOLOGY

### *2.1 Study Area*

The study was conducted on soybean value chain in Ghana in the transitional and Guinea savannah agro-ecological zones. Ghana is located within latitude $5^{o}$ 36m north and longitude $0^{o}$ west within the West African sub-region of Africa with a population of about 28 million people. "Agriculture employs 34% of workforce and accounts for 19 % of Gross Domestic Product" (Ferreira et al., 2022)."Agricultural production activities spanning across the six agro-ecological zones found in the country namely: Rain Forest, Coastal Savannah, Deciduous Forest, Transitional Zone, Guinea Savannah Zone and Sudan Savannah zone" (Asare-Nuamah&Botchway, 2019). However, the soybean value chain project which is the focus of the study is located in the Transitional and Guinea 3Savannah agro-ecological zones.

"The transitional zone is a large tract of grass; tree, shrubs and thicket vegetation cover that spanning between the Tropical Forest Zone and the Guinea Savannah Zone. It is found in the northern part of the Ashanti Region, the southern part the Brong Ahafo Region, the northern part of the Volta Region and southern part of the Northern Region of Ghana. The Guinea Savannah zone is found in the Northern, Upper West and part of Upper East Regions of the country. One of the hottest and driest agro-ecological zones in the country and the mean annual day temperature could hover around $40^{O}$C or more. The mean annual rainfall is about 1000mm with a unimodal rainfall distribution from May to September that supports only one cropping season in a year" (Buckle, 1996). Most crop production activities in both agro-ecological zones are done under small-scale production system and rain-fed conditions.

Administratively, Ghana currently has 16 regions with Accra as the capital (Asare-Nuamah &Botchway, 2019), however, at the time of the study, the country had ten administrative regions and four of these regions in the northern part of the country were selected for the study. The selection of the regions was based on the initial review of document of soybean production and value chain activities in these regions. The selected regions include Brong Ahafo (now divided into three: Brong-Ahafo, Bono East and Ahafo-see Figure 1), Northern (now into three: North East, Savannah and Northern-see Figure 1), Upper West and Upper East. The three regions host key components of the commercial soybean value chain in Ghana: The Northern and Upper West and East regions have highest concentration of soybean producers in the country. Brong Ahafo is the location for the major soybean processing factory in the country in addition to a number of small- scale soybean processing facilities. Figure 1 shows important areas of soybean production and locations of processing factories associated with the soybean value chain in Ghana, respectively, thus underscoring the reason for the selection of the regions and districts for this study.

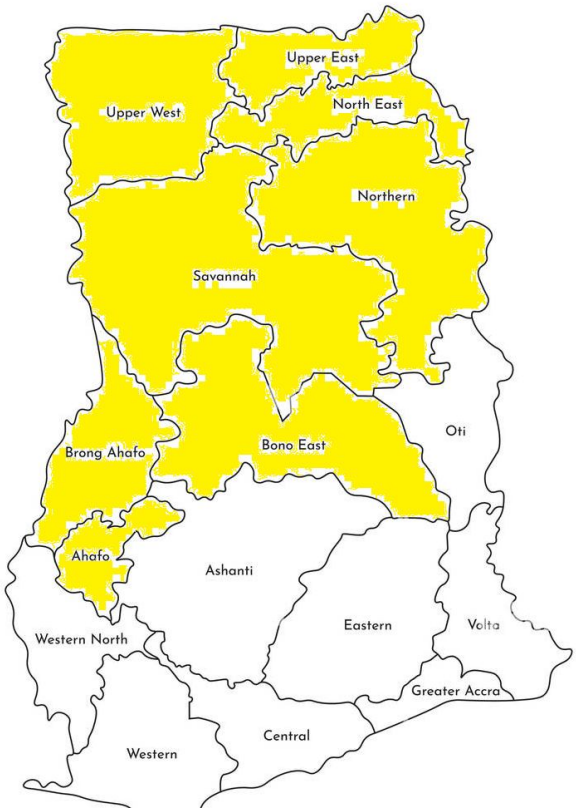


**Figure 1: Map of Ghana showing areas of high concentration of soybean producers-shaded regions on the map (adapted from Goldsmith, 2019)**

### *2.2 Sampling Techniques and Sample Sizes*

Purposive, stratified, random and snow balling sampling techniques were employed to obtain appropriate sample size from which to gather relevant data for the study. The population for the study was made up of the total number of the various stakeholder types who have been registered with the soybean value chain project in the four regions in Ghana. Currently, there are three thousand (3,000) soybean producers registered with the soybean value chain project, in addition to eighty-five (85) aggregators and nine (9) processors, fifty-five (55) input dealers of the various types, thirty-nine 39 logistic services providers as well as twenty (20) financial services providers.

