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ASSESSING THE IMPACT OF NPK 15:15:15 FERTILIZER ON SMALLHOLDER AGRICULTURAL PRODUCTIVITY IN BOMBALI SHEBORA CHIEFDOM, BOMBALI DISTRICT.

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ABSTRACT

The farming sub-sector of Sierra Leone is characterized by traditional rain fed and low techniques of production and thus, is prone to the recurrent natural calamity of drought, which leaves hunger and death in its wake. Today, farmers in Sierra Leone have difficulties in feeding their households on their increasingly fragmenting land, using traditional and backward techniques of production. Hence the drastic need to improve agricultural productivity and production through the adoption and adaptation of improved agro-chemicals and techniques is apparent. For modernize agriculture, a strong support system involving input supplies and other services like marketing, transport, storage, processing etc. are inevitable. This study is intended to analyze the impact of agricultural input of fertilizer on smallholder productivity including the demand –supply system of the study area; to map the actors and their linkages, knowledge and information flows, to identify influential factors for the smooth functioning of the system in Bombali Shebora Chiefdom Bombali District. A simple-random sampling technique was used to select four farmer Associations and 200 respondents. Structured interview schedule and questionnaires were used for collecting the essential quantitative and qualitative data. To generate qualitative data, field observations; informal interview with key informants; and discussions with separate focus groups were conducted. The quantitative data were analyzed using descriptive statistical tools. The major result of the study indicates that the system is highly characterized by relatively poor linkage and inefficient knowledge flow between actors and farmers in the study area., from the supply sector factors like organizational mandatory clarity, sufficient and irrigable seed farm, skilled man power, delay of

temporary loan settlement by users, policy environment, storage facilities at grass root level, efficient marketing system, timely demand claims from users, clearly defined role and responsibilities of each partner, availability of improved seeds in terms of their germination, viability and adaptability, research centers cooperation and willingness to share resources including knowledge, farmers willingness to take risks and demand for improved crop varieties were some the of mentioned factors that influence the system positively and/or negatively.

1.1 Background of the Study

As the world enters an era of rapidly growing demand for food, declining resource availability and rising volatility, leaders in global food processing have recognized the need for more sustainable food production and are beginning to implement strategies for improved environmental, social and economic performance in their supply chains (Redecop, 2012). The issue of sustainable food production is a key topic of discussion among global representatives from government, NGOs and the food industry, who have all recognized the challenges ahead as the world enters a new era, marked by scarcer resources, greater demand and higher risks of volatility (WEF, 2011).

Agricultural supply in Sierra Leone has recently been depressed by changing weather conditions. These depressing factors have reduced the potential for higher yields due to less than sufficient rains as well as late rains. These weather episodes have been associated with the global phenomenon of climate change. The arid and semi-arid parts of Africa, particularly in northern Sierra Leone, have been worst hit by prolonged drought spells causing livestock deaths due to shortage of water and vegetation for grazing.

Despite Africa's rich agricultural resource endowment, the African continent remains the only region of the developing world where the agricultural input business is not well-developed. Despite the importance of agriculture in their economies, many countries on the continent specifically sierra Leone are yet to establish a systematic focus in their agricultural planning history that shows a conscious effort to purposely prioritize the development of the agricultural input business. Economic growth and poverty reduction in Africa can be achieved by enhancing the productivity and profitability of agriculture through the development of the agricultural input sector (ECA, 2014).

Agricultural production remains an important sector in the economy of Sierra Leone. It is divided between large scale and small-scale production and there exist a wide range of crops that are produced. In the last few years, large-scale producers have declined significantly due to changes in

land use. Close to 70 per cent of sierra Leonean farmers reside in rural areas where smallholder agriculture is their main livelihood activity. According to conducted research, more than two-thirds of all people surviving on less than $1 a day live and work in rural areas (UNDP, 2005). Sierra Leone's rural populations whose incomes and food are rooted in the agricultural sector are mainly poor and themselves victims of unfair trade practices. These practices hamper rural agricultural progress. Access to inputs and services important in increasing their agricultural supply become difficult due to their meager incomes. It is documented that every year $350 billion is the amount of direct and indirect subsidies that are pumped into the agricultural sector (UNDP, 2005). It has been argued that this has far reaching effects on rural farmers in agricultural countries such as Sierra Leone compared with developed country farmers in international markets. Subsidized exports undercut them in global and in local markets, driving down proceeds received by farmers and the wages received by agricultural laborers.

1.2 Statement of the Problem

Majority of the farmers in Sierra Leone have been using traditional ways of agricultural practices. This has contributed for low productivity of the agricultural sector. To solve these problems, governmental and non-governmental organizations have made efforts to bring about change in agricultural production system of subsistence farmers. They have introduced improved agricultural technologies like fertilizers, high yielding varieties of seeds, pesticides, farm tools, etc. As a result, farmers who participated in the extension package program showed relative change in the style of their production process. To increase production and productivity, the collective interaction of actors in the sector is a must. Agricultural input suppliers are one of the actors that are responsible to deliver according to the demand of the farmers. However, due to the growing demands of the farmers in the study area, for improved agricultural inputs, the supply sector could not satisfy the needs of the farmers. This indicates that there are different factors directly or indirectly influencing the input supply system that believed to boost up production and productivity of the smallholder farmers. But the reasons why input-supplying system failed to satisfy the needs of the farmers is not analyzed so far in the study area. Therefore, this study focused on identification of actors, their linkage and knowledge flow among actors in enhancing crop production and productivity, influential factors of the system and the enabling policy environment of agricultural inputs demand-supply system by giving special emphasis on rice, beans and maize technologies. Hence it attempts to fill the existing gap of knowledge regarding the input supply system.

1.3 Aim and Objectives of the study

The general aim of the study is to assess the impact of fertilizer input on smallholder agricultural productivity in Bombali Shebora Chiefdom.

1.3.1 The specific objectives of the study are:

i. To determine the actors and their linkages, knowledge and information flow in the fertilizer demand-supply system on smallholder productivity in Bombali Shebora chiefdom.

ii. To identify factors influencing the smooth functioning of fertilizer demand-supply System on smallholder productivity in Bombali Shebora chiefdom.

iii. To determine the economic effect of fertilizer input on smallholder productivity in Bombali Shebora chiefdom.

2,0 LITERATURE

The relevant literature on the Assessment of Farm Input Supply on Agricultural Production concepts, the main items discussed are:

Innovation Concept and definition, Actors Mapping, Linkage and Knowledge Flow, Agricultural Services and Service Systems, Seeds as Agricultural Resource Base, agricultural policy, Input sector reform and emerging market structure, Input and Output Marketing, The fertilizer sub-sector, Macroeconomic Constraints, to the development of agriculture, Input demand supply system, Product Market, and Technology Effects

2.1 Innovation Concept and definition

According to Gardner *et al*., (2007), innovation encompasses the entire process, from idea to implementation, of the development of new products, services, methods, management practices and policies. The word “innovation” is often used as synonymous with the outcome of the process, but should not confuse with “invention”. Spielman (2005) succinctly defines an innovation system as “a network of agents, along with the institutions, organizations, and policies that condition their behavior and performance with respect to generating, exchanging, and utilizing knowledge.”

Moreover, an innovation system can be defined as a network of organizations, enterprises, and individuals focused on bringing new products, new processes, and new forms of organization into economic use, together with the institutions and policies that affect their behavior and

performance. The innovation systems concept embraces not only the science suppliers but the totality and interaction of actors involved in innovation (World Bank, 2004).

Then innovation as a process is linked to learning processes and to the information and knowledge management capability that the agents and actors have different motivations and confront different challenges (Barbier, 2003).

According to Spielman *et al*. (2008), innovation agent is someone who introduces or uses such knowledge a process that entails seeking information from various sources and integrating elements of the information into social or economic practices that somehow change the behaviors and practices of individuals, organizations, or society. Thus, innovation occurs when someone uses an invention- or uses existing tools in a new way- to change how the world works, how people organize themselves, and how they conduct their lives (Fagerberg, 2004).

2.2 Types of innovation

Fagerberg (2004) identified a variety of innovation classifications and some of them are:

i. Organizational innovation – involves the creation or alteration of business structures, practices, and models, and may therefore include process, marketing and business model innovation.
ii. Process innovation- involves the implementation of a new or significantly improved production or delivery method.
iii. Product innovation – involves the introduction of a new good or service that is new or substantially improved. This might include improvements in functional characteristics, technical abilities, ease of use, or any other dimension.
iv. Service innovation – refers to service product innovation which might be, compared to goods product innovation or process innovation, relatively less involving technological advance but more interactive and information-intensive.

2.3 Actors Mapping, Linkage and Knowledge Flow

2.3.1 Actors mapping

The purpose of this subsection is to provide information on how actors are functioning within the system- main actors and organizations in the sector with the specific roles they play; extent of linkage between actors and organizations and the nature of these linkages for supporting

interaction; level of coordination, and identification any missing actor or role in input demand-supply system.

2.4 Linkage

Generation of technology is not an end by itself. It must be utilized by end users. This can be realized through the presence of effective linkage among the major stakeholders in the agriculture, agricultural knowledge and information system. Linkages between major institutional actors in agricultural knowledge and information system are widely recognized as essential for an effective flow of technology and information between research, extension and farmers. The types and nature of linkage between actors within the agricultural knowledge and information system directly influence the production and productivity of small holder farmers. It is commonly recognized by agricultural knowledge and information system stakeholders that poor performance of the system is often related to linkage problems (Akalu and Enyew, 2006).

According to Hagmann *et al*., (2002), linkages between service providers in to service delivery system are critical to 'make the system work as a system'. The different roles and mandates of service providers need to be clarified and even more important; they need to 'learn to play the roles' and work together in synergistic way towards making a difference.

Hence, to map the interactions thereby learning among the actors in the service delivery system, tools for diagnosis and institutional change in agricultural innovation systems are adopted (Hall *et al.,* 2007).

