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WEST AFRICAN TAX ADMINISTRATION FORUM

TAX DATA INFRASTRUCTURE NEEDS ASSESSMENT

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TAX DATA INFRASTRUCTURE NEEDS ASSESSMENT

This Technical Report contains findings on data infrastructure capability assessment of tax administrations in WATAF member states. The findings and recommendations must however be interpreted within the purview of the attributes of the qualitative data employed in the study.

Suggested Citation/Attribution

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About WATAF

The West African Tax Administration Forum (WATAF) comprises Tax Administrations of all of the 15 West African countries: Benin, Burkina Faso, Cabo Verde, Cote d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo that are members of the Economic Community of West African States (ECOWAS). WATAF was created to lead tax policy coordination and concerted tax administration capacities in the region. WATAF promotes tax transparency, harmonises regional tax laws and policies, promotes regional integration, and facilitates regional knowledge sharing, including dialogues to improve the quality of tax administration in Member States in order to increase the mobilisation of domestic revenue.

The inaugural meeting of WATAF was held at the Forum of Heads of Tax Administration in West Africa at the Rockview Hotel, Abuja, Nigeria on 12 September 2011. The original signatories to WATAF's formation were representatives of Tax Administrations from five West African Countries, namely, Benin, Ghana, The Gambia, Liberia, and Nigeria.

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ABBREVIATIONS AND ACRONYMS

AI	Artificial Intelligence
ASYCUDA	Automated System for Custom Data
CIAT	Inter-American Centre for Tax Administrations
ECOWAS	Economic Community of West African States
ICT	Information and Communication Technology
IMF	International Monetary Fund
IOTA	Inter-European Organisations of Tax Administrations
ISORA	International Survey of Revenue Administrations
OECD	Organisation for Economic Cooperation and Development
OSF	Open Society Foundation
SQL	Structured Query Language
WATAF	West African Tax Administration Forum

Executive Summary

Tax data can aid efforts of revenue administrations to identify sources of revenue leakages. Such possibility depends on the quality of tax data, including its reliability, completeness, and currency, which can be guaranteed through high level data infrastructure capability. The study employed exploratory research design to assess the capability of data infrastructure of revenue administrations in West Africa with a view to identifying insights for improvement in domestic revenue mobilisation. The study is premised on the understanding that revenue leakages take various forms and could be minimised in environments with limited institutional capacity when strategic investments are made to improve data quality, data matching, and data usage.

Qualitative analysis was employed in this study with the use of content analysis and textual interpretations of the information gathered from both primary and secondary surveys. The main thematic areas are data storage, integration, analysis, and security facilities in revenue administrations. Moreover, the broad ICT-data related infrastructure was also examined. Results show that data analytic tools are commonly utilised in the selected revenue administrations, despite low revenue staff/population ratio. The results are mixed on the use of centralised data systems, with no structural deficiency in the use of either centralised or independent sub-unit data systems. However, there is no evidence that substantial investments were made in cloudcomputing facilities orartificial intelligence (AI) infrastructure. In particular, AI adoption is nearly non-existent in West Africa. Further analysis shows that various custom-built and commercial ICT tools that can serve various stages of tax data lifecycle are available and in use across selected revenue administrations.

In order to enhance revenue mobilisation in West Africa, systematic and strategic investments in tax data infrastructure and skill development are vitally imperative, and much more so, given the averagely low staff capacity of the revenue administrations. On average, there is limited tax collection capacity in West Africa, but improved efficiency of revenue administrations through the deployment of suitable technological tools would enhance tax revenue performance without necessarily increasing the tax burden on the economy. Through a peer review process, appropriate data infrastructure can be conveniently adopted in a cost-efficient manner. In sum, the study suggests that the sharing of country experiences in tax data infrastructure should be prioritised among West African countries. This would help to 7 understand the opportunities and challenges of certain technological tools and to protect the sensitivity and sovereignty of tax systems in each country.

1. Background

Data infrastructure[1] - inclusive of physical and intangible capital stock as well as support personnel - are facilities that comprise key equipment and a set of tools that provide resources and services necessary to make a system of data generation, acquisition, transmission, conversion, storage, processing, and presentation for final users possible. These items also include related human resources and support facilities such as electric power, physical buildings, etc. that are critical to attaining effective data usage. They are the leading and notable aspects of a data system that help an organisation perform satisfactorily in the face of challenges to business operations[2] and harness the power of data for growth and development. Tax administrations, particularly in developing economies, need robust capacity in data processing and utilisation to meet the current challenges of domestic revenue mobilisation. Whenever such capacity is absent, the risks of widespread tax evasion become exacerbated.

Data generation nowadays has become more frequent, convenient, and less expensive owing to advancements in digital technology, and as a result, large or big datasets are available for use. Hence, data is seen as the new “crude oil”. Data and data infrastructure determine the extent of the benefits an organisation would reap from existing volumes of data. In real sense, it constitutes the support system for planning and decision-making that mitigates and minimises risks in the face of uncertainties.

Tax data is no exception to the large sets of data now available. The OECD recognises data management as a requisite new skill for effective digitalisation of tax administration[3] and improved revenue collection. Tax administrations have access to volumes of micro-level taxpayer data on the one hand and, on the other, data types from enterprise operations. The capability of data infrastructure in a tax administration is therefore a key area to consider because both the data-generating process and the infrastructure it utilises are subject to change.

The more advanced the digital technology, the wider the possibility of access to a higher frequency and a larger amount of data. The processing and utilisation of the same depend on the capability of the infrastructure.

[1] By data infrastructure, we refer to the set of provisions that enable all types of tax data to serve the purpose of decision making. These provisions range from physical to intangible assets, as well as human expertise to manage the data for meaningful use.

[2] According to the Global Development Network (GDN) programme document (see GDN, 2017. Doing research assessment: Understanding research systems in developing countries, GDN, New Delhi.)

