



ADVANCING TECHNOLOGY TRANSFER FOR SUSTAINABLE DEVELOPMENT

Technology acquisition and transfer by
firms, and the supportive national policies,
strategies and measures in Ghana

A REPORT SUBMITTED BY
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1.0 Introduction

Technology is one of the critical drivers of economic opportunities and development. Advances in technology have contributed significantly to improvements in the quality of life in both developed and developing countries (Juma and Yee-Cheong, 2005, Frempong, 2006). For instance, since the industrial revolution, countries with the most technological capacity have experienced rapid growth. Thus, these countries have become increasingly wealthy, and their rates of growth have not diminished (Pritchett, 1995, cited in Watson et al, 2003). It has given a competitive edge to firms from technologically developed countries to lead in global trade and industry.

Consequently, accessing and acquiring technologies have become part of the critical issues in global technological and socio-economic discourse. It has become critical because of the need to be competitive in global international trade. Multinational companies have been the key actors in the technology transfer mechanisms. Blakeney (1989, cited by UNCTAD, 2001) defined technology transfer as a mechanism of disseminating technologies of commercial value.

Technology transfer can be seen in two spheres - intra-firm and inter-firm transfers. Intra-firm technology transfer is a situation where technology is transferred from Multi-National Companies (MNCs) to their subsidiaries in different countries (Hoekman et al, 2004). In this situation, technology is developed in one location but exploited in the other. The MNC's ability to facilitate and manage inter-subsidary technology transfer creates a competitive advantage for its operation in different locations or countries. The inter-firm technology transfer is normally when technology from one company is transferred to an unrelated company. It is usually an economic/financial transaction between a willing technology supplier (MNC) and a technology recipient to transfer/receive a technology based on a contractual agreement. Inter-firm technology transfer is based on different models such as joint ventures, licensing agreements, R & D partnerships, distribution and supply agreements, or technical exchanges among others. The importance of an inter-firm technology transfer is to build the capacity of the recipient company to become competitive in the global market.

Technology consequently had become a 'hot' global commodity that can facilitate competitiveness and socio-economic development. Given the critical role of technology in both enterprise and national development, the United Nations Conference on Trade and Development (UNCTAD) has

championed technology transfer, especially between companies in developing countries and developed countries on an equitable basis. In the past, UNCTAD established a Technology Transfer Code which provided guidelines for technology transfer and from whom many developing countries have drawn regulations to guide technology transfers in their countries. The establishment of regulations are not only to provide incentives but also to guard against restrictive and unfair provisions /practices that might be smuggled into technology transfer agreements which invariably may be inimical to the host countries.

Owing to the pivotal role technology plays in firms' competitiveness as well as development, many developing countries (including Ghana) have established institutions and regulations that will bolster the acquisition of foreign technologies for rapid industrial development.

The United Nations' Economic Commission for Africa (UNECA) in diverse fronts had helped African countries to benefit from the acquisition and assimilation of foreign technologies. Through its internal research and commissioned ones, UNECA assessed the various mechanisms and country experience in the acquisition of foreign technologies to enhance socio-economic development. Consequently, it has commissioned this study in several African countries including Ghana among others to assess the:

- Preferred modes and channels of technology acquisition by African firms,
- Impact of technology transfer at firm-level and
- Government support measures that firms found to be helpful or encouraged technology transfer both from abroad and within the country

1.1 The Study Context

The study which seeks to analyse technology acquisition and transfer by firms and the supportive national policies, strategies and measures in Ghana is organized into four chapters-introduction, methodology, results and discussions, and conclusion and policy implication. Chapter One, which is the introduction captured information on the concept of technology transfer, economic outlook and technological innovation, policy and institutional framework for technology transfer in Ghana, regulatory framework, technology transfer processes and procedures, types of technology transfers, and the pros and cons of a technology transfer agreement in Ghana.

Chapter Two, which is the methodology provided details of the type of data used, how the data was gathered, ethical procedures that were followed to obtain the data, how the data was analysed, challenges encountered during data collection and how they were resolved, and limitations of the study.

Chapter Three, which is the results and discussion section entails the data as generated from the SPSS software, presented in tables and figures. The analysis in the chapter provided information on the background of the surveyed firms, technology transfer strategies and activities in terms of strategic plans, policies, guidelines, licensing, systems, infrastructures, and personnel. In addition, the chapter provided an analysis of business professional and technical services, capital goods purchase and sales, the geographical spread of the firm's technology transfer partners, the motivation and challenges of technology transfers in Ghana, etc.

Chapter Four concluded the study by summarising and stating the key findings of the study and suggested the need to prioritize technology transfer among Ghana firms by making relevant investments in technology transfer agreements.

There is also an appendix which discusses two specific case study involving two local R&D institutions and private companies in the country.

2.0 Institutional, Policy and Regulatory Environment for Technology Transfer in Ghana

2.1 Policy Framework

The Ministry of Trade and Industry (MoTI) is the key institution with oversight responsibility of providing policy and regulations to bolster the development of the industrial sector in the country. The agencies that operate under the ambit of MoTI to support the industrial development of the country include; Ghana Investment Promotion Centre (GIPC), Ghana Export Promotion Council (GEPC), National Board for Small Scale Industries (NBSSI), Ghana Standards Authority and the GRATIS Foundation of Ghana. There are trade associations such as the Association of Ghana Industries, Private Enterprise Foundation and Ghana Chamber of Commerce and Industry among others which are voluntary organisations that play advocacy roles in policy making and

implementation. The Ministry of Trade and Industry develops the industrial policy which guides all activities and actions of the industrial sector in Ghana.

The main policy supporting the industrial sector of Ghana is the Industrial Policy developed by MoTI and to some extent the National Micro, Small and Medium Enterprises (MSME) Policy. The Industrial Policy is designed to promote increased competitiveness and support Industrial productivity, increased employment and prosperity for all Ghanaians. It is also to provide competitive prices and high-quality products for both the national and international markets. The key development objectives of the Industrial Policy are to:

- expand productive employment in the manufacturing sector
- expand technological capacity in the manufacturing sector
- promote agro-based industrial development
- promote the spatial distribution of industries to achieve a reduction in poverty and income inequalities.

The various issues that the policy aims to address are:

- Labour and industry relations
- Incentive frameworks for industrial development
- Privatisation and public-private partnership for development
- Technology in industry
- Intellectual property rights in industrial development
- Financing for industrial development
- Gender equity in industry
- Health and safety guidelines in the industry
- Micro, small and medium enterprises development

The Industrial Policy recognised the failure of the manufacturing sector to the various economic and trade policy reforms pursued over time. Manufacturing firms have faced considerable challenges in the form of increased competition in the domestic and export markets and high

production and distribution costs arising from high-interest rates, obsolete equipment, inefficient infrastructural services and low productivity. As part of the policy, the Government intends to initiate and implement programmes to develop requisite skills, ensure adequate and cost-competitive production inputs and services, and also provide financing for industrial development.

The MSME policy recognizes the dominance and the catalytic role MSME play in the economic development of the country. It has the potential to fast-tracking socio-economic development critical to achieving some of the targets of SDGs. This policy attempts to enhance the development of a congenial business environment to bolster the integration of Ghanaian MSME into the global economy.

The overarching objective of the policy is to foster job creation and income generation through the promotion of new and existing MSMEs and improving their competitiveness to enhance their participation and contribution to the Ghanaian economy.

The strategic objectives to achieve the key objective and others include;

- To facilitate the building and promotion of a dynamic, viable and promising MSME sector that encourages an innovative entrepreneurial culture and supports high-growth start-ups;
- To promote enterprises with high-value addition, export-oriented, or import substitution focus and encourage the use of local raw materials;
- To improve access to finance;
- To promote Research and Development;
- To improve the productivity of the MSME sector;

What is conspicuously absent in the policy is access to proven technologies which are key to enhancing MSME's competitiveness in both national and international markets. Though research and development was itemized as part of the strategic objectives, it does not address the issue of access to technology, especially foreign ones which are crucial to the effectiveness of the local MSMEs.

2.2 Institutional and Regulatory Framework for Technology Transfer

A number of institutions with accompanying regulations have been established and passed to support industrial development of the country. These institutions, among others include the Ghana Investment Promotion Centre, Minerals Commission, Ghana Energy Commission and Ghana Petroleum Commission. The Ghana Investment Promotion Centre (GIPC) is the key institution in terms of technology transfer and its operation cut across many sectors of the economy.

The GIPC was re-established by Act 2013, Act 865 with the mandate of attracting and promoting investments into critical sectors of the Ghanaian economy including agriculture and agro-processing, financial services, energy and renewable energy and health. Others include transport infrastructure, recreation and tourism, manufacturing, oil and gas, mining and mineral processing, and ICTs among others.

Apart from attracting and promoting investments into the country, it acts as a registry to register, assess, and monitor technology transfer agreements (TTA) entered into by local companies with international ones. This function is in line with the Technology Transfer Regulations, Legislative Instrument, 1992, L. I 1547 mandates all companies to register their TTA with GIPC. This technology could be technical expertise, knowledge, or facilities. The law requires that every technology transfer should conform to the stipulations of L. I 1547. For example, L. I 1547 stipulates that no TTA should not contain clauses that mandate the transferee to export exclusively through the transferor or on unfavourable terms; or requiring the transferor's prior permission before any export transaction is made; or transferring technology that is freely and easily available in Ghana, among others.

The other institutions which regulate technology transfers include the Ghana Minerals Commission, Ghana Energy Commission and Ghana Petroleum Commission among others. The Minerals Commission was established under the Minerals Commission Law (PNDCL.154) and re-established by the Minerals Commission Act, 1993 (Act 450). The Commission is responsible for the regulation and management of the utilization of the mineral resources of Ghana and the

coordination of the policies with them. It also provides a license for mineral prospecting and mining to both local (artisanal) and foreign companies.