2.5 Knowledge Flow

Knowledge can be understood as both information and skills that are acquired through individual experience and trial and error, within an organization or a learning community, or from outsiders adapting it to local contexts. Knowledge that rural and farming communities are typically interested in includes cultural management practices; new agricultural technologies; diagnostic information about plant and animal disease and soil related problems; market information on inputs and sales (prices, seller, buyers, retailers); market demand and quality of products required for these markets; and land records and government policies. The concerted efforts and practices used by organizations and individuals to identify, create, accumulate, re-use, apply and distribute knowledge are commonly labeled knowledge management (Hartwich, *et al*., 2007).

According to Paul and Engel (1997), knowledge is not simply that is possessed and accumulated, it emerges out of process of social interaction and should be looked at in terms of social relationships. What people know and how they go about learning is intrinsically woven in to their life as social beings. Knowledge emerges as a result of social efforts to come to grips with the demands, the social and physical environments in which individuals and groups are immersed and said about knowledge that to know is to act effectively. Knowledge includes the ideas, concepts routines and skills people acquire over time to support their livelihood.

Since knowledge is dynamic, it is constantly produced and reproduced, shaped and reshaped and yields many types of knowledge, differentiated within and between localities (Mango, 2002).
According to Joshi *et al*., (2004) knowledge continuously evolves as farmers learn both by evaluating the outcome of previous actions and by observing the environment. This means that knowledge that enters a locality is not simply internalized, but becomes transformed by various actors to suit their circumstances.

The important questions need to be answered in the knowledge/information network analysis are what types of knowledge/information are important for the successful performance of the system? Who are the source user of these types of knowledge and information? Who or what are the intermediaries- the actors, printed materials or other media that move knowledge and information among actors? How effective are the existing communication networks in linking relevant sources, intermediaries and users of knowledge and information (Salomon and Engel, 1997).

2.6 Agricultural Services and Service Systems

Services to the agricultural sector are extra ordinarily heterogeneous, ranging from agricultural extension to legal counseling on land tenure issue. According to Helmut (2000), as cited by Anteneh, (2008), typical services to the agricultural sector include: agricultural research, agricultural extension and information services; education and training; rural financing (e.g. saving, credit) and insurance marketing of agricultural products and market promotion; input delivery services for plant production (e.g. seed, fertilizer, pesticides, irrigation water, machines/tools) and animal production (e.g. genetic material, forage, veterinary products, drinking water, machines/tools); regulatory services often provided by governments (e.g. certification of seeds and bio-products, quality control of agricultural products, regulations of water rights etc.) and technical support services i.e. all activities related to the provision of the technical and social

infrastructure for agriculture (e.g. transport, supply of fuel and spare parts, planning of resettlement schemes etc.).

Systems theory or systems science argues that however complex or diverse the world is that we experience, we will always find different types of organization in it, and that such types of organization can be described by concepts and principles which are independent from the specific domain under consideration. Hence, if we could uncover the general laws, we would be able to analyze and solve problems in any domain, and pertaining to any type of system. The systems approach is distinguished from the more traditional analytic approach in its emphasis on the interactions and relationships between the different components of a system. Although the systems approach in principle considers all types of systems, in practice it focuses on the more complex, adaptive, self-regulating systems which can be termed "cybernetics"(Görlitz, 1989). In systems theory, reality is seen as a complex pattern of various relationships between different elements. A system which can be defined as a simplified reproduction of a part of reality is composed of **elements** with **attributes**, i.e. their perceived characteristics, and describes the specific **relationships** between them and their **boundaries**. What is regarded as a system (i.e., which elements and relationships are selected to form a system) depends on the perspective and the specific objectives (e.g. small-scale farmer obtaining access to agricultural inputs, private research institutions advising commercial farmers, government institutions privatizing extension services, development organization designed to improve the agricultural services in a specific region). The systems, or holistic, approach is useful when seeking to analyze and understand better the complexity of service systems (Doppler and Calatrava, 2000). In the context of services to the agricultural sector, five important aspects can be identified:

- **Type** of service: this comprises the key features (technical aspects, economic characteristics, quality aspects, effects) of an individual service such as agricultural extension, research, etc.
- **Actors of** the service system: this aspect includes the provider sub-system (service supply) and the client sub-system (use of service).
- **Functional relationships** of the service system: this includes the components of service provision (financing, delivery, assurance), the interaction of and between actors and services, and the governance of services (mode and mechanisms).

- **Level and scope** of the service system: this includes the micro-level (farm- household), meso-level (region or district) and macro-level (national) as well as the regional range of the service system.
- **Frame conditions** of the service system: this includes the technological (service infrastructure) and ecological conditions in the region in which the service system is operating, as well as the political, economic and socio-cultural conditions influencing or being influenced by the system.

Each of the above mentioned aspects can be further differentiated and analyzed in the context of sub-systems. Numerous possibilities of classifying agricultural services in a system context exist, with the emphasis shifting away from a simple technical interpretation to the processes and functional relationships of the service system itself. Adopting a systems perspective, agricultural services can be categorized as follows (Ibid):

- Services for the application and management of agricultural inputs, such as water (irrigation), veterinary products (veterinary services), machines and tools (mechanization), pesticides (plant protection), etc.
- Services for the acquisition and management of agricultural production factors, such as land (e.g. Provision of land) and labor (e.g. hired labor).
- Services for post-production systems: these include all services related to operations, from the harvesting of agricultural products to consumption (e.g. processing, transport, storage, etc.), including the respective actors and all influencing factors and framework conditions (often referred to as “post-harvest systems”).
- Supply-chain services: these include all services related to the production and postproduction of a specific commodity (e.g. cotton, tomatoes, cocoa, etc.).
- Information and knowledge services: these include services related to the creation and dissemination of agricultural information and knowledge.
- Services for innovation systems: these include all services related to the development and dissemination and utilization of a particular innovation (e.g. research, extension, input supply, etc.).
- Regional services: these include all services related to the production and postproduction of crops and livestock in a specific region.
- Public sector services: these include all services provided by the public sector as well as their political and social influence on frame conditions (e.g. legal aspects, institutional arrangements, etc.).

- Services of interest representation: these include services such as co-ordination, representation, negotiation, advocacy and lobbyism. These services are strongly related to the governance of a service system.

2.7 Status of agriculture and food insecurity in Sierra Leone

The West African state of Sierra Leone is purely an agrarian, with the sector accounting for an estimated 42.5 percent of GDP and employing around two-thirds of the national labor force. Sierra Leone is endowed with approximately 5.4 million hectares of arable agricultural land, of which almost 75 percent is available for cultivation. The country has fertile soils and its ample rainfall averages roughly 3,800mm per year, making it one of the most humid countries in Africa. This climate supports a broad range of crops including rice, cassava and groundnuts, as well as livestock and cash crops, such as coffee, cocoa, and palm oil. Still, the sector's vast potential is largely untapped.

Despite past challenges, Sierra Leone's abundant natural resources provide it with a strong base for economic growth, especially in agriculture. Agriculture is a key economic driver for the country, contributing more than 50% of GDP. It is also the primary source of income for most of Sierra Leone's population. It employs two thirds of Sierra Leone's labour force, mostly as smallholder farmers, who operate on farmers 0.5-2.0 hectares and earn less than $1.25 a day. Diversity in agriculture is very limited. Rice, Sierra Leone's staple crop contributes 75 % of agricultural GDP and is grown by 80 % of farmers. 693,000 tonnes of rice was produced in 2013. Other domestic food crops include cassava, yams, peanuts, corn, pineapples, coconuts, tomatoes, and pepper.

Though agriculture plays a key role in Sierra Leone's economy, the country relies on imports to feed its population. Sierra Leone's population has insufficient food access, and suffers from very high levels of hunger. Sierra Leone is among the world's 10 hungriest nations; there were only 5 countries with hunger levels higher than Sierra Leone in the 2015 Global Hunger Index. Only 15 % of Sierra Leone's population was food secure in 2015, with 43 % severely food insecure. Malnutrition severely affects Sierra Leone's children as nearly 40 % of children under the age of five suffer from stunting.

Low agricultural productivity limits available food and drives the need for imported food. Reliance on imports has led to decreased employment and higher priced goods. As Sierra Leone's population is projected to grow at 3.2 % annually, the need to close the current food gap through increased agricultural production is imperative.

Research for OCA's Seed Tech Investor Presentation confirms a significant opportunity for the agriculture inputs sector, which the World Bank predicts it to be worth $8 billion by 2020. However, limited access to agri-inputs remains a significant constraint for millions of farmers. It is estimated that nearly 3 million farmers are underserved by current input providers. This includes farmers in Sierra Leone's key arable provinces (Makeni, Port Loko and Tonkolili), estimated to account for $ 2.5 billion of the national agricultural market. Improving access to the agri-input sector is an imperative to increasing economic growth and stabilizing national food security. In spite the predominance of the agrarian economy not much agricultural production has been realized due to the high dependency of farmers on subsistence farming including the use of low level technology and the constraints in harnessing the much desired farming inputs for an effective farm production. Invariably, such supply of farm inputs is a recurrent challenge to agricultural productivity nationwide. Unquestionably, access to farm inputs could enhance farmer's capacity in food production and by extension food self-sufficiency nationwide.

Giving the above scenario, the need for a clear understanding of the impact of farmers access to agricultural inputs to farmer's productivity cannot be over emphasized.

2.8 Seeds as Agricultural Resource Base

Seeds played a critical role in agricultural development since pre historic man domesticated the first crops 10000 years ago. The domestication of wild species into crop plants probably started with the collection, storage and utilization of seeds not only for food, but also for planting a major step in the evaluation of settled agriculture. The domestication of plants was a gradual transformation from hunting and gathering to sedentary agriculture rather than a sudden revolution. During this process conscious and unconscious selection occurred, leading to significant modification of many our crop plants from their wild ancestors into highly adapted and diverse population of local land races (Zewde, 2004).

