STRENGTHEN Publication Series

Working Paper No. 14 – September 2019

International Labour Organization

1919·2019

Employment Impact Assessments: Analysis of the employment effects of infrastructure investment in Rwanda using multiplier analysis of construction subsectors

Maikel Lieuw-Kie-Song and Haile Abebe with Theogene Sempundu and Eddy Bynens

This document has been produced by the International Labour Office with the financial assistance of the European Union.

Development and Investment Branch

Employment Policy Department

International
Labour
Office
Geneva

STRENGTHEN Publications Series
Working Paper No. 14

2019

Employment Impact Assessments: Analysis of the employment effects of infrastructure investment in Rwanda using multiplier analysis of construction subsectors

Maikel Lieuw-Kie-Song and Haile Abebe with
Theogene Sempundu and Eddy Bynens

Development
Investment
Branch

Employment
Policy
Department

First published 2019

Copyright © International Labour Organization 2019

ISSN 1999-2939; ISSN 1999-2947 (web pdf)

International Labour Office; Employment Sector.

ILO Cataloguing in Publication Data

Printed by the International Labour Office, Geneva, Switzerland

Preface

Employment is a key driver for development as it constitutes a bridge between economic growth and poverty reduction. People and households moving out of poverty most often do this through moving into more productive and decent jobs or improving existing jobs. Contrary, shortage of adequate decent employment opportunities is recognised as a root cause of migration, becoming more and more critical in view of demographic developments that will see record numbers of youth entering the labour market in the coming decades.

Placing the aim of achieving full and productive employment at the heart of development policy is therefore critical for reducing and eventually eliminating poverty, reducing inequality and addressing informality. This is also now globally recognized with the adoption of Sustainable Development Goal (SDG) 8 "Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all"

The European Commission (EC) and the International Labour Organization (ILO) recognize that achieving this goal will require an approach where the goal of more and better jobs is also integrated into sectoral and trade policies. However, this requires a shared understanding among policymakers and social partners about the positive interaction between sectoral, trade and employment policies and the elaboration of a policy framework allowing sectoral and trade policies to be formulated and implemented in a coherent way to achieve employment and development objectives.

The ILO clearly recognizes that putting the aim of full and productive employment at the heart of development policy is critical in creating decent work and fostering social justice. These perspectives reflect a commitment to the objective of creating quality jobs globally and to pursuing cooperative solutions to this challenge. In the "Agenda for Change", the European Commission (EC) calls for a more comprehensive approach to supporting inclusive growth characterised by people's ability to participate in, and benefit from, wealth and job creation while in its proposal for a new "European Consensus on Development" it is proposed to promote investment and innovation to boost growth and quality employment opportunities in partner countries

In order to build a shared understanding among policymakers through policy dialogue and contribute to a coherent policy framework that is centered on generating and upgrading employment, the EC and ILO have jointly initiated the project entitled "Strengthening the Impact on Employment of Sector and Trade Policies". This project, being implemented in ten partner countries and working with national governments and social partners, aims to strengthen the capabilities of country partners to analyse and design sectoral and trade policies and programmes that would enhance employment creation in terms of quantity and quality.

This innovative project entails developing new methods and capacities to assess how sectoral and trade policies impact on both the qualitative and quantitative dimensions of employment. It requires new processes to bring together different Ministries, public and private stakeholders to have evidence-based dialogue about how their respective policies do, and could, better impact on employment.

This series of project publications aims to capture the tools, methods, and processes developed under this project, as well as the findings from implementing these in the ten partner countries. By doing so, the experience and learning of the project can be disseminated to other countries and partners for their benefit, thus supporting the integration of global and national employment objectives into sectoral and trade policies and consequently supporting the elevation of the global employment agenda and achievement of SDG 8.

Mito Tsukamoto
Chief, Development
and Investment Branch
Employment Policy Department

Jean-Louis Ville
Director Human Development and Migration
Directorate-General for International Cooperation
and Development

Contents

List of Tables

List of Abbreviations

EmpIA	Employment Impact Assessments
FTE	Full Time Equivalent
EB	Equipment Based
GDP	Gross Domestic Product
LB	Labour Based
LBT	Labour Based Techniques
MINECOFIN	Ministry of Economy and Finances
MININFRA	Ministry of Infrastructure
NEP	National Employment Programme
NFRPS	National Feeder Road Policy and Strategy
NISR	National Institute of Statistics of Rwanda
RWF	Rwandan Franc
SAM	Social Accounting Matrices