The Commission has enunciated several regulations to foster effective and safe exploitation of the country's mineral resources. Some of the regulations include Minerals & Mining (General) Regulation, Minerals & Mining (Support Services), Minerals & Mining (Licensing) Regulations, and Minerals and Mining (Local Content and Local Participation) Regulations among others. Of all these regulations, the one which supports technology transfer is the Local content and local participation regulation. The purpose of the regulation among others is to increase the capability and competitiveness of domestic businesses, developing local capabilities in the mining industry value chain through education, skills transfer and expertise development. The regulation stipulates the patronage of goods and services which can be produced by local businesses. In this regard, the regulation supports the use of procurement as a tool for technology transfer. As the mining companies procure locally based on standards and specifications, the local firms will be challenged to develop technological capability to respond to the requirements of the mining companies.

Relatedly, the Ghana Petroleum Commission has also established the Local Content and Local participation Regulation, 2013, L.I. 2204. Sections 22 -26 are devoted to technology transfer. Section 25 is very explicit on the formation of technology alliances in terms of joint ventures, partnering of licensing agreements between indigenous Ghanaian companies or citizens and foreign contractors and service companies or supply companies.

The L.I 2204 made a provision for the establishment of a National Plan on technology transfer which is to be established in consultation with the National Development Planning Commission, relevant Ministries, Departments and Agencies identified by the Commission. The Plan has not been established; however, the Petroleum Commission is reported to be establishing an internal technology transfer unit as pertains to GIPC. The unit forms part of mechanisms to help indigenous Ghanaian companies to build their capacity and participate in highly technical areas in the upstream oil and gas sector.

The Energy Commission also promulgated regulations on local content. The Energy Commission (Local Content and Local Participation) (Electricity Supply Industry) Regulation, 2017, L. I 2354 aims among others to develop and promote local content and local participation in electricity

supply industry through education, skills and expertise development, technology transfer and know-how.

It has become fashionable for these regulatory Commissions to establish regulations to guide technology transfer and local capacity building through active participation of indigenous companies in the respective industries. However, it is of critical importance for in-depth studies to be conducted to assess the implementation of these regulations and their impact on local capability building through. The studies will help the policy and regulatory bodies with the opportunity to evaluate the implementation of the various local content and local participation regulations.

2.3 The Technology Transfer Agreement (TTA) Registration Procedure

In this section, we concentrate on the GIPC since its mandate as already stated cuts across many sectors of the economy.

The GIPC Act provides some information on the type of TTA which can be registered. Section 43 of GIPC Act, Act 865 and Regulation 9 of LI 1547, provide that TTA which has a duration of more than 18 months and less than 10 years qualifies to be registered with GIPC. However, such TTA can be renewed for a period of not more than five years. It will be interesting to question the rationale of excluding TTAs which are less than 18 months. Agreements in the area of service or management could have a shorter duration but might have provisions that might be worth the scrutiny of GIPC. What is not clear is whether the exclusion period aligns with international TTA regulations or best practices, especially UNCTAD's Code on Technology Transfer.

2.3.1 Types of Technology Transfer Agreements

GIPC Act 865 categorizes technology transfer agreements into four (4) main forms:

- Agreements covering Industrial Property Rights
- Agreements for the provision of Technical Services/Assistance
- Agreements covering the transfer of Know-How
- Agreements for the provision of Management Services

The technology transfer regulation stipulates that an entity may enter into a TTA that the entity considers beneficial to its operation. A TTA entered into by firms or entities must be assessed (to

conform to other national regulations) and registered with the GIPC. The registration of the TTA apart from gaining approval for the contract will enable the transferor to benefit from the incentive schemes provided by GIPC.

The GIPC is required to keep records of any TTA entered into for future needs and monitor the implementation of the agreement as enshrined therein so that other laws are not violated during implementation. Upon registration, the TTA registered under Act, 865 is deemed to have come into force from the registration day. The law provides an opportunity for review and renewal of the agreement depending on the implementation issues that may arise. However, this must be done with the permission and approval of the GIPC, and relevant allied statutory bodies.

Registration of a technology transfer agreement takes about six weeks to complete at the GIPC. The registration requires, completing and submitting three certified or original copies of the TTA form known as 'Form GIPC/T1'. To apply, the following documents are to be added; a certified true copy of the business certificate or certificate of incorporation, an exhaustive schedule of training, annual predicted payments to be transferred through the execution period of the TTA, proof of registration of industrial property, if required, two foremost and recent audited accounts of Transferee Company, a copy each of company regulation, GIPC registration and registration renewal (if required) certificates, and evidence of application and approval fees, which are non-refundable.

2.3.2 Technology Transfer Agreement Monitoring and Appeals Procedures

The law also provides remedial measures for non-adherence to TTA. The GIPC is also mandated to monitor and enforce the agreement between entities (transferor and transferee) following Act 865 to promote mutual understanding and a healthy business environment. To perform its functions in monitoring contractual agreements, the GIPC can demand any crucial information from the entities and the firms shall submit to the demand. For monitoring and compliance with regulations in the law, an officer of the GIPC or assignee, after identification may enter the facility of an entity for a reasonable amount of time (GIPC, 2022-Act, 865).

An aggrieved entity to the manner of operation or a decision of the GIPC or its assignee can appeal the decision to the governing board of the GIPC for remedial actions. It is required that an appeal

is made against any decision of the centre by the aggrieved entity to the GIPC board no more than six days after decision day.

The GIPC has a schedule of fees to be paid for the registration of TTA. The local company which files the initial application for TTA registration pays GH¢11, 600 (US\$1,466)¹ and pays GH¢ 17, 640 (US\$2,198) for renewal. There is also a schedule for fees to pay as regards the repatriation of profits/fees by the foreign company. Payment of fees is based on the quantum of the money to be transferred to the foreign partner. For example, a transfer up to US\$500,000 per annum attracts a fee of GH¢ 17, 640 (US\$2,198), while a transfer up to US\$1million attracts a fee of GH¢ 34, 574 (US\$34,575)². It should be noted that these fees are paid by the local company which for tax purposes are considered as part of the cost of the company's operation. This provision ensures that the local company is not too disadvantaged in terms of payment of technology transfer fees.

Although TTA is a requirement of the law, some benefits will be accrued to companies that register their agreement. As observed by Clinton Consultancy (2022) and Danquah (2018), the TTA allow the transfer of payments. For example, subject to the Foreign Exchange Act, 2006 (Act 723) a TTA firm is 'guaranteed unconditional transferability of fees (convertible currency) in respect of a technology transfer agreement registered under the law [GIPC Act 865] The yearly transfer payment is treated as a cost to the transferee firm in Ghana, and a deduction of it is made before tax. The import of this provision is to grant tax-free incentives for the transferor. This provision raises a concern. One would be quiet if this provision relates largely to TTA within joint venture companies, since in this case, both parties are investors. However, a pure management service agreement should not enjoy such unbridle incentive. It is an income earned by a foreign entity operating in the country and its operation should fall within the tax regime of the country. It may be helpful for GIPC to differentiate between types of TTA with accompanying incentives.

In addition, the Centre can submit to the minister responsible for finance on behalf of entities, transferors in particular, for tax waiver on a given technology. However, before such a request is

¹ The exchange used in the conversion is GH¢ 8.0241 to US\$1: See <https://www.bog.gov.gh/treasury-and-the-markets/daily-interbank-fx-rates/> data retrieved on 10th August, 2022.

² See <https://gipc.gov.gh/fees-charges/> data retrieved on 10th August, 2022.

granted, the Centre has to evaluate the dexterity of the foreign technologies which are to improve the efficiency and productivity of the firms or enterprises.

It is important that all TTA are registered since failure to register such TTA has some negative implications for the companies involved. A non-registered TTA (which is over 18 months) cannot benefit from the incentive scheme – repatriation of funds since the Bank of Ghana will demand the Certificate of registration of the TTA before the repatriation is made. Further, parties in a non-registered TTA cannot resort to GIPC for the resolution of disputes and the only remedy available to the parties is to go to court which might be expensive and time-consuming.

2.4 Industrial Performance

The industrial sector is the second largest sector in Ghana. The sector grew by only 0.8% in 2014, a far cry from its growth rate of 6.6% in 2013 (ISSER, 2015). Performance over the years in the sector has been underpinned primarily by growth in the mining and quarrying industries, with petroleum being the main contributor. The exception from this is the manufacturing and the water/sewage plant industry, which recorded marginally higher growth rates on their 2013 figures, all other sectors grew more slowly than this in 2014 (ISSER, 2013; 2014 & 2015).

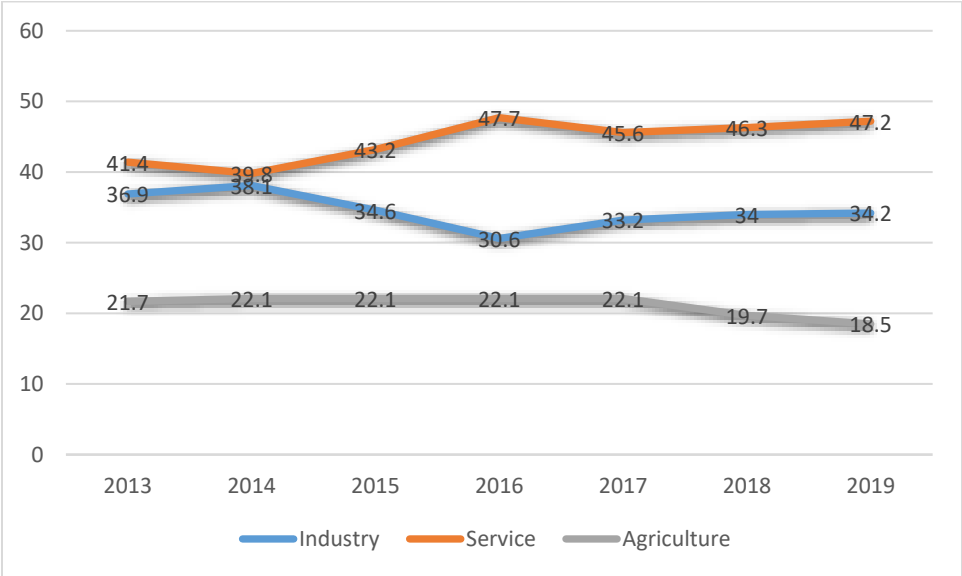


Fig 1: Sector Contribution to Gross Domestic Product (Percentage)

Source: Ghana Statistical Service

In terms of contribution to Gross Domestic Product (GDP), the industrial sector since 2014 had fallen behind the service sector. Its lowest contribution to GDP was in 2016 when it contributed 30.6% and picked up in the subsequent years. The agricultural sector lacked behind the Service and Industry with its lowest ebb in 2019 where it contributed 18.5%. The performance of the industrial sector since 2011 is reported to be anchored by mining and quarrying, and oil and gas (ISSER, 2021).