[3] OECD (2020). Tax Administration 3.0: The Digital Transformation of Tax Administration. OECD Paris. http://www.oecd.org/tax/forum-on-tax-administration/publications-and-products/tax-administration-3-0- the-digital-transformation-of-tax-administration.htm.

According to the United Nations Economic Commission for Africa (UNECA), the contribution of African countries to innovation and technological advancement is negligible[4], and so the region has remained among the highest net consumers of scientific tools and evidence. The status implies that West Africa tends to lag in adopting the latest technologies, incurs a huge cost for technology acquisition, and requires training and knowledge transfer to make effective use of these products.

These considerations may, in one way or another, impede the utilisation of relevant modern tax data infrastructure in revenue administration. Of note are the existing competence and capabilities within the tax administrations in the region, and the possession of a crystal-clear commitment to improve.

The national databanks[5] in West Africa may contain facts on fiscal, development, and macro-economic indicators generated by national and international bodies for public use. However, the data infrastructure that is available in the region places restrictions on the databanks. Breakthroughs in computing and technical knowledge can be leveraged to harvest and preserve different tax data types that tax authorities may encounter. Unlike in developed countries, longitudinal surveys that span several decades are difficult to come by in West Africa. Tax administrations, however, can choose to be different with proper planning and implementation of a tax data programme that is supported by modern data infrastructure.

The current study entails an assessment of the existing capabilities of data infrastructure in West African tax administrations, and it does so with a view to suggesting ways to improve it. The study also offers policy suggestions for tailoring capability development in WATAF member states. The assessment is benchmarked both within the group (normative) and relative to known data infrastructure in the literature.

> The remainder of the report is structured as follows: Section 2 contains THE equipment for data and its functions in tax administration. Section 3 presents data and methods, while Section 4 is an analysis of the data and discussion of the results. In Section 5,' we present the summary and recommendation.

[4] 4The information is contained in: Mutume, G. (2007). Africa aims for a scientific revolution. Africa Renewal. (https://www.un.org/africarenewal/magazine/october-2007/africa-aims-scientific-revolution). Also, see Gurid-Fakim, A., and Signe, L (2022). Investment in science and technology is key to an African economic boom. Foresight Africa: Africa in Focus,(https://www.rookings.edu/blog/africa-infocus/2022/01/26/investment-in-science-and-technology-is-key-to-an-african-economic-boom/)

[5] Refer to African Development Bank Report (2020)

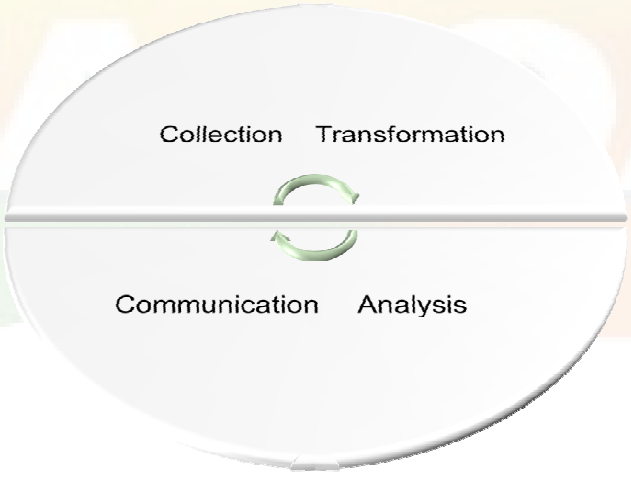
2 Managing Data for Policy Decisions

Basically, data collection, interpretation, and measurement are among the core challenges to data-driven decision-making, including tax policy. In this section, the data life cycle and equipment are carefully discussed, and implications are drawn for the data infrastructure framework.

2.1. Data Life Cycle

In every organisation that generates data, the expected data life cycle ranges from data collection, transformation, analysis, and communication to productisation of data to deliver decision-making insights. Tax administrations generate and collect a high volume of data from a variety of sources and taxpayers, and in almost all cases, these data must undergo processing to aid revenue collection and administration. For tax authorities to improve revenue collection, deliver improved service, and maintain efficient relations with taxpayers and other stakeholders, their decisions need to be informed by intuitions that suggest or point to tax-

Figure 1: Typical data life cycle



payers' behaviour, attitude, assessment of the tax system, perception of tax administrative service, and the like.

Among others, tax administrations need to build, modernise, and strengthen their data infrastructure system in order to draw useful, substantial insights from the large, heterogeneous, and complex data they generate regularly and derive maximum value that can improve reve-

nue functions. Figure 1 displays a few broad common features of the data lifecycle that could be found in tax administrations. Tax administrations collect data on taxpayers' tax returns that comprises several attributes.

In revenue administration, taxpayers and vendors fill out various forms for different purposes, either hard or digital, as required by tax codes. Also, human resource forms can be found with various tax authorities. Moreover, the transformation of these data could involve data wrangling, compression, and encryption, knowing full well that tax data contain a substantial amount of private information. In managing tax data, various sets of tools are employed, including those that could facilitate easy communication of results for revenue policy and decision-making.

2.2. Data Equipment and Their Functions

Numerous sets of tools that constitute an infrastructure system for data are discussed in this section. These tools are useful across all organisations, including tax administrations that generate and use data for management decisions. As previously mentioned, these infrastructures can be tangible (physical tools) or intangible (software).

Computer systems: These are desktops, laptops, servers, and other devices that are used for processing and analysing data. Servers are computers that store and manage data and provide services to other devices on the network. The needs and size of a tax administration determine the extent to which servers will be deployed, such as for hosting websites, managing email, or running applications.

Data storage and networking devices: The storage tools include hard drives, solid-state drives, and other storage devices that are used for storing data. High-speed storage networking equipment is also related to this category. As the volume of data generated and stored by organisations increases, high-speed storage networking equipment becomes essential for accessing and transferring data quickly and efficiently. On the other hand, routers, switches, and other related devices are examples of devices for networking.