According to (Buddenhagen and Richard, 1988; as cited by Zewde, 2004), domestication of wild species into cultivated crops has probably altered natural adaptation very little in the centre of origin. The migration of human populations and/or diffusion of crops from the centers of crop domestication exposed crops to new biophysical environments. The landraces, by disseminating into different agro-ecosystems, have acquired new genes or gene combinations and frequencies to fit into their new environments. Thus, farmers' selection coupled with natural selection conditioned the adaptation of landraces to their agro-ecosystems.

The history of seed trade is as old as agriculture itself. Farmers exchanged seed in various traditional forms such as gifts, barter, labor exchange or social obligations. However, information on when, where and how organized seed production and trade started, is limited. It is believed that the introduction of new crops and knowledge- based agriculture including scientific plant breeding, mechanization, intensification and commercialization at various stages of agricultural development might have played a key role (Zewde, 2004).

The informal seed system deals with small quantities of seed is semi-structured, operates at the individual farmer or community level and may depend on indigenous knowledge of plant and seed selection, sourcing, retaining and management, as well as local diffusion mechanisms. The informal sector is more flexible and adaptable to changing local conditions and less dependent on or less influenced by other external factors (Cromwell *et al*; 1992).

The distribution of improved seeds to farmers started with the launching of the Chilalo Agricultural Development Unit (CADU) in 1967. In 1978 the Ethiopian Seed Enterprise (ESE) (formerly known as Ethiopian Seed Corporation) was established as a government parastatal under the now defunct Ministry of State Farms, Coffee and Tea Development. The primary objective of the enterprise was to produce and supply improved seeds to state farms and small farmers (Techane and Mulat, 1999).

2.9 Sierra Leone agricultural policy

The government of Sierra Leone's policy and strategic framework for the agriculture sector focuses on providing better quality and wider access to inputs and infrastructure, and improving storage and processing facilities to increase productivity, achieve food security, and expand exports. Investors should consider a number of areas of policy and regulation that impact the structuring and commercial viability of investments in the agriculture sector. Policy makers assumed that significant productivity growth could be easily achieved by improving farmers' access to technologies which would narrow the gap between farmers' yield and what agronomists called 'exploitable yield potential'. Researchers also reported the existence of technologies that can make a huge difference and shift upwards farmers' yield frontier in grain production.

2.10 Input sector reform and emerging market structure

In an effort to expand, professionalize and mechanize the agricultural sector in the country, the government is seeking not only foreign investments in plantations and processing facilities, but

also in agricultural inputs. Currently, a lack of high quality agricultural inputs is hampering further development of the sector. This means opportunities lie in the supply of fertilizer, improved seeds, agro-chemicals, animal feeds and veterinary inputs.

2.11 Input and Output Marketing

Market entry and exits into agricultural inputs, fertilizers, pesticides, planting materials, fishing gear, farm machinery and tools are dominated by the private sector and are generally not constrained by government intervention. Livestock input supplies on the other hand, have been mostly government controlled. Importation of these products is infrequent, perhaps due to low demand and uncertainties in the sector. Distribution outlets are also non-existent and farmers have to obtain supplies from the capital city, Freetown, or depend on cross-border trade in unidentified and unregistered products entering the market through Guinea. Costs of agricultural inputs in the country are generally higher than the neighbouring countries as supply is low with attendant higher transportation costs due to the deplorable rural roads conditions. The lack of rice mills, feed mills and other agro-processing companies means that farmers have difficulty selling crops (i.e. commercializing) in order to have the cash required to cover input costs. Thus inputs are closely connected to rapid improvement in agro-processing to ensure that sales promote demand and eventually availability.

The legal and regulatory framework for input marketing, including the sale, storage and use of agrochemicals, is embodied in the Sierra Leone Export Development and Investment Corporation (SLEDIC) Act 23, 1996, the Control of Pesticides Act 1989, and the Fisheries (Management and Development) Decree19. These Acts may have to be reviewed with the view of facilitating access and distribution where necessary. Private sector and small operatives dominate the food marketing system, although organized groups and associations are beginning to emerge in some areas due to support provided by some NGOs and GoSL

2.12 The fertilizer sub- sector

The supply of yield enhancing inputs in Sub Saharan Africa (SSA) is restricted and highly priced in relation to international market prices. Within SSA, fertilizer use is mainly confined to export cash crops. Gregory and Bumb (2006) identified five pillars that are required to develop input markets and achieve market efficiency. Increasing supplies and market efficiency can reduce input prices. These five pillars are the policy environment; human capital development; access to

finance; market information; and regulatory frame works. These generic components need to be adopted in the context of country-specific situations. Holistic improvements in all areas will reduce transaction costs and improve accessibility to fertilizers in rural areas.

Recognizing the need to increase the use of fertilizer, the Government of Sierra Leone has taken several measures, including issuance of national fertilizer policy, liberalization of the market to allow private sector participation, deregulation of prices and expansion of extension services.

2.13 Macroeconomic Constraints, to the development of agriculture

A key issue is what should be the respective roles of Government, NGOs, and producer organization. With its very limited capacity, it is vitally important that Government focus its energies on areas in which it has an essential role. These include formulation of an overall agricultural strategy; establishing an enabling environment for NGO activity, private sector investment, and farmer organizations; assuring plant and animal protection; supporting agricultural and livestock research; and providing for the acquisition, multiplication, and dissemination of new and improved plant and animal material. NGOs have proven particularly effective at disseminating information on new techniques and technologies. Farmer organizations also have an important role to play in this dissemination, as well as in helping to develop markets, storage, finance, and other ancillary services. The need for farmer groups, as business units, co-operatives, or similar structures, is the best way to consolidate volume and work towards improving the quality of rice. Farmer field schools (FFS) are being developed, which offer technical training, access to inputs, and markets for rice, maize, beans and other crops, but registration options for rural enterprises, including farmer groups, are not clear under the existing legislative structure. They are unprotected by the law, limiting access as well as ability to engage in formal commercial activities. Current policies make it difficult to formally register farmers groups as anything but cooperatives or associations, and the designation of “cooperative” has negative connotations in rural communities. Governance is a key issue with the democratization process and has been a focal point in the community capacity building process of most NGOs and some multilateral funded initiatives.

2.14 Poor Policy and Regulatory Environment

Other parts of this report deal extensively with the poor policy and regulatory environment in Sierra Leone. Areas where this impacts particularly on export–oriented agriculture include inefficient and duplicative pre-shipment inspections, high port and handling charges, weak

customs administration, excessive harassment by police, and poor transport regulation. If a diversified agricultural export base is to be built, long term investment will be needed. Growth and diversification cannot rely only on the activities of rural smallholders but will require entrepreneurs to invest in larger scale production, processing, and trading in order to drive the sector forward. This will require a far better enabling environment.

It is ironic that the largest investors in the cocoa sector at present are the exporters (with dryers and trucks, for example), who, because of their Lebanese origins, are generally held responsible for all the difficulties. Realizing the very considerable potential of the cocoa sector will require substantial additional investments in cocoa trees, seed gardens, and a host of other areas.

Growing public sector initiatives support agriculture, but coordination and cooperation are absent. As a result, technical messages on best practice for cocoa and other tree crop production and post-harvest handling may be inconsistent, and dissemination of research and improved technologies is limited.

2.15 Lack of Market Access and Information

Lack of market access is primarily due to lack of information regarding markets, their prices, and their standards. Farmers and traders depend mostly on word-of-mouth transmission of market information. Their knowledge of overseas or even regional markets and trade practices is minimal. Farmers have no knowledge of the world market price for cocoa and other export crops. They know almost nothing about grades and standards.

Forward planning, strategies, and prioritizing of actions requires a foundation of reliable information not only of markets but also of the capacity to supply those markets. Information gathering, from tree stock surveys to understanding regional export markets, needs to be developed. Initially, this must be a government function but in time the private sector should formulate its own plans based on information within the trade.

2.16 Insufficient Intermediate Technologies and Input Supply

Intermediate technologies exist for production and processing of rice, cassava, oil palm, cashew, and other products, but they are not used very extensively in Sierra Leone today. Yet there are vestiges of these technologies evident in the rusted and dilapidated equipment that is found

throughout the countryside. What is needed is delivery systems for making this equipment available, providing access to servicing and spare parts, and giving producers and processors the financial means to purchase or lease it.

The same is true for intermediate inputs. There are almost no input delivery systems in existence in Sierra Leone today. Other than through donor financed and NGO projects, there are almost no fertilizers, chemicals, and other agricultural inputs available outside of Freetown.

Poor Infrastructure

The appalling state of the roads in the interior not only impacts directly on the marketing cost of agricultural products but also has significant indirect consequences in adding to the cost and difficulty of supplying food and agricultural inputs in rural areas. The amount of time taken to get products and inputs to and from market takes away from the time that might otherwise be used for cash crops.

Port activities and costs are a major constraint on exports. They not only add to the cost of marketing, which precludes the export of lower value goods, but also prevent the export of perishable produce because of risk of delay.

2.17 Lack of Access to Agricultural Credit

Some years ago, subsidized agricultural credit was available through specialized banks, projects, and other institutions. This credit was generally rationed and went disproportionately to large producers and processors. Much of it was never repaid. The result was a collapse of these institutions and a restructuring of the banking system along sounder financial principles. Today this system is relatively sound but credit is scarce and expensive. It is beyond the reach of most rural enterprises, which need access to finance in order to modernize agriculture.

With little credit available to farmers, the question arises as to how they may be expected to invest in the planting of cocoa, oil palm, and cashew trees, which are relatively long-term investments. Even if the financial situation in rural areas were much better, most of this credit would be working capital for traders and perhaps a bit of medium-term credit for a few larger producers. Almost none of it would be available for planting trees. We should recognize, however, that most of the investment in tree crops is made on quite small areas of land, where the farm-household invests some of its surplus labor during the time of year when it is not otherwise needed. Thus

lack of credit is not as much of a constraint as might be perceived. Furthermore, the farmer purchases few inputs, given the biological means of plant protection currently in vogue, so there is little need for cash for this purpose. The major cash need is to buy seedlings, which could initially be paid for by the donors, though this has to be done in a way that will not discourage the development of a seed multiplication industry.