Table 1: Global Innovation Index 2021 Ranking

Country	GII	Score	Income group rank	Rank in sub-Saharan Africa
Ghana	112	22.3	23	12
Senegal	105	23.3	19	8
Nigeria	118	20.1	28	16
Cote d'Ivoire	114	21.0	25	14
Burkina Faso	115	20.5	5	15

Source: https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2021.pdf (data retrieved on 01/08/2022)

One of the critical ingredients for developing a vibrant industrial sector is the level of innovativeness that exist in the country. Table 1 provides information on the level of innovation competitiveness of a selected number of countries. In 2021, Senegal ranked better than all the selected countries in terms of the global innovation index (GII). Senegal ranked 105 globally and 8th in sub-Saharan Africa. Ghana is ranked 112 in terms of GII and 12th in sub-Saharan Africa.

In the last two decades, Ghana has arisen as one of the most stable democracies in Africa with a relatively strong growing economy with a GDP of USD 69 billion in 2020 from USD 5 billion in 2000 (WB, 2022). After almost three decades of political stability and economic reforms, in 2010, Ghana was recognised by the World Bank as a lower-middle-income country, which was a demonstration of its fiscal and monetary changes, political strength and improved capacity to use its natural resources for social and economic (African Business, 2015).

However, Ghana's economy took a nosedive after the emergence of the Covid-19 pandemic, with soaring inflation, 27.6% from 7.5% a year before and about 80% debt-GDP ratio (GSS/BoG, 2022). The emergence of the Covid-19 pandemic has affected all facets of life, economically and socially at the individual, national and international levels. More so, the ways economic transactions are done have been significantly altered, requiring the application of technologies to deliver goods and services. To remedy the current challenges of the Ghanaian economy will require improving efficiency in production and delivery of goods and services within the economy. This could be achieved through the effective development, dissemination or transfer and application of technologies in all sectors of the economy to promote economic development and the production and distribution of goods and services. To do this will require an effective legal framework and state-led policies. In the subsequent sections, we discussed the regulatory framework for technology transfer in Ghana.

3.0 Methodology

3.1 Sampling and Data

The consultant employed various research methods to design and undertake the study. The study used largely quantitative method and a qualitative method to a less extent.

Information/data was obtained from two sources; primary and secondary. The secondary source was largely literature review of published materials (research reports, policy and regulatory materials) and internet resources. The literature review provided insights into the general discussion of technology transfer, national policies, institutional and regulatory frameworks supporting technology transfer in the country. The data and/or information gathered from the literature informed the structure and direction of Chapter One of this report.

This study is a cross-country one involving researchers from Egypt, Ethiopia, Ghana, Kenya, Senegal, South Africa and Zambia. Consequently, quantitative data were collected using a uniform questionnaire provided by UNECA to collect data on common indicators to ensure cross-country analysis of experiences. Some of the indicators covered by the questionnaire include technology transfer strategies and activities, collaborative partnerships, and licensing. Quantitative data were obtained through the administration of structured questionnaires from the firms engaged in

technology transfer activities. There was training and pretesting of questionnaires to ensure that the research assistants understood correctly all the issues involved in the study.

3.2 Sampling Procedures

CSIR-STEPRI through a previous study had lists of firms from the Association of Ghana Industries (AGI), Ghana Enterprise Agency-GEA (formally National Board for Small Scale Industry), Ghana Chamber of Commerce and Industry (GCCI), and the Ghana Tourism Authority (GTA). From these lists, the firms were categorized into five sectors; agro-processing, finance, tourism, education, and ICT sectors. The study proposed sampling of 50 firms and 12 R&D institutions³ for the survey. The numbers of respondents assigned for each firm are represented in Table 2

Table 2: Sampling frame

Sector	No. of firms to be interviewed
Agro-processing	15
Finance	5
Education	5
Tourism	15
ICT	10
Total	50

Source: Field survey, 2022

The firms to be interviewed were randomly selected. The firms were under different umbrella associations. So, at the end of the random selection, the firms selected were put into the various associations they belong. This resulted in twenty (20) firms belonging to AGI, eleven (11) with GTA, seven (7) with GCCI, and twelve (12) with GEA (see Table 3).

3.3 Data Collection

The questionnaires were administrated by four well-trained enumerators who were assigned to contact the firms and make arrangements for the data collection at the convenience of the firms. At the request of the firms, some of the questionnaires were sent via email and hardcopy. The

³ The results were to be analysed from two data sets-firms and R&D institutions. However, the data from the R&D institutions are so inadequate to provide any meaningful analysis and interpretations, therefore the analysis was done with data from the firms.

distribution took about eight (8) working days. The firms were given 10 working days to respond to the questionnaire because of the detailed nature of the questions. Despite observing all the questionnaire administration protocols, the returns and responses to the questionnaires were very poor.

Table 3: Number of questionnaires distributed and responses

Associations/Institutions	AGI	GTA	GCCI	GEA
Number of questionnaires distributed	20	11	7	12
Response rate	5 (25)	4 (36.4)	1(14.3)	3(25)

*percentages (%) in parenthesis

Source: Field survey, 2022

3.4 Data Analysis

SPSS template was created to input the data obtained because some questionnaires were completed in hardcopy. Descriptive statistics such as frequencies, percentages, and means were employed to summarize the key results of the study. SPSS, Excel, and Tableau were used to analyze the data and results presented in tables, charts, and graphs. Some of the questions were unanswered, so there were follow-ups through phone calls to find out if they were oversights. It was realized that respondents either had no data on them or deliberately did not provide them. The analysis was therefore done per the data available.

3.5 Research Ethics

First, phone calls were made to the selected firms to inform, solicit consent, ask for support, and willingness to participate in the study. Although the survey was for the firms, individuals in the firms were assigned to handle issues of the questionnaires. Where necessary, there were personal visits before the questionnaire administration. Respondents were informed of the purpose of the study and that the data to be generated was for research purposes only and the research report would be devoid of corporate names. Participants were informed that participation is voluntary and that the data generated would be confidential. Upon acceptance to participate in the survey, official letters from the United Nations Economic Commission for Africa were sent to the various firms through email and hardcopy.

3.6 Research Limitations and Challenges

It was found that the firms were unwilling to provide data on finance, human resources, etc. which were considered confidential. During the period individual team members made follow-ups with

the firms to know the progress of the questionnaires. At the end of the 10 working days, most of the firms had not completed the questionnaire, indicating that the questionnaire is demanding, and they have no data to answer some of the questions. The firms were encouraged to provide data as much as available and comfortable to provide. Also, they were encouraged to submit the questionnaire to the appropriate divisions under the firm since some of the questions required data from specific divisions of the firm, for example, human resources, administration, finance, etc. Despite all efforts from the research team, it took about 7 weeks to receive less than half of the questionnaires. A total of 50 questionnaires were distributed. However, the response quality and rate from the firms of the various associations are unpropitious as could be observed from Table 3. Some of the reasons given by the companies for their failure to respond to the questionnaires include;

- The questionnaire cannot be found in the email which was not accurate because some acknowledged receipt
- Hardcopies cannot be tracked, so additional questionnaires were sent, in some cases more than twice but the same excuse was given.
- Some of the questions that would require the board's approval to respond to and when the board will meet is unknown.

Time constraints necessitated that the available questionnaires were used for the analysis and the fact that it was realized that some of the firms were reluctant to complete the questionnaires despite initially agreeing to partake in the survey. Notwithstanding the research limitations and challenges, analysis and interpretations were conducted to reflect the available data. Due to the poor response rate it will be difficult to make broad inferences on the general technology transfer experiences of the Ghanaian firms.

4.0 Findings and Discussions

4.1 Background of the Firms

A total of thirteen (13) questionnaires were received out of the fifty (50) distributed to the firms, representing 26.0% and two (2) were received from the R&D institutions⁴ out of the twelve (12) distributed. The sectoral responses in terms of agro-processing, finance, tourism, education and ICT firms are reported in Table 4

Table 4: Number of responses to questionnaires per sector.

Sector	Agro-processing	Finance	Tourism	Education	ICT	Total
No. of questionnaires received	3(22.1)	3(22.1)	3(22.1)	2(15.4)	2(15.3)	13(100)

*percentages in parenthesis

Source: Field Survey, 2022

From Table 4 it is observed that 3 responses each were received for agro-processing, finance and tourism sectors. And education and ICT also had two responses each. The companies in agro-processing sector were largely into food and beverage production. For education, the companies were providing hostels and accommodation for students, the financial sector is banking (mobile and internet banking), the tourism sector is travel and tour services, and the ICT sector is online marketing and payments.

All the firms surveyed are profit-oriented and 84.6% are independent firms (not affiliated with any other firm) while the remaining 15.4% are subsidiaries of companies in other countries. The data showed that all the subsidiary companies are listed on the Ghana Stock Exchange, while the independent companies are not. Although there are benefits to being listed on the stock, for

⁴ The results were to be analysed from two data sets-firms and R&D institutions. However, the data from the R&D institutions are so inadequate to provide any meaningful analysis and interpretations, therefore the analysis is done with data from the firms.

instance, the ability to raise capital through public subscription or shares, it is interesting to observe that most of the firms are not listed on the stock market. This may be so because these firms could be small and medium-sized. However, the Ghana Stock Exchange has provided an alternative platform (Ghana Alternative Market)⁵ for small and medium enterprises (SMEs) to trade in shares to raise capital for their operations. . Nonetheless, the majority of the companies sampled have not availed themselves of this facility provided by the Ghana Stock Exchange (GSE). This may largely be due to the cultural attitude in which the Ghanaian prefers sole ownership and management of business without the involvement of the public. Enlistment of these companies on GSE may help them to negotiate or acquire foreign technologies on favourable terms, since foreign companies might find companies listed on GSE to be credible and may not necessarily include restrictive clauses to protect their interest.