Data security software and equipment[6]: This includes software tools that are used to secure data from unauthorised access, hacking, and other security threats. In addition, the security equipment ranges from intrusion detection, prevention systems, and antivirus software, to other security tools that are used to protect the organisation's data and systems from threats and attacks. The security devices protect data from unauthorized access and possible data corruption.

[6] The benefits of cloud computing services seem enormous, but they pose high risk for tax data management. Tax authorities in West Africa must have a strong capacity to secure their databases when deploying cloud computing services. Due to the inherent vulnerability to attacks, this assessment does not consider cloud computing services to be extremely essential for tax data management, hence their omission from the list. However, it serves the important purpose of keeping anonymous tax return data. In essence, tax administrations need to ensure that data stored in the cloud is coded, de-identified, or re-identified in order to protect taxpayers' identities. Another set of devices that expose an organisation's databases to external devices or networks are the content delivery networks (CDNs), which distribute contents such as video, images, and other media to users around the world. CDNs help to reduce latency and improve the user experience.

Power supply: This includes the physical infrastructure required to supply power to the data infrastructure equipment, such as power outlets, power strips, and uninterruptible power supplies. The power and cooling systems, as well as racks and cabling, which are used to support and manage the physical infrastructure of the data centre, could also be associated with these tools.

Backup and recovery devices: Devices such as external hard drives and tape drives are used for backing up and recovering data. These are used to protect data in the event of data loss or system failure. Backup systems may also include diskbased backup systems or cloud-backup services.

Data visualisationsoftware: The tools that are used for creating visual representations of data, such as charts, graphs, and maps. This allows organisations to create virtual versions of servers and other systems, which can help save on hardware costs and improve system flexibility.

Load balancers: Load balancers distribute network traffic across multiple servers or data centres, improving performance and reliability. Load balancing can help organisations ensure that their systems are available and responsive to users.

Automation and orchestration tools: These tools serve to streamline information technology processes, reduce errors, and improve efficiency. Automation can be used for tasks such as software deployment, updates, and monitoring.

Monitoring and analysis tools: These tools help organisations understand their data infrastructure, track performance, and identify issues before they become problems. The tools can provide insights into network traffic, system health, and resource utilisation.

The list of available tools for the data lifecycle cannot be exclusively listed at a point in time because of advances in information and communication technology (ICT), dynamics in data science, and the current drive-in innovation in science. Regardless of the name, placement, or classification, these sets of tools are to serve the following broad classes of functions in any business organisation, be it private or public: data collection, storage, security, integration, and analysis. Figure 2 displays type of data infrastructure according to various listed functions.

However, the recent developments in ICT tools have expanded the possibilities for-deploying some specialised tools for administration functions, such as tax collection. These digital tools include artificial intelligence (AI), machine learning (ML), robotics, blockchain, etc. Artificial intelligence (AI) is a work-enabler that functions like human

Figure 2 : Types d'infrastructures de données

Data Access	*Data Storage*	*Data Integration*	*Data Processing*	*Data Quality*
Databases	*Data Management*	*Data Security*	*Data Centres*	*Networks*

intelligence based on some computer programmes. AI can be adopted to perform certain amounts of tax administration, and according to the ISORA Survey, some uses of AI include automated provision of personalised information to taxpayers, virtual assistants, risk assessment processes, tax fraud detection, decision-making on tax administration, dispute resolution, and so on. Whereas robotics functions in place of humans.

Robotics are programmable machines that perform like humans. It is usually a quick self-service technology that facilitates business transactions without human interference. Certain tax administrative functions are also adaptable to the deployment of robots for the purpose of avoiding inconsistencies and complexity that do arise from human behaviour. Robotics can also be a useful technology to guarantee a predictive experience for taxpayers in their dealings with the tax systems in West Africa.

It is worth noting that a few administrations in West Africa have deployed some sort of modern digital technology to aid revenue collection and tax business development.

3. Approaches to the Study: Data and Method

The kernel of the current study is an assessment of the data infrastructure capabilities of the member states of WATAF in order to identify some relevant suggestions for future investments and projects. The overall aim of the study is to stimulate improved tax service delivery, efficient tax administration, and above all, enhanced domestic revenue mobilisation in West Africa. The study is purely exploratory, utilising contextual information from various sources and the key functional areas to base an assessment of tax data infrastructure.

3.1 Population and Sample

The 15 countries in ECOWAS, which are also member states of WATAF, constitute the population of the study. The initial study was intended to present country cases for all of the countries (census), but a paucity of data prevented this goal[7]. Hence, a sample of selected countries was taken. The sample was adjudged representative but could not be generalised to all. Moreso, the exploratory nature of the study prevents (valid) inference-making

3.2 Data Sources and Method of Analysis

A semi-structured questionnaire[8] was designed to elicit information from key areas of tax data

[7] Censuses give researchers the advantage of collecting useful information from (nearly) all respondents, or, modestly, a large proportion of the study population, who usually provide the original information required for research objectives of this nature.

[8] The research instrument is included in the Appendix. Although it benefited from insights from ICT experts, it is original and should be credited as a contribution by WATAF to knowledge production. Future research and researchers may improve the questionnaire, expand its coverage, adapt its content, and update it for their use. Since the research instrument attempts to benchmark a system of data infrastructure, it can also assist subnational tax agencies in understanding their capabilities in tax data infrastructure and assessing areas to channel their investment.

infrastructure. The sections of the survey instrument solicited information on the respective tax administration's data- and ICT-related departments, the existing facilities, data governance, data storage, security, networking, and so on. Relevant pieces of information were extracted from the websites[9] of the sampled countries. This was supported by information from the OECD[10], the ATAF's African Tax Outlook, as well as responses from senior officials from selected revenue authorities in West Africa. The analysis of the qualitative contextual data was executed based on the themes that represent the core areas of the data lifecycle. In particular, content analysis techniques using thematic format was adopted in the study.

