zef
Center for
Development Research
University of Bonn

AGRODEP
African Growth & Development Policy
modeling consortium
by AKADEMIYA2063

Working Paper 233

Alkassoum Saadatou Sangare, Tite Ehuitché Beke and Mahamadou Tankari

Assessing employment and labour market effects of rural infrastructure investments in the Sahel region:

Cases of Niger and Côte d'Ivoire

ISSN 1864-6638 Bonn, June 2024

PARI

ZEF Working Paper Series, ISSN 1864-6638
Center for Development Research, University of Bonn

Authors' addresses

Alkassoum Saadatou Sangare
Laboratoire LARADES - Université Djibo Hamani de Tahoua and Cellule d'Analyse des Politiques publiques et d'Evaluation de l'action Gouvernementale
saadalk@gmail.com

Tite Ehuitché Beke
Université Félix Houphouët-Boigny d'Abidjan and Centre d'Analyse des Politiques Economiques du CIRES
beketite@yahoo.fr

Mahamadou Tankari
Akademiya2063
mtankari@akademiya2063.org

Assessing employment and labour market effects of rural infrastructure investments in the Sahel region

Cases of Niger and Côte d'Ivoire

Alkassoum Saadatou Sangare, Tite Ehuitché Beke and Mahamadou Tankari

Abstract

Investments in infrastructure are necessary to achieve the objective of Sustainable Development Goal-2 (SDG2), which is to “end hunger, ensure food security and promote sustainable agriculture” and to also create jobs in the Sahel region, specifically in Niger and Côte d'Ivoire. A significant portion of the populations of these two countries live in rural areas where they are mainly employed in agriculture. But due to a low availability of of infrastructure, many rural populations do not benefit from basic services such as access to energy and irrigation. Starting from an input-output analysis and a multiplier model based on the social accounting matrices of Niger and Côte d'Ivoire, this research analyzes the impact of an investment policy in rural infrastructure on job creation and agricultural development. The results confirm the significant contribution of development of rural infrastructure for employment and highlight the importance of adjusting investments to local circumstances for maximizing the employment contribution. In the case of Niger where the initial state of the coverage of water and electricity needs is very low, additional investments in such infrastructures make it possible to maximize job creation. In Côte d'Ivoire, employment creation appears greater following investments in road infrastructure. However, these jobs do not include long-term cumulative effects that would result from the increase in income. A large part of the jobs created are in the construction sector. The other additional jobs would come from sectors of agriculture, trade, and food processing to which are added the extractive industry for the case of Niger and the basic metal industries and transport in the case of Côte d'Ivoire. The study recommends that Sahelian countries align their investment strategy in infrastructure with a skills development strategy in the field of construction. This contributes to the structural transformation of Sahelian economies and increases the field of possibility for unqualified rural workers.

Keywords: Rural Infrastructure, Agricultural development, Employment, Input output model

JEL codes: O18, Q10, R15, Q16

Acknowledgments

This study was developed in the context of the Program of Accompanying Research for Agricultural Innovation (PARI) and the Analysis and Implementation of Measures to Reduce Price Volatility in National and International Markets for improved Food Security in Developing Countries (Volatility) project, both supported by the Federal German Ministry for Economic Cooperation and Development (BMZ).

We would like to thank Getaw Tadesse, Lukas Kornher and Heike Baumüller for their valuable comments on the draft versions of this study.

Table of contents

1 Introduction

Infrastructure investments are critical for achieving the Sustainable Development Goals (SDGs). Achievement of these goals is greatly influenced by the availability or improvement of related infrastructure. In low and middle-income countries, particularly in the Sahel[1] region, the infrastructure that ensures access to basic services such as safe drinking water, electricity, road, and all weather access to markets is still inadequate. Africa's Pulse report 2017 reveals that only 35% of the Sahel population has access to electricity, with rural access rates less than one-third of urban ones (World Bank, 2017). On the other hand, adequate infrastructure is needed to connect farmers and firms to markets in order to create employment and income. However, transport infrastructure is likewise lagging with Sub-Saharan Africa being the only region in the world where road density has declined during the period 1990-2011 (World Bank, 2017).

The agri-food industry is the Sahel's largest economic sector accounting for a third of its GDP and 75 percent of total employment (IFC/World Bank, 2017). However, agricultural productivity is low due partly to a lack of adequate infrastructure. For instance, the proportion of cropland irrigated in the Sahel is dramatically lower than that of other developing regions (2% in the Sahel compared to 37% in Asia and 14% in Latin America) (FAO, 2016). Besides, transport costs are substantially higher in Africa, than in other regions, despite lower labour costs (World Bank, 2008).

In sum, infrastructure is a serious challenge in the Sahel countries. Poor access to basic services, poor road networks, and lack of irrigation infrastructure, menace food security, driving up costs of food products and reducing competitiveness (IFC/World Bank, 2022). Accounting for this context, it is crucial that economies in the Sahel region promote investments in infrastructure thereby contributing to food security, poverty reduction, and job creation.

Massive infrastructure investments have important impacts on employment and the labour market. Although job creation is rarely the primary objective of infrastructure investment in the short term, enhancing qualitative and quantitative employment outcomes is increasingly seen as one of the development impacts of infrastructure investments that need to be optimized. For this reason, there is an increasing interest in assessing and capturing these effects.

During their construction, infrastructure investments generate significant employment in the construction as well as related sectors that provide its inputs. Globally, there is an increased interest in monitoring these employment impacts so that these can be better understood and factored into National Development Plans and National Employment Policies. At the same time, such knowledge can help strengthen the use of infrastructure investment as a policy response to the negative employment effects of economic downturns and other types of crises. With a demographic growth of around 3,3%[2] in 2020, the Sahel region has the highest population growth rate (Toshiko Kaneda and all, 2020). This region is thus challenged by the need to feed an increasing population sustainably. Agriculture is a key component of this equation. Particularly, infrastructure investment in the agro-industrial sector such as small-scale irrigation infrastructure, energy, feeder roads, trans-regional infrastructure, and integrated agro-industrial parks, could play a major role in shaping the future of the region's food systems.

The lack of an adequate number of decent jobs for a growing young population, particularly in rural areas, is a major issue in the Sahel region. Indeed in the Sahel, more than 60 percent of the population is under the age of 25. Two-thirds of them live in rural areas and rarely have the opportunity to access employment, develop their skills, and benefit from financial services, inputs, and technologies (FAO, 2023). The main transition axes in the Sahel are rural solar energy, irrigation, sustainable and climate-

[1] The vast semi-arid region of Africa separating the Sahara Desert to the north and tropical savannas to the south, which is as much a land of opportunities as it is of challenges.

[2] Estimate made by the authors based on statistics provided in the World Data collection for the 5 Sahel countries (Mali, Niger, Burkina Faso, Mauritania and Chad)

smart agriculture, and the restoration of collective lands. They could lead to the creation of more than 8 million jobs for young people, with the majority working on the land and fields (Wiggins S. and all, 2023). Assessing employment and labour market effects of infrastructural investments related to food systems will be central to informing and designing a comprehensive agro-industrial policy and the future of food systems in the Sahel region.

This study focuses on the Sahel region and mainly targets Niger and Côte d'Ivoire, two countries which share common characteristics in terms of challenges of inclusive growth, agricultural development, poverty reduction, promotion of food security, and job creation (AfDB, 2023). The programs to revitalize and modernize the agricultural sector undertaken in the two countries are based on addressing the constraints and challenges to agricultural development, including limited access to rural infrastructure. The underlying belief is that increased investment in rural infrastructure could boost the productivity of the agricultural sector and generate employment effects. This research aims to enlighten policies on the evidence of this correlation but above all to quantify the effect of an increase in rural infrastructure (feeder roads, irrigation, water, electricity) on rural agricultural development and the creation of jobs. It also answers the question of how this contribution can be maximized.

The study is organized as follows: the second section provides an overview of the socio-economic profiles and political context related to infrastructure investments in Niger and Cote d'Ivoire. The third part presents the literature review on the Employment Impact Assessment (EIA) model and discusses the data sources and methods used for the analysis. The fourth section presents the results and discussion of the analysis.

2 Socioeconomic profile and rural infrastructure investments in Niger and Côte d'Ivoire

2.1 Recent macroeconomic performances and socioeconomic challenges

Macroeconomic trends in Niger between 2012 and 2019 were marked by rapid growth in fluctuating GDP on average between 4.1 percent (2013) and 5.9 percent (2019) with peaks of 11.8 and 7.2 percent respectively in 2012 and 2018 respectively. However, since the COVID-19 crisis, economic growth has slowed a 3.5 percent in 2020 and 1.4 percent in 2021 (WDI, 2022) before rebounding at a 7 .1 percent in 2022. In Côte d'Ivoire, where the average growth of real GDP was 7.8 percent over the period, the post covid economic recovery was faster since the growth rate was located at 7.4 % in 2021 after 2 % in 2020. In both countries, the recovery was favored partly by the implementation of recovery plans and the pursuit of investments in infrastructure within the framework of the National Plan Development (NDP) (AfDB, 2022). As an illustrative basis, the analysis of sectoral contributions between 2012 and 2021 shows that the recent growth of Côte d'Ivoire was drawn mainly by the tertiary and secondary sectors (22.2%) driven by the construction sector and the public investments in infrastructure (AfDB, 2022).

However, the growth recorded in both countries has not been sufficient to significantly improve the standard of living of populations. The annual growth rate of GDP per capita is 4.48 percent (WDI, 2022) in Côte d'Ivoire. And even if the poverty rate increased from 44.4 percent in 2015 to 39.4 percent in 2018, poverty still watches about 10.064 million Ivorians, rural populations being the most affected (54.7% D 'impact). The situation is also not brilliant in Niger where the incidence of poverty was 41.8% in 2021 with more than 10 million Nigeriens living in poverty. In rural areas, it is 46.4%.

2.2 Employment and socioeconomic challenges

Niger and Côte d'Ivoire, like several developing countries, face several socio-economic challenges, including the development of the rural world and the issue of employment for young people occupy a place of choice. The importance given to the rural world results from the importance of the agricultural sector in the economic development of these countries. Niger has a little diverse economy, dependent on agriculture for 40 % of GDP. In Côte d'Ivoire too, agriculture remains the engine of economic growth, generating more than 22% of GDP in 2021. Statistics from the World Bank (WDI 2022) show that the employment rate in agriculture is important in the two countries. It is at 45, 57% including 38.92% for women and 50.52% for men in Côte d'Ivoire while in Niger 71.14% of the active population including 69.22% for women and 72.52% for men work in the agricultural sector.