2,18 Lack of Capacity for Agricultural Research

Although at one time agricultural research in Sierra Leone was highly respected, today there is very little of this capacity that remains. Yet increasing farmer productivity and incomes will depend critically on introducing new technology, plant materials, and other elements of modern agriculture. This will require rebuilding agricultural research capacity. Fortunately, a number of the scientists previously involved with research are still around and could form the nucleus of a research base. To be effective, this research needs to be closely linked with various kinds of extension agents (MAFS, NGOs), with farmer organizations, and with input suppliers. Introduction of new materials will also require appropriate quarantine facilities and regulations, which protect plant and animal health but do not unduly restrict research. There may be important economies of scale that can be exploited by operating regionally. The West Africa Rice Development Association (WARDA) and the Sustainable Tree Crop Program (STCP) are two such examples

3.0 Conceptual Frame of the Study

3.1 Input demand supply system

Agricultural input supply system has an immense contribution in enhancing the productivity of agricultural commodities through collective action of relevant actors within the system. The system also plays important roles in bridging modern agricultural technologies to the peasant sector.

Moreover, it has potential to influence goals, strategies and resources and thus bring about changes in policies, programs and other related agricultural projects. To insure food self-sufficiency, identifying of influential factors in the smooth functioning of the system is essential to design purposeful intervention planning for betterment of the farming community in particular and the society at large.

According to different sources and the real world situations, the input demand-supply system is influenced by personal, situational, economic, institutional and organizational factors. Therefore,

in this study the researcher tries to analyze these relationships, identify the influence of independent variables on the dependent variable and also tries to identify the influential factors of the input demand-supply index of the area under study. The conceptual framework diagram of this study is presented in figure-1.

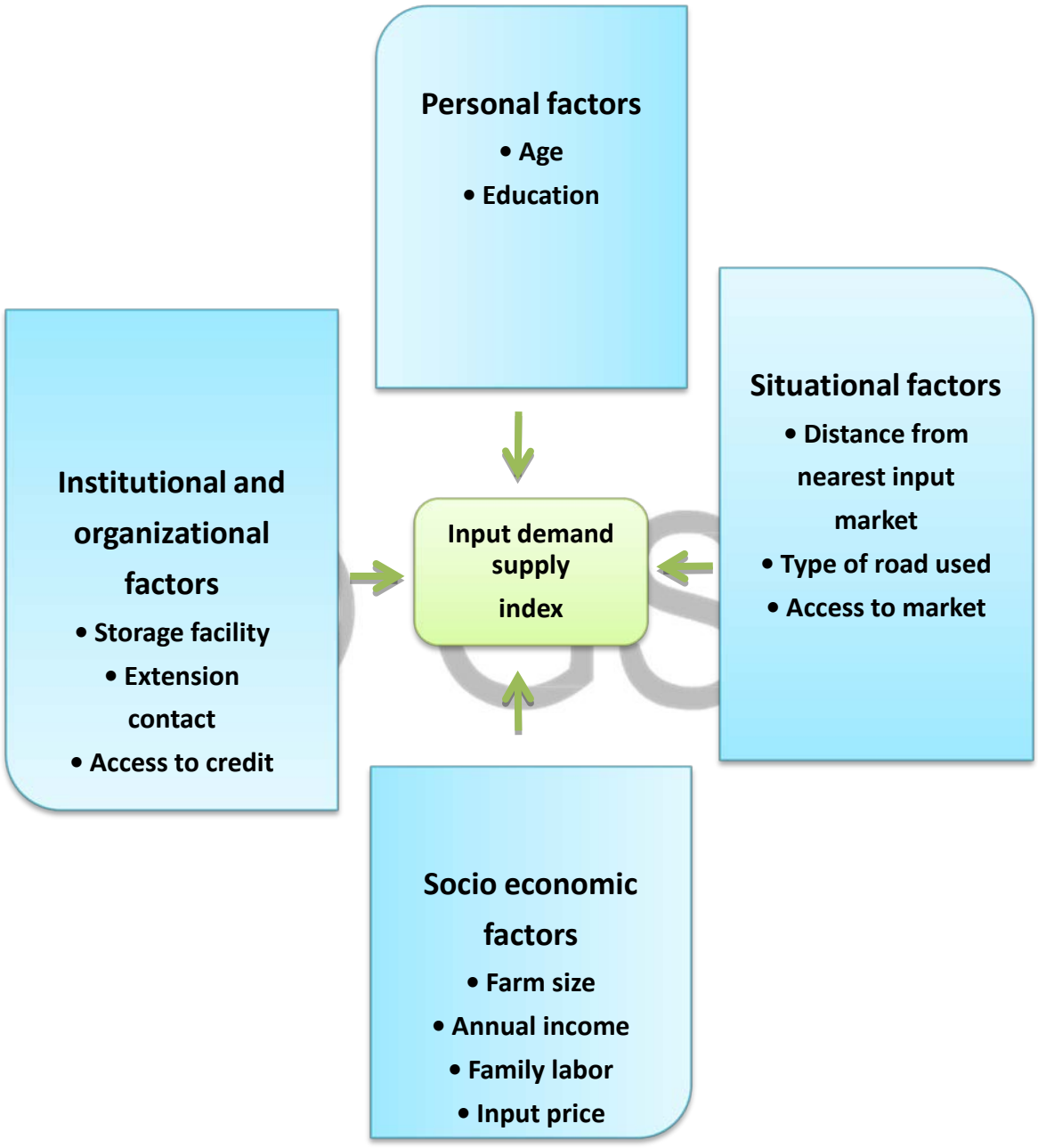

Figure 1: Conceptual framework of the input demand-supply index

Source: Own computation

3.2 Product Market, and Technology Effects

The most obvious way to use trade for poverty reduction is to expand output and employment. This can be done in a number of ways. More area can be brought into cultivation, thereby engaging

a larger number of households in the export activity. This avenue holds significant potential in Sierra Leone since there is abundant land and most traditional cash crop production was severely curtailed or halted completely by the war.

Another way to increase output and employment is through the introduction of better farming practices or new technology, which improve farmer productivity and increases the range of options regarding production. Where the bottleneck is at the processing level, better processing technologies not only raise the incomes of the processors but also are likely to increase demand for primary product production as an input into processing. Reliance on low-productivity varieties and techniques for producing cocoa, oil palm, and cashew – as well as the advanced age of many of the trees – has resulted in extremely limited participation by Sierra Leone in export markets for these commodities. However, as demonstrated later in this report, opportunities exist for introducing new, high-yielding varieties and improved processing technology, both of which can contribute to a substantial expansion of exports. Other countries in West Africa, such as Ghana and Côte d'Ivoire, have replanted their cocoa farms with higher-yielding, hybrid varieties, and reaped huge benefits. Countries such as Guinea-Bissau have benefited from widespread planting of cashew as a new export crop.

There is also considerable scope for improved production and processing of annual food crops. Cassava is a major food crop, but its availability is limited less by production technology than by processing. In its raw form, cassava tubers have limited storability, so processing is key. Currently, Sierra Leone exports substantial quantities of *gari,* a storable and transportable processed food made from cassava, which is trucked to neighboring countries. Most of this processing is done by women using manual techniques, but simple equipment is available that could substantially increase processing productivity. Rice is another product which is already being exported on a small scale to neighboring countries and could enjoy expanded trade and/or substitute for imports if more processing were done with small rice mills. Improvements in technology will result in both higher incomes for processors, many of whom may be poor and in lower costs to poor consumers. This in turn will likely increase demand for food, that will expand farmers' incomes and employment.

4.0 METHODS

4.1 Research Design

The research design for the study is descriptive in nature. The procedure used in the investigation of the problems include, determination of the population and sample size, sampling procedure, preparation of instrument for data collection and analysis of data. The data described the full time farming operation of the target population. The educational attainment of farmers and constraints of rice production.

4.2 Description of the Study Area

The study was conducted in Bombali Shebora Chiefdom, Bombali District, Northern Province of Sierra Leone. It is an amalgamation of two chiefdoms- Bombali whose headquarter is Makeni town and Sharay a smaller adjoining chiefdom. Bombali Shebora Chiefdom is a transitional area between the north-eastern hills and central lowlands of Sierra Leone. The chiefdom is fairly rectangular in shape. Its stretches between latitude 8° 36' and 9° 56' north and extend from longitude 11° $56^{'}$ to 12° 13' west. The north central portion of the chiefdom is constricted to barely 25miles (40.2km) in breadth compared with some 55miles (88.5km) to the south.

The chiefdom is divided into 5 sections namely Matotoka, Kagbara, Kefala, Makump and Rogbaneh. It has a population of about 22,802 (population census 2004).About 70-75% 0f the people are Muslims whereas the remaining 25% practice Christianity and African traditional religion. However all religious groups take active part in religious ceremonies such as animal sacrifice, pouring libation, fasting in month of Ramadan and seasonality. The chiefdom has a small range of temperature within 78F (25.6°C) and 90F (32.2°C) throughout the year. Humidity is high all year round. The rainy season is between mid-May and mid-September when rainfall reliability is over 50% and the average rainfall is about 20mm per year. Vegetation is of secondary bush, grading to Savanna and Grass Land in most places with extensive cultivation, nomadic and uncontrolled bush fires. Much of the original forests have been reduced to grass land. Soils in this area are of loamy clay and river detritus, friable and easily worked by farmers, subsistence agriculture is the main economic activities of the people with rice maize and ground nut as the main crops being cultivated. Other crops include cassava, sweet potato, and pepper, although some engaged in permanent crop production like citrus, palm oil, mango etc. The area however offers more promise to the farmers concentrating on swamp cultivation than to the peasant cultivator who is interested in growing a host of other crops.