4.1.1 Employment

In terms of employment, the firms reported a mean staff strength of 151 in 2018. The maximum number of employees reported by the firms for the same period is 1700, with the modal number of employees being 6. A similar trend is observed for 2020, however, fewer employees are recorded for the year 2020 in terms of the average and maximum numbers of employees. In 2020, 3, 141, 1600, and 4 are respectively reported for the minimum, average, maximum and modal number of employees (Table 5).

Table 5: Number of employees of the firms

Employment statistics	2018	2020
Mean	151	141
Minimum	0	3
Maximum	1700	1600
Mode	6	4

Source: Field Survey, 2022

The firms were asked to indicate, in percentages (%) whether the male and female full-time employees have increased, decreased or no change (zero) from 2018 to 2020. This is to examine

⁵ The Ghana Alternative Market (GAX) is a parallel market operated by the Ghana Stock Exchange. It focuses on businesses with growth potential. The GAX enlists companies at various stages of their development, including start-ups, and small and medium enterprises.

whether more males or more females were employed or not over the period. The responses which were categorized into ranges in Table 6 is to enable the study to examine the sampled firms' employment recruitment strategy to understand whether gender considerations are acknowledged in the process. The result shows that from 2018 to 2020, five firms reported an increase in the numbers of full-time male employees within the range of 41-50%. The same scenario is observed for the females for the same period. Secondly, four firms reported an increase in full-time male employees within the range of 31- 40%. Also, about 4 (30.8%) firms reported an increase between 51 – 60% for full-time female employees (Table 6). In general, all the firms have seen an increase in the numbers of both male and female employees for the period 2018 to 2020.

Table 6: Percentage change (%) in male and female full-time employees from 2018 to 2020

Change	Freq. (Male)	Freq. (Female)
11-20%	1 (7.7)	-
21-30%	1 (7.7)	2 (15.4)
31-40%	4 (30.8)	-
41-50%	5 (38.5)	5 (38.5)
51-60%	1 (7.7)	4 (30.8)
61-70%	1 (7.7)	2 (15.4)
Total	100.0	100.0

*percentages in parenthesis

Source: Field Survey, 2022

4.1.2 Educational Background

The firms were asked to indicate, in percentages (%) whether employees with their academic qualifications have improved, decreased, or no change (zero) from 2018 to 2020. This is to examine whether specific academic qualifications have improved or not over the period. An example is to find out whether the number of employees with doctoral degrees has increased, decreased, or remained the same. A negative sign (-) is used to represent decrease and zero for no change. The results, which were categorized into ranges are shown in Table 7, which provides information on the educational background of the firm's full-time employees. The import is to establish whether there is an improvement or not from 2018 to 2020. Only 1 (7.7%) of the firms reported an increase (21-30%) for Doctor of Philosophy (Ph.D.) while certificates/diplomas, which

are the lowest tertiary academic qualifications recorded various changes (Table 7). For instance, 2 (15.4%) of the firms reported an increase between 1-10% for certificates/diplomas and 3 (23.1%) of the firms also reported an increase between 1-10% for bachelors. Six firms (46.2%) reported no change for employees with bachelor's degrees for the period 2018 to 2020. A firm (7.7%) reported a decrease between 81-90% in the number of full-time employees with Diplomas/Certificates

Table 7. Change of educational qualification of full-time employees from 2018 to 2020

Change	Diploma/Certificates	Bachelor	Master	Ph.D.	Others
0	3 (23.1)	6 (46.2)	-	-	-
1-10%	2 (15.4)	3 (23.1)	-	-	15.4
11-20%	1 (7.7)	-	2 (15.4)	-	7.7
21-30%	-	-	-	1 (7.7)	-
31-40%	-	1 (7.7)	1 (15.4)	-	7.7
41-50%	1 (7.7)	-	-	-	-
51-60%	1 (7.7)	-	-	-	-
71-80%	1 (7.7)	2 (15.4)	-	-	15.4
81-90%	1 (7.7)	-	-	-	15.4
81-90% (-)	1 (7.7)	-	-	-	-
91-100%	1 (7.7)	-	-	-	-

*percentages in parenthesis

Source: Field Survey, 2022

4.1.3 Markets of Operation

No more than 15.4% of the firms reported having operations in other countries, while the majority (84.6%) were operating in the domestic market. Of the firms having international operations, half (50.0%) of such firms is operating in more than five countries and the remaining half (50.0%) have operations in only one country. The subsidiaries outside of Ghana are located in Asia (more than five subsidiaries) and South Africa (one subsidiary).

Further, the survey investigated the markets in which the firms exported their products and their revenue. Only 7.7% of firms reported exporting products to other countries while the remaining 92.3% did not. In terms of revenue, Mean and maximum revenues of US\$18,610.82 and US\$50,000.00 respectively were recorded for the period 2018. In 2020, a mean revenue of US\$8620.36 and a maximum of US\$11043.53 were reported. The decline in revenue could be attributed to several reasons, one of which could be the Covid-19 pandemic which significantly affected most economic activities not only in Ghana but globally as well.

4.1.4 In-house R&D Facilities

The majority (84.6%) of the firms had no dedicated research and development unit/team but 15.6% had a such in-house facility with an average of two staff employed in the R&D unit/office. The companies with the R&D units had budgets for the units which is not more than 10% of the total revenue for 2018. With the majority of the firms without in-house R&D units, the only available option open to them to acquire modern technologies might be through foreign sources.

4.2 Technology Transfer Strategies and Activities

This section provides information on technology transfer strategies and activities among the firms as observed in the survey data. These include firms' strategic plans, policies, guidelines, licensing, systems, infrastructures (laboratories offices,) and personnel. Most (76.9%) of the firms have no formalized technology transfer strategy in the form of a strategic plan, policy or guidelines. A little above 23% (23.1%) of firms reported having technology transfer. Those who have technology transfer agreements also have strategic plans, policies, and guidelines to bolster the utilization of maximum benefits from technology transfer arrangements. There is a need to sensitize the majority of the firms to develop strategies, policies, and guidelines for technology transfer. Having these structures in place will guide these firms to know which foreign technology they should acquire, terms of engagement and what they hope to achieve through the technology transfer.

4.2.2 Technology Transfer Units

From the survey data, only 3 (23.1%) firms have dedicated teams or units such as technology transfer, licensing, industry liaison and knowledge exchange offices for handling technology transfer issues. The staff in these technology transfer units in 2018 ranged from a minimum of 4 to a maximum of 23. In 2020 the firms reported a maximum of 18, an average of 11, and a minimum of 3 technology transfer employees, which are lower than in 2018. The firms that

reported having a technology transfer strategy did not provide data on specific funds allocated for implementing the strategy. The provision of the financial data would have helped assess the seriousness of the firms in dealing with technology transfer issues. The information on the systems in place for technology transfer activities is reported in Table 8.

Table 8: System in place for TT activities (%)

System	Yes	No
Regularly conduct satisfaction surveys on TT partners	30.8	69.2
Monitoring and evaluation	30.8	69.2
TT outputs included as a performance appraisal criterion for R&D staff	38.5	61.5

Source: Field Survey, 2022

Most of the firms (69.2%) do not conduct regularly satisfactory surveys on technology transfer partners, have no monitoring and evaluation division, or include technology transfer (TT) output as a criterion for performance appraisal of the research and development staff. For example, in Table 8, of the firms reporting to have R&D divisions, 69.2% have no monitoring and evaluation mechanism and neither do they conduct regular surveys on TT partners (69.2%) to improve upon the partnership. As regards developing technology transfer, for the year 2020, no specific budget was allocated and/or reported to support developing technology transfer partnerships. All (100%) firms reported zero budgetary allocation to develop technology transfer partnerships. Although no budgetary values were reported for TT partnership, 9 (69.3%) of the firms believe the amount did not change and the remaining 4 (30.7%) believed it might have increased. The perceived proportional change in budgetary allocations to developing TT partnerships are shown in Table 9.

Table 9. Perceived proportional change in the R&D budget.

Portion (%)	0	1-10	21-30	31-40	51-60
Firms	9 (69.3)	1 (7.7)	1 (7.7)	1 (7.7)	1 (7.7)

*percentages in parenthesis

Source: Field Survey, 2022

About 2 (15.4%), 6 (46.2%), and 5 (38.5%) of the firms expect budget forecast for the next 3 years (2021-2023) to increase, remain the same, and decrease respectively from that of 2020. And the expected magnitudes of change for the firms are reported in Fig 2. The results in Fig 2 show that 11(84%) of the firms do not expect any change in the budget for technology transfer activities. On the other hand, one firm each expects an increase of between 21-30% in technology transfer budget and another firm also expects 41-50% increase. It remains doubtful if the projected changes could be achieved since the firms did not report data on the TT budget.