In addition, rural areas in the two countries house a large fringe of the population, generally the youngest, the poorest, and the least endowed in capacity and competence. Statistics show that young Ivorians represent the active population segment most affected by unemployment, with a rate of 4.45% higher than the overall unemployment rate (2.82%). The combined rate of unemployment and underuse of labour reaches 13% among young people aged 15 to 24. In Niger, this rate is 14% in 2020 (BIT, key labour market indicators (ICMT)) while the ILO unemployment rate for young people aged 15 to 34 is estimated at 12.2 % in 2017, (INS and Afristat, 2019). The underemployment affects approximately two in three young people.

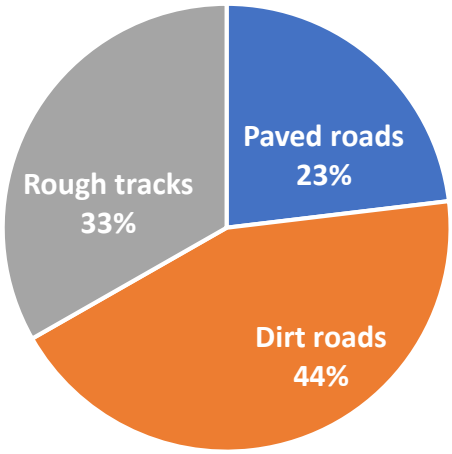
The rate of young people who are not in employment, education, or training (NEET) is another indicator revealing the job situation in the two countries. It is estimated by the ILO at 39.2% in rural areas of Côte d'Ivoire Coast, significantly higher than in urban areas (31.1%) (ILO, 2019). In Niger, the proportion of young people aged 15-24 years almost tripled between 2014 and 2017, from 25.2% to 68.6% (WDI, 2022).

Other socioeconomic challenges exist and manifest in terms of access to basic infrastructural services with significant disparity between rural and urban areas. In 2020, only 43 % of the Ivorian population had access to electricity in rural areas against 94 % in urban areas. In Niger, the rate is 9.72% in rural areas against 63.84% in urban areas. The rate of access to drinking water was 80% and 97% in an urban environment respectively in Cote d'Ivoire and in Niger against 56% and 55% in rural areas, while 48% of the Ivorian urban population (respectively 38% of the Nigerian population) had access to sanitation infrastructure against only 21% and 6% in rural areas in Côte d'Ivoire and in Niger respectively (WDI, 2022). In addition, rural unpaved roads representing 90% of the Ivorian road network remain marked by a high rate of degradation despite their crucial importance for the transport of agricultural products and the development of the agro-food system (AGEROUTE, 2020).

2.3 Dynamics of infrastructure investments

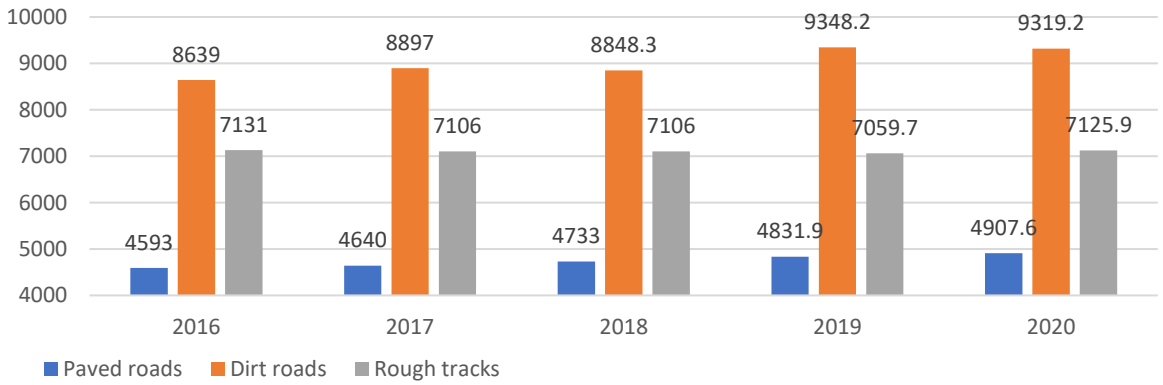
The state of Niger and its partners have invested heavily in the development of transport infrastructure. The average annual investment rate of around 30% of GDP has enabled the country to build 1,114 km of paved roads, rehabilitate 729 km of existing roads, and construct major infrastructure projects. The number of paved roads in the country has increased over time from 3952 km in 2010 to 5066 km in 2019. In 2021, it stands at 4952 km or around 23.1% of the total road length estimated at 21,433 km (Figures 1 and 2).

Fig 1: Distribution of the national road network by type in 2021 in Niger



(Statistical directory of the Ministry of Equipment 2017-2021, 2021)

Fig 2: Development of the road network in km by type and by year in Niger



(Statistical directory of the Ministry of Equipment 2016-2020, 2021)

In Côte d'Ivoire, the implementation of the National Development Plan (NDP, 2016-2020) has contributed significantly to accelerating investment in basic infrastructure. Indeed, transport, energy, and water infrastructure have been the focus of major investments under public-private partnership (PPP) projects (Table 1).

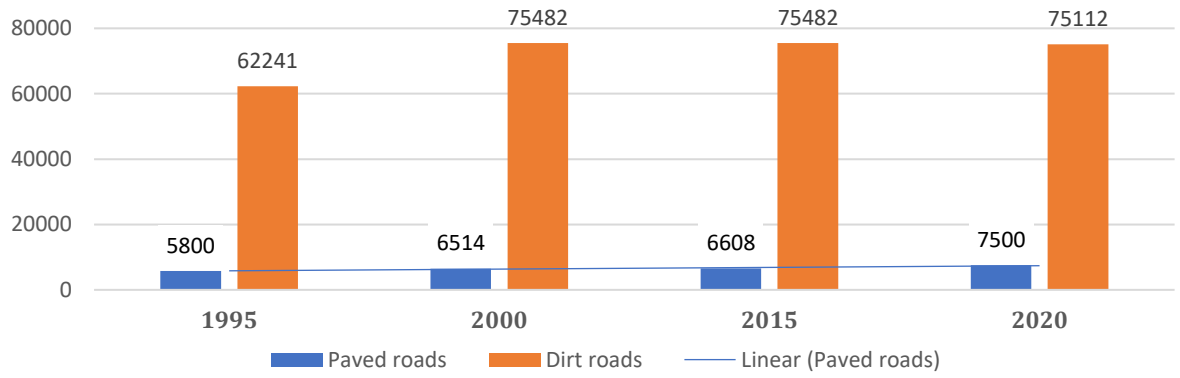
Tab 1: Distribution of investment in infrastructure sectors in Côte d'Ivoire and Niger

	Cote d'Ivoire			*Niger*		
Sector	Investment amount (in billion Fcfa)	Share in total Investment (%)	Share in public Investment (%)	Investment amount (in billion Fcfa)	Share in total Investment (%)	Share in public Investment (%)
Transport	5,310.043	9	4	175.046	7	0.02
Road infrastructure	4,863.055	8	17.8	204.209	9	25,8
Energy	4,882.012	8	11.2	252.887	11	21,0
Water	2,065	3	6	330.386	14	4,5
Digital Economy	1,485.563	3	0.5	-	-	-

(Côte d'Ivoire NDP (National Development Plan) 2021-2025, Niger PDES (Economic and social development plan) 2017-2021 (Ministère du Plan, 2017) and Report on the execution of the 2021 public investment program (Niger))

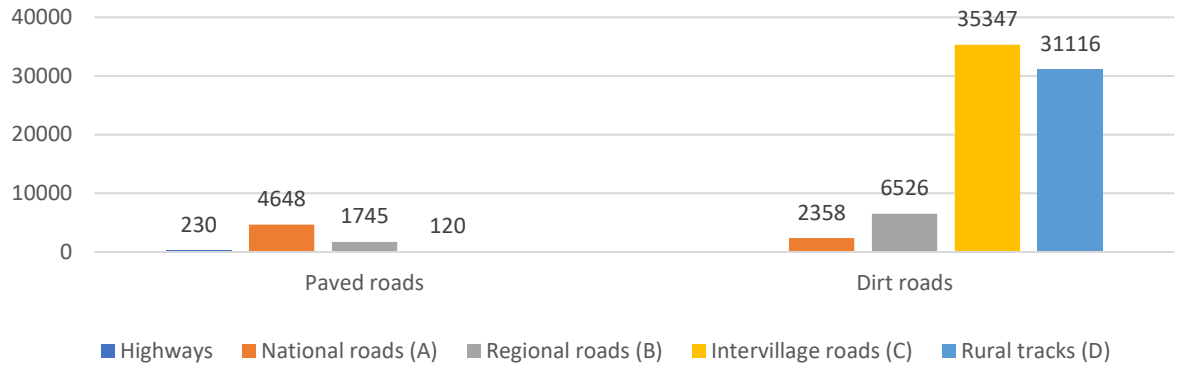
In Côte d'Ivoire, investments in rural electrification have enabled the electrification of 3,041 localities between 2012 and 2019. Continued investments in the road sector since 2016 have enabled the construction of 1,004 km of new paved roads, including 878 km of intercity roads and 126 km of highways. Statistics on the current state of the road network show a linear stretch of around 82,612 km of classified roads, comprising 7,500 km of paved roads and 75,112 km of earth roads, including 35,467 km and 31,116 km of rural and feeder roads respectively (Figures 3 and 4).

Fig 3: Dynamics of the road network in Côte d'Ivoire according to road classification



(AGEROUTE (Agence de Gestion des Routes), 2020)

Fig 4: Distribution of the road network in Côte d'Ivoire



(AGEROUTE (Agence de Gestion des Routes), 2020)

Despite investments in infrastructure in both Côte d'Ivoire and Niger, huge access challenges remain in rural areas. The limited access of rural areas to basic infrastructure can be seen in both the availability and the quality of these infrastructures. Indeed, in Niger, the limited resources allocated to the construction, maintenance, and rehabilitation of the road network justify the poor condition of a large part of the network, which has an impact on transport costs. Road quality does not change significantly while the Rural Accessibility Index (RAI), remains almost constant over the 2017-2021 period (Table 2).