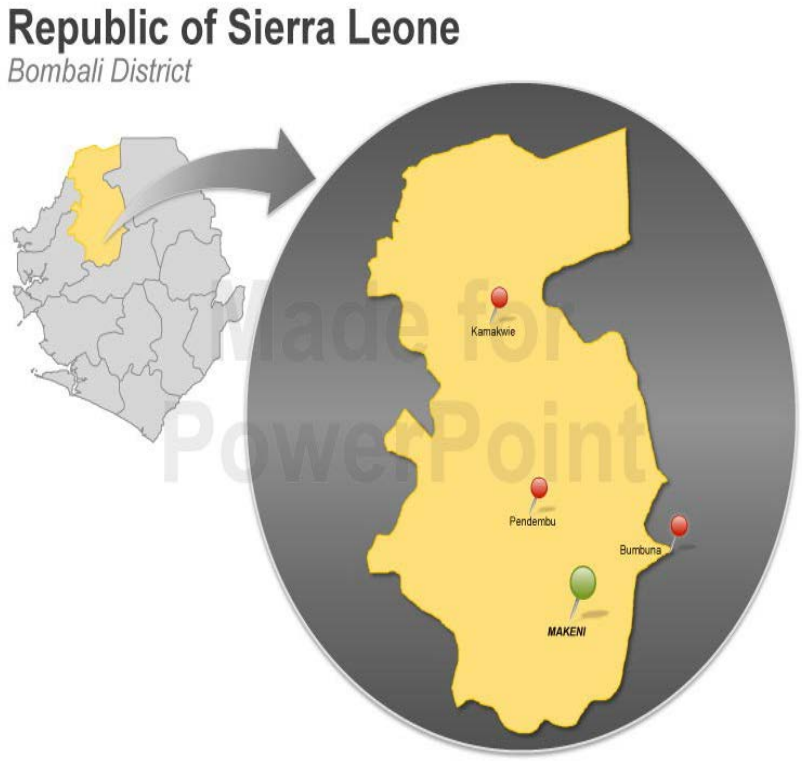

Figure 2: Location of the study area

4.3 Sampling Techniques

Sample size is determined based on research time and resource available and accordingly the total size of the respondents was 200 farmers. Female-headed HHs in the selected sections was included in the sample with proportion of 20% for their engagement in crop production processes.

There are 5(five) selections. Forty respondents were taken from each section which constituted the population for the study. Random sampling procedure was used to selects the respondents. The results revealed were satisfactory which implies that the questionnaires were reliable.

To develop sampling frame for the study, both probability and non-probability sampling methods were used. Multi-stage random sampling from probability sampling techniques and convenience sampling technique from non- probability sampling were used. Respondents were randomly selected using probability proportional to size (PPS) in terms of the population density of the selected sections.

Table 1: Distribution of sampled respondents by sections in the study area, (Bombali Shebora Chiefdom, 2021)

No	Name of section	Total number of HHS	Number of respondents in the sample		
			No. of male HHS	No. of female HHS	Total
1	Matotoka,	1285	52	9	61
2	Kefala,	1461	40	9	49
3	Kagbara	1352	30	7	37
4	Makump	150	20	10	30
5	Rogbaneh	2829	18	5	23
Total		7077	160	40	200

Field data, 2021

4.4 Research Instrument

The instrument used was well structured questionnaires seeking for specific information from full time rice producing farmers. The questionnaires were structured based on the objectives of the research which was divided into appendices.

The questionnaires were pretested further to improve their reliability and validity. Pre-testing of questionnaires was done to check for flaws for adjustment. This investigation was purposely carried out in other to eliminate any threat of the statistics to be collected and to make adjustments in the questionnaires where the need arises.

4.5 Data Collection, Analysis and Procedures.

The primary data necessary for the study were collected from sample respondents by using pre-tested and structured interview schedule.

For the purpose of data collection, 10 enumerators, who have acquaintance with socio economic concepts and knowledge of the culture of the society as well as local language proficiency were selected, orientated and employed.

The interview schedule was consisted different types of questions or items, related to the topic of the research and relevant variables to gather the needed information. Thus structured interview schedule was developed and used in order to allow the respondents to freely express their opinion

on issues related to the research topic. After formulating the interview schedules, necessary editing was done for its observed consistency and logical sequence with frame of reference of the respondents. Then it was subjected to a pilot study on non-sample respondents with a minimum and adequate sample size. Based on the nature and extent of responses obtained, necessary modifications and further editing was done in the interview schedules to ensure its clarity and completeness for generating the needed information from the respondents. As to input/service providers, data were collected through questionnaires distributed to relevant actors related to the research topic.

To supplement the quantitative data, qualitative data was collected through focused group discussions, informal interview with key informants, discussions with village level extension staff and related actors.

To collect data on information/knowledge flow, Rapid Appraisal of Agricultural knowledge systems (RAAKS); information source-use exercise (Text boxes) were used. These tools help to identify the important types of information and knowledge, the source and users of knowledge and information, the intermediaries that move knowledge and information and the status of linkage among actors (Salomon and Engle, 1997).

4.6 Method of Data Analysis

Different types of analytical methods can be used to evaluate different research results and make a sound conclusion for a given survey information. Literature reveals that each and every analytical method has their advantages and limitations; it is always advisable to select the one that can better suit to answer the specific purpose (Hopkins *et al*., 1996; Pallant, 2001).

The role of statistics in research is to function as a tool in analyzing its data and drawing conclusions there from. Only after this, we can adopt the process of generalization from small groups (i.e., sample) to population.

In this study, data was analyzed using quantitative and qualitative procedures and methods. Descriptive statistical tools were used to analyze the quantitative data. The important statistical measures that were used to summarize and categorize the research data were means, percentages

and frequencies. Qualitative assessment was carried out using key informants and focused group discussion; input suppliers' survey and government policy document content analysis.

5.0 RESULTS

5.1 Actors Mapping, Linkage and Knowledge Flow within the System

Actors mapping

To map the actors, discussions were made with SMS of MAF and farmers in the study area. According to the survey result, actors involved in the chiefdom are mainly concerned with technology generation, promotion, input supply and knowledge transfer to farmers. From the result of the discussion; ministry of agriculture and forestry(MAF), Sierra Leone Agricultural Research Institute (SLARI), cooperazione internazionale (COOPI), International Fund For Agricultural Development (IFAD), smallholder commercialization and agribuness development project (SCADEP), linking farmers to market (LFM), seed multiplication project sierra Leone, are identified as main actors currently involved in different intervention areas of the chiefdom in relation to agricultural input supply system . Actors who are assumed to have indirect involvement in the system are identified as missed actors viz. child fund, future in our hands (FIOH) and Action Aid. Identified actors and their role in the system are illustrated below.

5.2 Role of actors in the study area

5,2,1 Ministry of agriculture and forestry (MAF)

MAF is mainly concerned with provision of extension service to farmers through subject matter specialists (SMSs), and development associations (DAs) assigned in each farmers associations (FAs) who are responsible to transfer knowledge about plant production, animal production and natural resource conservation and development using individual and group contact. It is also engaged in facilitation and joint action of activities carried out by partners such as input suppliers, GO and NGOs for the successful accomplishment of their goals and objectives towards improving the livelihood status of farmers in the project area. Moreover, with regard to agricultural input provision, farmers demand would be finalized through DAs and line work process for the timely delivery of inputs.

5.3 Sierra Leone Agricultural Research Institute (SLARI)

As it is well known that agricultural inputs specially seed technologies are the result of research organizations', efforts have been made to maximize the production and productivity of seed technologies per unit area. In the context of this approach, **SLARI** played significant role in execution of enormous types of seed technologies which are best fitted to different agro-ecological zones.

In the study area, the research organization has provided different types of rice varieties to be selected by farmers. It also works with seed multiplication project to strengthen farmers to farmers seed exchange system. The organization started to strengthen the linkage with the chiefdom and farmers in transferring knowledge through Farmers Research and Extension Groups (FREG).

5.4 Cooperation Internazionale (COOPI)

In input demand-supply system, COOPI has played significant role in mobilizing farmers for rural development activities. It facilitates joint actions such as input supply, input credit provision and monitoring and evaluation of productive safety net activities.

5,5 International Fund for Agricultural Development (IFAD)

The International Fund for Agricultural Development (IFAD) is concerned with all agricultural activities undertaken in the study area. The organization play key role in facilitating input credit, input distribution, technical assistance, and monitoring and evaluation of the extension program. It is also involved on capacity building to SMSs and farmers through workshops and refreshment trainings.

5.6 Smallholder Commercialization and Agri Buness Development Project (SCADEP)

Smallholder commercialization and agribuness development project (SCADEP) seeks to promote agricultural productivity through improved accessto markets, improved access to finance as well as development of inclusive smallholder farmer agribusiness linkages in the study area.

5.7 linking farmers to market (LFM)

The main function of the union is supplying inputs to farmers through member cooperatives to farmers and facilitation of market link for grain produce to its primary member cooperatives. As to input supply, the union is mainly concerned with provision of commercial fertilizer from international organization at regional level to farmers grass root level on credit and cash bases.

According to a key informant of the organization, the input delivery system is not efficient as expected. This is because, the organization lacks warehouses, trucks and vehicles to damp inputs at farmers disposal, transport inputs for distant areas and to facilitate input delivery system with concerned parties respectively. However, to reverse the situation, the organization tried to deliver inputs through cooperation with public line sectors.

5.8 Seed Multiplication project Sierra Leone

The main occupation of the organization is seed multiplication, processing and distribution. Promotes food self-sufficiency (Food Security) as a result of presence of high seed quality,

Enlighten farmers to choose varieties of high yield like the NERICA series or ROK series.

Besides these, variety adaptation trial is carried out in conjunction with the ministry to provide inputs that best suited to the agro ecology of the chiefdom. However, the organization could not satisfy the need/ demand for improved hybrid seed varieties due to lack of irrigable seed multiplication farm and related constraints. The organization arranges quarter and yearly meetings, forums and workshops in collaboration with Rural Capacity Building Project (RCBP) to share knowledge among member partners. Seed multiplication being as improved seed supplier shares its experience and gets feedbacks from line sector representatives to improve the seed multiplication process.

5.9 Missed actors

In the process of actor identification, key informants and relevant staff (related to agriculture) of the chiefdom, some missed actors were identified. These actors have their own contribution for the system either by playing facilitation role or indirect involvement. The identified missed actors were Sierra Leone Network on the Right to Food (SiLNoRF) , furure in our hands sierra leone. The roles of these actors in the system are discussed below.