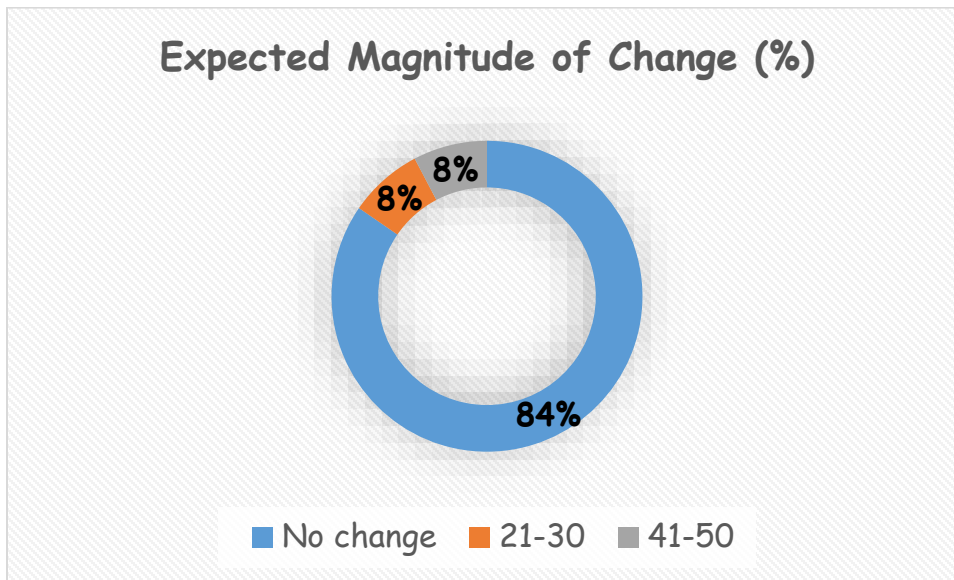


Fig 2. Expected change in TT budget from 2021-2023

Source: Field Survey, 2022

4.3 Collaborative Partnership

The data shows that in terms of collaborative partnerships, 84.6% of the firms reported no technology development and acquisition while two firms (15.4%) do have such collaborative partnerships. Table 10 provides details or the specifics of the collaborative partnership with other firms in support of technology development and acquisition activities. Except for partnership collaborations with external firms in other countries, which had one collaborative partnership, all the firms reported zero (0) for the different types of collaborative partnership (see Table 10). The implication is that most of the firms surveyed do not have collaborative partnerships with other

firms, public enterprises, or institutions either inside or outside Ghana and this need to be given attention.

Table 10. Number of collaborations with other firms and institutions.

Number of collaborative partnership	External firms in the country	External firms in other countries	Public sector enterprises in the country	Public sector enterprises in the country	Higher education institutions in the country	Higher education institutions in other countries	Other
Zero	100	92.3	100	100	100	100	92.3
One	-	7.7	-	-	-	-	7.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Field Survey, 2022

In respect of percentage (%) change from 2018, no change is reported for most of the partnerships as could be observed in Table 11. Only one firm (7.7%) indicated an increase in collaborative partnership between 1-10%.

Table 11. Changes in collaborations from 2018

%	External firms in the country	External firms in other countries	Public sector enterprises in the country	Public sector enterprises in the country	Higher education institutions in the country	Higher education institutions in other countries	Other
No change	100	92.3	100	92.3	92.3	100	84.6
1-10	-	7.7	-	-	-	-	7.7
11-20							7.7
41-50	-	-	-	-	7.7	-	-
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Field Survey, 2022

Spin-out: In 2020, no spin-out firms and dividends were reported as a result of TT development and acquisition. In all the TT development and acquisition scenarios, there was almost no change

(see Table 12). For instance, all of the spinouts arising from TT development and acquisition with external firms in the country, public sector enterprises in the country, higher education institutions in other countries, etc. reported zero change. However, spins-out with external firms in other countries reported some level of change (1- 10%) as indicated by one firm. While spin-out with the educational institutions in the country also report some change within the range of 41 – 50%. The implication is that most of the collaboration between the firms and other institutions (both local and external) did not result in spin-out firms. This could be an indicator of the lack of innovativeness of the local firms.

Table 12: Change (%) in 2018 and 2020 spinouts

	External firms in the country	External firms in other countries	Public sector enterprises in the country	Public sector enterprises in the country	Higher education institutions in the country	Higher education institutions in other countries	Other
No change	13 (100)	12 (92.3)	13 (100)	13 (100)	12 (92.3)	13 (100)	12 (84.6)
1-10%	-	1 (7.7)	-	-	-	-	1 (7.7)
11-20%							1 (7.7)
41-50%	-	-	-	-	1 (7.7)	-	-
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*percentages in parenthesis

Source: Field Survey, 2022

4.4 Technology Licensing

The study seeks to examine the status of technology licensing among firms; therefore, firms were asked if they have licensing agreements with other firms and public institutions that are inside or outside Ghana. If they have, have these licensing agreements in terms of percentage increased, decreased, or remain the same (zero or no change) for the period 2018 to 2020. The responses which were categorized are reported in Table 13. Like partnerships, technology licensing witnessed no change for the year 2020. In all scenarios of technology licensing including patents, intellectual property and trademarks, the firms surveyed did not license and/or report a significant change, whether with national or international firms. From Table 13 it is observed that only 1

(7.7%) of the firms reported an increase between 1-10% for technology licensing with external firms in other countries. In terms of technology licensing with higher education institutions in the country, only 1 (7.7%) of the firms reported an increase between 41-50%.

Table 13: Technology licensing

%	External firms in the country	External firms in other countries	Public sector enterprises in the country	Public sector enterprises in the country	Higher education institutions in the country	Higher education institutions in other countries	Other
No change	13 (100)	12 (92.3)	13 (100)	13 (100)	12 (92.3)	13 (100)	11(84.6)
1-10	-	1(7.7)	-	-	-	-	1(7.7)
11-20							1(7.7)
41-50	-	-	-	-	1(7.7)	-	-
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*percentages in parenthesis

Source: Field Survey, 2022

Even though it is only one firm that reported an increase, it is important to note that the increase is significant, between 41-50%. The firms also provided no forecast for technology licensing for the period 2021-2023. Although it is only one firm that reported change in technology licensing with higher education institutions in the country (Table 13), it is important to observe that the increase or change is significant, between 41-50%.

4.5 Business Professional and Technical Services, and Capital Goods Purchase and Sales

Technology transfer within and between countries is essential to sustain economic growth. In recent years, the purchase and sale of capital goods within and between countries have become important channels for technology transfer in developing countries. These capital goods include

machinery, equipment and tools for the production of goods and services by firms. The firms were asked whether they purchase and sell capital goods locally or from other foreign countries. The results are presented in Table 14. According to the firms, the average amount spent on the purchase of capital goods locally in 2020 was US\$83,945.67 which is about a 10% increase from 2018 estimates. However, only US\$1,228.58 was spent on the purchase of capital goods from other foreign countries, representing about an 8% decrease in 2018. Firms spent a total amount of US\$1,007,348 on the purchase of capital goods locally in 2020. This data need further interrogation since capital manufacturing capability in the country is not very strong and therefore many local firms have depended on foreign sources for capital goods.

Table 14: Capital Goods Purchase and Sales in 2020

Capital Goods Purchase and Sales in 2020	Amount (US\$)	% Change from 2018
Total spending on purchase of capital goods locally	83,945.67	10
Total spending on the purchase of capital goods from other countries	1,228.58	-8
Total sales of capital goods locally	5,146.5	3.7
Total sales of capital goods to other countries	1,107.3	-5

Source: Field Survey, 2022

Also, the total sales of capital goods locally and in other foreign countries are US\$5,146.00 and US\$1,107.30 respectively. The total sale of capital goods to other foreign countries decreased by 5%. The results from the survey data, further revealed that about 53.8% of the firms reported no change in expenditure on the purchase of capital goods locally, while only 30.8% of firms indicated a 1-20% increase in purchase of capital goods from other countries. However, only 15.4% of the firm observed a 41-60% increase in purchase of capital goods locally. Most of the firms did not report spending on the purchase of capital goods from other countries.

Firms were asked if their budget forecast for the purchase of capital goods in the next 3 years (2021-2023) will be increased or decreased. About 46.2% of the firms expected an increase in the budget forecast for the purchase of capital goods in the next three years while 53.8% reported no change. However, the results further showed that about 5 (38.5%) and 4 (30.8%) of firms indicated a 1-10% and 21-30% increase respectively in the purchase of capital goods in the next 3 years.

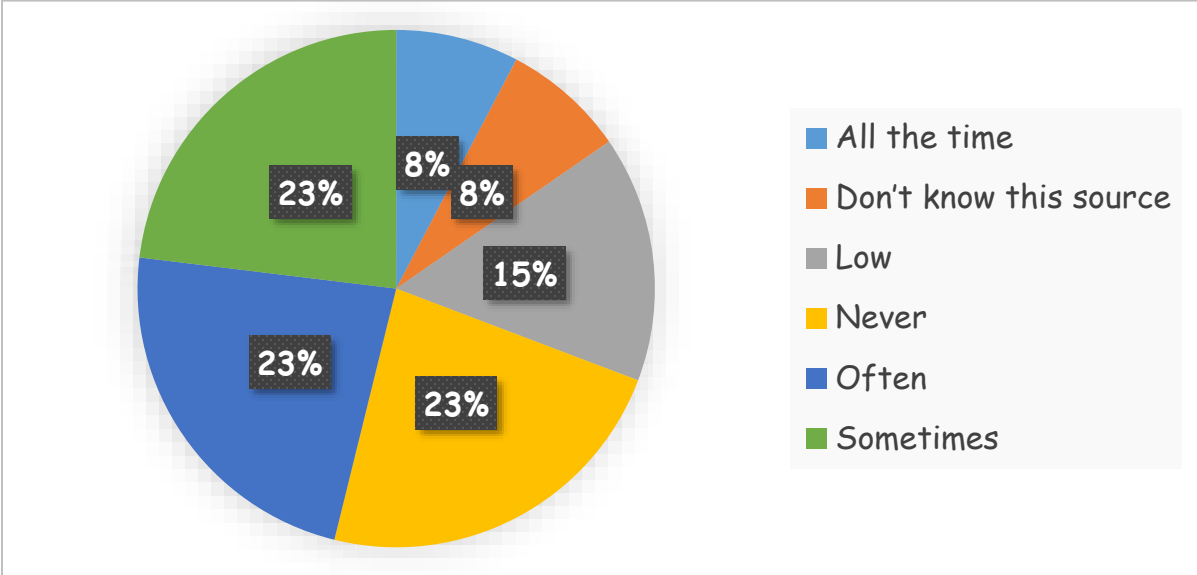


Fig 3. Frequency of use of open-source technologies by the firms

Source: Field Data, 2022

4.5.1 The Use of Open-Source Technologies among Firms

Open-source technologies are gradually becoming the norm and are being adopted by many firms not only in Ghana but the globe as well. They offer a low-cost alternative for the firm by using licensed software. Most of the firms interviewed reported the utilization of open-source technologies in the running of their business. The results in Fig 3 show the firm's frequency of use of open-source technologies in Ghana. Most firms used open-sourced technologies in Ghana. The results revealed that about 23% of the firms never used open-source technologies, while another 23% used it often. Further, 8% use open-source technologies all the time while 23% used them sometimes. However, about 8% don't know about this source while about 23% never use open-source technologies. The platforms used by firms to access these technologies include Facebook

through android smartphones (46.2%), GAAP (7.7%), online sales (7.7%), and internet browsers like Mozilla Firefox (23.1%).