Tab 2: Road network distribution by infrastructure quality in Niger

Indicator	2017	2018	2019	2020	2021
Percentage of paved roads in good condition (%)	65,8	62,5	67,2	70,65	62,90
Percentage of dirt roads in good condition (%)	80,5	79,7	71,6	91,1	72,80
Rural Accessibility Index (RAI) (%)	36,9	36,21	36,7	37,2	37,1
Road availability km/1000 hbts	0,66	0,63	0,64	0,63	0,61
Road density km/1000 km²	10,68	10,72	11,19	11,23	11,29

(Statistical directory of the Ministry of Equipment 2017-2021, 2021)

For the next years, the ambition of Niger's public authorities by 2025 is to provide efficient, safe, and economical domestic and international transport infrastructure and services for all categories of Niger's population and all sectors of its economy, in a sustainable way and with minimum impact of the environment. This will be achieved mainly through the upgrading and asphalting of roads and urban highways (more than 85% of the overall infrastructure investment budget), as well as the construction of modern earth roads, crossing structures, interchanges, and railroads.

The Ivorian government understands the importance of rural infrastructure in economic transformation and employment creation. To this end, the National Agriculture Investment Plan (Ministère de l'Agriculture et du Développement Rural, 2017) includes local investment programs in the following infrastructure: irrigation and hydro-agricultural infrastructure, basic social infrastructure (energy, water), feeder road infrastructure and other infrastructure (processing and marketing, etc.) representing a total amount of 4,325.4 billion FCFA over the period 2018-2025.

Economic literature establishes a close link between investment in infrastructure and all the other sectors of the economy (Osei, 2013). In particular, theory demonstrates the existence of multiplier

effects on production and employment induced by infrastructure investment (Keynes, 1936 [1973]; Barro, 1990). In the short term, increased investment in infrastructure generates direct and indirect employment in the construction sector, related sectors, and the economy as a whole. In the medium and long term, direct employment effects will arise from the provision of infrastructure services, while other induced benefits may arise from reduced transport costs and increased incomes.

What are the effects of investment in rural infrastructure on employment in Niger and Côte d'Ivoire? This study aims to shed some light on these questions, by estimating these effects.

3 Data and methodology

3.1 Modelling approaches for assessing employment impacts

Various methodologies exist for assessing jobs at national levels. These methodologies offer a means both for the identification and quantification of existing jobs and for projecting the effectiveness of policies and investment programmes in creating employment.

The selection of the most appropriate tools for carrying out an employment assessment depends largely on the questions that it sets out to answer. For example, it depends on whether the study estimates current or potential jobs, takes only a short term or is intended to take a more dynamic longer-term view, and analyses occupational and skills needs and income distribution. Methodologies suited to answering different questions are not only different but their selection also depends on the quality of the available data.

The following section presents and discusses three approaches: Macroeconomic models, input-output, and social accounting matrix (SAM). In practice, studies often employ a combination of several methodologies and approaches.

3.1.1 Macroeconomic models

Macroeconomic models help calculate the employment effects of specific policies and investments (over predefined scenarios) showing processes of change in the economy as a whole. They are divided into three main types: optimization models, econometric models, and system dynamics models.

Computable general equilibrium models (CGMs) are emerging as the most widely used optimization models for policy impact analysis due to their ability to explore the relationships between sectors, consumers, and government and to model the more complex dynamic effects of policies on a variety of macroeconomic parameters, including employment. Classic CGMs are, however, often criticized because they make the simplistic assumption of a fixed labour supply and a uniform, flexible wage balance between labour supply and demand. (Boeters and Savard, 2011).

Econometric models use historical data to estimate relationships between key drivers of the economy by simulating changes in exogenous input parameters. However, they cannot be used with confidence to test interventions that have never been implemented. The historical correlation may no longer hold true in the future (Lucas, 1976).

As for the system dynamics model, it focuses on the identification of causal relationships that influence the creation and evolution of the issues studied (Sterman, 2000). This type of model is most often used as "what if" tools that provide information about what would happen if a certain policy were implemented on a specific date and in a specific context. The pillars of system dynamics are feedback loops, nonlinearity, and delays, represented by stocks and flows and identified through the selection and representation of causal relationships existing within the analyzed system (Barlas, 1996). One of the limitations of the model is that it often lacks the level of detail offered by evaluation methods based on input-output (IO) analyses and the social accounting matrix (SAM).

3.1.2 Input-Output Models

Input-output (IO) analyses are empirical tools that rely on constructing a matrix or table that lists all subsectors of an economy detailing how a sector's outputs are used as inputs in others. These models draw on information from national accounts budget data, fund flows, and labour force data. An IO table features the following four major entry blocks: industry-by-industry intermediate demand, gross value added, inputs, and total final demand. Based on assumptions about the relationship between economic and employment variables, employment multipliers can be calculated to estimate direct and indirect employment effects.

A large number of studies have used the IO method to find answers to questions such as "How many jobs can result from a given investment program in sustainable economic zones?" Or “for a given level of investment, which sector(s) would generate the greatest number of jobs?” Input-output tables disaggregate the production system and value chains and can illustrate the interactions within it. Their main disadvantage is that they do not include detailed data on the distributive aspects of economic processes such as the spending patterns of economic actors (government, businesses, and households).

3.1.3 Social Accounting Matrix (SAM)

The SAM approach can be seen as an extension of the IO tables to the whole economy because it also brings together, in a coherent manner, data on income generation and production, but also the use of resources. It has been widely used by the ILO in recent decades to measure the direct and indirect effects of public investment on employment through multiplier analysis (ILO, 2020; ILO, 2021). The SAM model is, however, static and uses fixed coefficients. The SAM year is also unlikely to match the current year.

In this study, Input-Output Analysis and SAM-based multiplier model (extension of I/O model) are preferred to assess the employment effects of infrastructure investments in Sahel countries. This makes it possible to generate employment multipliers to estimate the direct and indirect effects but also to capture the distributive aspects of economic processes. The model also allows the simulation of alternatives for an infrastructure project, including maintenance, rehabilitation, or construction in the short/long term. It has the merit of being easy to build, solve, and interpret, which facilitates the communication of results to policymakers. However, changes in the behavior of businesses or consumers and technical coefficients such as labour productivity or a possible substitution between labour and capital are not captured by the model.

3.2 Conceptual framework of input-output (I/O) and SAM-based multiplier models

The theoretical framework of I/O model was developed by Leontief (1936) as a method of systematic quantification of reciprocal productive relations between different sectors of economic activity within an economic system (Miller & Blair, 2009).

This model has been widely used for the assessment of the impact of economic policy measures such as investment in productive sectors and on economic agents. For example, in Cameroon, this type of model was constructed to simulate the impact of public investment in the roads and building sub-sectors on employment and the economy in general. The results encouraged the Cameroon government to develop a strategy for the promotion of the labour-based approach in its priority investment programs including in the sub-sector of rural roads (ILO, 2015a). This approach was also used to understand the role of key infrastructure sectors such as roads and buildings as well as canal irrigation construction in the economies of two Indian states (Gujarat and West Bengal). Multipliers were computed for selected infrastructure construction sectors (national highways/urban roads, rural roads, buildings, and irrigation canals) to examine their potential to generate quality employment (ILO, 2015b). More recently, in 2021, the World Bank assessed the short-term job generation potential of infrastructure investments in Argentina by breaking down the construction sector into multiple infrastructure subsectors (Arakaki G. A. and all, 2021).

Extension of the I/O model to the SAM-based multiplier model allows to assess direct, indirect, and induced effects of policies on output, income, and employment by disaggregated households (such as urban and rural), firms, and other institutions and types of demand.

3.3 Construction of the SAM multiplier model

The starting point for the calculation of multipliers is Leontief's equilibrium equation:

$$\boldsymbol{y_n = A_n\, y_n + x}$$

applied to the case of a Social Accounting Matrix (SAM) obtaining the SAM Leontief inverse (Pyatt & Round, 1985). The standard representation is as follows:

$\boldsymbol{M = (I - A)^{-1}}$ where the matrix $\boldsymbol{A}$ is the coefficient matrix (calculating dividing each element of the SAM by the total of their corresponding column), and each element $\boldsymbol{m_{ij}}$ in $\boldsymbol{M}$ shows the output requirements of the account $\boldsymbol{i}$ to increase the final demand of the account $\boldsymbol{j}$ by one unit (Mainar-Causapé et al., 2018).

This matrix is used as a tool to evaluate the capacity of each economic sector to generate output and employment in the rest of the economy through the analysis of multipliers.

- **Ouput Multiplier**

The sum of the multiplier values of $\boldsymbol{M_a}$ (corresponding to the commodities columns and the rows of productive activities of $\boldsymbol{M}$) shows the output multiplier. This multiplier indicates the final increase in gross output of all production activities generated due to a unitary exogenous shock in exogenous values for the corresponding commodity. A high value of this multiplier indicates an account with a large backward income expansion influence on the rest of the economy, given its interdependence with other sectors (Pulido & Fontela, 1993).

- **Value-added Multiplier**

The value-added multiplier relates the new value-added in each sector by the additional production in response to exogenous shocks in demand (Miller & Blair, 2009). Similar to the calculation of the employment multiplier, a value-added vector can be used to calculate the value-added multiplier. The vector $\boldsymbol{v}$ contains the ratios between the value added and the output of each activity.

- **Employment Multiplier**

The employment multiplier measures the impact on the number of jobs that would be generated by an exogenous shock in final demand. For its calculation, it is necessary to have the vector of employment $\boldsymbol{e}$, which represents the ratios between the number of jobs and the output of each activity (per million of output value). The elements of $\boldsymbol{e}$ in diagonal form the employment matrix $\boldsymbol{E}$, that is multiplied by the part of the multiplier matrix $(\boldsymbol{M_a})$ with rows corresponding to the productive accounts and the columns corresponding to commodities.

The employment multiplier is defined as $\boldsymbol{M_e = E}\ .\ \boldsymbol{M_a}$, of which element $\boldsymbol{me_{ij}}$ is the increment in the number of jobs in the sector $\boldsymbol{i}$ when there is a unit exogenous injection into the endogenous final demand account of $\boldsymbol{j}$. The sum of the columns in the matrix shows the global effect on employment produced by the exogenous increase in demand (number of jobs per million of additional output from each activity (Mainar – Causapé et al., 2018).

Due to the model assumptions mentioned above, the results should not be interpreted as an accurate forecast of job creation resulting from exogenous shocks. Furthermore, the results do not take into account social variables, such as the quality of employment. However, the results can be useful as an indicator of the commodities in the economy with the greatest potential for employment generation.

