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Strengthening the Role of Research in Agricultural Development Programmes in Sierra Leone

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Abstract
Sierra Leone Agricultural Research Institute (SLARI) has a key role to play in Sierra Leone's agricultural development. Despite the availability of highly productive and remunerative technology, a wide gap still exists between what scientists have achieved on their research stations and the average yield obtained on farmers' fields. For the contribution of agricultural research to be successful in Sierra Leone, effective agricultural research has to be pursued. A well-planned staff development and succession plan is essential to strengthen SLARI's research work force.
SLARI needs to be reinforced to help in sustaining productivity, food security, competitiveness and profitability of the agricultural sector in Sierra Leone. The Extension Division of the Ministry of Agriculture and Forestry (MAF) needs to work more closely with SLARI to draw on agricultural research results when preparing district plans, recognizing that good extension needs constant updating in the light of new research results.
SLARI should be empowered to be able to re-orient and align its objectives with the transformative development agenda and develop the capacity to better respond to development challenges and be more sensitive to the order of the day and beyond. SLARI should be able to properly position itself for effective research leadership and develop an appropriate research roadmap. By doing so, SLARI will be able to contribute in transforming Sierra Leonean's agriculture into a vibrant and competitive sector.
Key words:*Sierra Leone, Agricultural Research, SLARI, CORAF/WECARD*

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I. INTRODUCTION

Sierra Leone is in the lowland humid tropics on the west coast of Africa, between latitude 6° 55'N and 10° 00'N and longitude 10° 16'W and 13° 18'W (Figure 1). The country covers a total area of 7.2 million hectares, of which 5.4 million hectares are arable (WFP, 2015).Over 80 % of the total land area is upland and the rest is lowland with potential for high rice yields. The potentially cultivable lowland area comprises 630,000 ha of inland valley swamps; 120,000 ha of bolilands; 110,000 ha of riverine grasslands; and 200,000 ha of mangrove swamps. Approximately 56.0 percent of the land is less than 150 meters above sea level (SLARI, 2011).

The climate in Sierra Leone is the monsoon-type humid tropic with two distinct seasons; the rainy season which runs from May to October, and the dry season lasting from November to April (Frausin*et al*., 2014;). The rainy season brings 3,000-5,000 mm rain per year to the coastal areas, and 2,000-2,500 mm of rain per year to the inland areas (Frausin*et al*., 2014;). Average monthly temperatures range between 23 to 29°C, with a maximum of 36°C in the lowlands towards the end of the dry season to a minimum of 15°C in the highlands at the beginning of the dry season. The soils are generally highly weathered, leached, and acidic.

Figure 1: Map of West Africa showing the location of Sierra Leone.
Source: https://commons.wikimedia.org/wiki/File:West_Africa_regions_map.png

Agriculture is the mainstay of Sierra Leone's economy, and many systemic and deeply rooted challenges exist within the sector. Farming is still largely subsistent, characterized by low external input, low yields, and the use of backward production and processing technologies. Crop yields are often low due to poor soils with low fertility (Rhodes, 1988; Conteh *et al.,* 2017), limited access to agricultural inputs, and problems with pests and diseases. Lack of market information and inaccessibility of markets, low levels of mechanization, and labor shortages are among other factors negatively affecting production (Frausin*et al*., 2014;). Pre- and post-harvest losses are also substantial, reaching up to 30 % of total output in many rural areas (Amadu*et al*., 2017). Agricultural development is a critical priority for the Government of Sierra Leone, and. Government is keenly aware that sustainable livelihoods, food security and mass employment will be possible only through successful development of the agricultural sector (MAF, 2019).

Agricultural research has an important role to play in addressing these challenges (Perez and Rosegrant, 2015; Phillip and Ahmed 2009; Pray *et al*., 2017), since many of the new technologies, inputs, and techniques of production that increase agricultural productivity are developed through agricultural research. However, despite the availability of highly productive and remunerative technology, a wide gap still exists between what scientists have achieved on their experimental farms and research stations and the average yield obtained on farmers' fields. For the contribution of agricultural research to be successful in Sierra Leone, effective agricultural research has to be pursued (Coulson and Diyamett, 2012). An effective agricultural research will make it possible to improve productivity with better methods and farming practices, care of livestock, evolution of high yielding varieties and application of fertilizers. It will also help to conserve land and soil fertility as a permanent asset for the nation, improve the storage and preservation of farm products, diversify the enterprise patterns with the evaluation of suitable varieties of crops and breeds of animals, and eventually help the country's citizens to achieve better lives.