The regions and districts identified for the study were purposively selected. The choice of the purposive sampling technique to select these regions and districts was informed by the fact that they are areas of very high concentration of soybean growers as well as locations for key components of the soybean value chain project, couple with the fact that recent policy on donor funded project in food production activities in Ghana are to be restricted to the

territory beyond latitude $8^0$N. These were the three reasons that precluded the use of the probability sampling technique in this case.

The varying degrees of coordinated soybean production systems that were identified coupled with the fact that this study was interested in assessing the influence of these production systems on product flow efficiency and financial benefit provided the two major reasons for adoption of stratified sampling techniques to select the various categories of actors in the linkages that had been registered with the project. This technique suggested by Sarantakos (1998) allows for the inclusion in the sample size, population characteristics that are of major interest to the researcher.

The various chain actors contracted under the scheme were stratified into the following subgroups: (1) small scale soybean producer cultivating less than five hectares of farm land and does not belong to any farmer organization {i.e. independent small-scale producers (ISSP)} (2) small-scale soybean producers cultivating less than five hectares of farm land and a member of a farmer organization {i.e. group-based small-scale producers(GSSP)} (3) large-scale soybean producers cultivating over five hectares farm land and do not belong to farmer-based organization {i.e. independent large-scale producers(ILSP)} (4) large-scale soybean producer cultivating over five hectares of land and a member of a farmer-based organization {i.e. group-based large-scale producer (GLSP)}. The classification of the chain actors in the various groups was based on Previous studies (Kwapong et. al., 2021; GLSS, 2017) that have used farm size as a basis for classifying farms into small-scale and large scale. We extended that classification procedure by including membership to farmer-based organization.In this study, farmer-based- organizations are relevant because they allow for easy marketing and collection of produce from small-scale producers to the processors. Also, “members of the farmer-based organizations have access to critical inputs for the production process. Further, farmer-based organizations serve as intermediary between input dealers and farmers to enable them obtain inputs on credit basis for the production process” (Bachke, 2019). These are the reasons why in this study, membership of farmer-based organizationswas used as one of the criteria for classifying the soybean producers.

After, stratifying the producers for the study based on the scale of production and membership of a farmer-based organization, the simple random sampling method using the lottery method was used to draw producers from each stratum until the total sample of 223 was obtained. A total of 43 producers were drawn from independent small-scale producers, and 60 each from the group-based small-scale producers and independent large-scale producers

However, major weaknesses of this technique are that there is the need for accurate information on proportion of population in each stratum since this could lead to an increase in error, and also an increase possibility of faulty classification in the absence of stratification. The weaknesses were however dealt with in this particular study with a careful review of project documents obtained from facilitating organizations to provide the basis for the stratification.

The population of the other stakeholders (input dealers, buyers and service providers) apart from the producers are scattered over the communities in the study area and it is not easy to find them in the communities where they are supposed to be located. For these reasons, the snowball sampling technique was the appropriate sampling procedure used to obtain the sample size of those stakeholders. Some key informants who themselves were qualified to be included in the sample were identified and then interviewed with the appropriate research instrument. These persons in turn led to more persons who were also interviewed. The process continued till an appropriate sample size of each stakeholder type was obtained. Snowball or chain referral sampling was particularly useful in this study because of the wide geographical spread of the identified key stakeholders.

Following previous studies (Hung, 2015), altogether, a total sample of 300 was used for the study comprising input dealer =22, buyers (e.g. aggregators and processors) =9, producers=223, and service providers (e.g. financial, tractor and haulage services) = 46.