4. Characteristics of Tax Data Infrastructure: Capability Assessment and Options for Investment

This section contains an analysis of selected tax data infrastructure in revenue administrations in West Africa. The presentation adopts a normative style of benchmarking and assessment. For instance, the availability of a given analytical tool in some countries but not in others suggests the countries without it lack capacity or tools. Therefore, where possible, the use of both generic and custom-built digital tools is employed to describe and present the study's findings .

4.1 Electronic Systems in Tax Administration

In Table 1, the use of electronic media in revenue administration across West Africa is examined. The table shows the electronic tax platforms. All the countries listed have adopted electronic tax returns and electronic tax payments as parts of their tax systems to a reasonable extent, except the Gambia, which did not adopt electronic methods as a means of tax payments and tax returns. However, electronic payments of tax liabilities are in use in the Gambia, but their effects on the filling and payment of returns is not considered substantial. The findings are based on the information in the ISORA survey as of 2020. Countries that use electronic returns provide the tax officials with accurate information in addition to easy accessibility and identification of any errors. It also enables taxpayers to identify errors before submission and receive a fast acknowledgement. Countries that utilise the electronic returns enjoy easy data processing. It is compulsory to utilise electronic payment platform provided by the revenue authorities in Ghana, Liberia, Nigeria, Senegal, and Sierra Leone, whereas in other countries other means of tax payment are permissible.

[9] Available on, for example, Togo (https://www.otr.tg/index.php/fr/), Benin (https://www.impots.bj/), and Liberia (https://revenue.lra.gov.lr/).

[10] Available at OECD (2021), Tax Administration 2021: Comparative information on OECD and other Advanced and Emerging Economies, OECD Publishing, Paris, https://doi.org/10.1787/cef472b9-en and CIAT, IMF, IOTA, OECD (2022). International Survey on Revenue Administration (ISORA) 2020 and 2021. ISORA reports present a few measures on ICT (and data) infrastructure in tax administrations. Among others, tax administration expenditure, operational ICT solutions, and staff size can be utilized. However, the reported estimated total expenditure on ICT and research infrastructure can be misleading, because external funding may have been included. It is usually a substantial part of development assistance in West Africa.

Countries that have made electronic tax payments compulsory can gather accurate information about the tax payment and errors are easily identified but countries that have various means of tax payment can lack adequate information about tax payment as there may be opportunity for avoidance of tax or provision of inadequate information.

It is very important for countries that have yet to utilise electronic tax payment to adopt it to reduce tax avoidance and ensure that adequate information is provided by taxpayers.

The table also shows that about 53 percent of countries (Benin, Burkina Faso, Guinea Bissau, Niger, Nigeria, and Togo) adopt mobile payment as part of their tax systems. One common observation is that countries have names for their tax platforms. A few of these names include TaxProMax (Nigeria), Gamtaxnet (The Gambia), Liberia Integrated Tax Administration System, LITAS (Liberia), Dimana (Togo), and Kontorku (Guinea Bissau). The combination of both the electronic tax payment system and the traditional payment system may have been necessitated by low infrastructural capacity in a few tax administrations, or probably due to inadequate investment[11] in human resources to manage the volume of data and queries that require quick and immediate attention.

Table 1: Electronic Data Infrastructure in Tax Administration

	Electronic Return	Electronic Tax Payment	Strictly Electronic Tax Payment	Mobile Payment
Benin	YES	YES	NO	YES
Burkina Faso	YES	YES	NO	YES
Cape Verde	YES	YES	NO	NO
Cote d'Ivoire	-	-	-	-
Gambia	NO	NO	NO	NO
Ghana	YES	YES	YES	YES
Guinea	-	-	-	-
Guinea Bissau	YES	YES	NO	YES
Liberia	YES	YES	YES	YES
Mali	YES	YES	NO	NO
Niger	YES	YES	NO	YES
Nigeria	YES	YES	YES	YES
Senegal	YES	YES	YES	NO
Sierra Leone	YES	YES	YES	NO
Togo	YES	YES	NO	YES

Source: *Computation based on data from International Surveey on Revenue Administration ,2020*

Note: *The extent of use of electronic tax mechanisms varies from one country to another. The International Survey of Revenue Administration (ISORA) report is a joint publication of Organisation for Economic Coopration and Development (OECD), Intra-European Organisation of Tax Administrations (IOTA), Inter-American Centre for Tax Administrations (CIAT) and International Monetary Fund (IMF)*

[9] In Liberia Revenue Administration (LRA), the personnel in charge of statistical data analysis needs capacity building. A very few officials are saddled with the responsibility of data analytics and modelling, and a team structure has yet to be instituted in this respect. This claim is based on an August 2022

4.2 Human Resource and Institutional Status of West African Tax Administration

Apart from the preliminary results on the background information of revenue authorities in West Africa, the ratio of staff capacity of revenue administrations to the entire population is reported. This is necessitated by the fact that the use of technology to drive tax business processes may be efficient based on a number of considerations. Table 2 shows the staff capacity and the use of websites to collect statistics on queries from taxpayers in the respective countries in West Africa. The staff-to- population describes the extent to which revenue authority capacity spreads across the economy, particularly at the national tax jurisdictions. It therefore suggests that utilising improved data infrastructure to enhance revenue mobilisation is pivotal. Forty percent of the countries (Benin, Burkina Faso, Niger, Nigeria, Senegal, and Sierra Leone) have one staff per 10, 000 people. These estimates are approximations to the nearest whole number. The actual figures range from 0.49 (Nigeria) to 1.1 (Burkina Faso) to 10, 000 people within the population of their countries. This may affect the efficiency of the staff members leading to low productivity.