In Sierra Leone, direct institutional funding from the central government budget remains the most important source of funding for agricultural research (Momoh, 2014). However, the large discrepancies that exist between approved government budgets and actual disbursements of government funding have remained a major problem that has hindered the performance of agricultural research in Sierra Leone. These discrepancies, including delayed disbursements, have had severely negative consequences for long-term research planning and outputs. The role of privately funded agricultural research is very limited. Complicating this situation is that private companies tend to keep information about their research efforts confidential and often have no legal obligation to report on them. Research-extension-farmer linkages are weak, thus research results are not well disseminated (Gboku and Bebeley, 2016).

In his address at the State Opening of Parliament in May 2018, the President of the Republic of Sierra Leone, His Excellency, Brigadier (Retired) Julius Maada Bio stated:

"In the New Direction, the overall goal of our agricultural policy is sustainable and diversified production of food on a scale enough to feed the growing population as well as providing gainful employment. Our immediate priority actions will focus on (i) attracting and increasing investment in agriculture (ii) sustainable investment in mechanized commercial agriculture (iii) increasing food crop production (iv)

increasing and diversifying cash crop production (v) increasing livestock production (vi) improving irrigation water management (vii) improving land management and (viii) improving governance and research."

This choice of immediate priorities for Sierra Leone's agricultural development is clearly laudable, especially with the inclusion and recognition of the role of research in the nation's immediate agricultural development priorities. In this article, the evolution of agricultural research in Sierra Leone, together with its linkages with other regional agricultural research institutions, is examined as a prelude to providing a strong case for more support from major stakeholders to improve the role that agricultural research can play in the nation's agricultural development efforts.

II. IMPORTANCE OF AGRICULTURAL RESEARCH

Agricultural research is among the most important public goods in most developing countries, and thus is expected to form a critical component of public agricultural expenditures.The literature on agricultural development reveals clearly how past research investments have made large contributions to poverty reduction, nutrition improvement and resilience, through systemic transformation of local agriculture and food systems (Dick *et al*., 2003**;**Mengistu, 2015**;**Campus, 2017; Pray *et al*., 2017). The causal pathway for these impacts is that a flow of locally-adapted innovations gets adopted by farmers and agribusinesses, raising real incomes for those at risk of poverty and offering more stable, lower-cost access to healthy diets and living conditions around the year to those at risk of malnutrition (Figure 2).