Abstract

Employment Impact Assessments (EmpIA) are used to improve our understanding of how policies and investments impact on the quality and quantity of employment. One of such approaches is to use social accounting matrices (SAM) and conduct employment multiplier analysis. The aim of this short analysis of the Rwandan construction sector is to show how the employment impacts of public expenditure on different types of infrastructure differ using a social accounting matrix (SAM) based approach. The analysis uses the SAM of Rwanda for the year of 2011 and breaks down construction sector into five major sub-sectors: *equipment-based feeder roads, labour-based feeder roads, national roads, government buildings, and rest of construction.* Subsequently, based on the disaggregated new SAM, employment multiplier analysis of each sub-sector is conducted to show the differential direct, indirect and induced employment effects.

KEYWORDS: Social accounting matrix, public investments, labour based employment, infrastructure, construction, feeder roads, Rwanda

1. Introduction

Over the past two decades, Rwanda has been one of the fastest growing economies in Africa. Between 2001 and 2015 the Rwandan economy grew by 7.2 per cent average real GDP growth and 6.9 per cent GDP per capita growth rate per annum. Through this growth, the country has made important strides in poverty reduction, and economic transformation. The poverty headcount is down to 39 per cent in 2014 from as high as 78 per cent in 1995, and extreme poverty has also dropped from 24 per cent in 2011 to 16.3 per cent in 2014. However, employment growth has not been able to match the rate at which new workers are entering into the labour market. According to the Five Years Rwandan National Employment Programme (NEP) of 2014, the Rwandan economy should create 200,000 off- farm jobs each year in order to meet the employment need of its expanding labour force. It is therefore crucial that the economic growth in Rwanda to become more employment rich.

Labour market statistics of Rwanda shows that the working age population entering into the labour force is increasing every year. According to the Integrated Household Living Conditions Surveys (EICV3 and 4) of 2011 and 2014, working age population (16 years and above) has increased to from 4.9 million to 5.4 million over these three years. Employment by economic activity is still dominated by the agriculture sector, as it constituted 68 per cent of total employment in 2014, albeit down from 72 per cent in 2011. Agriculture is followed by services which contribute 23 per cent and 29 per cent of total employment in 2011 and 2014 respectively. The third most important sector in terms employment is the construction sector, which contributes 5 per cent of employed population in 2014. The Labour Force Survey of 2016 shows that, the percentage of employed population in construction sector has increased to 7.5 per cent in 2016. Even though there have been some positive trends over the last few years; high informality, low productivity, and underemployment are still major features of the Rwandan labour market. Thus, creating more employment opportunities and improving the labour market remain as a key challenge for the Rwandan government which aims to create 1.4 million new jobs in 2024.

The Rwandan government understands the importance of infrastructure in economic transformation and employment creation. To this end, the government continues to invest heavily in the infrastructure and transport sector. With the main theme of sustainable growth through infrastructure development and promotion of Made in Rwanda, the government has committed almost 23 per cent of its annual budget to infrastructure development in 2017/18 fiscal year. Almost tenth of the annual budget is allocated to transport infrastructure (MINECOFIN 2017). One of the policies adopted by the Government of Rwanda that has potential to support higher rates of employment growth is the National Feeder Road Policy and Strategy (NFRPS) from January 2017 (MININFRA 2017). The sustained increased investment planned in this policy and strategy will lead to increased direct employment in the

construction sector, as well as indirect employment in sectors related to construction. This paper aims to contribute to strengthening this policy by analysing the construction sector in Rwanda in general, and the feeder roads sector in particular so as to quantify how the implementation of this policy will impact on job creation, and how this contribution can be maximized. This paper is done as part of the ILO/ EU Strengthening the impact on employment of sectoral and trade policies. This global project covers nine countries, including Rwanda and the paper will be incorporated into the project country report.

The rest of the paper is organized as follows: section two provides an overview of policy background for our analysis. Section three discusses data sources and methods used for the analysis. Section four presents the results and discussion of the analysis. The remaining sections cover policy simulation, conclusions and recommendations.

2. Policy background

Infrastructure investments in general and the road sector investments in particular, are likely to remain an important part of public investment in Rwanda as the road network needs to continue to improve to support Rwanda economic growth. Various internationally used indicators on the adequacy of the road network all indicate that there will be a need for continued road investment in Rwanda. This is one of reasons why the construction sector is identified as a priority policy in the National Employment Policy process (MIFOTRA 2016, draft). Furthermore, as the road network is both expanded and improved, spending on road maintenance will also need to increase. For the feeder road network alone, the National Feeder Road Policy and Strategy (NFRPS) estimates that on average USD 73 million will be required per annum between 2017 and 2027 to improve and maintain the feeder road network. This implies more than doubling current expenditure on this category of roads.