3.4 Data: Social Accounting Matrix (SAM) of Niger and Côte d'Ivoire

To analyze the effects of infrastructure investment on employment and the labour market in Sahelian countries, we use data from the accounting matrices of Niger and Côte d'Ivoire. The initial databases collected from national statistical institutes have undergone several modifications for the purposes of analysis.

These social accounting matrixes were generated from the 2019 aggregated matrix derived from the national accounts and information gathered from the 2019 supply and use table and from the 2018 National Household Living (EHCVM) and the Integrated Regional Survey on Employment and Informal Sector (ERI-ESI) 2017-2018 surveys, which give the structure of employment by socio-professional category and branch of activity.

The changes made to both matrix mainly concern the disaggregation of the labour factor into 4 sub-accounts in Niger (skilled urban, unskilled urban, skilled rural, unskilled rural) and 6 sub-accounts in Côte d'Ivoire (skilled urban, semi-skilled urban, unskilled urban, skilled rural, semi-skilled rural, unskilled rural), that of the capital account into 3 sub-accounts in Niger (public, private, agricultural) and 2 sub-accounts in Côte d'Ivoire (livestock or agricultural capital and non-agricultural capital). Non-agricultural capital includes machinery, equipment, etc.

This SAM database for Niger and Côte d'Ivoire was also disaggregated for a specific analysis of the construction sector where construction account is detailed across water infrastructure, electricity infrastructure, rural road infrastructure, irrigation infrastructure, and other infrastructural construction accounts.

In summary, the 2019 Côte d'Ivoire SAM contains 96 accounts and Niger's one contains 111 accounts.

Tab 3: Côte d'Ivoire and Niger SAM's characteristics

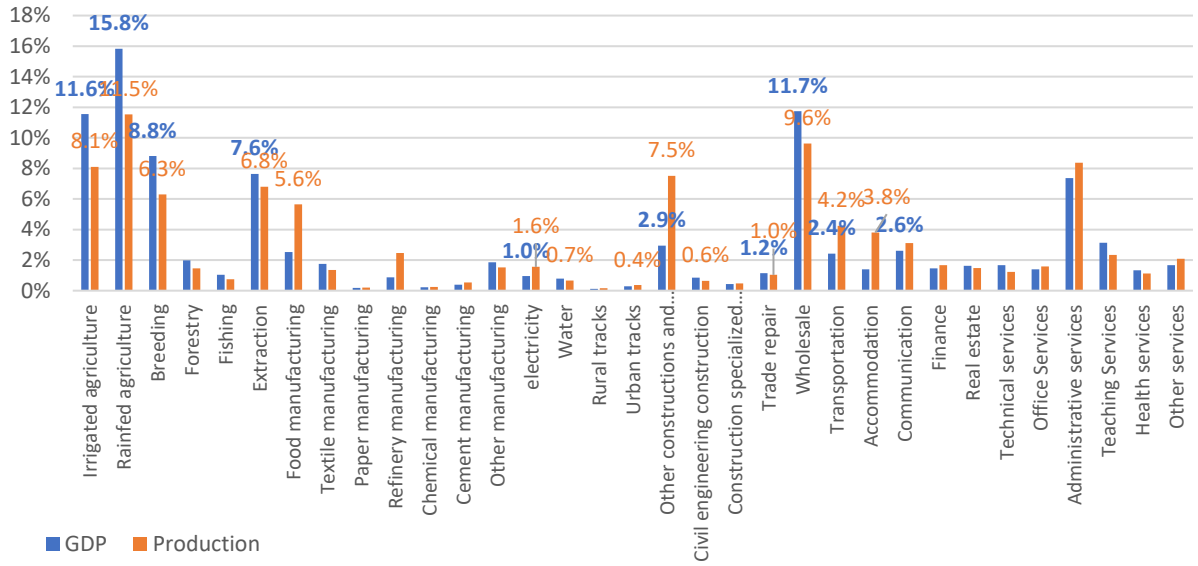
Côte d'Ivoire SAM accounts	Niger SAM accounts
• 37 activities (1 household agricultural activity and 36 marketed national activities)	• 35 activities (35 marketed national activities)
• 37 commodities (1 HPHC and 36 marketed commodities)	• 35 commodities (35 marketed commodities) • 19 tradable commodities (international trade)
• 9 factors of production (6 labour accounts, 1 land factor, and 1 livestock or agricultural capital, and 1 non-agricultural capital or other capital)	• 8 factors of production (4 labour accounts, 1 land factor, and 3 capital factors (private capital, public capital, and agricultural capital))
• 3 households (disaggregated by rural/urban and Abidjan)	• 5 households (disaggregated by public and private employees, informal employees, self-employed farmers, non-agricultural self-employed, and inactive)
• 5 tax accounts	• 2 tax accounts
• 1 transaction costs (margins)	• 1 transaction costs (margins)
• 3 other institutional accounts: enterprises, government, and the rest of the world	• 3 other institutional accounts: enterprises, government, and the rest of the world
• 1 savings and investment account.	• 3 savings and investment accounts (private investment, public investment, change in inventories)

(Authors' creation based on the two countries SAM 2019)

3.4.1 *Economic structure of Niger and Côte d'Ivoire based on the latest Social Accounting Matrix (SAM 2019)*

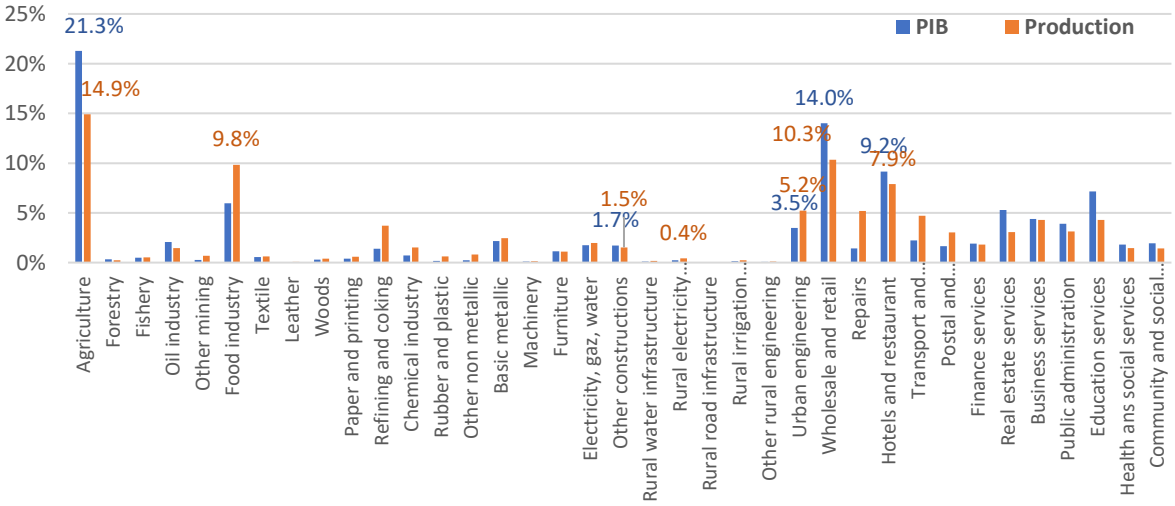
Figures 5 and 6 present the sector contributions to production and GDP in Niger and Côte d'Ivoire according to the SAM 2019. The contribution of industries to Niger's output and value-added in 2019 reveals that agriculture alone accounts for 19.6 percent of total output and 27.8 percent of value added. It is followed by the trade branch (9.6 percent of the total output and 11.7 percent of the GDP), while the construction branch contributes 4.5 percent to value-added and twice as much to production (9.2 percent).

Fig 5: Sector contributions to production and GDP in Niger according to the SAM 2019



(Authors' calculation based on SAM 2019)

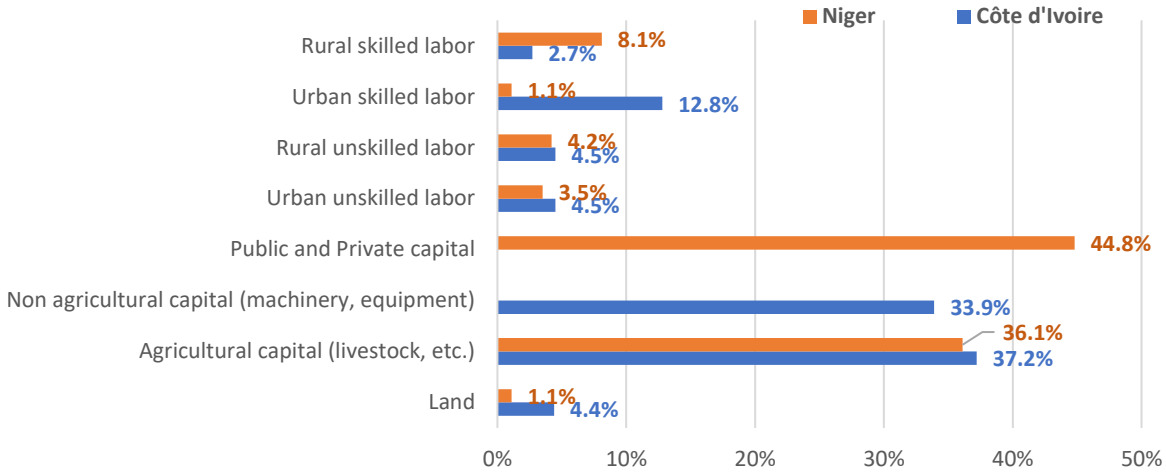
Fig 6: Sector contributions to production and GDP in Côte d'Ivoire according to the SAM 2019



(Authors' calculation based on SAM 2019)

Sectoral contributions to total production and GDP in Côte d'Ivoire are broadly similar to those in Niger, with trade, agriculture, and food processing as predominant sectors. The agricultural sector has an important contribution to the total output (14.9 percent) and the GDP (21 percent). It is followed by the trade branch with around 14 percent of the GDP and a contribution of 10.3 percent to the total output. The construction sector contributes 5.7 percent to value-added and 7.6 percent to the total output. Figure 7 presents the contribution of production factors to the GDP in Niger and Côte d'Ivoire.

Fig 7: Contribution of production factors to the GDP in Niger and Côte d'Ivoire



(Authors' calculation based on the two SAMs 2019)

In both two countries, the capital factor has the highest contribution to the GDP, with 44.8 percent for public and private non-agricultural capital and 36.1 percent for the agricultural capital in Niger. The contribution of capital factor to the GDP in Côte d'Ivoire is also the highest with 37.2 for agricultural capital and 33.9 for non-agricultural capital. Relatively to the capital factor, the contribution of the labour factor to the GDP in Niger is low (16.9 percent)[3]. This is broadly similar to that of Côte d'Ivoire with a contribution of the labour factor to value added at around 24.5[4] percent (Figure 7).