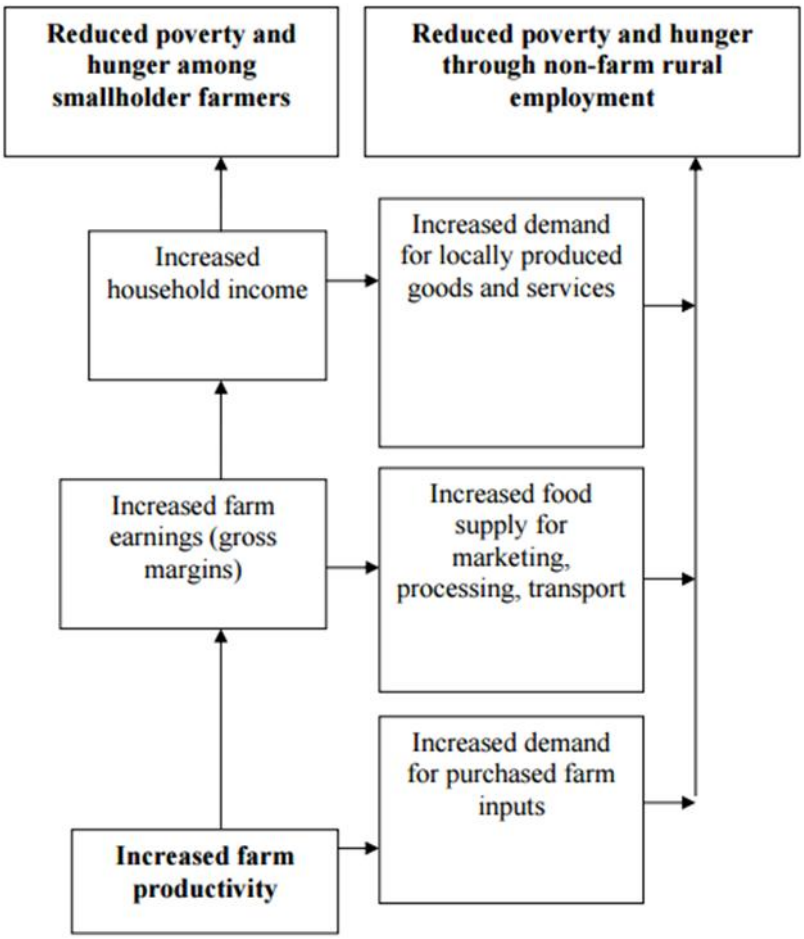

Figure 2: Impacts of farm productivity on poverty and hunger. Source: Pray *et al*., (2017).

Studies reviewed by Pray *et al*. (2017) have shown that increases in the productivity of farming improve living standards for farmers and other rural households, expand agribusinesses and drive economic development, by raising the returns to farmers' land and labor, increasing demand for agribusiness services, and lowering the price of food. Increases in agricultural productivity achieved in recent years have also improved the quality and safety of the food supply, leading to improved nutrition outcomes. In so doing, agricultural research has spurred sustainable transformation of rural and urban environments in ways that confer resilience and limit vulnerability to climate and other shocks.

The returns to agricultural Research investments have been shown to be high (Alston *et al*. 2014; Hurley *et al.*, 2014). Thus, it is not surprising that in the launching of the Comprehensive African Agricultural Development Programme (CAADP), the African Union's (AU's) New Partnership for Africa's Development (NEPAD), made a commitment to implementing an agriculture-led development agenda and set a target for government spending on agricultural Research of at least 1 percent of agricultural gross domestic product (GDP.) All 15 countries in the West African sub-region have signed a CAADP Compact and have a national agricultural investment plan (NAIP) in place.

Alene and Coulibaly (2009) showed that research and development expenditures by the CGIAR (Consultative Group on International Agricultural Research) centers in Africa and by African governments on their research systems increased agricultural value added per hectare, that value added per hectare increases GDP (Gross Domestic Product) per capita and finally that increases in GDP per capita reduces the percentage of people living on less than $1 per day.Overall, AleneandCoulibaly (2009) showed that agricultural research reduced the poverty rate by 0.8 % annually. By doubling research investments in Sub Sahara African (SSA), poverty would be reduced by 9 % annually, which would involve better input supply systems, infrastructure, efficient extension programs, and credit (Alene andCoulibaly, 2009).

Abass*et al* (2016) report in an econometric study of a survey of rural households in northeast Zambian that small scale cassava processing machinery developed and spread by the International Institute of Tropical Agriculture (IITA) and the Zambian National Agricultural Research Organization (NARO) reduced the number of rural people in poverty. Kaitibie*et al* (2010) assessed the impact of changes in Kenyan milk regulation which made it legal for small farmers, small processors, and small merchants to operate. These changes were promoted by Kenyan and International Livestock Research Institute (ILRI) social scientists with support of a dairy development project funded by the United Kingdom's Department of Foreign and International Development (DFID). This change in Kenyan government's policy allowed more people to enter the market and pushed down marketing margins which benefitted small farmers and consumers.

Most of these gains are from crop research. For livestock research by CGIAR centers,Jutzi and Rich (2016) have provided a very useful summary of impact studies. They look at the impact of CGIAR work on avian influenza, rinderpest eradication, goat parasites, dairy policy change, new forages, and natural resource management techniques. They find positive benefit-cost ratios and/or high rates of return for most projects but some like the projects on control of avian influenza had benefit-cost ratios of less than one (Jutzi and Rich 2016).

The dramatic impact of agricultural research and modern technology in Asia and Latin America is well known. Questions related to depth and kind of tillage, varieties of crops to be planted in different localities, kinds of animals to use for certain purposes, depth and distance and time of seeding and planting, varieties suited for different sections and different purposes, rotation of crops, kinds and amounts of fertilizers to use, time and amount of water, and, in fact, the development of all the various routine practices of actual farming come within the scope of agricultural research.