Another important aspect of the NFRPS is its emphasis on the use of Labour Based Technologies (LBT). This is captured in Policy Statement 10 which states that *"Feeder Roads development as a way of strengthening local rural economy through creation of off farm Jobs shall fully capitalize on labour-based technology and local available resources."* (MININFRA 2017). The policy does not set specific targets with regards to this however, partly taking into account the recognized need to strengthen implementation and institutional capacity to implement the feeder road strategy using largely LBT. This does however raise the question how the employment impacts would differ if LBT versus more conventional methods of construction were used. It would be important here to not only take into account the direct employment effects, but also consider the indirect and induced employment effects. This paper aims to shed some light on these questions, by estimating these effects.

3. Method

3.1 Sectoral employment data

Employment data for 2011 (Date for the latest available SAM) is based on the EICV 3 (2011) data available from the National Institute of Statistics of Rwanda (NISR). While the sectors from EICV do not exactly match those used in the SAM, they are close enough to match them. This data measures employment both in terms of primary occupation and hours worked in different sectors. Of these two the authors favour using hours worked, since more than 50 per cent of the population has multiple occupations, and it is believed that especially in rural areas, for many people the construction sector is not their primary occupation. Using primary occupation data would thus tend to ignore the population for whom construction is a secondary occupation. However the limitation of hours worked is that it is hard to estimate how many people were actually affected as it is not possible to distribute the additional hours worked across the population. Because the hours worked would also include hours worked by people who have their secondary or tertiary occupation in the relevant sector, one cannot simply divide

the hours worked by the people in the sector to calculate the average number of hours each worker worked in the sector.

Table 1 shows the hours worked in each sector based on Charpe 2017 (Column 2). Apart from hours worked per sector, Table 1 also contains the output of each sector based on the SAM (Column 1) which allows us to calculate the apparent productivity for each sector which is simply total output divided by the total hours worked (Column 3). For the construction sector this yields RWF 0.0016 million RWF/ hour, which is the equivalent of be RWF 1,600 per hour.

It is important to note the large differences in apparent productivity between sectors, and in particular to note the low productivity of the agriculture sector (0.0002 or RWF 200/hour) compared to other sectors. Apparent productivity in this sector is expected to be low, based on the high number of people employed in this sector. This is further compounded by the high amount of subsistence agriculture in Rwanda. The result of this is that a lot of agricultural output is never marketed. And while this output is estimated, it is well-known that these estimates are difficult to do accurately (OECD 2002). However this low productivity has important implications on estimating employment effects for the sector using these figures, as any increase in output will result in a large increase in the estimated number of additional hours worked.

Finally the number of hours worked, can be converted into full time equivalents (FTE) which then gives an indication of how many people would be working in the sector if they all worked full time. In this paper, a FTE is deemed to be equivalent to 2000 hours worked per year, based on working for 50 weeks per year and 40 hours a week (Column 4). Based on this, it shows that in 2011 the construction sector created the equivalent of 211,650 full time jobs in 2011.

Table 1 Sectoral output, and number of hours worked and apparent productivity

Sectors	Sectoral output(Million FRW)	Total hours worked (Thousands)	Output RWF/hour worked	Full time equivalent
Agriculture	1,245,528	5,676,000	0.0002	2,838,000
Forestry	86,625	26,200	0.0033	13,100
Fishing & Hunting	18,334	19,700	0.0009	9,850
Mining and Quarrying	73,378	93,000	0.0008	46,500
Textile Manufacture	36,937	17,400	0.0021	8,700
Wood and Paper Products	21,357	45,215	0.0005	22,607
Chemical Industries	29,607	6,272	0.0047	3,136
Non-metallic Products.	90,733	5,616	0.0162	2,808
Gas, Water & Electricity	19,876	24,000	0.0008	12,000
Construction	668,027	423,300	0.0016	211,650
Wholesale and Retail Trade	550,431	258,781	0.0021	129,391
Hotel & restaurants	170,688	90,800	0.0019	45,400
Transport	363,529	146,700	0.0025	73,350
Communications	137,141	13,600	0.0101	6,800
Financial services	133,427	24,380	0.0055	12,190
Real Estate	195,722	1,724	0.1136	862
Business Services and repair	94,146	16,600	0.0057	8,300
Total	**4,525,645**	**6,944,388**	**0.6517**	**3,472,194**