5.10 Sierra Leone Network on the Right to Food (SiLNoRF)

Advocate and lobby for a legal framework on the right to food in Sierra Leone;

Lobby the government to increase the budget for agriculture to at least to 11% of the total government budget as well as to strengthen Small Holder Commercialisation program;

Lobby the government to put in place guidelines which are in line with international guiding principles (such as the FAO Voluntary Guidelines on the Right to Food and on Land Tenure and Fisheries) for large scale land investment in Sierra Leone Create a platform that allows for

constructive dialogue by stakeholders, whereas the communities can actively participate in land lease negotiation processes built on the principles of transparency, accountability and justice.

5.11 Future In Our Hands Sierra Leone

co-ordinate and facilitate the efforts of village development groups by enabling them to access farming inputs, modern farming techniques, education and skills poverty alleviation programmes, sanitation and credit facilities for self-sustainability and self-reliance. Programme interventions – capacity building, food security, women and youth empowerment, environment, health and sanitation, advocacy.

5.12 Linkage

According to Hagmann et al., (2002), linkages between service providers in to service delivery system are critical to 'make the system work as a system'. The different roles and mandates of service providers need to be clarified and even more important; they need to 'learn to play the roles' and work together in synergistic way towards making a difference.

To bring sustainable agricultural development, partners within the sector must develop joint collaborative action to ensure efficient and effective input/service delivery system. To support actors in the sector, the ministry agriculture and forestry (MAF) started to strengthen the linkage among multiple actors. Potential actors like IFAD, SLARI and COOPI are participated in joint planning for action. The main aim is to promote farmers participatory research through strong collaborative action by potential actors and to develop area specific technologies through adaptation trials and farmers- to-farmers seed exchange specifically on cereal and pulse crops. The MAF is in charge of facilitating joint activities carried out by partners through budget and material support i.e. capacity building, workshops, joint monitoring and evaluations, for farmers.In the study area, linkage of actors is worked out on the basis of their proximity to the farmers and link for support among themselves.

5.13 Linkage of actors with farmers in the project area

Actor interaction is mapped using character based map. By using character based map; here we can look at individual actors and see that they link up with oneanother. Following Anandajayasekeram et al. (2008) the actor linkage maps were produced by placing farmers in the center and linking the other actors based on their contribution to the demand sector (farmers). A participatory actor's linkage map was produced by farmers and other key informants according to

the proximities to them and farmers and key informants were asked to identify key actors they have linkage and draw the map (Figure 4).

As indicated in the linkage map, farmers and key informants put the linkage between them and actors as strong with MAF, SCADEP and LFM. On the other hand, they put medium for the linkage with, COOPI, and IFAD. Lastly, they put weak linkage with SLARI and seed multiplication project. The probable reason for this is actors who are involved in input/ service provision prefer to communicate facilitators rather than farmers even if there is room to communicate.

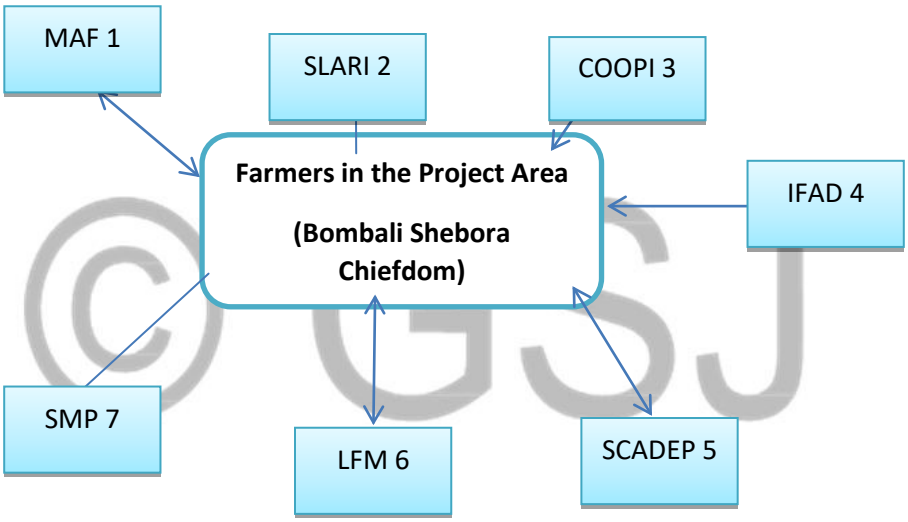

Figure 3: Actors' linkage map developed by MAF and key informants

Key: Linkage strength

Strong linkage

Medium linkage

Weak Linkage

Linkage description

1. Extension service, farmer's mobilization, input distribution
2. Adaptation trial, demonstration of improved technology
3. Provision of improved seed technology
4. Technical support and facilitation of input supply
5. Improved seedling/seed supply, technical support
6. Mobilization and administrative support, seed support, and market link

7. Technical support, seed and fertilizer supply

5.14 Knowledge Flow

Linkage between actors could be seen through how they frequently communicate and draw active knowledge/information flow mechanisms to end users. In the study area, frequency of knowledge flow among actors is also identified according to how frequent knowledge transferred to end users. Table-5 shows frequency of knowledge flow within the system.

Table 2: Frequency of knowledge flow within the system

Name Of Actors	Frequency Of Knowledge Flow		
	Frequently	**Sometimes**	**Rarely**
MAF	X		
SLARI			X
COOPI		X	
IFAD		X	
SCADEP		X	
LFM		X	
SMP		X	

Field data, 2021.

From the survey result, frequency of knowledge flow within the system is not as such satisfactory due to absence of strong linkage among all actors. The probable reason for this is actors who involved in the system are not transferring knowledge to farmers directly rather they transfer to MAF independently. Therefore, MAF might shoulder all responsibilities to transfer knowledge delivered by partners to farming community and feedbacks from the farmers to partners. The study revealed that knowledge flow between partners and MAF is relatively frequent.

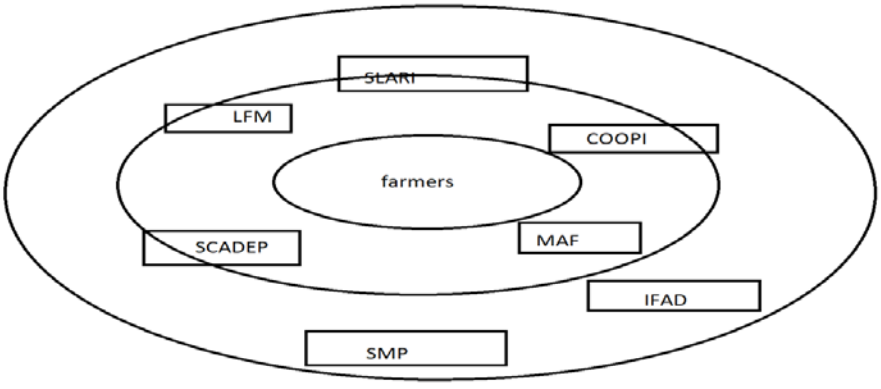

Figure 4: Position of actors drawn to show their closeness to farmers in knowledge flow

5.15 Constraints of input demand-supply system

Constraints of the system were identified from the perspective of input/service providers and users independently. Questionnaires and interview schedules were used to collect the data from input/service providers and users respectively. The results of the survey are discussed below.

5.16 Constraints of input/service providers

According to key informants and input/service suppliers survey result, the following are constraints of the supply sector.

• Unavailability of agricultural inputs at farmers disposal due to lack of transport and storage facilities.

• Lack of flexibility of policy, for example, three years' time for seed release and register impedes the efficiency of supply sector instead using many locations for test can minimize the time to a year.

• Organizing market follows a very complicated and tedious process that took time and energy of farmers and staff, cooperative law is not flexible to take other forms of organization (groups).

• Absence of strong quarantine for imported and shopped crop varieties' seeds.

• Low attention with regard to seed biodiversity; particularly for those of our endemic/indigenous crop varieties

5.17 Constraints of users (farmers)

From MAF and user survey conducted, farmers pointed out the constraints they had. The identified constraints by demand sector are discussed below.

Among three crops selected for the study (rice, maize and bean), prioritization of crops in terms of the level of constraints faced by farmers towards each commodity during the process of input delivery was identified by respondents. According to the survey result, the rank given by the farmers i.e. rice 109(54.5%), maize 30(15%) and bean 19(9.5%) was first, second and third respectively. Therefore, rice found to be a crop that is highly constrained in input supply system (see Appendix table 2).

The constraints of farmers in agricultural input/ service delivery were identified during the survey. From the result obtained, exorbitant input price, mismatch in kind, inability to deliver timely, insufficient delivery, source from far distance, poor quality of inputs and less extension support

were identified and ranked according to their importance. Table 6 illustrates respondents' perception in terms of frequencies, percentage and rank.

Table 3: Constraints of farmers in securing fertilizer input (N=200)

Types of Constraints	Frequency	Percentage (%)	Rank
Exorbitant input price	45	22.5	1
Mismatch in kind	29	14.5	2
Not timely	27	13.5	3
Insufficient delivery	23	11.5	4
Source from far distance	14	7	5
Poor quality	11	5.5	6
Less extension support	9	4.5	7
No response	42	21	

Field data, 2021.

From the result obtained, exorbitant input price was ranked as the first constraint of agricultural input demand by the farmers. The focus group discussion revealed that currently agricultural input price was escalated beyond the affordability of many farmers. The discussant mentioned that the price of fertilizer and seed increased by more than double fold comparing to past 2-3 years. This in return discouraged farmers to demand for production enhancing inputs. The second constraint described by the sample respondents was mismatch with demand in terms of kind of inputs. During the focus group and key informants discussion, participants pointed out that there was difference between the demands in kind and inputs delivered in the study area. For example, improved rice variety like ROK 10 has got high demand by the farmers for its high adaptability and yield potential. However, the delivered rice varieties were NERICA L19 and NERICA L 27, which were out of their demand.