III. REGIONAL RESEARCH ORGANIZATIONS

Sierra Leone's agricultural research cannot be divorced from efforts of the sub regional research coordination body, the West and Central African Council for Agricultural Research and Development (CORAF/WECARD). Other sub regional research coordinating bodies (SROs) exist for eastern and southern Africa, but this article will only focus on CORAF/WECARD. Established in 1987, CORAF/WECARD initially only covered French-speaking African countries and was dominated by French advisors. For the first few years the secretariat was based in Paris; it was only transferred to Dakar, Senegal, in 1990. That year it was also decided to include the sub region's English- and Portuguese-speaking countries, which eventually occurred in 1995 (Roseboom and Flaherty, 2016).Currently, there are 22 member countries in CORAF/WECARD: Benin, Burkina Faso, Cameroon, Cape Verde, Central African Republic, Chad, Republic of the Congo, Côte d'Ivoire, Democratic Republic of the Congo, Gabon, The Gambia, Ghana, Guinea-Bissau, Guinea-Conakry, Liberia Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, and Togo.

Initially, the SROs only aimed to coordinate the work of the different regional agricultural research networks and programs within their mandated areas. By the late 1990s, however, they started to develop their own sub regional agricultural research strategies. This was a first clear sign that the SROs and their members were starting to take charge of the supranational agricultural research agenda in their sub regions (Roseboom and Flaherty, 2016). However, the SROs have no research capacity of their own; they focus on mobilizing their members' national agricultural research centres to conduct agricultural research that is of regional interest through commissioned or competitive agricultural research grant schemes (CARGs). Sierra Leone has been working closely with CORAF/WECARD on implementing agricultural research projects.

In addition to the SROs, the Forum for Agricultural Research in Africa (FARA) was established in 2001 as a continental agricultural research coordinating body to promote and coordinate collaboration in agricultural

research across Africa (including North Africa).To this end,FARA developed a Framework for African Agricultural Productivity (FAAP) in 2004. This framework argued for a substantial increase in investment in agricultural research, extension, and education, and an institutional reform agenda putting farmers at the center of agricultural innovation

Sierra Leone agricultural research centres have also benefitted considerably from collaboration with the regional CGIAR centres, notably Africa Rice and the International Institute of Tropical Agriculture (IITA).

IV. SIERRA LEONE AGRICULTURAL RESEARCH INSTITUTE (SLARI)

Sierra Leone has had a long history of agricultural research, spanning almost 100 years (SLARI, 2011). Agronomic research was done at the Njala Experiment Station (see Figure 3), Southern Province, which was opened in 1910. The Rice Research Station which was established at Rokupr, Northern Province in 1934 was devoted to research on mangrove and swamp rice and in 1953 was transformed into the West African Rice Research Institute. A veterinary station was set up at Makeni in 1942, and a livestock station at Kabala in 1943, both in Northern Province. In 1953, the oil palm research programme at Njala became the West African Institute for Oil Palm Research. From 1953, forestry research was carried out at the Forestry Research Station at Bambawo in Eastern Province, and high yielding Amazonian cocoa planting materials were propagated and distributed from Kpuwabu. From 1953, fisheries research was conducted at the West African Fisheries Research Institute at Kissy near Freetown (SLARI, 2011).

In 1985, the National Agricultural Research Coordinating Council (NARCC) was established to coordinate research and harmonize research activities. The mission of NARCC was to support the promotion of pro-poor sustainable growth for food security and job creation as part of Sierra Leone's Poverty Reduction Strategy Paper. Its mandate was confined to annual crops. The two constituent institutes of NARCC were the Rice Research Station dealing with rice, millet, sorghum, banana, plantain and vegetables, and the Institute of Agricultural Research dealing with cassava, sweet potato, yam, maize, cowpea, groundnut, soybean and sesame. The earlier research institutes became defunct (SLARI, 2011). In addition to the research institutes, Njala University and the University of Sierra Leone also carry out agricultural research.

After a period of coordination of agricultural research under NARCC, the Government of Sierra Leone (GoSL) established the Sierra Leone Agricultural Research Institute (SLARI) through the SLARI Act of Parliament of 2007. The SLARI Act of 2007 states: "Being an Act to establish the Sierra Leone Agricultural Research Institute as the sole government agricultural research and technology generating body for the benefit of the farming, fishing and forestry sectors in Sierra Leone and to provide for other matters".