Source: Modified from Charpe 2017

3.2. Rwandan Social Accounting Matrix (SAM) 2011

The analysis and assessment of the estimated impacts presented in this paper are based on the latest social accounting matrix (SAM) available for Rwanda, the 2011 SAM as published by Pradesha and Diao (2014). In general the SAM has three main objectives:

- Providing information on the social and economic structure of a country.
- Provide a snapshot view of the flows of receipts and payments in an economic system;
- From a statistical basis for building models of the economic system, to analyse socio-economic impact of policies (Bellù 2012).

Like any other SAM, the Rwandan SAM is constructed based on two fundamental principles of economics: income and expenditure. For every income made by one sector or economic activity, there is a corresponding expenditure paid to the other sectors of the economy. Hence, it represents all economic transactions and transfers between different production activities among economic actors and institutions with in the national economy and with the rest of the world in the year of 2011.

These transactions and transfer of payments between accounts are recorded and presented in a table or square matrix. And each cell in the matrix represents a monetary transfer from one account to the other. The row of the SAM represents recipient or income to the account, columns represent expenditure or payments made by one accounts to the other account in the SAM. To illustrate this we have presented aggregated version of Rwandan SAM 2011 in Annex 4. For example, the cell at the intersection of column "Activities" (column 1) and the row "Commodities" (row 2) represents production activities payment 1,754,249 RWF to "Commodities" as *intermediate consumption*. Likewise, the cell at the intersection of "Households" account in row 4 and "Government" account in column 5 represents households in Rwanda received 89,060 RWF from the government in the form of *social transfer*.

3.3 The construction sector according to the SAM and household survey data

Table 2 present the construction sector account in the 2011 SAM. It shows the value of the inputs from each of the main sectors in the SAM, as well as the factor outputs. According to the SAM the total output of the construction sector in 2011 was RWF 668 billion. The sector with the highest inputs into the sector was the transport sector with inputs of RWF 77 billion, followed by finance and insurance at RWF 64 billion. The other main sectors are the construction sector itself with RWF 54 billion, Wood paper and printing at RWF 37 billion, non-metallic minerals at RWF29 billion and Chemicals at RWF 16 billion. Together these 6 sectors account for 39 per cent of total input into the construction sector.

In terms of value added to the sector, they are generated by the labour and capital factors. Of the factors, labour provides the biggest added value with RWF 192 billion, of which unskilled labour provided the largest share at 142 billion. Total factor capital amounted to RWF 149 billion. The high share of total value added through unskilled labour is of particular significance, as it demonstrates the sector's ability to create employment for and provide income to the unskilled, which are also generally the poorest segment of the population. A drawback of how this SAM is structured is that it does not capture the role of imported content of the construction sector. This is an important limitation given that it is known that large shares of construction sector inputs are in fact imported.

Table 2 Sector and factor inputs into the construction sector

	Construction spending (RWF millions)	Percentage
Agriculture	0	0.00
Forestry	2,071	0.31
Textile and clothing	39	0.01
Wood, paper and printing	367,91	5.51
Chemicals	16,352	2.45
Non-metallic minerals	28,691	4.29
Furniture and other manu.	132	0.02
Electricity, gas and water	248	0.04
Construction	54,393	8.14
Wholesale and retail trade	9,294	1.39
Transports	77,061	11.54
Communication	12,002	1.80
Finance and insurance	64,357	9.63
Real estate	277	0.04
Business services	23,387	3.50
Repair	2291	0.34
Labour – unskilled	141,584	21.19
Labour - Low Skill	42,827	6.41
Labour - High Skill	7,652	1.15
Capital - Non-Agriculture	134,664	20.16
Capital - Sector Specific	13,913	2.08
Total	**668,027**	**100**

Source: Pradesha and Dioa 2014

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 analysed. In the disaggregation five construction sub-sectors were created; *equipment based feeder Roads, labour based feeder roads, national roads, government buildings and rest of construction*. The data for the disaggregation was obtained from government records on government investment on these subsectors in 2011. The amount of government investment in these subsectors for 2011 was treated as the output of these sectors. This is considered a reasonable assumption since this type of infrastructure is only build through government investment. In order to obtain the different inputs into the different subsectors, a detailed analysis of representative sample projects was conducted by a team of road sector experts in Rwanda[1]. In doing so, for *LB feeder roads*, inputs data were collected from the following sample projects; Byamagumba-Kanomber-Kabere feeder road, Rwasa-gabiro feeder road, and Byumba Rwasama feeder road. Karembo-Zaza-Mugesera road project and Sashwara-Kabatwa road project were surveyed to collect inputs data for *equipment based feeder* roads and *national roads* respectively. With regard to *government buildings*, inputs data were collected from the construction of maternity ward at Rwamagana district Hospital. Based on the results of the survey, expenditure of these projects on different inputs was then matched with the existing sectors in the SAM. These results are presented in **Table 3** and through this, a new set of coefficients were estimated.