### *2.3 Data Collection*

Both primary and secondary data were used in this study. The primary data used for this study were obtained from selected representatives of key actors and stakeholders associated with soybean value chain project. Questionnaire, interview schedule and focus group discussion were the three main instruments used to generate the primary data collected over a period of four (4) months (January- April 2013). The questionnaire was designed to generate the primary data to address the objectives of the study. The questions were designed to elicit data from all stakeholder types on the following items: perception of product flow structure and efficiency were measured using a Liker scale from 1-10, where 1-5 is inefficient and 6-10 is efficient. For the product flow structure, the variables used were flexibility and responsiveness. The items designated as tangible and intangible financial benefits were entered into 3-point Likert scale system (i.e. 1= least agree 2= agree and 3= strongly agree). A weighted average of each respondent's score on the scale was then used to operationalize the performance level of each chain activity rather than any particular facet of performance. In this paper, the efficiency of product flow was operationalized to include statements that sought to explain items that measure the underlying constructs for the efficiency of product flowand financial benefits (See Tables 1 and 2 for details on the questions).

For the product flow efficiency, the variables used were timeliness of delivery and reduced wastage. The questionnaire was pre-tested with similar value chain actors and stakeholders in a different commodity value chain system in the same study area. Participants were asked to comment on the format of the questionnaire including specific aspects such as wording, length and the order of the questions. The feed-back obtained after this exercise was incorporated to improve the quality of the questionnaire.

Twenty-five experienced enumerators were recruited from extension agents in the offices of Ministry of Food and Agriculture (MoFA) in the study area. The enumerators were given a day's training on how to administer the questionnaire. On the field each questionnaire was administered for an average duration of one and half hours. To increase the response rate, which was recorded in this study as 77%. This was achieved because each enumerator stayed with each respondent for as long as it took to complete a questionnaire. This rate of retrieval is relatively good enough compared to similar studies. Gyau and Spiller (2007) obtained 101 out of 147 representing 69% response rates in their study of the role of

organizational culture in seller-buyer relationship of export firms in the Ghana Fresh Produce Industry. Also, Jarrat and O'Niel (2002) obtained a retrieval rate of 12% of the 1250 questionnaires used in their study of relationship quality and organizational culture involving the service and manufacturing firms in Australia.

In all eight, (8) interviews were conducted each lasting three hours with the following actors in the chain: nucleus farmers or their representatives, large-scale farmers, small- scale farmers, tractor service providers, seed growers, input dealers, credit officers, processors, representatives of senior management of facilitating organizations and value chain management committee members. Some of these participants were purposefully selected while the ones representing organizations/firms were nominated by the heads of their organization/firm. The interviews were conducted to observe as well as to have insights and validate some of the key issues that were raised during the focus group discussion session and respondent survey. The interviews were held either in organization's premises, if participants were from organizations and farming communities if the participants were farmers. However, with all other participants it was in office locations that were agreed upon for that purpose. Some interview sessions were captured on tapes with permission of participants while others were captured as written records. All interviews were conducted between March and April 2012.

The secondary data were the other important data set that were deemed necessary to address the qualitative objectives of the study and these were obtained from policy documents of Ministry of Food and Agriculture (MoFA), Northern Rural Growth Programme (NRGP) as well as project documents from both International and Local Non-Governmental Organizations (NGOs), and private sector companies associated with the soybean value chain project in Ghana. Secondary data thus generated were used to supplement the primary data analysis.

### *2.4 Data analysis*

Data were analyzed using descriptive statistics (e.g. means), process map, principal component analysis, and Analysis of Variance (ANOVA). The descriptive statistics (mean) was used to analyses respondents' perception of product flow structure and efficiency, the process map was used to reflect soybean product flow across actors, and the principal component analysis and ANOVA were used to assess and test the significance of perception of tangible and intangible financial benefits across actors of the soybean value chain.In this paper, the descriptive statistics methods were used because we aimed at exploring or describing the respondents' perceptions of product flow efficiency and structure (Bulanov et al., 2021). The process map was used because of the need to map out the activities of the various value chain actors to identify value adding activities and non-value adding activities.We used the principal component analysis because of the large data set measured for the study and the need to reduce the dimensionality of the data but still maintain its variability. The principal component analysis method is seen as the most suitable method for this (Jolliffe and Cadima, 2016).Finally, the ANOVA test was used because we wanted to test significance in the perceptions of more than two stakeholder types in the study. According to the Pandis (2015), when we have a continuous data with more than two groups and we want to test significant difference among them, ANOVA is appropriate. It is against this backdrop that the ANOVA test was used in this study,