SLARI is now the agricultural research and agricultural technology generating body for the benefit of the farming, fishing and forestry sectors, and therefore the use of SLARI will represent agricultural research organizations in Sierra Leone, noting that agricultural research is also carried out by Njala Universiy, University of Sierra Leone and other Non-Governmental Organizations (NGOs). At present, SLARI has seven operational centres (Figure 3) spread all around the country: (i) Njala Agricultural Research Centre (NARC); (ii) Rokupr Agricultural Research Centre (RARC); (iii) Kabala Horticultural Crops Research Centre (KHCRC); (iv) Teko Livestock Research Centre (TLRC); (v) Kenema Forestry and Tree Crops Research Centre (KFTCRC); Freetown Fishery Research Centre (FFRC), and (vi) Magbosi Land, Water and Environment Research Centre (MLWERC).

The functions of SLARI, outlined in the SLARI Act of 2007, clearly show that SLARI will be a key player in the nation's drive towards food security, wealth creation and economic growth. Among the key functions of SLARI prescribed in the SLARI Act of 2007 include the following:

1. Provide information that will assist government and other stockholders in the development of agricultural policies.
2. Conduct research on food and cash crop productivity, livestock production and health, fish production, land and water management, forestry production and conservation, foods and nutrition, technology and socio-economics of post-harvest activities; emerging technologies in agricultural science, bio-safety and environmental conservation.
3. Enhance public awareness on importance of scientific research to agricultural and economic development.
4. Disseminate knowledge on improved technologies to stakeholders.
5. Facilitate and provide the relevant training and manpower development to serve the agricultural needs of the country.

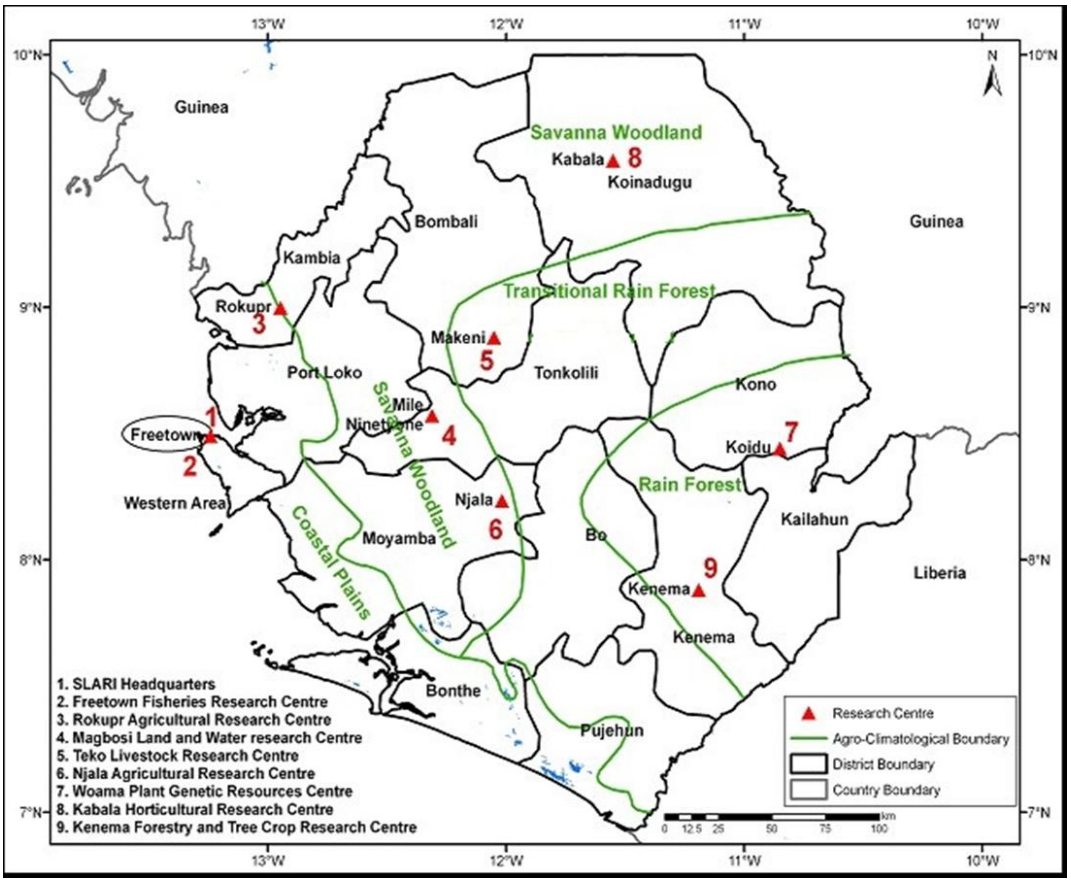

Figure 3: Map of Sierra Leone showing the location of the Research Centres. Source: SLARI, 2011.