[1] To estimate inputs of construction subsectors a survey was conducted by Sempundu,T., Bynens,E., Ngendahinyeretse, A. See Annex 1A and 1B for the method used.

Table 3 Estimating inputs of subsectors of construction (decomposed) (All in millions of RWF)

Sectors and Factors	Feeder Roads EB	Feeder Roads LB	National Roads	Government Buildings	Rest of construction	Total
Agriculture	0	0	0	0	0	0
Forestry	46	26	51	216	1731	2071
Textile and clothing	1	1	2	3	33	39
Wood, paper and printing	116	115	226	1,031	35,302	36791
Chemicals	0	1	406	2,479	13,466	16352
Non-metallic minerals	3,244	867	2,752	4,465	17,364	28691
Furniture and other manu.	3	2	3	11	113	132
Electricity, gas and water	6	3	188	17	33	248
Construction	1,215	638	1,346	2,295	48,899	54393
Wholesale and retail trade	1,188	227	1,785	5,953	140	9294
Transports	1,555	1,760	2,203	2,159	69,385	77061
Communication	175	67	188	452	11,121	12002
Finance and insurance	525	402	569	226	62,636	64357
Real estate	6	3	10	226	32	277
Business services	466	201	501	1,355	20,863	23387
Repair	73	0	0	456	1762	2291
Labour - Unskilled	848	2,552	1,387	1, 639	13,5159	141584
Labour - Low Skill	506	282	478	1171	40,390	42827
Labour - High Skill	505	566	599	724	5,257	7652
Capital - Non-Agriculture	4,130	648	3,596	2950	123,340	134664
Capital - Sector Specific	310	178	236	372	12,816	13913
Total	**14,920**	**8,539**	**16,526**	**28,201**	**599,842**	**668,027**

Source: Source: Calculated by authors based on Sempundu et. al

The rest of construction account was treated as the residual of the sector, thus containing all other construction sector activity including all private sector and household spending on construction, as well as government spending in other types of infrastructure. Thus remaining output of the construction sector (Total output minus government spending on the four new subsectors) was allocated to the rest of construction account. By doing this the SAM remains balanced even though new subsectors have been introduced.

In terms of the outputs of these subsectors, it was assumed that these are not used as intermediates or purchased inputs into any other sectors of the economy and all the outputs of these sectors are therefore allocated to the saving and investment account in the SAM.

With regards to the apparent productivity of the new subsectors, these were also estimated using the available project data. To do this, for each of the subsectors the total project value was divided by the total employment general by the project. These estimates are provided in the table 4. It is worth noting that while the apparent productivity for LB feeder roads is only half of construction as a whole, this is still four times as high as apparent productivity in agriculture.

This is also reflected in the difference between the wage rates of the two sectors. In general wage rates for unskilled work in the construction sector found to be roughly twice as high (Between RWF 1500 and 2500 per day in construction as compared to the RWF 800 to 1200 in agriculture sector). For labour based construction projects, wage rates were typically lower than the construction sectors as a whole and more similar to the agriculture sector (RWF 1300 per day). This is done as a deliberate

policy in order to avoid that the LB roads sector puts too much pressure on increasing rural wages which could impact negatively on some agricultural activities.

Table 4 Apparent productivity in the construction sub-sectors

Subsectors	Apparent Productivity (RWF/hour)
National Roads	3500
Feeder roads	4500
LB Feeder roads	800
Government Buildings	3300
Rest of construction	1600

Source: Calculated by authors based on Sempundu et. al.

Using both the original and the SAM with the decomposed construction sector, we then proceeded to conduct the *Leontief multipliers analysis* and the results of both analysis were then compared with each other. The method for conducting the multiplier analysis is presented in Annex 3. First, we estimated the impact of an exogenous shock of additional government spending on infrastructure on output of the economy as a whole. This shock was first applied to the Input-Output table contained in the SAM only to estimate the direct and indirect employment effects. The same shock was then applied to the SAM to calculate the direct, indirect and induced output and employment effects.