## 3. RESULTS AND DISCUSSION

### 3.1 *Perception of product flow structure and efficiency*

The results start with the perception of chain actors on product flow structure and efficiency. The results are reported in Table 1. Two items were used to assess product flow structure including flexibility and responsiveness measured on a scale of 1-10, where 1-5 is inefficient and 6-10 is efficient. Regarding product flow structure, with exception of flexibility that was perceived as inefficient by input dealers, all the remaining actors perceived flexibility of the product flow structure as efficient. With respect to responsiveness, all the chain actors perceived the product flow structure as efficient except financial service producers that perceived it as inefficient. The main thrust of the product flow is to deliver efficiently the required type, volume and quality of raw soybean produce that enhance customer/buyer value.

Regarding product flow efficiency, it was observed that financial service providers had the lowest score of 4.6, suggesting that the product flow along the chain was inefficient. This could be attributed to the simple reason that financial service providers are not directly associated with product flow in the chain. Therefore, could not make any better assessment of its efficiency. Input dealers also perceived the reduced wastage dimension of product flow efficiency as inefficient with a score of 4.4. on the average, however,soybean producers, buyers/aggregators, processors, logistic service providers and chain facilitatorsdeemed product flow efficiency as efficient. This could be attributed to the fact they are directly involved in the value chain activities.

**Table 1: Results on the perception of product flow structure and efficiency**

| | Specific chain / Activity indicator | Input dealers | Soybean producers | Buyers/ aggregators | Processors | Logistic services providers | Financial services providers | Chain facilitators |
|---|---|---|---|---|---|---|---|---|
| Product flow | | | | | | | | |
| Structure | | | | | | | | |
| I | Flexibility | 5.0 | 6.0 | 6.8 | 7.0 | 6.8 | 4.6 | 7.4 |
| Ii | Responsiveness | 6.2 | 6.1 | 7.2 | 7.8 | 7.0 | 5.0 | 6.2 |
| Efficiency | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| I | Timeliness | 6.4 | 5.9 | 6.6 | 6.2 | 6.6 | 4.0 | 6.6 |
| Ii | Reduced wastage | 4.8 | 6.1 | 7.4 | 6.4 | 6.8 | 4.8 | 7.0 |
| Total average score | | 5.6 | 6.0 | 7.0 | 7.6 | 6.8 | 4.6 | 6.8 |

**Scale: 1-5 is inefficient and 6-10 is efficient**

### *3.2 Soybean product flow map*

Next, we present the movement of soybean across actors in the value chain in Figure 2. The Figure captures the current state map of the direction of flow of products in the chain. Also, it details activities that are value-adding (V), non-value adding but necessary (N) and wasteful activity (W). A critical study of the Figure suggests the preponderance of chain enterprise activity towards non-value adding but necessary activity. This implies a focus on efficiency and an indication that there is a limited scope for adding value upstream. Meanwhile, wasteful activity should be targeted or eliminated to "further improve the efficiency of product flow.

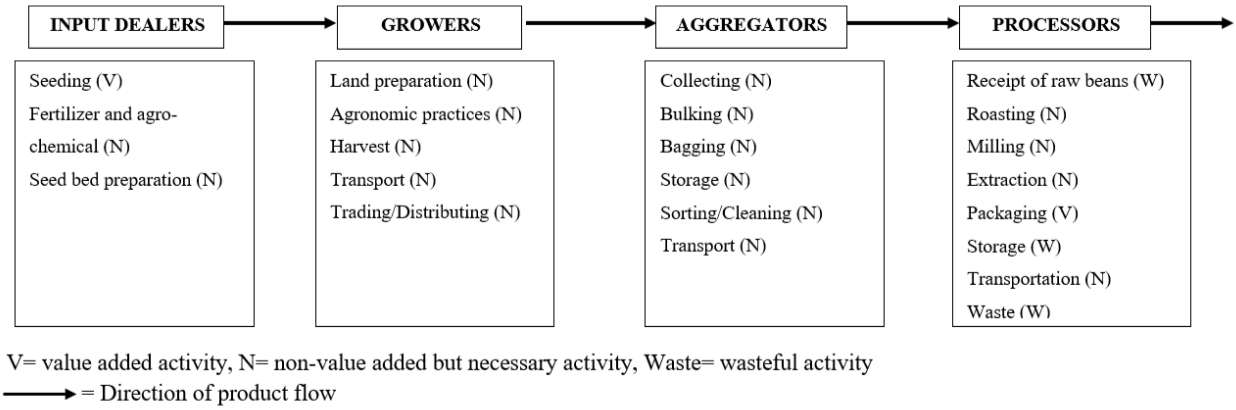


Fig. 2: Current state map of product flow (Field data, 2011)