V. SELECTED ACHIEVEMENTS OF SLARI

SLARI scientists have made very important contributions to Sierra Leone agriculture. They develop seed varieties and other management technologies, test them and continue to test them. It takes time for these varieties and management technologies to see the light of the day.

SLARI made important progress in developing the agricultural research capacity during the last decade. A considerable number of scientists have been trained at the masters and doctoral levels within the last five years. However, this rapid buildup of research staff is not paralleled by an equal growth in operational and financial resources.

While the major focus of the first phase of SLARI's Strategic Plan was on capacity and infrastructural development, much was achieved in the area of technology generation and promotion.

To backstop its adaptive research, SLARI has developed extensive formal linkages with regional and international research organizations. RARC has collaborative programmes with several International Agricultural Research Centres (IARCs) such as the Africa Rice Centre, International Institute of Tropical Agricultural (IITA), International Centre for Research in Semi-Arid Tropics (ICRISAT), International Plant Genetic Research Institute (IPGRI) and World Agroforestry Centre, and the International Food Policy Research Institute (IFPRI). There is also collaboration with the Food and Agriculture Organization (FAO)and the European Union (EU). The Institute also maintains strong links with universities and research organizations overseas.

Through the Forum for Agricultural Research in Africa (FARA) and the West and Central Africa Council for Agricultural Research Development CORAF/WECARD, SLARI has participated in the Dissemination of Improved Technology Project (DONATA) and the Regional Information and Learning Systems Project (RAILS).Both projects, jointly implemented with extension staff, aim to fast track the level of adoption of proven improved technologies along the value chain.

VI. CHALLENGES FACING SLARI

When SLARI was established, the dream was clear, the vision untainted and the mission clearly spelled out. The idea was to make SLARI a research hub for all available agricultural produce in the country, both food and cash crops and livestock, and make it available to farmers and investors which will eventually translate to food surpluses in the country. Currently, however, the vision is getting blurred and the mission becoming a

mere statement due to limited funding, deficiencies in facilities, equipment, and low agricultural research investment, among other factors. As in many other developing countries, a large proportion of the SLARI budget goes into staff salaries, and very limited funds are available for operating costs, with the result that the field and laboratory work suffers. The laboratories in most of the research centres are empty and the few equipment available in some of the centres are obsolete. In recent times, SLARI is observing a mass exodus of highly qualified and experienced staff to other organizations with better conditions. This has limited SLARI's contribution to agricultural development in Sierra Leone.

The Comprehensive African Agricultural Development Programme (CAADP) estimated that 10 percent of the national budget should go to the agricultural sector and at least 2 percent of the agricultural GDP should go to national agricultural research by 2010. Sierra Leone's contribution to agricultural research is still at about 0.3 % (GoSL, 2017). In the CAADP ratings of 2017(https://www.nepad.org/caadp/countries/sierra-leone), Sierra Leone scored 1.5/10 and is rated as not on track in implementing the Malabo Declaration (CAADP) on Agriculture transformation in Africa. Recommendations were that:

•Sierra Leone needs to build on its efforts on irrigation by increasing the use of fertilizer and the share of agriculture land under sustainable land management practices.

•The country should increase public expenditure in agriculture to meet the CAADP Malabo target of 10%, enhance access to agricultural financial services by men and women, and invest in nutrition interventions to reduce stunting among children under 5 years old.

•The country should ensure efficient data collection and reporting on the Malabo indicators for the next round of the Biennial Review reporting(https://www.nepad.org/caadp/countries/sierra-leone).

Agricultural research is always long term. It takes time to generate new technologies, and considerably more time will elapse before the productivity consequences of new technologies are fully realized. Thus, investments in agricultural research are best seen as sources of long-term growth and, perhaps, as a means for tackling the natural resource degradation caused by agricultural production.

Estimating the effect of agricultural research and development is difficult. Growth in productivity can be observed in the same manner as spending on research and development, but it is much more difficult to observe which spending on research leads to which increase in productivity. Also, for new technologies to have an impact on the poor, they need to be widely adopted. Adoption rates for improved varieties of crops remain low throughout Africa; farmer-saved seeds, which are unlikely to be improved, account for around 80 % of planted seeds in Africa compared to a global average of 35 % (AGRA, 2013).