4. Discussion of results

4.1 Output multipliers using original IO table and SAM

The first set of construction sector multipliers are presented in Table 5. They are the results from applying an exogenous shock through additional government spending equivalent to 1per cent of GDP on the construction sector. The first column provides the multipliers looking only at the backward linkages (M1), and captures the direct and indirect impacts on output. What it shows is that an increase in the final demand by one RWF in construction sector will increase total inputs by 1.8 RWFs. As can be expected, most additional output would be created in the sector which provide most inputs in the construction, namely transport, financial services, wood, chemical and non-metallic.

Table 5 Construction sector M1 and M2 multipliers

Sectors	I-O output multipliers (M1)	SAM output multipliers (M2)
Agriculture	0.0255	0.8804
Fishing & Hunting	0.0000	0.0103
Forestry	0.0040	0.0662
Textile Manufacture	0.0001	0.0848
Wood and Paper Products Man.	0.0697	0.0798
Chemical Industries	0.0776	0.1799
Non-metallic Products. Man.	0.0473	0.0665
Furniture and other manu.	0.0123	0.0999
Gas, Water & Electricity	0.0032	0.0119
Construction	1.0962	1.1089
Wholesale and Retail Trade	0.0167	0.2808
Hotel & restaurants	0.0002	0.0387
Transport	0.1516	0.3565
Communications	0.0321	0.0650
Financial services	0.1742	0.2010
Real Estate	0.0050	0.0922
Business Services and repair	0.0781	0.0980
Total	**1.7938**	**3.7208**

Source: Calculated by authors

The second column provides the multiplier which includes, the direct, indirect and induced effects, (M2) and this also captures the forward linkages, in particular of consumption. With the induced effect, the total output multiplier increased significantly to 3.7. The difference between the multipliers captures the induced effect. Sectors that show hardly any increase in output when only looking at the indirect effects, such as agriculture, agro processing, forestry, wholesale and retail and textiles now increase significantly. This gives an indication of how the induced (consumption) transmits into these sectors. An important reason for this is the large factor payment to unskilled labour, as their increased spending is likely to benefit these sectors.

4.2 Output multipliers of the decomposed construction using the SAM

4.2.1. Output multipliers with decomposed IO table

Table 6 presents the M1 multipliers for the five subsectors of the construction sector. As the variation in inputs as estimated from the project data was relatively small, the difference between the multipliers is also not as large. The total direct and indirect effects are largest for the government building sector, 2.2 the sector with the most inputs from other sectors. The LB feeder roads in this case have the smallest multiplier 1.8, as the non-labour inputs are the smallest of the subsector.

Table 6 Construction Sector multipliers for the decomposed construction sector

Sectors	Feeder Roads EB	Feeder roads LB	National roads	Government buildings	Rest of construction
Agriculture	0.018	0.025	0.029	0.047	0.024
Fishing & Hunting	0.000	0.000	0.000	0.000	0.000
Forestry	0.004	0.004	0.004	0.009	0.004
Textile Manufacture	0.000	0.000	0.000	0.000	0.000
Wood and Paper Products Man.	0.019	0.024	0.025	0.051	0.074
Chemical Industries	0.056	0.075	0.087	0.143	0.075
Non-metallic Products. Man.	0.221	0.105	0.170	0.162	0.032
Furniture and other manu.	0.029	0.017	0.025	0.025	0.011
Gas, Water & Electricity	0.005	0.003	0.016	0.005	0.003
Construction	1.097	1.089	1.097	1.100	1.096
Wholesale and Retail Trade	0.082	0.028	0.110	0.214	0.002
Hotel & restaurants	0.000	0.000	0.000	0.000	0.000
Transport	0.158	0.244	0.185	0.138	0.150
Communications	0.024	0.020	0.025	0.031	0.033
Financial services	0.122	0.137	0.128	0.115	0.181
Real Estate	0.004	0.006	0.005	0.013	0.005
Business Services and repair	0.093	0.065	0.082	0.118	0.076
Total	1.932	1.840	1.989	2.171	1.764
Total (without agriculture)	**1.914**	**1.815**	**1.960**	**2.124**	**1.740**

Source: Calculated by authors

4.2.2. Output multipliers with decomposed SAM

The results for the M2 multipliers are presented in Table 7. The variation in between the total value of multipliers of the different subsectors is very small. However there is variation in how different subsectors are impacted. For example the contribution of agriculture and transport are significantly larger for LB feeder roads when compared to feeder roads or to the other sectors.