The third constraint of farmers demand for agricultural input supply is timeliness of input delivery. As crop production is associated with planting time, inputs should be delivered ahead of time. According to focus group discussants, they suffered with problems regarding to the delay of inputs supply which in turn contributed pest attack and yield loss for lately planted crops.

The fourth constraint of input supply is insufficient delivery of inputs. The focus group discussion revealed that currently farmers suffered with shortage of agricultural inputs. According to discussants, the amount of input delivered is by far lesser than the required. The collected down

payment from farmers for input purchase is returned back to farmers due to shortage of inputs. This, in response, seriously exposed farmers to purchase unknown source of inputs from local markets in the name of improved technologies but weak in their yield potential and quality.

The fifth constraint of input supply was source from far distance. As the survey result showed, there are no input stores at farmers' disposal. Therefore, farmers tend to move long distance (about 1025kms) to bring agricultural inputs. This may discourage them to search for improved agricultural inputs. According to key informants and discussants, unavailability of inputs at their disposal forced them to remain on traditional practices. The analysis was also presented on the chart below:

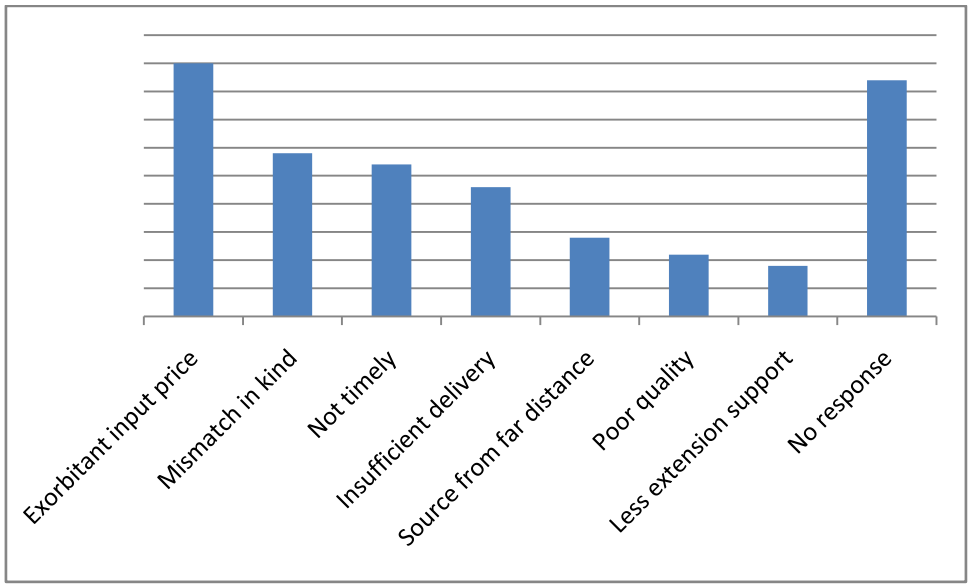

Figure 1: **Constraints of farmers in securing fertilizer input**

5.18 Major factors that influence the smooth functioning of the system

Factors that influence the smooth functioning of the system is seen using questionnaire for input/service providers and focus group discussions and interview schedule for users. Therefore, in this section, findings are discussed from input/service providers and users point of view independently.

5.19 Farm Input/ service providers' perspective

For the successful provision of agricultural inputs/services the input supply sector should work in harmony to satisfy the need of the clients. During the study, factors that influence the smooth

functioning of the supply sector were identified by each partner involved in the system in terms of input supply and knowledge provision. From the result obtained, the sector is positively/negatively influenced by the following major factors:

5.20 Input suppliers

• Sufficient and irrigable seed farm (-)
• Skilled man power (+)
• Delay of temporary loan settlement by users (-)
• Policy, in creating conducive environment (+/-)
• Storage facilities at grass root level (-)
• Efficient marketing system (-)
• Timely demand claims from users (-)
• Demand for improved crop varieties (+)

5.21 Knowledge providers

• Organizational mandatory clarity (+/-)
• Clearly defined role and responsibilities of each partner (-)
• Availability of improved seeds in terms of their germination, viability and adaptability (+)
• Research centers cooperation and willingness to share resources including knowledge (+)
• Farmers willingness to take risks (+)

4.3.4 Farmers/Users Point Of View

In this section, the result would be presented on the basis of methods used to collect data. In the first sub section, the result of FGD (focus group discussion) would be presented, and users' survey data results presented in the second sub section. To find out influential factors of the demand sector, focus group discussions were made in the selected four sample FAs. (farmers associations) From FGDs conducted, prioritization of influential factors is carried out by using pair wise ranking. Table-7 shows identified factors by the farmers in priority order.

Table 4: Influential factors of fertilizer demand- supply index from farmers perspectives

Influential Factors	Farmers Associations				Sum of scores	Rank
	Women of substance	Makump youth FA	Kefala women	Pate bana youth FA		

	FA		**youth FA**			
Credit	3	4	4	4	15	1
quantity	2	2	3	3	10	2
Price	1	3	3	2	9	3
Timeliness	1	1	4	1	7	4
Pest	0	0	2	0	2	5
Quality	0	0	1	0	1	6

Field data, 2021.

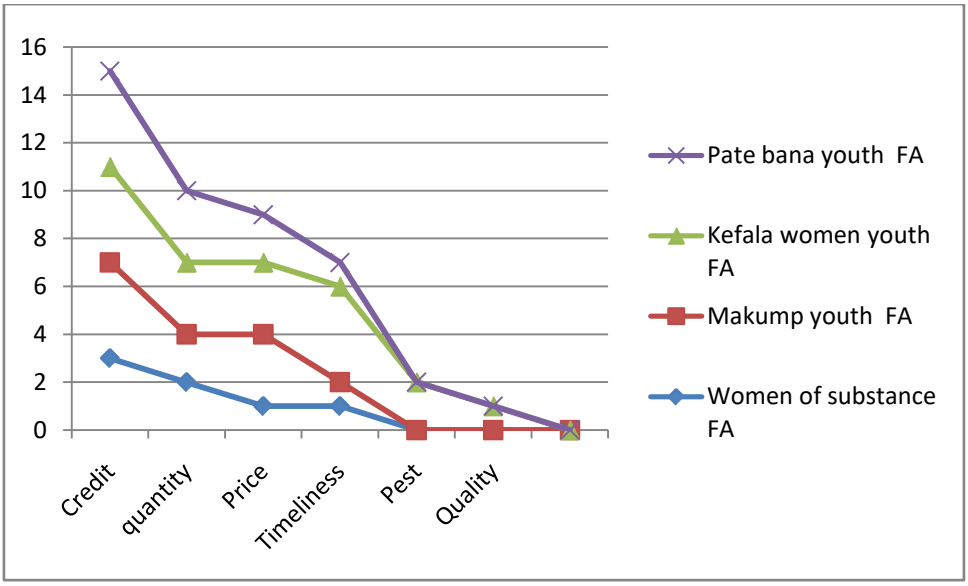

Figure 2. **Influential factors of fertilizer demand- supply index from farmers perspectives**

From the result obtained, lack of insufficient credit service, low quantity of input delivery, high cost of input price, timeliness, pest attack and quality are crucial factors that singled out by the farmers according to their priority order respectively. Based on FGD findings, some of the identified factors are discussed in this section.

Input credit The most important roles that credit is expected to play in agriculture may include- facilitating adoption of improved agricultural technologies, transformation of traditional agricultural practices, mitigating adverse conditions (drought, crop failure, disease and price

uncertainties), improving physical and human capital, increasing farm efficiency, increasing flexibility of farmers decisions, attaining economies of scale in production, consumption, smoothing, and so on (Edlengaw, 2006).

From the result obtained, insufficient credit service was the most serious problem remained unsolved in the study area. The probable reason for this is lack of commitment of facilitators at District level. MAF Department, the agricultural credit system is of two types (extension package and household package) - for extension package especially for inorganic fertilizer (NPK and UREA), the director of the region is responsible to finish loan agreement with the branches of Commercial Bank of Sierra Leone. They are also responsible to sign on the modalities and they have to confirm that their running cost budget accounted for collateral.

For house hold packages, Rural Finance Fund (RFF) is responsible to deliver loan to farmer cooperatives through their unions. In most cases improved seed would not be provided in credit basis, therefore farmers are forced to pay 100% of the price.

According to MAF, fertilizer credit is given to the farmers with 25-50% down payment using quota system. During focus group discussion, farmers seriously underlined that the input credit for each FA distributed was very limited which does not exceed from few farmers. Therefore, the majority of the farmers remained without getting fertilizer credit. However, fertilizer suppliers confirmed that there is no input shortage in their stock rather the problem emerged due to lack of using allocated loan fully by the chiefdom. From the survey result, the reason why they underuse yearly allocated loan for fertilizer is due to collateral in the loan agreement. Inability for timely settlement of the debt causes the transfer of the district running cost budget to commercial bank accounts. Therefore, to minimize the risk what they did is limiting the amount of loan to manageable size for recollection of the remaining debt.

Lack of input credit is not associated only with access and utilization it also associated with debt settlement. If a given FA did not settle previously utilized debt, it will not get input credit for coming crop seasons. This, in return, disfavored the majority of the farmers by exposing to three main problems;

- Farmers who settled their debt timely could not get input credits due to farmers who did not settle their debts in a given period of time.

- Farmers would be exposed to serious food shortage due to low productivity.
- Consequently most farmers are migrating to nearby towns and FAs to be hired as daily laborer to search alternative sources of income.

On the other hand, inputs delivered to the farmers are not in sufficient quantity, not timely and are costly. This also exposed farmers to four main problems;

- Inability to deliver inputs as per farmers demand (in type and quantity) made farmers unable to increase their productivity per unit area by influencing on the growth of the total production in the chiefdom.
- Even inputs which delivered in small quantity, does not reach at farmers' disposal timely. This has caused for low productivity due to incidence of crop pests and shortage of moisture due to late planting.
- The cost of inputs is increasing from time to time by causing smallholder farmers out of the game. This resulted the majority of poor farmers not to adopt production enhancing inputs and consequently the overall productivity of the chiefdom would be affected to meet the proposed goal.
- Insufficient delivery of inputs may force farmers to search alternative market source (local market) where the quality of inputs is in question. As it was clearly observed, the quality of seeds and fertilizer sold from local market was very poor for productivity and increasing soil fertility respectively.