VII.DEVELOPMENT NEEDS WHERE SLARI CAN PLAY ITS BEST ROLE

SLARI now and in the future will need to contribute to reaching and surpassing Sierra Leone's move towards the Sustainable Development Goals, especially those related to hunger, poverty and environment.
Future directions in which the linkage between SLARI and the Ministry of Agriculture and Forestry (MAF) can be strengthened include:

- Technologies for increasing agricultural production and productivity to ensure food security.
- Addressing challenges of degradation of land and water resources, and emerging ecological imbalances, due to increased biotic pressure on land.
- Addressing problems of malnutrition through diversification of agriculture and promotion of root and tuber crops, grain legumes, horticulture, livestock, etc.
- Increasing value addition in agriculture through processing, marketing and storage facilities. These are imperative for the development of agro-processing industries, which are the key areas for development in agriculture.
- Developing economically viable and location-specific technologies in rain-fed and irrigated areas, and strengthening institutional frameworks for farmers' education and training in improved farm techniques.
- Accelerating the development of rain-fed and irrigated horticultural and plantation crops, with full back-up support for processing and marketing, both for the domestic market and for exports.
- Increasing the utilization of irrigation potential and promoting water conservation and its efficient management.
- Providing improved variety of seeds, and identifying agricultural implements and machinery and other critical inputs to farmers in or near their village.

VIII POSSIBLE AREAS FOR INTERVENTION BY THE GOVERNMENT OF SIERRA LEONE

For Sierra Leone's agriculture to be more efficient and productive in providing more food and feed with less environmental damage, SLARI has a lot to offer by designing a broader research agenda. This may call for a possible overhauling of the research system towards strengthening of human resources, and improving physical and financial capacities.

A well-planned staff development and succession plan is essential to strengthen SLARI's research work force. SLARI does not currently have an effective and functional staff development plan. Staff motivation and commitment are at an all-time low, and strengthening of these areas is critical for SLARI's attainment of its mission. No matter how SLARI is staffed with well-skilled and high caliber scientists, we cannot achieve the desired outcome unless the staff is well motivated and develop the right attitudinal settings. In this respect, SLARI must be empowered to have a competitive incentive and remuneration mechanism put in place to lure and retain competent talent and bring a revival of the human capital. Furthermore, performance-based output and rewarding systems can also do much in this regard.

To provide flexibility of work force recruitment and management process, SLARI needs to be granted a reasonable degree of administrative autonomy by freeing it from civil service regulations. Scientific institutions are not expected to have too much of administration (Menjistu, 2015). The basic idea is that scientists should be able to feel free to pursue their creative work without too many distractions from the management. This would ideally be realized through direct empowerment of SLARI. Under such a management setting, however, to bring the required commitment and accountability and build competent quality futuristic work force in the research system, the recruitment modality needs to change to a contractual basis and renewed periodically based upon performance.

Section 2(2) of the SLARI Act (2007) states that *"The Institute shall be a body corporate with perpetual succession and powers to acquire, hold and dispose of property, whether movable or immovable, to enter into 'contracts, to sue and be sued in its corporate name and, subject to this Act, to do all things which a body corporate may lawfully do".*

Section 5(1) also states "*The Institute shall have a Council which shall be the highest administrative and policy making authority and shall have control and supervision of the Institut*e, *and subject to this Act, the power to exercise all the powers and authority of the Institute".*

Section 5(2)(d) further states: *"It shall be the function of the SLARI Council to determine conditions of service of staff of the Institute".*

The research direction and focus of Sierra Leone is clearly indicated both in the National Sustainable Agricultural Development Plan (NSADP) and the SLARI Strategic Plan (SLARI, 2011). Both policy documents clearly indicate that in the short term, while strengthening the research capabilities, the country's major research direction will be adaptation of improved technologies, to be accompanied by domestic research and technology development (MAFFS. 2014). Therefore, the country's short-term research agenda is to find suitable technologies from elsewhere in the globe, and adapt them for immediate use.

Beyond technologies for food and feed, agricultural research in Sierra Leone should now be seen to be moving towards technologies for addressing agro-industrial needs and agri-business development with the view of contributing towards import substitution. Processing, product development and value addition research are now receiving greater attention along this goal. This is expected to raise the productivity and quality of commodities of domestic and export market. A move along this direction is currently underway with the development and promotion of cassava flour, for example, to substitute for imported wheat flour in Sierra Leone (IFAD, 2010; MAFFS, 2014).