Table 7 M2 Construction Sector multipliers for the decomposed construction sector

Sectors	Feeder Roads EB	Feeder roads LB	National roads	Government buildings	Rest of construction
Agriculture	0.822	0.908	0.817	0.806	0.888
Forestry	0.062	0.068	0.062	0.065	0.066
Fishing & Hunting	0.010	0.011	0.010	0.009	0.010
Textile Manufacture	0.082	0.086	0.080	0.078	0.085
Wood and Paper Products Man.	0.032	0.037	0.038	0.061	0.084
Chemical Industries	0.154	0.169	0.179	0.234	0.178
Non-metallic Products.	0.241	0.122	0.189	0.180	0.051
Furniture and other man.	0.029	0.017	0.025	0.025	0.011
Gas, Water & Electricity	0.013	0.012	0.024	0.012	0.012
Construction	1.111	1.101	1.110	1.110	1.109
Wholesale and Retail Trade	0.358	0.302	0.378	0.480	0.265
Hotel & restaurants	0.040	0.038	0.038	0.037	0.039
Transport	0.361	0.454	0.382	0.326	0.356
Communications	0.060	0.054	0.059	0.063	0.066
Financial services	0.149	0.159	0.148	0.131	0.209
Real Estate	0.102	0.087	0.097	0.098	0.092
Business Services and repair	0.103	0.082	0.093	0.126	0.097
Total	3.727	3.708	3.731	3.842	3.615
Total (without agriculture)	**2.905**	**2.800**	**2.914**	**3.036**	**2.727**

Source: Calculated by authors

4.3 Value added multipliers

The analysis with the full 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 captures 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.

The value added multiplier of the construction sector as a whole is 1.7 and is similar for all the subsectors, with only minimal variations in the totals. What is significant however is the difference between the contribution of labour and capital to the value-added. For LB feeder roads, the share of value added by unskilled labour is the highest and almost twice as high as for the other subsector implying that this sector allows unskilled labour to make a higher contribution to GDP and that a higher share of income will also flow to unskilled labour.

Table 8 Value added multipliers from SAM without decomposition

Factors	Value added multipliers of construction
Labour - Agriculture	0.179
Labour - Unskilled	0.393
Labour - Low Skill	0.261
Labour - High Skill	0.185
Capital	0.712
Total	1.731
Total (without agriculture)	**1.552**

Source: Calculated by authors

Table 9 Value added multipliers from SAM with decomposition of construction sector

Factors	Feeder roads EB	Feeder roads LB	National roads	Government buildings	Rest of construction
Labour - Agriculture	0.167	0.185	0.164	0.166	0.181
Labour - unskilled	0.237	0.485	0.243	0.265	0.408
Labour - Low Skill	0.259	0.247	0.307	0.263	0.259
Labour - High Skill	0.206	0.227	0.201	0.205	0.183
Capital	0.839	0.594	0.704	0.772	0.709
Total	1.709	1.739	1.618	1.672	1.740
Total (without agriculture)	**1.542**	**1.554**	**1.454**	**1.506**	**1.559**

Source: Calculated by authors

4.4 Income multipliers

In this section we present the income multipliers obtained from the analysis. The SAM allows us to distinguish the income multipliers for rural and urban households, and thus shows how these two categories of households are impacted differently. As can be expected, the LB feeder roads have the highest overall income multiplier, but also the highest multiplier for rural households.

Table 10 Income Multipliers without decomposition

Households	Income multipliers of construction
Rural households	1.047
Urban households	0.875
Total	1.922

Source: Calculated by authors

Table 11 Income multipliers for decomposed construction sector.

Households	Feeder roads EB	Feeder roads LB	National roads	Government buildings	Rest of construction
Rural households	0.881	1.131	0.917	0.904	1.062
Urban households	1.009	0.801	0.876	0.947	0.871
Total	1.890	1.932	1.794	1.851	1.932

Source: Calculated by authors

While the overall value of the income multipliers does not vary that much for the different construction subsectors, there is a significant impact in who captures the most gains of the income multipliers. For LB feeder roads, the majority of additional income benefits rural households, while for feeder roads, the majority of additional income actually accrues to urban households.