While everyone in the population does not qualify as a taxpayer, particularly children and minors who do not fall within the labour force, we can argue that each is affected by tax policy and its administration in one way or another. An attempt to estimate the actual ratio with regards to technical/core staff capacity to urban population (or adult population) to get a sense of the potential reach of revenue administration may be a reasonable endeavour. However, the purpose of this report is to make a case for the improvement of tax data infrastructure in revenue authorities, because tax business is everyone's business. An effective and efficient revenue mobilisation that engenders robust state-citizen engagement serves to benefit all. Adequate staff capacity with technical know-how is crucial for the government to derive the benefits of utilising digital data systems in revenue administration.

In relation to tax-to-gross domestic product (tax/GDP), Cabo Verde recorded 20.1 percent, a figure that was greater than every other country in the sample. It suggests the country's staff strength may have translated into efficiency in collection. A further analysis indicates that Cabo Verde does not lag in the use of modern digital tools to manage tax business or even over the data lifecycle. While Nigeria has a semiautonomous tax administration, the ratio of staff is like many other countries in the region. Thus, in addition to staff capacity development, the deployment of relevant infrastructure, including tax data equipment, may help in increase the efficiency of revenue mobilisation in these countries.

The table also reveals that sixty percent of the countries in West Africa administer online queries to taxpayers. It thus suggests that most of these countries adopt modern digital technology as a means of gathering information about taxpayers. It creates an avenue for tax authorities to minimise the running cost of administration. It also reduces the administrative

survey conducted by WATAF and presented in a publication titled Building Data for Tax System Development and Service Delivery, WATAF WCR 23/002 (Liberia). The LRA is an example of circumstances of a few revenue administrations in West Africa but cannot be generalised and used as a benchmark for all countries. Studies in need assessment treat each unit of analysis as a case study, an approach that is also shared in this study. As much as possible, a common trend or theme is emphasised where necessary.

burden on tax officials and enables them to have more time for important activities. With the use of an electronic platform, the revenue authority can preserve data and information on taxpayers. It also shows that the data infrastructure is strong because it caters to a large number of taxpayers and their requests. The online platform allows taxpayers to lodge complaints and give feedback.

It allows them to request assistance in complying with their obligations and further eliminates transport costs to tax offices. This platform enables taxpayers to review their information,

Table 2: Human Resource and Institutional Status in Tax Administrations

Country	Staff/Population (in 10000 persons)	Taxpayer Query online data	Institutional Status
Benin	1	YES	Under ministry and separated
Burkina Faso	1	-	Under ministry
Cape Verde	7	YES	Under ministry and integrated
Cote d'Ivoire	2	-	-
Gambia	3	NO	Semi-autonomous and integrated
Ghana	2	YES	Semi-autonomous and separated
Guinea	-	-	/
Guinea Bissau	-	YES	/
Liberia	2	YES	Semi-autonomous and integrated
Mali	-	-	Under ministry
Niger	1	NO	Under ministry and separated
Nigeria	1	YES	Semi-autonomous and separated
Senegal	1	YES	Under ministry and integrated
Sierra Leone	1	YES	Semi-autonomous and integrated
Togo	3	YES	Semi-autonomous and integrated

Source: Computations using information from various sources

which enhances their compliance.

Table 2 further shows the institutional status of the countries. In the Gambia, Liberia, Sierra Leone, and Togo, tax administration is autonomous and integrated, i.e., domestic taxes and customs are merged under the same authority. This indicates that the selected tax administrations have the legal and administrative capacity to ensure that adequate personnel are employed to manage taxpayers' size in order to bring about an increase in tax revenue. The practice of a semi-autonomous tax system makes tax systems free from political interference and, at the same time, improves tax compliance, which helps to increase tax revenue. Independence authority granted to tax authorities encourages a fair and less discretionary collection.

Semi-autonomous tax systems may also create the managerial flexibility and space required for a more effective tax administration compared to the conventional tax system. Tax authori-

ties in these countries are merged with customs, which may enable data collection to be more effective. Tax semi-autonomy is expected to improve tax revenue collection. The tax administration of some countries selected is semiautonomous but separated (that is, the operation of domestic taxes and customs is under the same authority). The tax authorities have the power and resources to invest in the required infrastructure to enhance business operations. This enables qualified personnel to be in operation rather than people who lack the technical know-how of tax administration.

Likewise, a few of the selected countries (Cabo Verde and Senegal) operate institutionally integrated tax systems with the Ministry of Finance as supervisor, suggesting that the budget for tax administration would be dependent on the ministry. Tax administrations may not have the power to determine the capacity of the personnel required for an effective and efficient tax system, which may affect their productivity in the collection of adequate information from taxpayers, which in turn may have a negative effect on the tax revenue generated. Domestic taxes in these countries are under the same authority as customs. Whereas in Benin and Niger, tax administration is under the ministry of finance and is treated separately from customs, but the tax authority does not have the power to invest in business operations, and in Burkina Faso and Mali, tax administration is exclusively run as a department under the ministry of finance.

In most countries, the Ministry of Finance supervises their tax agencies, but this may have substantial implications for the latter's performance. The magnitude and nature of the effects depend on each country's organisational arrangements for the ministryrevenue agency relationship, the technical capability of the ministry, and constitutional provisions for revenue administrations. As a consequence, the extent and suitability of data infrastructure in each WATAF member country may be linked to the relationship with the supervisory ministry. Also, about half of the countries operate a semi-autonomous tax administration. This approach may provide the tax authority with an opportunity to draw up a budget for infrastructure on an annual basis, thereby improving data infrastructure,

4.3 ICT Data-Related Infrastructure in Tax Administrations

The level of digital infrastructure in a tax administration suggests how much has been invested in data and data-related infrastructure. For tax administrations to maximise efficiency and effectiveness in revenue mobilisation, they need to have strong capacity in ICT infrastructure suitable for data generation, processing, and preservation.