SLARI should be empowered to be able to have a competitive funding scheme that will provide solutions to nationally identified problems based on competitive grants. Competitive funds improve identification and prioritization of agricultural research needs, improve formulation of research project proposals, more transparent selection of agricultural research projects, and improved monitoring and evaluation (M&E) of project implementation. In general, in the long term, Sierra Leone should minimize relying on outside sources and should be able to finance agricultural research out of our own means.

In order to re-vitalize the human resource base, the most sustainable solution will be to establish training stations within SLARI for enhanced skilling up opportunities. Encouraging self-learning within SLARI itself through creating a scientific environment as seminars, lectures, panels, etc. would also offer great opportunity to learn. This is already on-going at the Njala Agricultural Research Centre (NARC). In general, for upgrading knowledge of research staff there should be a well-planned continuous staff development and succession program.

SLARI should be empowered to be able to embrace in its agenda the issue of job creation especially of youth and women. Policy research and recommendations are already in SLARI's research agenda, but this area needs to be strengthened in our future research. All in all, Sierra Leone's agricultural research system needs to be reinforced to help in sustaining productivity, food security, competitiveness and profitability of the agricultural sector.

Evolving new agricultural technology and its quick dissemination requires a series of integrated and communicating linked systems among the agencies concerned (FAO, 1997). This involves three sub-systems: (i) a research system, responsible for generating and evolving new agricultural technology and innovations; (ii) an extension system responsible for transfer of new technology, facilitating its adoption and also reporting back

field problems to the research system (feedback); and·(iii) the client system (farmers), who are the ultimate users of technology.

Training should be an important function and integral part of a research institution. SLARI should be able to plan, organize and conduct production-oriented and problem-oriented training programmes of short and long duration for extension workers and farmers. Short-duration training programmes, e.g., on specific crops or technology, should be organized before the start of the crop season. These programmes should be practical in nature and the trainees should be provided with the opportunity of 'learning by doing.'

SLARI should also organize training programmes for other agencies, such as input suppliers and other agencies, in order to educate them about the nature, characteristics, potential and requirements of modern agriculture. Training should be a regular activity in SLARI, and SLARI should be empowered to have a separate unit for this purpose, supported by core technical staff and other training facilities, including teaching and audiovisual aids, transport, hostels, etc. The training programmes should emphasize not only subject-matter content but also extension methodology and understanding of farmers' characteristics and behavior.

SLARI should have a publication programme for simple extension literature, containing technical recommendations in local languages - in the form of bulletins, handbooks on packages of practices, folders, leaflets, etc. - for use by extension workers and farmers. This should be in the form of packages of practices for all crops and livestock of the area, and also on other specific technology evolved by the institute, university or others. If possible, SLARI should publish its own magazine or newsletter for rapid dissemination of research results.

SLARI can also take on some service and supply functions in a limited way. Services such as soil and water testing, taxonomic identification of insects, diagnosis of diseased plants and providing proper advice to farmers can be very effective in helping farmers. The supply of small samples of seed of newly released cultivars and other plant material could be another method of disseminating them quickly. The supply of soil testing kits, plant protection kits, dairy and veterinary kits, etc., could also be undertaken wherever possible.

SLARI should be empowered to be able to re-orient and align its objectives with the transformative development agenda and develop the capacity to better respond to development challenges and be more sensitive to the order of the day and beyond. SLARI should be able to properly position itself for effective research leadership and develop an appropriate research roadmap. By doing so, SLARI will be able to contribute in transforming Sierra Leonean's agriculture into a vibrant and competitive sector.

IX. CONCLUSION

There is need to look at the agricultural sector problems holistically – looking at how issues on productivity, value addition, markets and prices impinge on each other. From that can follow agreed and feasible plans for all Sierra Leone's main crops, which involve the whole value chains, from production through to processing and sales, and include specific commitments by all the stakeholders which can be monitored and to which they can be held. Research has key roles in each of these processes. These roles of research in national agricultural development should be recognized and utilized.

The Extension Division needs to work more closely with SLARI to draw on agricultural research results when preparing district plans, recognizing that good extension needs constant updating in the light of new research results. Agricultural development programmes under the Ministry of Agriculture and Forestry (MAF) should give some considerations for the role of research in project conception and implementation. Only then can the specific contributions most needed from agricultural research be firmed up, and the services funded are reliably planned, on a medium to long-term basis.

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