3.4.2 The construction sector in Niger and Côte d'Ivoire according to the SAM 2019

Table 3 presents the construction sector account in the 2019 SAM respectively in Niger and Côte d'Ivoire. This table shows the value of the inputs into the construction sector from each of the sectors in the SAM 2019, as well as the factor outputs.

According to the SAM, the total output of the construction sector was four times more important in Côte d'Ivoire (XOF 4,545.368 billion) than in Niger (XOF 1,001.7 billion). The sector with the highest inputs into the construction sector in the two countries was the mining sector (cement, sand, gravel, etc.) with inputs of XOF 334.955 billion in Niger (respectively XOF 1,560.409 billion in Côte d'Ivoire), followed by manufacturing (XOF 91.099 billion and XOF 456.007 billion in Niger and Côte d'Ivoire).

The other main sectors in Niger are transport (4.5 percent), finance service (3.3 percent), and agriculture (4.1 percent). For Côte d'Ivoire, the business service (6.81 percent), refining (2.44 percent), transport (1.63 percent), electricity, and water (1.74 percent) have no less important contributions.

In terms of value-added of the construction sector, they are generated by the labour and capital factors. Capital provides the biggest added value in both countries, 27.1 percent and 30.6 percent in Niger and Côte d'Ivoire respectively. Of the labour factor, urban labour (skilled and unskilled) provides

[3] The sum of the contribution of both skilled and unskilled labour in rural and urban areas in Niger

[4] The sum of the contribution of both skilled and unskilled labour in rural and urban areas in Côte d'Ivoire.

the largest share at XOF 453.684 billion in Côte d'Ivoire. Similar to the Côte d'Ivoire structure, urban labour provides the largest share of the labour factor at XOF 30.447 billion, specifically the urban unskilled labour in Niger.

Tab 4: Sector and factor inputs into the construction sector in Niger and Côte d'Ivoire in thousands

	Construction spending			
	NIGER	**Percentage**	**COTE D'IVOIRE**	**Percentage**
Agriculture	**41033**	**4,1**	0	0
Forestry	24467	2,4	2805	0,06
Mining	**334955**	**33,4**	**1560409**	**34**
Paper	14707	1,5	2702	0,06
Refining	14684	1,5	111001	2,44
Other Manufacturing	**91099**	**9,1**	**456007**	**10**
Water	3007	0,3	**79061**	**1,74**
Construction	17067	1,7	2290	0,05
Repairs	17920	1,8	3098	0,07
Transport	**44976**	**4,5**	**74253**	**1,63**
Hosting services	25611	2,6	21687	0,48
Trade	6606	0,7	12443	0,27
Finance services	**33356**	**3,3**	43837	0,96
Business services	17367	1,7	**309489**	**6,81**
Other services	751	0,1	26623	0,59
Urban skilled labour	9616	1,0	**275587**	**6,06**
Rural skilled labour	98	0,0	5487	0,12
Urban unskilled labour	**30447**	**3,0**	**178097**	**3,92**
Rural unskilled labour	2219	0,2	9531	0,21
Capital	**271721**	**27,1**	**1370962**	**30,16**
Total	**1001707**	100,0	**4545369**	100

(Authors' calculation based on the two countries SAM 2019)

The relatively high share of labour factor (after the capital factor) in the total construction value added through unskilled labour is of particular significance, as it demonstrates the construction sector's ability to create employment for and provide income to the unskilled, which are also generally the poorest segment of the population. In Côte d'Ivoire, in addition to unskilled urban jobs, the Ivorian construction sector will also generate skilled urban jobs and therefore greater income gains.

In order to be able to conduct a more detailed analysis of the construction sector, the sector was disaggregated so that specific construction subsectors could be analyzed. The expenditure structure of these construction subsectors on different inputs is globally similar to the construction sector (see Tables A1 and A2 in the annex).

4 Results and discussion

4.1 Investment multipliers

Using the SAM 2019, the conventional Leontief inverse was calculated in order to compute output multipliers, value-added multipliers, and income multipliers.

4.1.1 Output multipliers using SAM

Tables 5 and 6 present the output multipliers for the sub-sectors of the construction sector in Niger and Côte d'Ivoire respectively. These output multipliers include the direct, indirect, and induced effects. Production multipliers indicate how the economy's output increases due to 1 million XOF increased spending in the construction sector and captures additional output due to indirect and induced effects. The results obtained show relatively similar multiplier effects in Niger and Côte d'Ivoire. The total effects on production are greater for the irrigation infrastructure sub-sector which represents the sector with the most inputs from other sectors. The rural feeder roads sub-sector records the second highest total effect on output followed by urban feeder roads.

The low variation between the values of the multipliers of the different subsectors observed in Côte d'Ivoire could be explained by the fact that the production data for the disaggregation were obtained from the records of public investments in these subsectors in 2019.

Tab 5: Output multipliers of the decomposed construction sector using SAM

		Other Construction	**Electricity and water infrastructure**	**Rural road infrastructure**	**Irrigation infrastructure**	**Other infrastructure**
NIGER	Primary sector	0.52	0.575	0.501	0.579	0.418
	Secondary sector	1.372	1.26	1.395	1.263	0.975
	Tertiary sector	0.753	0.714	0.723	0.855	0.533
	Global effect	**2.645**[5]	**2.549**	**2.619**	**2.697**	**1.926**
COTE D'IVOIRE	Primary sector	0.257	0.237	0.237	0.237	0.246
	Secondary sector	1.391	1.744	1.744	1.745	1.707
	Tertiary sector	1.141	1.203	1.203	1.203	1.229
	Global effect	**2.789**	**3.184**	**3.184**	**3.185**	**3.182**

(Authors' calculation based on the two countries SAM 2019)

Based on this construction sector production data, expenditures on different inputs in the different sub-sectors were then matched with the construction expenditure structure of the overall construction sector. The total values of output multipliers are significantly larger in general for the civil engineering infrastructure subsectors (water, electricity, road, irrigation, and others) in rural as well as in urban areas compared to other construction (Table 5).

4.1.2 Value-added multipliers

The analysis with the SAM also allows us to calculate the value-added multipliers, which are a key measure of GDP. The value-added multipliers indicate how total value added in the economy increases as a result of the increase in spending on the construction sector and capture additional value added due to both indirect and induced effects. The SAM allows us to disaggregate value added by labour and capital, and labour value-added can further be split into different skill levels.

[5] This effect is biased because the other constructions includes buildings and public works

Tab 6: Value-added multipliers from Niger SAM with the decomposition of the construction sector

	Feeder roads (rural)	Feeder roads (urban)	Other Construction	Irrigation infrastructure	Electricity and water infrastructure	Other infrastructure	Specialized construction
Urban skilled labour	0.046	0.060	0.047	0.093	0.082	0.077	0.039
Rural skilled labour	0.005	0.005	0.004	0.005	0.004	0.004	0.005
Urban unskilled labour	0.036	0.096	0.062	0.054	0.043	0.042	0.039
Rural unskilled labour	**0.132**	0.047	0.040	0.051	0.047	0.044	0.037
Public capital	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Private capital	**1.040**	**1.000**	**0.755**	**1.195**	**1.252**	**1.136**	**1.006**
Agricultural capital	**0.474**	**0.469**	**0.452**	**0.482**	**0.477**	**0.444**	**0.383**
Land	0.015	0.015	0.013	0.015	0.015	0.014	0.012
Total	**1.747**	**1.691**	**1.373**	**1.895**	**1.921**	**1.762**	**1.521**

(Authors' calculation based on SAM 2019)

Table 6 presents the value-added multipliers for all the subsectors of construction in Niger. The value-added multipliers in the totals show the low variations between the subsectors. Electricity and water infrastructure have the highest overall value-added multiplier at 1.9 followed by the irrigation infrastructure (1.8) and the rural feeder roads subsector (1.7).

What is significant however is the difference between the contribution of labour and capital to the value-added with the largest contribution of private capital. For rural feeder roads, the share of labour value-added by rural unskilled labour is the highest implying that this subsector allows unskilled labour to make a higher contribution to GDP and that a higher share of income will also flow to unskilled labour.

The value-added multipliers for Côte d'Ivoire are presented in Table 7. For all the subsectors, the value-added multipliers are globally similar, with only minimal variation for other construction and urban engineering infrastructure subsectors.

Tab 7: Value-added multipliers from Côte d'Ivoire SAM with the decomposition of the construction sector

	Other construction	Rural water infrastructure	Rural electricity infrastructure	Rural road infrastructure	Rural irrigation infrastructure	Other rural engineering	Urban engineering
urban unskilled labour	0.12	0.06	0.06	0.06	0.06	0.06	0.09
urban semi-skilled labour	0.11	0.06	0.06	0.06	0.06	0.06	0.09
urban skilled labour	0.11	0.05	0.05	0.05	0.05	0.05	0.08
rural unskilled labour	0.05	**0.07**	**0.07**	**0.07**	**0.07**	**0.07**	0.05
rural semi-skilled labour	0.02	0.03	0.03	0.03	0.03	0.03	0.02
rural skilled labour	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Land	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Livestock capital	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Non-agricultural capital	**1.07**	**1.10**	**1.10**	**1.10**	**1.10**	**1.11**	**1.11**
Total	**1.54**	**1.42**	**1.42**	**1.42**	**1.42**	**1.42**	**1.49**

(Authors' calculation based on SAM 2019)

A significant difference is observed between the contribution of labour and capital to the value added with the largest contribution of non-agricultural capital.

For rural engineering infrastructure (water, electricity, road, irrigation, other), the share of labour value-added by rural unskilled labour is the highest (0.07) implying that these subsectors allow unskilled labour to make a higher contribution to GDP and that a higher share of income will also flow to unskilled labour.

4.1.3 Household and employment income multipliers

We present in this section, the income multipliers obtained from the analysis. The SAM allows us to distinguish the income multipliers for rural and urban households (Côte d'Ivoire SAM) or formal and informal employees (Niger SAM) and thus shows how these categories of households are differently impacted.

Table 8 presents the income multipliers from Côte d'Ivoire SAM with the decomposition of the construction sector. As can be expected, the five (5) rural civil engineering infrastructure subsectors (water, electricity, road, irrigation, and other) have the highest multipliers for rural households. Thus, for rural infrastructure, the majority of additional income benefits rural households, while for urban engineering infrastructure, the majority of additional income actually accrues to urban households (Table 9).