4.5.2 Geographical Spread of the Firm's Technology Transfer Partners

The international flow of technological information and integration into domestic production and management processes are essential for developing countries to compete in the global economy and narrow the technological gap. Technology transfer between countries can either be an inward or outward transfer of technology. Technology transfer activities among firms in Ghana are limited to Africa, the Middle East, Asia, and North America. The majority of the sampled firms do not directly engage in the acquisition or provision of technology transfer activities. Only 7% of firms engage inward and outward technology transfer with their partners in Africa, the Middle East, Asia, and North America. This set of countries does not depart too much from the main sources of foreign direct investment into the country as reported by GIPC. For example, in 2020, the main leading sources of foreign direct investment associated with technology transfer were China, the United Kingdom, South Africa, Australia and the Netherlands (GIPC, 2021).

4.5.3 Technology Transfer Activities among Firms

This section discusses technology transfer activities between firms and other public institutions in Ghana. These include technology acquisition activities, technology provision activities, TT activities with other firms, TT activities with public sector enterprises, subsidiaries, universities, and the use of open-source technologies. From Table 10, most of the firms agreed that compared to the previous 3-year period (2015-2017), their firms' technology acquisition activities (53.9%), TT activities with other firms (69.2%), TT activities with own subsidiaries (69.2%) have significantly increased to over 50%. Additionally, TT activities with universities, public sector, and the use of open-source technologies have increased by over 50%. Contrary, technology provision activities by majority (61.5%) of firms have not witnessed any change over the past three years.

Table 15: Compared to the previous 3-year period (2015-2017), the firm's

Technology Transfer Activities	Significantly Increased (> 50%)	Increased (up to 50%)	No Change
Technology acquisition activities have	53.9	30.8	15.4
Technology provision activities have	15.4	23.1	61.5
TT activities with other firms have	69.2	15.4	15.4
TT activities with public sector enterprises have	7.7	61.5	30.8
TT activities with its subsidiaries have	69.2	23.1	7.7
TT activities with universities have	7.7	69.2	23.1
The use of open-source technologies has	15.4	53.9	38.5

Source: Field Survey, 2022

A high proportion of firms forecast that in the next 3-years period (2021-2023), technology transfer activities will significantly increase (over 50%). The results in Table 16 revealed that all the firms agreed that technology transfer activities such as acquisition, technology provision, TT with other firms, TT activities with public sector enterprises, subsidiaries, and universities, and the use of open-source technologies will increase significantly by over 50%.

The findings imply that the firms have projections of increasing technology transfer activities in the next three years (2021-2022). According to them, the next three years will witness the use of technology in various forms to facilitate their business activities and competitiveness in the global market. The ICT firms included in the study reported that their projections are in response to the government's digital agenda which aimed at expanding infrastructure development for the ICT Sector and developing ICT Parks to promote entrepreneurship, attract private investment and enhance ICT research and development.

Table 16: Forecast of technology transfer activities in the next 3 years (2021-2023)

Technology Transfer Activities	Increased (up to 50%)	No Change	Significantly Increased (> 50%)
Technology acquisition activities will	38.5	7.7	53.9
Technology provision activities will	-	-	100
TT activities with other firms will	-	23.1	76.9
TT activities with public sector enterprises will	15.4	15.4	69.2
TT activities with its subsidiaries will	15.4	15.4	69.2
TT activities with universities will	7.7	15.4	76.9
The use of open-source technologies will	7.7	23.1	69.2

Source: Field Data, 2022

4.5.4 The Extent of Acquisition and Deployment of Technologies by Firms

Table 17 shows the results of firms' past and projected acquisition and deployment of technologies. The majority (84.6%) of firms reported that they have not acquired and deployed renewable energy technologies in the past three years (2018-2020). Similarly, most firms have no projections to acquire and deploy renewable energy technologies in the next 3 years (2021-2023). According to the firms, the inability to acquire and deploy renewable energy technologies is due to high initial investment costs, high-interest rates, and limited access to capital.

Though only a few (15.4%) reported utilising online sales and deploying digital services in the past three years, the majority (84.7%) forecasted acquisition and deployment of these services within their firm in the next 3 years (2021-2023). Online sales and digital services will enable positive networking among firms and increase their customer base. According to the firms, since Covid-19, online platforms have opened new sales and sourcing channels and facilitated access to multiple types of digital networks which are essential for survival and expansion. However, the lack of digital skills continues to be a major challenge for the acquisition and deployment of digital and online sales technologies. It is therefore important for these firms to spend part of their resources to build digital skills within their establishment to enable them to take full advantage of the potential of the digital revolution.

Table 17. The extent of acquisition and deployment of technologies

The extent to which your firm has acquired and deployed technologies	Not at All	Limited	Some	Large	Significant
<i>In the past 3 years (2018-2020)</i>					
Online sales and digital services	15.4	7.7	53.8	7.7	15.4
Renewable energy technologies	84.6	7.7	-	7.7	-
<i>Forecast in the next 3 years (2021-2023)</i>					
Online sales and digital services	7.7	7.7	15.4	23.1	46.2
Renewable energy technologies	76.9	15.4	-	7.7	-

Source: Field Survey, 2022

Concerning access to government incentives for TT activities in Ghana, the majority (84.6%) reported that they are not aware of any incentive. About 7.7% indicated that though they have conducted searches there is no government incentive in the country. Only a few (7.7%) firms indicated there are government incentives for their business activities. The opinion of the majority is a bit strange since they all belong to trade associations that clamour for better incentives for indigenous firms. For example, the Association of Ghana Industries has been constantly engaging governments to create a congenial environment for firms to thrive.

4.5.5 Motivations for Technology Transfer by Firms

Firms undertake technology transfer activities for a wide variety of motivations which include (i) earning revenue from the firm's technology (ii) Safeguard intellectual property and avoiding infringement and related litigation (iii) Establishing industry standards (iv) taking advantage of government incentives (v) advance human and institutional capabilities (vi) cultivate strategic partnerships (vii) become a global technology leader in the sector (viii) Explore new applications (ix) respond to stakeholder requests (e.g. funders; investors; shareholders; government) and (x) make societal development impact.

Table 18. The firm's top motivations to technology transfer activities

Motivation for technology transfer activities	Mean Rank	Rank	Percentage
Earn revenue from the firm's technology	1.05	1	75
Safeguard intellectual properties and avoid infringement and related litigation.	1.75	2	65
Establish industry standards	2.07	3	63
Take advantage of government incentives	2.23	4	55
Advance human and institutional capabilities	2.69	5	51
Cultivate strategic partnerships	2.70	6	40
Become a global technology leader in the sector	2.825	7	35
Explore new applications	2.875	8	26
Respond to stakeholder requests (e.g. funders; investors; shareholders; government)	4.08	9	12
Make societal development impact	4.87	10	11

Source: Field Data, 2022

The firms were asked to list the top motivation factors for technology transfer activities. The results showed that the majority (75%) stated earning revenue from the firm's technology transfer was the main motivating factor. Safeguarding intellectual properties and avoiding infringement and related litigation was ranked second. Establishing industry standards was ranked third, taking advantage of government incentives was ranked fourth, and advancing human and institutional capabilities was the fifth motivating factor of the firm's technology transfer activities.

4.6 Challenges to Technology Transfer among Firms in Ghana

Two main challenges are identified here namely challenges related to the market and those related to firm:

Marketed Related Challenges:

The following are market-related challenges

- In the absence of a well-working licensing market,

- high price charged by licensors,
- perceived weak protection of intellectual property (IP), and
- difficulty to identify and access TT partners are among the major challenges identified by firms in Ghana.

Firm-Related Challenges:

Some of the firm-related challenges are;

- The lack of skills to manage TT activities,
- no clear strategy and guidelines to direct and govern TT activities,
- difficulty to negotiate and enforce TT agreements with external parties,
- Lack of information about technology needs and availability in the firm, and
- Intra-firm competition/ conflicts and fear of losing technological edge if technology is transferred out have been identified among key challenges to technology transfer among firms in Ghana.

5.0 Summary and Concluding Remark

Technology transfer has become one of the critical issues on the global technological and socio-economic discourse. It has become critical because of globalisation and international trade. Firms no longer operate in their home countries alone but extend their operations to other territories. Consequently, firms with superior technologies are very competitive and most countries, especially, the developing ones have put in place mechanisms to ensure that their indigenous firms acquire the right technologies on favourable terms.

In Ghana, some institutions have been established to help in the acquisition of technologies from foreign sources largely from multinational companies. These institutions as discussed in this report include Ghana Investment Promotion Centre, Minerals Commission, Petroleum Commission and Ghana Energy Commission. The lead institution, the GIPC (in terms of sectors it covers) among others provides an avenue for registration of technology transfer agreements, as well as provides incentive schemes for companies that register their agreements per law. The GIPC has provided regulations to determine the type of agreements which should be registered and the duration of the agreement which can be registered. The need has been raised in this report for the GIPC to reconsider the duration of the TTA that can be registered. The TTA regulation stipulates that any

agreement less 18 months should not be registered. However, many services and management agreements with inimical clauses can fall within this scope (and then miss the scrutiny of GIPC).

The other institutions - the Minerals Commission, Energy Commission and Petroleum Commission have established regulations that are to ensure technology transfer through local content and local participation. The importance of these local content and local participation regulations cannot be over-emphasis, but there is a need for rigorous studies to assess the impacts of these regulations in ensuring local capability building.

The main firms reported in this report are from the agro-processing, financial, tourism, education and ICT sectors. The agro-processing sector is involved in processing agricultural products, while firms covered under the educational sector are those providing student hostels and accommodation. The financial sector firms are those in banking, the tourism sector firms are those providing travel and tour services, and the ICT firms are those providing online marketing and payments. All the firms are profit-oriented and are independent firms, not affiliated with any other firm.