The current seed and fertilizer supply channel in the chiefdom would take the following forms:

Fertilizer

Central government ⟶ Primary cooperatives ⟶ Farmers
(bombali shebora chiefdom)

Seed

Seed suppliers ⟶ Primary cooperatives ⟶ Farmers
(Bombali Shebora Chiefdom)

4.3.5 Socio-economic characteristics of the sample respondents

Personal Characteristics include the variables related to personal characteristics such as age and level of education. The distribution of sample respondents based on their personal characteristics is presented in Table 5.

Table 5: socio-economic characteristics of respondents(N=200)

Variables	Attributes	Frequency	Percentage (%)
Age of respondent	15-29 (younger)	26	13
	30-49(middle)	139	69.5
	50- 65 (older)	28	14
	>65 (oldest)	7	3.5
	Total	200	100
Education level	Illiterate	30	15
	Can read and write	43	21.5
	Primary school	92	46
	Secondary school	35	17.5
	Total	200	100

Field data, 2021.

4.3.6 Age of the respondents

Age of farmers was one of the demographic characteristics hypothesized to influence agricultural inputs demand negatively; towards this end data on the age of farmers with respect to input demand-supply index seems important.

The age of farmers who participated in the study ranged from 20 to 110. Farmers aged 30-49 were the majority (69.5%) followed by age group 50-65(14%), 15-29(13%) and age group >65(3.5%).

4.3. 7Level of education

Education is one of the important variables, which increases farmer's ability to use production enhancing agricultural inputs. Low level of education and high illiteracy rate is typical in developing countries like Sierra Leone. In fact, education level of farmers is assumed to increase the ability to use improved agricultural inputs in a better way. Therefore, in this study, education level is a variable helping to demand production enhancing inputs by the respondents.

As indicated in Table 7, 15% of the sample respondents were illiterates, 21.5% were able to read and write, 46% had elementary school education, and 17.5% had attended secondary school

education. From the data presented, number of educated farmers (> 63%) is by far greater than that of illiterates (21.5%).

4.3.8 Descriptions of socio-economic characteristics of the sample respondents

Socio-economic factors relate to the purchasing power of farmers to agricultural inputs, which is determined by various social and economic variables such as size of land holding, annual income, family labor and input price. The findings are presented in Table 9.

Table 6: Distribution of sample respondents based on their socio-economic characteristics (N=200)

Variables	Attributes	Frequency	Per cent
Land holding	0.125-0.5	85	42.5
	0.51-1	93	46.5
	1.01-2.5	22	11
	Total	200	100
Annual income	500-1500	33	16.5
	1501-2500	41	20.5
	2501-4000	57	28.5
	4001-5500	38	19
	5501-7000	18	9
	7001—8500	5	2.5
	8501-10000	3	1.5
	>10000	5	2.5
	Total	200	100
Family labor	0.5-3.9	160	80
	4-6	38	19
	6.1-9	2	1
	Total	200	100
Input price	Yes	1	0.5
	No	199	99.5
	Total	200	100

Field data, 2021.

Size of land holding Land is a primary source of livelihood for all rural households. It was assumed that the larger the farm size, the higher is the possibility to use a combination of improved agricultural inputs. In the study area, the size of the land owned differed from household to household. Of the total 200 respondents, 85 (42.5%) own between 0-0.5 hectare, 93 (46.5%) own between 0.51-1 hectare, while only 11 (1.3%) own 1.01-1.5 hectares of land. Average land holding of total respondents was about 0.723 hectare with maximum and minimum of 2.50 and 0.125 hectares respectively.

4.3. 9Annual income of the respondents

Total annual cash income is an important variable explaining the characteristics of households, in that those who have earning relatively high income could probably increase the purchasing power of agricultural inputs and this in return would expose them to demand inputs. Results of different empirical studies show the effect of annual income on house holds' decision in using and adopt improved agricultural technologies. For example Kidane(2001) , Dejene et al., (2001) and Getahun (2004) reported positive influence of households' farm income on adoption of improved agricultural inputs. As indicated in Table 9, the minimum and maximum annual income was 500,000 and 2,500,000 respectively.

4.3.10 Family labor

Higher number of family active labor force leads to decisions to take risk for participation in technology packages. Therefore, family labor force contributes to the variation in agricultural input demand. In this study, family labor force was assumed to have positive relation with the dependent variable. Family labor force in the study area ranges from one person to nine persons with an average of 2.82 adult equivalents per household. The respondents were placed under three family labor force categories. Based on this, 80%, 19% and 1% had in the range of (0.5 – 3.9, 4 – 6 and 6.1- 9) adult equivalents respectively.

4.3.11 Input price

The price of inputs may be seen in terms of affordability by small scale farmers. Affordable prices of inputs may enhance farmers' interest to purchase inputs from the distribution centers, whereas exorbitant input price lead poor farmers to not demand improved agricultural inputs. Therefore, the variable is expected to have negative effect on the demand of agricultural inputs. From the data, almost all 199 (99.5%) of the respondent noted that the price of input is not affordable. From the

result of qualitative analysis, though the price is unaffordable, farmers were subjected to use below recommended rate and partly use of package inputs due to lack of alternative input sources (see Appendix table 5). The variable was not computed for statistical analysis due to relatively very low variability among respondents.

4.3.12 Descriptions of situational characteristics of the sample respondents

Situational characteristics include the variables that might influence farmers demand for improved agricultural inputs such as type of road used, access to market and distance from nearest input market. The findings are presented in Table 10.

Table 7: Distribution of sample respondents based on their situational characteristics (N=200)

Variables	**Attributes**	**Frequency**	**Percentage (%)**
Type of road used	No access	24	12
	Winter season	35	17.5
	All weathered	141	70.5
	Total	200	100
Access to market	Yes	73	36.5
	No	123	63.5
	Total	200	100
Distance from nearest input market	3-5	13	6.5
	6-10	52	26
	>10	135	67.5
	Total	200	100

Field data, 2021.

4.3 13 Type of the road

Type of the road may have an influence on input demand- supply index. All weathered roads would fever the inlet/outlet of farm inputs and produce at/from farmers' disposal. From the data obtained, 24(12%), 35(17.5%) and 141(70.5%) of the respondents have no access, winter season road and all weathered road respectively. According to respondent farmers, even if they have roads meant for transportation, due to lack of allocation of transport vehicles by responsible bodies still the problem remain unsolved.

4.3. 13 Access to market

Access to input /output marketing may have positive association with farmers' demand for agricultural inputs and to sell their produce with reasonable price. From the data obtained, 73 (36%) of the respondents have no access to market and 127 (63%) have access to market.

4.3 14 Distance from nearest input market

The availability of inputs on nearby markets would have positive influence for farmers to demand inputs. Whereas for farmers who located far from input markets may have relatively negative influence to demand agricultural inputs. From the finding, farmers who live in different range of distance (0.3-5, 6-10 and >10) are 13(6.5%), 52(26%) and 135(67.5%) respectively from nearest input market. Though for the purpose of the survey, 2 FAs are selected from nearby FAs and 2 are from a far, their settlement within the FA varies even in the nearby FAs from the center.

4.3.15 Distribution of sample respondents based on organizational and institutional factors

Organizational and institutional factors include the variables that might influence farmers demand for improved agricultural inputs such as access to credit institutions, storage facilities, existence of service cooperatives and extension service. The finding is presented in Table 11.

Table 8: Distribution of sample respondents based on their organizational and institutional factors (N=200)

Variables	Attributes	Frequency	Percentage (%)
Access to credit	Yes	117	58.5
	No	83	41.5
	Total	200	100
Storage facility	Yes	0	-
	No	200	100
	Total	200	100
Extension contact	0	22	11

	Rarely	39	19.5
	Once in a month	33	16.5
	Once in 3 weeks	41	20.5
	Once in 2 weeks	40	20
	Once in a week	25	12.5
	Total	200	20

Field data, 2021.

4.3.16 Access to credit

Access to credit can address the financial constraints of farmers. The finding shows that, 58.5% of the respondents had no access to credit institutions, whereas, 41.5% had access to and utilization of credit from institutions. Among those who have access to credit institutions, only 21.5% of them have got credit in 2018 production year in the study area. The constraints for access to credit in the study area might be lack of efficient credit system at farmers' disposal.

4.3.17 Storage facility

Existence of storage facilities at farmers' disposal would have an advantage for input suppliers to damp and timely deliver agricultural inputs. As a matter of chance no warehouses were seen that meant for input storage in the study area. From the data collected, the response of all respondents was the same (200%) and showing the absence of storages. This entails farmers are subjected to high transport cost and lack of timely delivery of inputs. Therefore, this variable could not show variation among respondents in relation to their input demand, and not included in statistical analysis.

4.3.18 Extension contact

Farmers' proximity to agricultural extension services would have positive influence on demand for agricultural inputs due to increased adoption rate of farmers on improved agricultural inputs. The variable is computed in terms of farmers' proximity/contact with DAs. From the survey, 178 (89%) of the respondents have contact with DAs at different level of frequency (rarely 39, once in a month 33, once in three weeks 41, once in two weeks 40 and once in a week 25) and the rest 22(11%) had no contact.

5.0 Conclusion

To bring sustainable agricultural development and ensure food self sufficiency of the nation, actors involved in the sector should act synergistically. Services like extension, input supply, credit provision, research and development were amongst all delivered in the project area for the realization of bringing about change at the farmers' sector.

The Findings from the study revealed that Agricultural inputs like seed, fertilizer, pesticides, improved farm tools, etc supply in line with efficient extension service would lead to increase productivity in the study area. However, the supply of these production enhancing inputs/services were constrained with various factors. These factors together with several personal, situational, socioeconomic, and institutional and organizational factors greatly affected the input demand supply index of the sector in the study area.

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