Tab 8: Income multipliers from Côte d'Ivoire SAM with the decomposition of the construction sector

	Other construction	Rural water infra-structure	Rural electricity infra-structure	Rural road infra-structure	Rural irrigation infra-structure	Other rural engineering	Urban engineering
Capital city households	**0.40**	0.32	0.32	0.32	0.32	0.32	**0.36**
Other urban households	0.37	0.29	0.29	0.29	0.29	0.29	0.33
Rural households	0.33	**0.36**	**0.36**	**0.36**	**0.36**	**0.36**	0.34
Total	**1.10**	**0.96**	**0.96**	**0.96**	**0.96**	**0.97**	**1.03**

(Authors' calculation based on SAM 2019)

Tab 9: Income multipliers from Niger SAM with the decomposition of the construction sector

	Feeder roads (rural)	Feeder roads (urban)	Other Construction	Irrigation infra-structure	Electricity and water infra-structure	Other infra-structure	Specialized construction
Public and private employees	0.288	0.214	0.177	0.261	0.246	0.229	0.171
informal employees	0.093	0.091	0.068	0.107	0.112	0.102	0.090
Self-employed farmer	**0.582**	**0.625**	**0.529**	**0.637**	**0.637**	**0.588**	**0.515**
Non-agricultural employer	**0.460**	**0.442**	**0.334**	**0.529**	**0.554**	**0.503**	**0.445**
Inactive	0.023	0.022	0.017	0.026	0.028	0.025	0.022
Total	**1.445**	**1.394**	**1.125**	**1.560**	**1.577**	**1.447**	**1.243**

(Authors' calculation based on SAM 2019)

The income multipliers for decomposed construction sector of Niger are presented in Table 9. While the overall value of the income multipliers does not vary that much for the different construction subsectors, there is a significant impact on who captures the most gains of the income multipliers. Also, unlike Côte d'Ivoire where the majority of additional income generated seems to benefit all social strata with a slightly greater effect on rural households, in the Nigerien context, it is mainly self-employed farmers followed by non-agricultural employers who capture the most profit.

4.1.4 Employment multipliers

This section presents the estimation of the employment impacts of an increase in infrastructure expenditure. Employment multipliers are derived from the additional output resulting from an exogenous shock and the direct employment coefficient of each sector. Table 10 presents the employment multipliers from Niger SAM for an increase in investment in construction subsectors.

Tab 10: Employment multipliers from Niger SAM with the decomposition of the construction sector

	Feeder roads (rural)	Feeder roads (urban)	Other Construction	Irrigation infra-structure	Electricity and water infra-structure	Other infra-structure	Specialized construction
Irrigated Agriculture	10	10	5	**13**	12	10	7
Rainfed Agriculture	**22**	**19**	8	**29**	**26**	**22**	**15**
Livestock	10	9	4	**12**	11	9	7
Forestry	3	2	2	3	3	3	2
Fishing	1	1	1	2	2	1	1
Extractive industry	**26**	**14**	5	3	3	3	2
Manufacturing_food	10	9	4	**13**	**12**	10	7
Textile_manufacturing	3	3	1	3	3	3	2
Paper_manufacturing	1	1	0	0	0	0	0
Manufacturing_refinery	5	4	1	3	3	3	2
Chemical_manufacturing	0	0	0	1	1	1	0
Cement_manufacturing	1	1	2	2	1	1	6
Manufacturing_other	1	1	1	1	1	1	1
Electricity	3	3	2	4	3	3	3
Water	1	1	1	2	2	1	2
Feder roads (rural)	**80**	0	0	0	0	0	0
Feder roads (urban)	0	**74**	0	0	0	0	0
Other Construction	0	0	**35**	0	0	0	0
Irrigation infrastructure	0	0	0	**102**	0	0	0
Electricity & water infrastr.	0	0	0	0	**93**	0	0
Other infrastructure	0	0	0	0	0	**83**	0
Specialized construction	1	1	2	0	0	0	**70**
Trade repairs	3	4	2	**17**	9	4	5
Trade	**17**	**15**	8	**14**	**16**	**15**	**13**
Transportation	13	11	4	8	7	6	5
Accommodation	8	8	3	8	6	6	4
Communication	6	5	2	8	6	5	4
Finance	4	5	2	3	3	2	2
Real estate	3	3	1	5	4	3	2
Technical_services	0	0	0	1	0	0	0
Business services	3	3	1	11	4	6	2
Public administration	0	0	0	0	0	0	0
Education	1	1	1	2	2	1	1
Health	1	1	0	2	2	1	1
Other services	2	2	1	3	2	2	1
Total	**239**	**213**	**98**	**275**	**237**	**204**	**168**

(Authors' calculation based on SAM 2019)

Table 10 shows a pronounced difference in the total employment multipliers among the different subsectors. The employment multiplier is the highest for the irrigation infrastructure investment with an additional employment of 275 Full Time Equivalents (275 FTEs), followed by rural feeder roads and the electricity and water infrastructure with 239 FTEs and 237 FTEs additional employment creation respectively. Most of the additional employment (FTE) created is in the subsector of construction itself. For example, for the irrigation infrastructure subsector, the additional employment is dominated by the subsector itself with 102 additional FTE jobs created. Apart from the construction subsectors, most additional employment would be created in agriculture (irrigated and rainfed), trade, food processing, and extractive industry.

The employment multipliers estimated from Côte d'Ivoire SAM using the decomposed construction sector are presented in Table 11. Table 11 indicates significant differences in the total employment effect among the subsectors of construction. The total employment effect created is the highest by increasing investment in the rural feeder roads with 8,155 FTEs jobs generated. As in the case of Niger, the additional employment created in each subsector is dominated by the subsector itself. For example, the employment impact of investment in rural feeder roads is the highest with 2543 FTE jobs generated in this subsector itself. Apart from the subsectors of construction, most additional employment would be created in agriculture, food processing, basic metallic industries, transport, wholesale and retail trade, and by increasing investment in rural infrastructure.

In conclusion, an increase in investment in the construction sub-sectors in Niger generates more additional employment when it comes from the civil engineering infrastructure sub-sector. With regard to Cote d'Ivoire, the job creation effects are significantly greater by increasing investments mainly in rural supply routes. In both cases, the direct effects that will result directly from the construction of the infrastructure are quite significant. Other additional jobs would be created in agriculture (irrigated and rainfed), trade, and food processing, to which are added the extractive industry for the case of Niger and basic metal industries and transport in the case of Cote d'Ivoire.

Tab 11: Employment multipliers from Côte d'Ivoire SAM with the decomposition of the construction sector

	Other construction	Rural water infra-structure	Rural electricity infra-structure	Rural road infra-structure	Rural irrigation infra-structure	Other rural engineering	Urban engineering
Agriculture	**19**	41	25	**553**	26	**103**	4
Forestry	0	2	1	24	1	4	0
Fishery	1	2	1	30	1	6	0
Oil industry	2	6	3	76	4	14	0
Other mining	2	7	4	96	5	18	1
Food processing	**18**	**36**	**22**	**490**	**23**	**91**	3
Textile	1	2	1	33	2	6	0
Leather	0	0	0	3	0	1	0
Woods	0	5	3	63	3	12	0
Paper and printing	1	2	1	30	1	6	0
Refining and coking	6	16	9	213	10	40	1
Chemical industry	5	8	5	104	5	19	1
Rubber and plastic	3	4	2	54	3	10	0
Other non metallic	3	22	13	**302**	14	56	2
Basic metallic	1	29	18	**399**	19	74	2
Machinery	0	0	0	5	0	1	0
Furniture	1	2	1	30	1	6	0
Electricity, gaz, water	3	13	8	177	8	33	1
Other constructions	**69**	2	1	21	1	4	0

Rural water infrastructure	0	**188**	0	1	0	0	0
Rural electricity infrastructure	0	0	**113**	2	0	0	0
Rural road infrastructure	0	0	0	**2543**	0	0	0
Rural irrigation infrastructure	0	0	0	1	**121**	0	0
Other rural engineering	0	0	0	0	0	**474**	0
Urban engineering	0	0	0	3	0	1	**16**
Wholesale and retail	**21**	**61**	**37**	**832**	**40**	**155**	5
Repairs	11	22	14	**304**	14	57	2
Hotel and restaurant services	16	32	19	**438**	21	**82**	3
Transport and communication	10	20	12	**271**	13	50	2
Postal and telecommunication	5	11	6	144	7	27	1
Finance services	5	8	5	108	5	20	1
Real estate services	7	14	8	184	9	34	1
Business services	8	31	19	**426**	20	**80**	3
Public administration	0	0	0	0	0	0	0
Education services	4	8	5	106	5	20	1
Health and social services	1	2	1	30	1	6	0
Community and social services	2	4	3	59	3	11	0
Total	**223**	**601**	**363**	**8155**	**388**	**1520**	**51**

(Authors' calculation based on SAM 2019)

4.2 Simulating the employment impacts of investments in rural infrastructure

We now turn our attention to estimating the employment impacts of four (4) alternative scenarios of government expenditure in rural infrastructure:

- Scenario 1: we assume an annual investment of XOF 25 billon in water and electricity infrastructure;
- Scenario 2: we implement a feeder roads policy by applying a shock of XOF 25 billion on feeder roads;
- Scenario 3: we suppose that the government invests a sum of XOF 25 billion in irrigation infrastructure;
- Scenario 4 is a combination of the three scenarios with an investment value of 75 billion.

The Business-As-Usual scenario (BAU Scenario) refers to the employment situation under the assumption that no additional investment in infrastructure is made. Sectoral employment characteristics, including the Full Time Equivalent (FTE) jobs, the employment-output ratio (employment coefficient), and the apparent labour productivity by sector in the BAU scenario are presented in Tables A3 and A4 in the annex.

Using the Niger and Côte d'Ivoire SAMs, we simulate the different employment impacts for each of the alternative scenarios.

Table 12 presents a comparative summary of the employment impacts of the four simulations in the main aggregate sectors of the economy in Côte d'Ivoire and Niger.