According to available information in the joint publication of the OECD and a few other partners using the ISORA survey, captured in Table 3, the use of either custom-built or commercial off-the-shelf digital tools is largely adopted by most of the countries in West Africa. The countries with 'NO' may have digital data infrastructure but have no information regarding the most recent year. For example, Sierra Leone and Togo have responses for the years 2018 and 2019, respectively, but not for 2020, based on the ISORA report. However, additional data sources via the self-administered questionnaire as well as the content analysis of the website

[11] A technical report by WATAF on Building Tax System for Tax Administrative and Public Service Delivery (WATAF Country Report 001, in press) contains partial evidence on availability of digital infrastructure in Togo Revenue Authority.

of the Togo Revenue Authority, for instance, show that modern tax data infrastructure such as the one examined in this section is being deployed[12]. Related discussion on this important part of assessing a country's infrastructure capacity is found in the subsequent sections.

The popularity of cloud computing notwithstanding, its use has yet to cover all the countries' tax administrations.

Table 3: ICT-Based Solutions in Tax Administrations

Country	Operational ICT Solutions	Cloud-based solutions
Benin	YES	NO
Burkina Faso	YES	NO
Cape Verde	YES	NO
Cote d'Ivoire	--	--
Gambia	YES*	YES*
Ghana	YES	YES
Guinea	NO	NO
Guinea Bissau	YES	NO
Liberia	YES	YES
Mali	--	--
Niger	YES	NO
Nigeria	YES	YES
Senegal	YES	YES
Sierra Leone	NO	YES
Togo	NO	YES*

Source: Author's computation based on International Survey on Revenue Administration (2021)

Note: --' means no information was available for the country. The operational ICT solutions are measured as either on premises commercial off the shelf or custom-built ICT equipment. The data was valid for 2020 survey only. Some countries (The Gambia, Togo etc) may have information on previous years or other categories of operational ICT solutions. *2019 data only.

4.4 Functional Tax Data Facilities in Tax Administrations

Table 4 shows some additional attributes of facilities for tax data collection and utilisation in a set of countries. The administration of tax data in some of the countries selected is centralised. That is, the data were stored in a centralised tax data warehouse. A tax data depository is a specialised warehouse designed to support the corporate tax reporting and compliance process. One main advantage of tax data is that it is entered once and could be used by many users for various purposes, which include tax data analytics and global tax planning. Centralisation of tax data saves time on tax data collection across a wide variety of tasks in the tax lifecycle. Centralisation of data also helps to reduce non-compliance risk because tax data warehouses eliminate the inherent risk of manual data entry.

Tax data warehouses provide validation, security, governance, transparency, and audit trials of data, which make it easier to prove tax compliance. The centralisation of tax data helps to build a strong and effective data infrastructure that is transparent and cost-efficient. Central-

Table 4: Function-Based Data Facilitites in Tax Administrations

Country	Centralisation	Extent of digital format	Conversion Tool	Data Integration
Liberia	Yes	Recently more digital	Scanner, manual entry	Yes
Nigeria	No	Full	Scanners, manual data entry/occasionally	Separated by units but a central database
Senegal	Yes	--	Scanners	Yes
Sierra Leone	Yes			
Togo	No	Largely digital	Scanners	--

Source: *Author's computation based on countries' information*

Note: *Data availability informed the selection of countries. '— connotes non-availaility of required information at the time of survey.*

isation of tax data helps tax officials identify new opportunities for tax analytics. However, in the case of Nigeria, data centralisation is not fully entrenched. A few reasons might be that customs and domestic taxes are separated in one hand and that the large size of the economy and taxpayers require the use of departments or units to manage information to a certain extent.

Table 4 further shows the extent of the data format adopted by the countries. Few of the selected countries have engaged in digitalisation of their tax collection and administration; hence, they are in possession of large amounts of digital data. The digitalisation of taxes reduces the workload for compliance byautomating the process of data collection, and at the same time it ensures spreadsheet integrity.

It also eliminates spreadsheet risks because compliance software does not use spreadsheets. It increases the time available for review, increases efficiency, and increases transparency. Tax digitalisation helps to prolong the lifecycle of data collected compared to manual collection, which makes officials always have access to tax data.

The data conversion tool is also presented in Table 4. Most countries use Scanners as data conversion tools. Using scanners for conversion helps tax authorities protect data from unauthorised users, maintain transparency, and, at the same time, guarantee data security. This is because access to data is controlled. The use of scanners by tax authorities also enables them to recover data in the event of a disaster. However, a few countries still adopt the manual method of data conversion alongside scanner usage. Nigeria, for instance, carries out data conversion occasionally, but with manual entry where necessary.

Table 4 reveals data integration in the countries selected. Liberia and Senegal are identified to practice data integration. This implies that units work together to ensure that relevant and adequate data are collected from taxpayers, which fosters efficiency and transparency. Data integration encourages time maximisation. However, in the case of Nigeria, data are collected separately by units, but the country operates a centralised database. This may be time- consuming and inefficiency-promoting compared to a practice that integrates collected data.

4.5. Analytical and Computing Tools in Tax Administration

Table 5 shows the basic data infrastructure in revenue administrations in West Africa. It shows that MS Excel software is the most common analytical tool adopted for analysis. The adoption of MS Excel by these countries enables tax authorities to present their data in a visual manner, which is easier for policymakers to understand, and it is also an easy technique for tax officials to learn, which helps to enhance the tax data infrastructure of countries.

Results in the table further show that Python and Power BI software usage account for approximately forty percent of the West African countries selected. The use of Python software enables tax officials to access taxpayers' files when needed and helps to analyse large volumes of tax data. Likewise, Power BI enables the analysis and sharing of large amounts of data, the accessibility of information when needed, and the ability to connect with other software. It is cost-effective and prevents data from being viewed by unauthorised users.