**Input dealers and producers (growers)**

Soybean production constitutes an important aspect of product flow in the chain. Producers obtain appropriate agronomic practices on production of soybean from the extension staff of the Ministry of Food and Agriculture (MOFA). They also obtain information from facilitating organizations such as ADVANCE, ACDEP and IFDC.Therefore,they are able to assess what inputs to buy from input dealers. The types of seed variety purchased by the producers are value-adding. This is because, to a large extent, they determine the type of soybean produce with the right product traits suitable for the buyer's need. Other agricultural inputs such as fertilizer and other agro-chemicals are considered necessary in production of soybean, but not value adding in the utilization of the raw beans by the processor.

Soybean producers contribute to the value chains efficiency of production through an appropriate quantity of timely delivery of harvested raw soybeans. This places a great responsibility on the producer to make the right soybean with the unique product compositional characteristics that is desirable to the processor.

Similarly, land management practices, consists of commercially and environmentally sustainable control of farm lands to ensure continuity of supply, production of soybean on time and to meet the required quality and quantity. Producers in the soybean chain are encouraged to maximize the opportunities to use best practices, economies of scale and efficiency in the procurement and use of inputs, harvesting, and the transportation of the raw soybeans from the farms. While these may be considered best agronomic practices in the soybean production upstream, they are not necessarily identified as enhancing consumer value downstream in the chain once the raw soybean is processed into finished soybean products such as soya oil/milk or poultry feed.

**Aggregators**

Aggregators/wholesale agents, normally situated between the producers and processors are the main buyers of raw soybeans from the producers.Their bulking activities along the chain contribute to the efficiency of product flow in the chain. The efficiency of flow of raw soybean essentially concerns the timely harvesting and transport of the product from the producers.How well the aggregators perform activities affects the timely delivery of the commodity to the processors. They sort out, bulk, transport, or hold the stock till they are ready to be delivered to processors.Therefore, these activities are considered essential but non-value adding in the final consumption of the finished soybean product downstream in the chain.

**Processors**

The linkages of processors to the chain are particularly important, because the processing of raw soybean into the various soybean products (i.e. oil, milk, feed) is entirely done at the processing facilities of these units. The roasting, crushing and subsequent processing of the raw soybeans into finished soya products are regarded as necessary but non-value adding, although some processes affect final product quality. Additional processing activities at processing plants that refined the crude soya oil into edible domestic oil and the blending of milk products to provide the right flavour, and other important attributes of the soya milk is considered value adding in the final consumption of these products. The analysis also showed that the following activities are value adding for the processors. That is, 1) the packaging of the finished products by the processors, 2) embossing the packaged product with the appropriate brand name and manufacturer's logo, and 3) providing appropriate nutritional information on the packaging material add value to the consumption of the products. Data from consumer research attest to the fact that the appearance of packaging material, the brand name, and information on the back label are quite important hence value adding (Fearne *et al*., 2009). On the contrary activities that are considered wasteful and costly include storage, transportation and multiple handling of products as it moves across the production lines.

**Aggregators and processors**

In the soybean value chain, the aggregators/wholesale agents as already noted in the section on aggregators buy, sort out, bulk up all the small purchases from the producers, store the bulk up products and they transport the raw beans to the warehouses of the processing factories in Techiman and Kumasi. This system of activities was considered wasteful due to multiple handling, transportation and storage.

Although on average, the soybean value chain is perceived as efficient (Table 1), all the respondents representing the various stakeholders in the focus group discussion recognized the scope for further reductions in the levels of waste in their business operations (Figure 2). This is particularly reassuring, not because waste was acknowledged as being a problem but because all stakeholders in the value chain recognized the scope of improvement (Table.1). During the focus group discussion, the question was posed as to what constituted the main barriers to achieving an enhanced efficiency compared to what was revealed by the study. The responses obtained revealed a high degree of consensus on the unpredictability of the weather in this era of climate change. The changes in weather haveresulted in unexpected variability in supply and unstable policy environment, that can create changes in demand. While some of these might be unavoidable, some could still be dealt with in a more effective information flow along the entire value chain.