Tab 12: Results from simulation of employment effects of implementing the different scenarios in Côte d'Ivoire and Niger

	Employment impact after simulating scenario 1					
	Côte d'Ivoire			**Niger**		
	FTE Jobs in BAU scenario	Increase in employment (FTE)	Increase in percentage	FTE Jobs in BAU scenario	Increase in employment (FTE)	Increase in percentage
Agricultural sector	6114017	897	0.01%	5288699	1334	0.025%
Extractive industry	90092	254	0.28%	27433	74	0.270%
Food industry	912538	724	0.08%	57060	295	0.517%
Manufacturing industry	362986	2089	0.58%	96934	356	0.367%
Construction	240058	3800	1.58%	48095	2330	4.845%
Service	4749905	4287	0.09%	1174483	1538	0.131%
Total	**12469596**	**12051**	**0.10%**	**6692704**	**5928**	**0.089%**
	Employment impact after Simulating scenario 2					
	Côte d'Ivoire			**Niger**		
	FTE Jobs in BAU scenario	Increase in employment (FTE)	Increase in percentage	FTE Jobs in BAU scenario	Increase in employment (FTE)	Increase in percentage
Agricultural sector	6114017	15172	0.2%	5288699	860	0.016%
Extractive industry	90092	4294	4.8%	27433	376	1.371%
Food industry	912538	12253	1.3%	57060	187	0.328%
Manufacturing industry	362986	35342	9.7%	96934	290	0.299%
Construction	240058	64282	26.8%	48095	1542	3.206%
Service	4749905	72528	1.5%	1174483	1198	0.102%
Total	**12469596**	**203871**	**1.6%**	**6692704**	**4453**	**0.067%**

	Employment impact after Simulating scenario 3					
	Côte d'Ivoire			Niger		
	FTE Jobs in BAU scenario	Increase in employment (FTE)	Increase in percentage	FTE Jobs in BAU scenario	Increase in employment (FTE)	Increase in percentage
Agricultural sector	6114017	722	0.01%	5288699	1477	0.028%
Extractive industry	90092	204	0.23%	27433	82	0.299%
Food industry	912538	583	0.06%	57060	324	0.568%
Manufacturing industry	362986	1682	0.46%	96934	403	0.416%
Construction	240058	3060	1.27%	48095	2556	5.314%
Service	4749905	3452	0.07%	1174483	2039	0.412%
Total	**12469596**	**9703**	**0.08%**	**6692704**	**6881**	**0.103%**
	Employment impact after Simulating scenario 4					
	Côte d'Ivoire			**Niger**		
	FTE Jobs in BAU scenario	Increase in employment (FTE)	Increase in percentage	FTE Jobs in BAU scenario	Increase in employment (FTE)	Increase in percentage
Agricultural sector	6114017	16791	0.27%	5288699	3671	0.069%
Extractive industry	90092	4752	5.27%	27433	532	1.939%
Food industry	912538	13561	1.49%	57060	806	1.413%
Manufacturing industry	362986	39113	10.78%	96934	1049	1.081%
Construction	240058	71142	29.64%	48095	6428	13.363%
Service	4749905	80267	1.69%	1174483	4775	0.407%
Total	**12469596**	**225626**	**1.81%**	**6692704**	**17261**	**0.258%**

(Authors' calculation based on SAM 2019)

According to these results, if the government implements scenario 1, increasing investments in water and electricity infrastructure in rural areas, then the total additional employment generated from this would be 12,051 FTEs (representing 0.1% of total jobs in 2019) in Côte d'Ivoire and 5,928 FTEs (representing 0.089% of total jobs in 2019 in Niger). This additional employment will be predominantly generated in the construction and service sectors. The implementation of scenario 1 will generate more jobs in absolute terms in the construction and services sectors in Côte d'Ivoire than in Niger. In relative terms, the additional jobs dominating in the construction sector represent 1.6% and 4.8% of total jobs in the construction sector in 2019 in Côte d'Ivoire and Niger respectively.

For the second scenario, if the government increases the feeder roads investments in an amount of XOF 25 billion, additional employment generated would be approximately 203,871 FTEs in Côte d'Ivoire (representing 1.63% of total jobs in 2019) as opposed to only 4,453 FTEs (representing 0.07% of total jobs in 2019) in Niger. These results confirm the high employment multiplier effect of road infrastructure in Côte d'Ivoire. In Côte d'Ivoire, the detailed additional employment generated from investments in feeder roads would be mostly in the construction sector with 64,282 FTEs representing 27% of construction jobs in 2019 and the service sector with 72,528 FTEs representing 1.5% of service jobs in 2019.

In the third scenario, an additional increase in irrigation infrastructure investment in the same amount (XOF 25 billion) would increase almost 9,703 additional FTEs employment in Côte d'Ivoire (0.08% of total jobs in 2019) and 6,881 additional FTEs employment in Niger (0.103% of total jobs in 2019). In absolute terms, the impact of investment in irrigation on employment is the highest in Niger compared to the other scenarios with almost 6,900 jobs created across the economy as a whole. A detailed analysis of the employment impact by major sectors shows the predominance of the service and construction sectors in both Côte d'Ivoire and the predominance of service, construction, and agricultural sectors in Niger.

Finally, after a simulation of the employment impact of the combined scenarios (scenario 4), the additional FTE jobs created correspond to a total of approximately 225,626 FTE in Côte d'Ivoire (representing 1,81% of total jobs in 2019) which is higher than the combined employment impact of each scenario. In Niger, the additional FTE jobs created are estimated at 17,261 FTE (representing 0.26% of total jobs in 2019). This is similar to the combined employment impact of the three scenarios. In addition, in both Côte d'Ivoire and Niger cases, additional employment generated would be mostly in the construction and service sectors. The third sector to benefit from the most additional jobs is the agricultural sector in Niger, with 3,671 additional agricultural jobs, and the manufacturing industry in Côte d'Ivoire with 39,113 additional FTE jobs.

The three (3) investment scenarios show that the infrastructure with the greatest potential for job creation is the irrigation infrastructure in Niger, and the road infrastructure in Côte d'Ivoire.

This difference is due to the structure of the economy and employment in the two countries. The employment multiplier for the irrigation infrastructure sub-sector in Niger is the highest, as this sub-sector induces the production and job creation effects in irrigated agriculture, rain-fed agriculture livestock farming, construction, and services. Indeed, the agricultural sector including livestock farming, which benefits greatly from investments in irrigation, contributes most to employment in Niger, accounting for almost 70% of the active population (ILOSTAT, 2021).

In Côte d'Ivoire, the road infrastructure sub-sector has the greatest impact on job creation. In fact, this sub-sector generates production and job creation effects in all sectors, particularly in the service sector, which contributes most to job creation in Côte d'Ivoire.

5 Conclusion and recommendations

Investment in the infrastructure sector has significant multipliers in Nigerien and Ivorian economies and thus provides an important tool to enhance job creation. In this analysis, Employment Impact Assessment (EIA) is used to improve our understanding of how investments in rural infrastructure impact the quality and quantity of employment. The method used for the EIA analysis is based on an established SAM multiplier analysis together with an employment satellite account. This approach is to use SAM and conduct employment multiplier analysis.

This method provides important results for policymaking. The results of the analysis show that an increase in one unit of infrastructure investment would increase significantly total economic output by 2.4 and 3.1 additional output units in the Nigerien and Ivorian economies respectively. Impacts on the GDP would be an increase of 1.7 and 1.4 units of GDP respectively in Niger and Côte d'Ivoire. Furthermore, total household income would increase by around 1 unit in Côte d'Ivoire and 1.4 units in Niger and employment would increase on average by 179 FTEs and 1,614 FTE additional jobs in Niger and Côte d'Ivoire respectively.

Finally, a simulation of the employment impact of an amount of XOF 25 billion investment in each construction subsector: water and electricity infrastructure (scenario 1), feeder roads (scenario 2), irrigation infrastructure (scenario 3) shows that 5,928 FTEs; 4,453 FTEs and 6,881 FTEs additional employments would be created in Niger. For the same scenarios, the employment impact would be higher in Côte d'Ivoire, generating 12,051 FTEs; 203,871 FTEs and 9,703 FTEs of additional jobs respectively for the three scenarios. The investment scenario that creates the most jobs in Niger is investment in irrigation infrastructure, while the one that creates the most jobs in Côte d'Ivoire is investment in road infrastructure.

These results indicate differences between Niger and Côte d'Ivoire. In Niger, investment in irrigation infrastructure has the greatest multiplier effects on employment followed by investments in water and electricity infrastructure and feeder roads. By contrast, for Côte d'Ivoire, investments in feeder roads provide by far the greatest multiplier effects on investments. This showcases differences in infrastructural needs between the countries. Both access to electricity and improved water sources are currently substantially higher in Côte d'Ivoire than in Niger. On the other hand, the population in Niger is very concentrated in the South West of the country, and therefore, improved access to feeder roads may not be an infrastructure priority. This signifies the importance of adjusting investments to local circumstances.

Finally, with a combination of the three scenarios, the additional FTE jobs created is the sum of the employment impact of each scenario corresponding to a total of 17,261 additional jobs generated in Niger (representing 0.26% of total jobs in 2019) and a total of 225,626 additional employments generated in Côte d'Ivoire (representing 1.81% of total jobs in 2019). These employment effects do not include second-order effects originating from increasing income. For instance, higher-income drives additional demand and investment, which reinforces employment effects in the long-term.

However, it should be pointed out that most of the additional employment created is within the construction sector itself. Outside the construction sector, most additional employment is created in the following sectors: agriculture, food processing, transport, wholesale and retail trade. All these sectors are relevant for food system development in the Sahel region. On aggregate, about 16,791 additional FTE jobs (representing 0.3% of agricultural jobs in 2019) are created in the agricultural sector in Côte d'Ivoire and 3,617 additional agricultural jobs (representing 0.07% of BAU agricultural jobs) are created in Niger. This leads to an increasing income in the agricultural sector in the two countries.

From a policy perspective it is recommended that in rural areas of Sahelian countries, the infrastructure investment strategy be aligned with a construction sector skills development strategy that specifically includes rural workers and particularly the rural young workforce. The challenge of employing young people in the Sahel region is all the more important as they are potential candidates

for illegal emigration. Moreover, the rural infrastructure investment strategy also supports the structural transformation of the Sahelian economies by enabling unskilled underemployed rural workers to shift from the agricultural sector into a more productive construction sector, increasing their contribution to economic output and GDP as well as their own income.

Offering rural employment opportunities in Sahelian countries has wider social and economic implications. In view of high population growth but limited agricultural land, additional rural employment is necessary to generate livelihoods for rural Sahelian households. Adequate employment will also reduce conflict risks and migration incentives and is therefore also in the interest of international donors and partner countries.

References

AfDB (2023). Performance et Perspectives Macroéconomiques de l'Afrique, Rapport.