Table 5: Basic Analytical Tools in Tax Administrations

Country	Analytical tool	SQL/Frequency	Data Mining/ Storage
Gambia	ASYCUDA World, MS Excel	Gamte, Camcel, Africell, COMIUM and Qcell.	Need basis/ Cloud computing
Guinea Bissau	MS Excel, ASYCUDA	Nil	Needs/Cloud web
Liberia	Python, MS Excel, ASYCUDA.	Yes/Always	Based on Needs/ -
Nigeria	MS Excel, Power BI, Python	Yes/Always	Always /NetAPP, Huawei Oceanster
Senegal	MS Excel, Power BI	--	Weekly/Secure Database
Togo	Python, Power BI, R, MS Excel, SYDONIA	Yes/Daily	Yes, almost daily by a team of officers

Source: *Author's computation based on countries' information.*

Note: *ASYCUDA – Automated System for Custom Data; MS Excel – Microsoft Excel; BI- Business Intelligence; and SQL- Structured Query Language.*

Python, R, and ASYCUDA (in French, SYDONIA) are common software and platforms being adopted by some of the countries as parts of digital tools or systems for data collection, hosting, and analysis. In relation to traditional methods of analysis, which are long gone, R has remained a user-friendly tool to analyse large datasets. Interestingly, R and R-Studio are available openly and for free. There may have been other analytical software, but Python also serves a useful purpose in supporting the analysis of large data sets for decision-making. These software enable data migration, enhance data collection, clean data, analyse it, and present it effectively. R and Python, in particular, facilitate quality plotting and graphing and are compatible with some other programming languages that enhance the data systems of organisations, including revenue administrations.

The Automated System for Custom Data (ASYCUDA) was initially developed by the United Nations Conference on Trade and Development upon a request from the Economic Community of West African States (ECOWAS) in 1981. The platform is now widely employed by revenue organisations to manage trade and customs data. Other versions of the initial version include ASYCUDA ASYCUDAv2, ASYCUDA++ and ASYCUDA World, the latest of which utilises an open and web-based technology for its functioning.

The importance of Artificial Intelligence (AI) to tax administration cannot be overestimated. AI provides quality monitoring, which helps to reduce corruption, manage the experiences of taxpayers and tax non-compliance issues, strengthen taxpayers' rights and obligations by providing them with required information, and save taxpayers from irregular situations by preventing them from carrying on tax activity at the point of irregularities. However, AI is yet to be adopted in West African revenue administrations, but owing to its importance, the countries may study its usability in their contexts before its adoption. Table 5 further reveals additional data management strategies in the selected countries.

The use of digital tools[14] by tax administrations in West Africa enable them to efficiently manage related databases . The table further shows the mining and storage of data. The percentage of countries that conduct data mining is 40 percent. Some countries carry out data mining based on requirements; that is, data mining is conducted only when there is a need for it. Occasional data mining may prevent tax authorities from having adequate information about taxpayers and further constrain the data infrastructure. While some revenue administrations occasionally mine data, the exercise is part of the regular routine of others for various uses and needs. In this regard, revenue administrations would avail themselves of taxpayers' information that can aid necessary decisions. The SQL tool also constitutes a useful tool as a component of tax data infrastructure and data utilisation in the selected countries.

Considering the importance of data storage in strengthening data infrastructure, cloud computing seems like a veritable tool, although its sophistication and sensitivity to attacks raise fears, particularly for use in revenue administration. Notwithstanding its vulnerability, cloud computing still presents opportunities for data and information storage. As earlier stated, its

[14] Structured query language (SQL) is a programming language for processing information in relational databases.

adoption should be based on a strict and holistic assessment of its technical adaptability to the structure of each country. Cloud computing helps to minimise cost, is sustainable and flexible, helps in quality control, and is secure as well as efficient. This storage method enables tax officials to have access to data whenever it is needed.

The different analytical methods adopted by countries enable them to present the data in different and more meaningful ways. It is important for countries that are yet to make use of these analytical tools to enhance their tax data infrastructure.

5. Strengthening Revenue Mobilisation through Tax Data Infrastructure: Policy Options

Infrastructure is critical to building an effective tax system and efficiently mobilising revenue. Tax data infrastructure is fundamental to judicious tax collection in these days of globally interconnected economies. The present level of capabilities of the West African countries, as shown in Section 4, implies a number of relevant recommendations for improved investment in the infrastructure in order to collect the much needed domestic revenue in these countries. Based on the findings, one can argue as follows:

1. Development plan for infrastructure in revenue administrations. Domestic resource mobilisation should be accorded an important place in development planning in West African countries. Revenue administrations need to see their functions as vitally needed by the economy, and thus there must be plans and programmes of action to regularly enhance their capabilities, including in the tax data infrastructure. For instance, the use of artificial intelligence and its related forms, such as machine learning, is sparse in all the countries in the region. Similarly, it is rare to see many home-grown technologies being utilised for revenue mobilisation, according to the available data. Investment in critical digital and non-digital tools would engender technical knowledge acquisition, training in skills and competence, as well as the possibilities of creating innovative products that can support data creation, generation, collection, utilisation, and productisation. The more capacity a revenue administration builds, the better the service delivery to the populace. This is more important in developing countries where the informal sector is large, and the demography of business is unstable.

2. West African revenue administrations must step up their efforts in mobilising domestic revenue through investment in data infrastructure that saves costs and enhances efficiency. The dominance of a low ratio of revenue-staff-to-population attests to the scarcity of resources to expand the human resources component. In view of the need to avoid overburdening tax administration with wage costs and their associated expenses in health insurance, recruitment and retention, pension and gratuity, etc, revenue administration should earmark a sizeable budget for regular training for staff in computing, digital services, as well as the acquisition

or development of relevant sets of technology tools in optimal combinations that guarantee higher efficiency and enhanced effectiveness, particularly in the short and medium horizons of transforming revenue administrations. No business will thrive beyond the technology that is in use, including tax data infrastructure. An insight from a pool of quality, complete, and reliable taxpayer-level data may surprisingly make substantial revenue contributions to government coffers.