Although there is an alternate stock market (GAX) for SMEs to trade and raise capital, the firms are not listed on the stock. There are fair gender dynamics among the firms surveyed and this need to be encouraged and sustained. Higher educational qualifications appear lacking among the firms. There are few firms with R&D units/offices but those units suffer from limited budgetary allocation and personnel for technology transfer

The majority of the firms have no partnerships with other firms, be it within or outside of the country. There are also a few firms or subsidiaries with limited or no technology export. Many of the firms have no formalized technology transfer strategy in the form of strategic plans, policies, or guidelines and only a few firms with dedicated teams or units such as technology transfer, licensing, industry liaison and knowledge exchange offices for handling technology transfer issues.

Many of the firms do not conduct regularly satisfactory surveys on their technology transfer partners, have no monitoring and evaluation division, or include technology transfer (TT) output as a criterion for performance appraisal of the research and development staff. There are no spin-out firms and dividends resulting from TT development and acquisition whether within the country or outside or in partnership with public institutions. In all scenarios of technology

licensing including patents, intellectual property and trademarks, the firms did not license and/or report no change, whether with national or international firms and firms hardly make a forecast for technological licensing in the future.

The use of open-source technologies is mixed, equal proportions were observed for ‘never use’, ‘often use’ and ‘sometimes use’. The challenges of technology transfer among firms are the absence of a well-working licensing market, too high prices charged by licensors, perceived weak protection of intellectual property (IP), and difficulty to identify and access TT partners, lack of skills in managing TT activities. Others are difficult to negotiate and enforce TT agreements with external parties, lack of information about technology needs and availability in the firm, intra-firm competition/ conflicts and fear of losing technological edge if technology is transferred out. While the policy and regulations guiding TT in Ghana, firms appear to lack knowledge in that regard.

Although the data for the study may not be sufficient to provide explicit conclusions, it provides some insight into TT operations of the sampled firms in Ghana. It appears firms consider TTAs confidential such that they are unwilling to provide the needed information to a third party. The importance of technology transfer to firms’ development notwithstanding, TT in Ghana is fraught with challenges (some presented above) despite existing laws and policies aimed at promoting TT.

APPENDIX - Case Studies

The main purpose of these case studies is to show the relation between local company and foreign companies in terms of technology transfer. However, due to difficulties in getting companies with technology transfer arrangements with foreign ones to respond to our request, we present two case studies involving technology transfer arrangements between two public research institutions and their counterpart private companies. The first case study involves the Centre for Plant Medicine Research (CPMR) and Kasapreko Company Ltd. The second case shows that relationship between the Food Research Institute of the Council for Scientific and Industrial Research (CSIR-FRI) and Natures Treasure Foods.

CASE STUDY 1: Centre for Plant Medicine Research

Background Information

The Centre for Plant Medicine Research (CPMR), formally called the Centre for Scientific Research into Plant Medicine, Mampong-Akwapim was re-established by the Specialist Health Training and Plant Medicine Research Act, 2011 (Act 833). The objective of the Centre is to conduct research into plant medicine for the promotion, encouragement, extension, transfer and application of scientific research, knowledge and development in the field of plant medicine. The functions of CPMR are, among others, to: (i) Establish guidelines for research into plant medicine and disseminate research findings (ii) promote national and international collaboration, technology transfer for effective development and utilization of research results in plant medicine for the benefit of the country. (iii) facilitate the evaluation of research findings to determine the therapeutic benefits of plant medicine for quality assurance (iv) establish botanical gardens for medicinal plants (v) Cooperate and liaise with traditional medicine practitioners (vi) Seek and generate funds for research into plant medicine (vi) protect the intellectual property rights of the Centre.

Over the years, the Centre has developed several products for human use. These include capsules, ointments, powders, roots, teas and decoctions. The sales of these products take place in 13 regions in Ghana as well as sales outlets in Abidjan, Cote D'Ivoire.

Transfer of Technology Arrangements

Generally, technology transfer arrangements take place in two areas - the basic research and herbal medicine production. The Centre has technology transfer arrangements with relevant institutions and individuals in the country. For example, as part of its professional development, the School of Pharmacy of the Kwame Nkrumah University of Science and Technology (KNUST) has signed Memorandum of Understanding (MoU) with CPMR for the latter to provide support for the professional training of herbal medical students from the School to conduct research and undertake project work. This is to help the students to gain some knowledge on how to prepare certain protocols and undertake experiments.

As part of the establishing Act, the Centre provides technical training to private professional herbal medical practitioners. Over the past five years the Centre had trained over 150 such professionals. Most of them are members of the Ghana Federation of Traditional Medicine Practitioners Associations (GHAFTRAM) who manufacture their own medicine.

Technology Transfer Arrangements with Kasapreko Company Ltd

Kasapreko Company Ltd. was established in 1989 by Dr. Kwabena Adjei, an indigenous businessman, with the aim of responding to the growing demand for high quality alcoholic drinks. The first product of the company was Kasapreko Dry Gin which was used for variety of purpose including traditional rites. The company then introduced Alomo Bitters through scientific support from CPMR and has made great inroads into the alcoholic beverage industry in the country. Alomo Bitters has now become the flagship and highest selling product of the company. In the next paragraphs, we will discuss the technology transfer arrangement between the CPMR and Kasapreko Company.

The relationship between Kasapreko and CPMR started around 2003 when the managing director approached the Centre with the idea of looking for a herbal medicine formulation that was tonic in nature and at the same time had aphrodisiac properties to be blended with alcohol to produce an alcoholic drink. Through research and intensive interaction between the Centre and Kasapreko Company, a formulation was developed which satisfied the company's business objective. The formulation was used to produce a local gin which is called Alomo Bitters. The formulation consists of 70% of the concentrates made of herbal extracts, alcohol and water.

Terms of Technology of Transfer

A technology transfer agreement is a legal contract used when a company, referred to as the licensor, licenses industrial or intellectual property rights to a licensee. It allows the licensor to retain ownership over the intellectual property while it is being licensed and utilized by the licensee. Normally, the agreement defines the terms of how the technology is to be used, the duration of use and the agreed compensation.

There was no formal contract or MoU between the Centre and Kasapreko Company. It was generally a “gentleman’s agreement” without any clearly stated obligations on the part of each partner including the ownership of intellectual property rights (IPR). So, over the years, there has been controversy over the ownership of the IPR. Further, the company has built internal capacity (absorptive capacity) and now requires only concentrates from the Centre and does the formulation in-house. So, the situation, according to an official of the CPMR, has now turned to be purely a commercial engagement.

The official further stated:

So, for the IP issue, we didn't look at it carefully, but we have learnt our lesson. So now he (CEO of Kasapreko) can claim ownership, we can also claim it too. But fortunately for us, what they produce, in terms of the quality is not like ours, they ask us to bring our formulation so that they can mix it with what they produce to enhance the quality of their product . So that's where we have a little bit of upper hand.

It can be argued that the initial focus of the centre in entering into the gentleman’s agreement or relationship with Kasapreko might not be monetary but to gain credibility or visibility. The Centre is a public institution and therefore monetary gain might be secondary since the services most public research institution provide until recently, are considered as social or public goods.

Further, the failure of the centre to press for a formal contract or MoU during the initial period of the engagement is a serious oversight which should never happen. It is even against the objective of the Centre. Thus, what would have been a multi-million relationship has been lost due to lack of contractual relationship between the two.

Company Performance

This section discusses the performance of Kasapreko Company with its star product (Alomo Bitters).

Market entry

The Alomo Bitters is the first commercially produced dry gin with herbal extracts introduced into the Ghanaian market. Working with the CPMR helped the company to produce high quality products, which has gained a strong niche in the alcoholic beverage subsector. Initially, Kasapreko used the name CPMR as part of its marketing strategies and this contributed to its strong market entry. This is because many Ghanaians trusted the efficacies, quality and safety of herbal products from the Centre. The massive acceptance of Alomo Bitters by the public has led to the proliferation of many companies producing similar (aphrodisiac) products under different brand names.

Capacity building

Technology cannot simply be transferred to a firm like a physical product but its effectiveness has to include important elements of capability building. Technological capabilities are the skills - technical, managerial or organizational that firms need to utilize efficiently the hardware (equipment) and software (information) of technology and accomplish any process. Therefore, it is important that every technology transfer, especially technical services/assistance and transfer of know-how should have capacity building as an essential part of the engagement.

Due to lack of formal contract or MoU between the two institutions, capacity building did not feature prominently throughout the engagement. As already mentioned, the company utilizes its internal capability acquired through its long operation in the alcoholic business and financial strength to employ qualified R&D personnel to help develop new brand of products and introduced them into the market. Such products include Alomo Silver and Alomo Gold.

Figure 1: Picture of Bottled and Satchet Alomo Bitters



Increased Market Position

According to an official of CPMR, the Centre has contributed immensely towards the performance of the Alomo Bitters on both local and international market. Alomo Bitters (as alluded earlier) has become the star product of Kasapreko Company due to the engagement of CPMR. Kasapreko Company initially used the name of the Centre as part of its marketing strategies and this has given the company competitive advantage in the local market. The company has now expanded its

markets to Nigeria, Togo, Cote D'Ivoire, Benin, Burkina Faso, Sierra Leone, Botswana, Uganda, Zimbabwe, South Africa, United Kingdom and the United States⁶. The Kasapreko Company is reported to be generating revenue of approximately \$70m⁷.

Introduction of new products

Kasapreko Management has engaged the Centre for the development of a new product based on Khaya. This is because the plants/herbs used in the initial development of Alomo Bitters have become difficult to obtain in Ghana and must be imported from Burkina Faso and other West African countries. Hence, the need for alternative herbs with similar properties became necessary. According to the Centre, the initial work on Kaya has provided interesting results.

Contributions to CPMR

The benefits the CPMR has derived from its engagement with Kasapreko Company have been substantial. The revenue derived from Kasapreko, according to an official at the Centre constitutes over 60% of its internally generated funds (IGF). This might be seen to be substantial but considering the market position of Alomo Bitters and the financial stature of the company, this IGF is considered as low.