## *3.3 Perception of Key Stakeholders on Various Chain Activity Performance*

This section presents the results of the survey, which was mainly focused on the quantification of the benefits that key stakeholders attach to the various chain activities.That is, product flow, information flow and relationship strength. Also, all three dimensions of the chain sustainability construct when evaluating the tangible and intangible financial benefits were considered. The results provide hints as to what motivates stakeholders' continuous participation in the value chain, and insights as to how the phenomenon can be harnessed to develop a sustainable and viable value chain system that creates space for the various actors to engage in meaningful economic activities.

### *3.3.1 Factors influencing tangible and intangible financial benefits across stakeholder types*

The results of the factor loading, KMO-MSA, alpha-values and percentage of variance explained by the factors are depicted in Table 2. All constructs of chain activity performance scale were conceptualized as two-factor constructs.The first factor was referred to as tangible financial benefits and the second factor as intangible financial benefits. The term tangible and intangible have been applied to describe the perceived financial benefits that accrue to the various actors in the soybean value chain in Ghana. Tangible financial benefits are so referred to because the items that were loaded contain statements that describe gains that can clearly be seen to exist and intangible financial benefits had items loaded to describe gains that do not exist as physical assets but still valuable to the chain actors.

Under product flow, seven items that were loaded on the first factor to explain the variance of 55% included such statements as reduced cost of production, increased profit, increase returns on investments, reduced waste, avoid over production, and improved timeliness of product movement. With an alpha value of 0.780, the result implied that the measurement scale is a good indicator of the underlying construct (Nunnally, 1978, Gyau& Spiller, 2008).

The second factor, intangible financial benefit with an explained variance of 57% contains four items and has alpha value of 0.748, which suggested that the statements used adequately explained the underlying construct. Since the reliability tests which were used to purify the measurements were above the conventional cut-off point of alpha coefficient of 0.6, it implied that the statements used to operationalize these two factors adequately measure the underlying constructs.

Table 2: Factor analysis for financial benefit of product flow across stakeholder types

| **Factor and Items**<br><br>**Financial benefit of product flow** | **Factor loading** |
|---|---|
| **Tangible financial benefit of product flow**<br><br>**Explained variance = 55.13% KMO = 0.757 Cronbah Alpha = 0.756** | |
| Reduce cost of production in my farm business | 0.622 |
| Increase the profit earn in my farm business | 0.805 |
| Maximize the returns earned on my investments | 0.839 |
| Improve the management of waste to reduce post-harvest losses | 0.607 |
| Avoid the over production of farm produce | 0.810 |
| Avoid unnecessary storage of farm produce | 0.884 |
| Improve the timeliness of the movement of farm produce within the chain | 0.524 |
| Improve my capacity to meet buyer's orders for volume and quality of raw material required * | |
| | |
| **Intangible financial benefit of product flow**<br><br>**Explained variance = 57.12% KMO = 0.737 Cronbah Alpha = 0.748** | |

| | |
|---|---|
| Identify every distinct activity in my farm business operation as potentially value-adding | 0.720 |
| Ensure my farm business' prompt response to changing client's needs. | 0.757 |
| Improve my farm business capacity to respond to client's feedback information | 0.784 |
| Identify distinctive activity in my farm business operations that are potentially damaging to the environment. | 0.762 |

*Item suppressed in exploratory factor analysis for less than 0.5 factor loading

In an attempt to compare chain activity performance scales across stakeholder types, the retained items from the factor analysis were subjected to one-way analysis of variance (ANOVA). Specifically, the ANOVA was used to analyze the impact of variance of each chain activity performance factor independently (Table 3).

### ***3.3.2 Perceived Financial Benefits of Product Flow across Stakeholder Types***

The results of the ANOVA test (Table 3) indicate that there are no differences in the overall tangible financial benefit performance scale across stakeholder types. Additionally, the two items which measured tangible financial performance namely, profit maximization and cost reduction items are also not significantly different with the type of stakeholder. Further, the results suggested a significant difference in the overall intangible financial performance scale among the stakeholder types in the chain.