3. Progressive tax system reforms entail, inter alia, digitalisation of tax administration. The use of tax data is among the key areas that are much needed for transformation. From property to business taxes, there is widespread evasion in West Africa. This is a consequence of a large, expanding informal economy that has substantial self-employed workers, who are not integrated into the tax systems. A huge investment in cloud-computing, electronic tax registry, personal identification, mobile payment system, spatial identification, and analytics to reach every labour market participant in each country would be of great benefit. For instance, the digital identification systems could be integrated into the tax identity for all and sundry. Decisions and tax policy choices could be based on the volume of population in the databases.

4. Tax data could be a new crude oil, provided revenue administrations leverage its quality and quantity to tame illicit financial flows, capital flight, tax evasion, and other forms of revenue leakage. Tax administrations in West Africa can invest in simulation models such as the computable general equilibrium models that depend on rich economy-wide datasets. These models have the capacity to simulate tax policy changes and their probable effects on the economy. However, without quality, reliable, and complete data on economic agents, the model estimates or findings may be spurious and misleading, or at best, the forecasts may have large variances.

5. In the short term, tax administrations should embrace peer learning and review mechanisms. It not only saves money but also facilitates less expensive acquisition of skills and capacity. Local development of data infrastructure, including software, may easily be replicated in other jurisdictions if its creators share their experiences and challenges in using it. In essence, tax administrations in West Africa can leverage the presence of ECOWAS and WAEMU to continually engage one another on areas critical to their operations, one of which includes the optimal use of tax data (infrastructure) for effective domestic revenue mobilisation in West Africa.

6. Most importantly, data quality plays a crucial role in knowledge creation and enterprise decisions. The capability of the tax data infrastructure of public agencies would determine data quality and possibly the ability to match various sources of data from all government databases. Countries with low, traditional infrastructure would experience much more tax revenue leakage than those with advanced infrastructure. Therefore, data quality must be enhanced through investment in data infrastructure in revenue administrations.

Appendix : Survey

WEST AFRICAN TAX ADMINISTRATTION FORUM

TAX ADMINISTRATION DATA INFRASTRUCTURE NEEDS ASSESSMENT

Background Information

The West African Tax Administration Forum (WATAF) is an intergovernmental organisation of the 15 Tax Administrations of the member states of ECOWAS. WATAF promotes more functional, effective, and responsive tax administrations (TAs) in its member countries, and achieves this goal through capacity building, technical assistance, and peer learning. One strategy that supports the drive to realising these objectives include the identification of the immediate and future needs of member countries to set relevant interventions.

This survey is developed to extract responses from member countries to assess the extent to which they match data infrastructure requirements for modern revenue collection functions. This form seeks information on the data infrastructure capability of WATAF member states to identify areas in the Secretariat that may provide support. It would also help to compare infrastructure systems across member states for peer learning. The insights from this study can serve as the basis for engagements with donors, development partners, technical assistance providers, and capacity development facilitators.

To this end, we request you kindly fill out the form and return it to the WATAF Secretariat.

Instruction: Please fill in the responses where the dots (....) are.

Section A: Institutional Information

i. Name of Tax Authorities:.....

ii. Department of the officer: .....

iii. Are the following departments/units available separately in your revenue administration? (Choose 'Yes' or 'No')

a.	Information and Communication Technology Department	Yes	I	No
b.	Statistics Department	Yes	I	No
c.	Management Information System Unit	Yes	I	No

Section B: Tax Administration Digital Tools

iv. Mention the digital/technology tools being used to manage external stakeholders such as taxpayers ……..
(Hint: This may be a platform or tool taxpayers and tax authorities meet to register, make payments, etc. Examples include the ITAX, TaxProMax, etc).

v. Are your data repository centralised for all information? (Choose 'Yes' or 'No').....

vi. What percentage of the digital format is your overall data collection from taxpayers and tax business operations? ……

vii What tools do you use to convert paper records to digital format? ……

……

viii. How frequently do you convert your paper records to digital format (daily, weekly, monthly, quarterly, etc)? ……

ix. Are your tax administration data repository integrated into all units or it is a standalone facility where officials move information when necessary? (Please describe it briefly) ……

x. What form of data storage tool do you use? ……

……

xi. What modern computing tool do you use for analytical tasks (examples include Microsoft Excel, R, Python, Looker, Tableau, Power BI, Report Builder, etc)? ……

……

xii. What modern digital tool do you use to retrieve and share data across units? ……

……

xiii. Do you use SQL, and how frequently? (You may mention another tool if you do not have the Structured Query Language) ……

……

xiv.. How frequently do you do data mining and what department does it?……

……

xv. Please underline one or more of the following if you use them. (You may statethe one you have if it is not listed). (Note that each category from 'a' to 'c' represents a unique function in data management):

a. Airbyte. Airflow. Fivetran. Stitch.
Others (specify) ……

b. AWS. Big query Snowflake Redshift.
Others (specify) ……

c. Atlas Amundsen Others……

xvi. Please comment on the use of Artificial Intelligence, Machine Learning, etc inyour tax administration. (Hint: Is it available, being used, being envisaged, etc?)

……

xvii. What are the biggest challenges your organisation faces in managing tax data?

……

……

xviii What are your organisation's plans for improving its tax data infrastructure?.....

xix How does your organisation ensure the accuracy and completeness of tax data?
.....

xx What processes are in place for identifying and resolving discrepancies or errors in tax data?
…….....

xxi What types of data backups and disaster recovery plans are in place to ensure the availability of tax data in case of system failures or other disruptions?

.....…….....

Thank you for your time.

WATAF Secretariat.