⁶ <https://kasapreko.com/alomo-bitters>

⁷ <https://africaforesight.com>

CASE STUDY 2: Technology Transfer between Nature's Treasure Foods and CSIR-Food Research Institute

This case study involves Nature's Treasure Foods and the Food Research Institute of the Council for Scientific and Industrial Research (CSIR-FRI).

Background

The Nature's Treasure Foods was established in 2017 as a joint venture among family members. It has a board of directors drawn from other companies which have experience in food processing and distribution as well as personnel from the financial sector. The company seeks to reduce food insecurity, increase incomes, promote affordable healthy lifestyles and sustainable plant-based diets. It operates within the food processing subsector of the Ghanaian economy.

There are various snack products on the Ghanaian market with the granola concept but basically from grains and cereals normally not grown in the country. Therefore, the company was formed to produce exotic granola products based on African fruits, nuts and spices. Local fruits such as shea, baobab, tiger nuts, cashew, and coconut that are rarely used in granola products are utilised by the company to produce various products.

Transfer of Technology arrangement

As mentioned earlier, technology transfer agreement /arrangement defines the terms of how the technology is to be used, the duration of use and the agreed compensation. Largely, the search for a technology by a company is to enable it to introduce a new product onto the market or to bolster its competitiveness.

For Nature Treasure Foods to acquire a niche and gain competitive position in the market, the company explored the opportunities of introducing innovative products based on local raw materials such as fruits and under-utilized spices to develop new products based on the usual cereal-based granola concept. With this vision, the company sought support from local R&D institution with the requisite expertise to help it achieve its business objectives. Consequently, the Company joined the incubation programme of the Food Research Institute of the Council for

Scientific and Industrial Research (CSIR-FRI)⁸. The Institute has rich expertise in food product development and food processing. The incubation programme of the CSIR-FRI helped Nature's Treasure Foods to utilize both technical (plants, equipment and laboratory facilities) and scientific knowledge for the product development and production. Though, Nature's Treasures Foods has moved from the premises of CSIR-FRI, it still remains part of its incubation programme⁹. As part of the incubation programme, Nature's Foods was assisted to standardize its process and obtain Food and Drugs Authority certification for its products.

Type and terms of technology transfer engagement

Largely, the contract between Nature's Treasures Foods and CSIR-FRI is a technical service contract with 10 years duration but renewable after five years. As part of the agreement and as an 'incubatee', a team of scientists have been assigned to the company to assist it in product development and address production challenges. Per the MoU signed between the CSIR-FRI and Nature's Treasure Foods, the ownership of intellectual property rights belongs to both parties. In effect, it is a formal arrangement with well-defined ownership of intellectual property rights emanating from their engagement. The agreement between Nature's Treasures Foods falls within two technology transfer categorisations of Ghana Investment Promotion Council (GIPC) Act 865 namely (1) provision of technical services and assistance and (2) transfer of know-how.

The duration of the MoU is 10 years and it qualifies to be registered by the GIPC regulations. However, the arrangement is based on MoU, which is not contractual and hence cannot be registered by GIPC as the law permits.

Market entry and Performance

According to the CEO of Nature's Treasure Foods, the technology transfer arrangements with the CSIR-FRI has been very beneficial. The performance of the company in the Ghanaian market has been good since its first product entered the market in 2017. Since then, it has been recording about

⁸⁸ Food Research Institute (FRI) is one of the thirteen affiliate Institutes and Centres of the Council for Scientific and Industrial Research (CSIR) with the mandate among others is research into problems of food processing, preservation, food safety, storage, national food and security.

⁹ The CSIR-Food Research Institute runs two types of incubation programme – on site (within the Institute's premises and off site (at the premises of the incubate).

95% growth in sales over the years. Within five years, the company has introduced five products which can be found in elite supermarkets in Ghana such as Shoprite, Melcom, Palace Mall, Shell shops, Max Mart, Ernest Chemist, CSIR-FRI shop, and Akwaaba Lounge at the Kotoka International Airport, among others.

Figure 2: Products of Nature's Treasure Foods



Capacity Building

As mentioned earlier, technology cannot simply be transferred to a firm like a physical product, but its effectiveness should important elements of capacity building. Capacity building featured prominently in the MoU signed between the parties. Consequently, the inclusion of capacity building enabled the company to utilize the vast technical capacity available at CSIR-FRI to improve its activities. As already mentioned, the staff of CSIR-FRI visits the company once a week to provide technical and product development and production support. The company also receives technical support from USAID. The support from CSIR-FRI and USAID has contributed to the immense progression in both technical and production capacities.

Access to improved technologies

The relationship with CSIR-FRI has provided opportunities for the company to access new R&D findings which will go a long way to improve its technical capabilities as well as market performance. Access to improved technologies has enable the company to introduce new category of products called NOSH, super fruit moringa and Coconut toffee. These products are also doing well in the local market.

Contributions to CSIR-FRI

According to an official of CSIR-FRI, the benefits derived from the engagement with Natures Treasure Food is twofold – monetary and visibility. In terms of monetary benefits, the Natures Treasure Foods pays CSIR-FRI an amount of GHS1200 (USD105)¹⁰ per month and this figure excludes direct operational expenses incurred by the CSIR-FRI. The other benefit to the CSIR-FRI relates to gaining visibility, especially at the time when there is much emphasis on partnership between R&D institutions and the private sector to commercialise research findings.

General Discussion

The cases reveal some key issues that need further discussion. In this section we discuss these issues, which include the current legal and regulatory framework for technology transfer, the popularity of MoU and visibility vs. monetary gains.

Legal and regulatory regimes for ToT in Ghana

As stated in the main report, GIPC 2013, Act 865 provides the regulatory framework for technology transfer arrangements. However, the focus had been on foreign technology transfer arrangements i.e., arrangements between foreign and local companies with the total exclusion of technology transfer arrangements between local institutions and private companies. Therefore, such local technology transfer arrangements are not mandated to be registered or subject to the technology transfer regulations set by GIPC. Once the arrangement is not registerable, it then

¹⁰ <https://www.oanda.com/currency-converter/en/?from=GHS&to=USD&amount=1200> data retrieved on 18th July, 2023

follows that the parties cannot benefit from incentive scheme provided by the GIPC law. This situation might not encourage the institutionalization of technology transfer among local institutions and might create dependence syndrome on foreign technologies.

MoU vs. Formal Contract

From the two case studies, the emphasis had been on MoU instead of a formal contract between the two parties. Experiences from the CSIR reveals that most of its institutes often sign MoU which should be the first step towards contractual relationships. The use of MoU is becoming fashionable with public institutions while private organisations will go beyond MoU and adopt formal contracts in their operations.

Visibility vs. Monetary Gain

An interesting phenomenon which was not very clear in the case of CRPM but very visible in relationship between CSIR-FRI and Natures Treasure Foods is the emphasis on non-monetary gains. According to an official of CSIR-FRI, the Nature's Treasure Foods pays paltry sum of GHS1200 (USD 105) per month to CSIR-FRI. This figure excludes the operational expenses incurred in dealing with the private company. Though Nature's Treasure Foods is part of the CSIR-FRI incubation programme, the sum is paltry, and cannot pay the salary of the staff of the Institute. The emphasis has rather tilted towards gaining visibility rather than monetary gains.

It may be possible that concept of gaining visibility underlined the initial engagement between CRPM and Kasapreko. The Centre has realized this mistake and has moved away from the issue of visibility to more of financials gains in its subsequent arrangements. As a result, in its research into using alternative plant materials (Khaya), the Centre has set up a committee to prepare MoU to guide the engagement. This is a positive development that will enable the Centre to benefit equitably in that engagement.

Conclusion

The discussion has centred on two case studies of technology transfer involving two local public R&D institutions and two private companies. Largely, the technology transfer in the two case studies were technical services and know-how contract. It is evident from these case studies that

the technology transferred from the local R&D institutions to the private companies made significant contributions to the performance in terms of development of new products, access to market, improvement in market positions, access to improved technologies and know-how.

The discussion in the main report reveals that the legal and regulatory framework of the country for technology transfers do not cover local technology transfers but rather that of arrangements between local and multinational companies. In this situation, local technology transfers arrangements are not regulated by the GIPC Act 2013, Act 865 and therefore cannot benefit from the opportunities provided under the Act. This is very discriminatory and does not encourage or bolster local technology transfers. There is need for the GIPC to take a second look at its regulation to cover local technology transfer relationships. This will among others, encourage the private sector to first scan the local R&D environment before resorting to the international market for support.

It is evident from the two cases that the technology transfer arrangements are based on MoUs rather than formal contracts. Though the MoUs are ‘agreements’ which indicate an intention, they are not contracts and therefore may not be legally binding and cannot be enforced by the laws of the land. In these case studies, while CSIR-FRI signed an MoU to guide its relationship with Natures Treasures Foods, there was none between CPMR and Kasapreko. The relationship between Kasapreko and CPMR in the formulation of Alomo Bitters concentrates was rather based on what is termed as a “gentleman agreement” which did not spell out roles and responsibilities. However, in the subsequent relationship with Kasapreko on research on Khaya plant, and MoU is being drafted. Though this is better than the case of Alomo Bitters, CPMR should rather press for a formal contract to adequately benefit from the relationship. It is argued here that local technology transfers arrangements should be anchored on formal contracts rather than MoUs. An MoU should be used as a preliminary step before negotiating for a formal agreement.

Finally, the R&D institutions should not only focus on the issue of ‘visibility’ but also push more for ‘monetary rewards’ in their relationships with private companies. This will help them generate adequate resources to fund their research activities as well as their operational costs. This has become critical in our situation where government support for R&D activities has been dwindling over the years. Evidence exists in the developed countries where R&D institutions have benefited

greatly from their relationship with private sector companies. R&D products, even when funded by governments should no longer be considered as social goods but must be commercialised to generate adequate returns.

It can be concluded from these case studies that opportunities for local technology transfer between local R&D institutions and the private sector exist. However, what is required is the necessary regulatory framework and the continuous conscientisation of the local R&D institutions to enter into formal contracts in their dealing with the private sector. This will enable them to benefit adequately should the transfer become very successful.

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