**Table 3: Analysis of variance (ANOVA) for financial benefit of product flow across stakeholder types in the soybean value chain system in Ghana**

| | Stakeholder Type | | | | | |
|---|---|---|---|---|---|---|
| Financial benefit of product flow | PDR | INP SUP | SEV PVR | BUY | F-values | Sig |
| | μ (σ) | | | | | |
| | n= 223 | n = 22 | n = 46 | n = 9 | | |
| Tangible financial | 1.894 | 1.969 | 2.001 | 1.958 | 0.910 | 0.437 |

| | | | | | | |
|---|---|---|---|---|---|---|
| benefit of product flow | (0.445) | (0.256) | (0.418) | (0.620) | | |
| Profit maximization | 1.837 | 1.848 | 1.858 | 1.805 | 0.035 | 0.991 |
| | (0.545) | (0.407) | (0.512) | (0.583) | | |
| Efficient management | 1.951 | 2.090 | 2.144 | 2.111 | 2.421 | 0.066 |
| | (0.498) | (0.275) | (0.500) | (0.726) | | |
| Intangible financial benefit of product flow | 1.793 | 2.056 | 1.940 | 1.861 | 2.681 | 0.047* |
| | (0.475) | (0.587) | (0.548) | (0.501) | | |

(s) = mean, "figures in parenthesis are standard deviation", * $p<0.05$, PDR = Producers, INP SUP = Input Suppliers, SEV PVR = Service Providers, BUY = Buyers

These results in Table 3 implied that the perceived tangible financial gains that accrue to each stakeholder attributed to product flow performance scale are not significantly different among the stakeholder types. However, the perception of overall intangible financial gains differs significantly ($p<0.05$) across stakeholder types, and most likely indicative of the effectiveness of information flow within the chain to reduce transactional cost in doing business within this particular chain setting.

## 4. CONCLUSION

This paper sought to examine soybean actors' perception of product flow structure and efficiency as well as stakeholders' perception of tangible and intangible financial benefits among the value chain actors. The results show that the product flow was adjudged to be efficient. The resulting current state map shows the preponderance of chain enterprise activity towards non-value adding but necessary activity providing hints that there is a limited scope for adding value upstream. The principal component analysis also reveals that with product flow tangible financial benefit loaded seven items- reduced cost of production, increased profit, increase returns on investments, reduced waste, avoid over production, and improved timeliness of product movement- to explain the variance of 55% The intangible financial benefit with an explained variance of 57% contains four items and since the reliability tests which were used to purify the measurements were above the conventional cut-off point of alpha coefficient of 0.6. In both cases, it implied that the statements used to operationalize these two factors adequately measure the underlying constructs.

The analysis of variance (ANOVA) result reveals that chain actors' perception of efficient product flow was not influenced by expected tangible financial gains that may likely accrue to them. However, their perception of intangible financial benefit of efficient product flow was significantly affected by expected overall financial gains that accrue to them as a result of their participation in chain economic activities.

The findings give an idea to the extent to which the value chain system can be sustained within the study area. Their perception of product flow efficiency implies that there is timeliness in the delivery of products or produce across stakeholders in the chain, which has the potential to improve on productivity and profitability across the chain actors. This would drive production and other activities including marketing and processing for a sustainable value chain system. The non-value added but necessary activities identified across the product flow downstream must be given adequate attention to improve product flow efficiency for a sustainable soybean value improvement. The intangible financial benefit such as response to customers' needs along the chain influences perception of product flow efficiency because it increases customer based of the actors, thus improving on sustainability of the activities of the actors in the chain.The findings further show the need to establish a value chain management system that coordinates all these activities for a sustainable and effective soybean value commercial chain system.

It is therefore recommended that (1) Chain facilitators/managers should provide adequate incentives for all chain actors to play their respective roles well to ensure that efficiency of product flow along the chain would be further improved to utilize the existing scope for value addition within the producer-processor interface. (2) The Ministry of Food and Agriculture (MoFA) should take steps to restructure the seed inspectorate division to improve its capacity to ensure the supply of good quality seed to farmers, (3) International and local non-governmental organizations associated with the chain system should institute training programmes to equip both producers and aggregators with skills and techniques to clean and sort out their wares into appropriate grades for a differential pricing on an adopted grading systems.

## Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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