AfDB (2022). Accélérer la transformation structurelle de l'économie pour une croissance inclusive, durable et résiliente aux chocs, Note Diagnostic Pays.

Arakaki, G. A., Morales, S. J., Rodriguez, C. L. (2022). Jobs and Distributive Effects of Infrastructure Investment, durable et résiliente aux chocs, The Case of Argentina (English). Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/721891623745711077/Jobs-and-Distributive-Effects-of-Infrastructure-Investment-The-Case-of-Argentina.

Barlas, Y. (1996). Formal aspects of model validity and validation in system dynamics. *System Dynamics Review,* 12(3), 183–210. https://doi.org/10.1002/(SICI)1099-1727(199623)12:3<183::AID-SDR103>3.0.CO;2-4

Boeters S. and Savard, L. (2011). The Labour Market in CGE Models' in the Handbook of CGE Modeling. Octobre 2011.

FAO (2016). Statistical Database, FAOSTAT

FAO (2023). Renforcer la résilience dans la région du Sahel en créant des emplois destinés aux Jeunes - Promouvoir de manière innovante l'accès des jeunes à des emplois décents et verts au sein des systèmes agroalimentaires, Food and Agricultural Organization (FAO) Rome. https://doi.org/10.4060/cc7163fr

Ferreira, V., Almazàn-Gomez, M., Nechifor, V., Ferrari, E. Diallo, F. (2021) Social Accounting Matrix for Côte d'Ivoire 2015; EUR 30784 EN, Publications Office of the European Union, Luxembourg

IFC (2017). Creating Markets, Annual report World Bank, September 28, 2017. Annual Report 2017: Creating Markets (ifc.org)

IFC (2022). Stepping Up in a Time of Uncertainty, Annual report, World Bank, October 6, 2022, https://www.ifc.org/en/insights-reports/2022/ar22-download

ILO (2015a) Guidelines for a Just Transition Towards Environmentally Sustainable Economies and Societies fir All.

ILO (2015b). Global Flagship Programme on Building Social Protection Floors for All, Geneva.

ILO (2019). L'Impact des Investissements Routiers sur l'Emploi en Côte d'Ivoire

ILO (2020). Reference guide for Employment Impact Assessment (EIA)

ILO (2021). Evaluations de l'Impact sur l'Emploi (EIE) – Analyser l'impact des investissements en infrastructure sur l'emploi.

ILOSTAT (2021). Base de données des Statistiques Internationales du Travail

INS and AFRISTAT (2019). Enquête Harmonisée sur les Conditions de Vie des Ménages 2018 (EHCVM, 2018).

Keynes, J. M [1936](1973). The General Theory of Employment, Interest and Money, vol. 7 of the collected writings of John Maynard Keynes. London: Macmillan.

Leontief, W. (1936). Quantitative input and output relations in the economic systems of the United States. *The Review of Economics and Statistics*, Vol. 18, N°3, pp. 105-125.

Lucas, R. (1976). Econometric Policy Evaluation: A critique, Carnegie-Rochester Conference Series on Public Policy, 1(1), 19-46.

Mainar-Causapé, A., Boulanger, P., Dudu, H., Ferrari, E., and Mcdonald, S. (2018). Social Accounting Matrix of Kenya 2014, EUR 29056 EN, JRC Technical Reports, Publications

Office of the European Union.

Miller, R and Blair, P. (2009). Input-Output Analysis: foundations and extensions. 2nd edition (Cambridge, UK Cambridge University Press).

Ministère de l'Agriculture et du Développement Rural (2017). Programme National d'Investissement Agricole de Deuxième Génération (2017-2025) – National Agriculture Investment Program (PNIA II- 2017-2025).

Ministère du Plan et du Développement (2021). Plan National de Développement 2021-2025.

Ministère du Plan et du Développement Communautaire (2017). Plan de Développement Economique et Social (PDES) – PDES 2017-2021.

Osei, V. (2013). The Construction Industry and Its Linkages to the Ghanaian Economy – Policies to Improve the Sector's Performance. International Journal of Development and Economic Sustainability, 1, 56-72

Pulido, A. and Fontela, E. (1993). Input-Output Analysis: Models, Data and Applications. Editorial Pyramid, Madrid.

Pyatt, G. and Round, J. I. (eds) (1985). *Social Accounting Matrices: A Basis for Planning*, The World Bank, Washington D C.

Sterman, J.D. (2000). Business Dynamics: Systems Thinking and Modeling for A Complex World. Mcgraw-Hill Companies, New York.

Toshiko K., Greenbaum, C. and Kline, K. (2020). World Population Data Sheet (Washington, DC: Population Reference Bureau, July 2020). https://www.prb.org/wp-content/uploads/2020/07/letter-booklet-2020-world-population.pdf

WDI (2022). World Development Indicators Database, The World Bank.

Wiggins, S., Newborne, P., Benoudji, C., Diarra, M., Kane, N., Kiebré, M.B. & Sangaré, S. (2023). Green jobs in agrifood systems – Setting a vision for youth in the Sahel. Food and Agricultural Organization (FAO), Rome, https://doi.org/10.4060/cc7033en

World Bank (2008). Transport Prices and Costs in Africa: A Review of the International Social Corridors. Chapter 2: Trucking in Africa Compared with Other Regions. World Bank, Washington, DC World Bank (2017), Africa's Pulse :une analyse des enjeux façonnant l'avenir économique de l'Afrique. Avril 2017, volume 15.

Annex

Tab A 1: Inputs of subsectors of construction in Niger (decomposed)

	Feeder roads (rural)	Feeder roads (urban)	Other Construction	Irrigation infra-structure	Electricity and Water	Other infra-structure	Specialized construction	**Total**
Agriculture	0	0	32356	0	0	0	0	**32356**
Livestock	0	0	8677	0	0	0	0	**8677**
Forestry	0	0	24467	0	0	0	0	**24467**
Mining	**4964**	**6215**	**80503**	0	0	0	0	**91682**
Paper	318	635	13754	0	0	0	0	**14707**
Refining	485	1109	13089	0	0	0	0	**14684**
Cement	646	1334	**219365**	**1836**	**786**	**1124**	**18182**	**243273**
Other Manufacturing	120	2541	**85888**	0	0	**2550**	0	**91099**
Water	16	66	2380	0	0	0	544	**3007**
Construction	166	647	16254	0	0	0	0	**17067**
Repairs	106	892	12473	**2271**	450	386	1342	**17920**
Transport	1235	3222	40519	0	0	0	0	**44976**
Accomodation	275	1401	23935	0	0	0	0	**25611**
Trade	65	309	6232	0	0	0	0	**6606**
Finance services	452	1876	31028	0	0	0	0	**33356**
Business services	112	532	11728	**2379**	176	1713	726	**17367**
Other services	10	43	698	0	0	0		**751**
Urban skilled labour	0	531	5623	1371	521	1286	283	**9616**
Rural skilled labour	0	0	0	0	0	0	98	**98**
Urban unskilled labour	0	2486	26301	416	158	391	695	**30447**
Rural unskilled labour	1420	0	0	257	98	241	203	**2219**
Capital	6743	16625	166878	19626	9541	22845	29463	**271721**
Total	**17133**	**40464**	**822150**	**28157**	**11730**	**30536**	**51536**	**1001707**

(Authors based on SAM 2019)

Tab A 2: Inputs of subsectors of construction in Côte d'Ivoire (decomposed)

	Other construction	Rural water	Rural electricity	Rural road infra-structure	Rural irrigation	Other rural engineering	Urban engineering	**Total**
Agriculture	0	0	0	0	0	0	0	**0**
Forestry	0	427	1062	39	580	276	421	**2805**
Other mining	**14378**	1044	**2594**	96	1417	675	33011	**53214**
Textile	0	0	0	0	0	0	12	**12**
Wood	369	2714	**6745**	250	3686	1740	69845	**85350**
Paper and printing	78	84	208	8	114	54	2156	**2702**
Refining and coking	8131	3285	8165	303	4462	2107	**84547**	**111001**
Chemical products	**79989**	2860	7107	264	3884	1834	**73595**	**169533**
Rubber and plastic	39335	1694	4211	156	2301	1086	43603	**92387**
Other non metallic	**65737**	**21784**	**54142**	**2010**	**29585**	**13969**	**560619**	**747847**
Basic metal	11526	**23883**	**59358**	**2203**	**32436**	**15315**	**614628**	**759348**
Machinery	36815	2297	5708	212	3119	1473	59102	**108725**
Furniture	491	382	949	35	518	245	9823	**12443**
Electricity, gas, water	2546	2444	6073	225	3319	1567	**62887**	**79061**
Construction	77	61	150	6	82	0	1914	**2290**
Repairs	1549	42	103	4	57	27	1317	**3098**
Hotel and restaurant	21687	0	0	0	0	0	0	**21687**
Transport and communication	2475	130	323	12	176	84	4109	**7309**
Postal and telecommunication	3705	627	1558	58	852	405	59739	**66944**
Finance services	17802	0	0	0	0	0	26035	**43837**
Real estate services	13887	20	50	2	27	13	11169	**25169**
Business services	**29554**	**7522**	**18696**	**694**	**10216**	**4863**	**237945**	**309489**
Community services	139	35	88	3	48	23	1118	**1454**
Urban unskilled labour	80144	0	0	0	0	0	97954	**178097**
Urban semi-skilled labour	63059	0	0	0	0	0	77072	**140131**
Urban skilled labour	60955	0	0	0	0	0	74501	**135456**
Rural unskilled labour	953	1537	3819	142	2087	993	0	**9531**
Rural semi-skilled labour	549	885	2199	82	1201	572	0	**5487**
Rural skilled labour	0	0	0	0	0	0	0	**0**
Capital	**342740**	**27630**	**68670**	**2549**	**37524**	**17861**	**873988**	**1370962**
Total	**898671**	**101385**	**251979**	**9354**	**137691**	**65180**	**3081109**	**4545369**

(Authors based on SAM 2019)

zef
Center for
Development Research
University of Bonn

Working Paper Series

Authors: Alkassoum Saadatou Sangare, Tite Ehuitché Beke and Mahamadou Tankari

Contact: saadalk@gmail.com, beketite@yahoo.fr, mtankari@akademiya2063.org

Photo: James Courtright (CC BY-SA 4.0)

Published by:
Zentrum für Entwicklungsforschung (ZEF)
Center for Development Research
Genscherallee 3
D – 53113 Bonn
Germany

Phone: +49-228-73-1861
Fax: +49-228-73-1869
E-Mail: presse.zef@uni-bonn.de

www.zef.de