4.5 Employment effects

We now turn our attention to estimating the employment impacts of this anticipated increase in government expenditure. The employment effects can be calculated by multiplying the additional output from an exogenous shock with the apparent labour productivities for each sector. The initial results of doing this showed a very large employment effect in the agriculture sector which warrants further discussion. When also including the induced employment effects, the total additional hours worked were dominated by additional hours worked in the agriculture sector, and as much as 77 per cent of the additional hours worked are in this sector. This large share is explained by the high multiplier effect in the agriculture sector combined with the very low productivity in this sector.

However, it is important to discuss some of the assumptions behind the multiplier-based analysis used, so as to critically analyse these results. One assumption in this method is that to increase output in the sector, additional employment is required to produce this, and that there is no increase in productivity of the existing workforce, or price adjustments. So, in sectors with very low productivity, an increased output will, using this assumption, require a lot of additional labour input. Another important assumption in this type analysis is that sectors do not have supply constraints, and are assumed to be able to respond to increased demand by simply increasing its output and that prices would not shift much. This assumption should be questioned in the agriculture sector in Rwanda, one of the reasons being the limited availability of land. Because of this the sector is generally not able to respond to increased demand by increasing the area under cultivation which would require additional labour input. Instead, the agriculture sector adjusts to increased demand not just by increasing output, but also through price adjustments switching crops if prices or demand are expected to increase. Furthermore, it is even more difficult to estimate how subsistence agriculture would respond to increased demand this output is not marketed.

Table 12 Additional hours worked on non-farm employment due to increased spending of 1 per cent of GDP on the construction sector

Sectors	Increase in total hours with I-O output multipliers	Increase in total hours worked with SAM output multipliers
Fishing & Hunting	-	612,186
Forestry	64,839	1,073,082
Textile Manufacture	2,547.00	2,160,058
Wood and Paper Products Man.	7,456,785	8,537,323
Chemical Industries	883,187	2,047,492
Non-metallic Products.	156,183	756,855
Furniture and other Manu.	-	-
Gas, Water & Electricity	213,968	795,694
Construction	36,648,707	37,073,299
Wholesale and Retail Trade	425,389	7,152,645
Hotel & restaurants	5,631	1,089,548
Transport	3,243,755	7,627,959
Communications	170,009	344,255
Financial services	48,629	1,954,889
Real Estate	2,354	43,415
Business Services and repair	732,934	919,687
Total	**56,875,147**	**72,188,387**

Source: Calculated by authors

Given these factors, it was decided to discard the agriculture sector indirect and induced employment results, as the assumptions behind this approach are not considered valid for the agriculture sector in Rwanda. This is not to conclude that there would be no additional output or employment in the agriculture sector, but just that these results cannot be deemed to be accurate enough the capture the likely indirect and induced employment effects in the agriculture sector. This is also in line with the policy goals and targets of the Rwandan government of focusing on "off-farm" employment created. The employment effects are presented in Table 12 with only with non-farm employment.

In this case, and not unexpectedly, most of the additional hours worked are in the construction sector itself. Converting the additional hours worked into FTEs shows that total employment in the construction sector would be approximately 18,300 FTEs, direct and indirect non-farm employment created would be approximately 28,400 FTEs, while the total direct, indirect and induced employment created would be 36,100 FTE. For the induced effects, apart from the construction sector, most additional employment would be created in transport, wholesale and retail trade, and wood, paper and paper products.

We will now shift to considering the employment effects estimated using the decomposed construction sector and apparent productivities for the subsectors presented in table 4 and these results are presented in Table 13.

Table 13 Employment effects on non-farm employment in (additional hours worked)

Sectors	Feeder roads EB	Feeder roads LB	National roads	Government buildings	Rest of construction
Forestry	1,005,001	1,102,259	1,005,001	1,053,630	1,069,840
Fishing & Hunting	594,356	653,791	594,356	534,920	594,356
Textile Manufacture	2,088,735	2,190,625	2,037,790	1,986,846	2,165,152
Wood and Paper Products	3,423,488	3,958,408	4,065,392	6,526,024	8,986,656
Chemical Industries	1,752,717	1,923,436	2,037,249	2,663,219	2,025,867
Non-metallic Products.	795,776	402,841	624,073	594,356	168,401
Furniture and other Manu.	-	-	-	-	-
Gas, Water & Electricity	869,245	802,380	1,604,760	802,380	802,380
Construction	13,206,581	73,618,365	16,964,605	17,992,764	37,076,643
Wholesale and Retail Trade	9,119,112	7,692,659	9,628,560	12,226,743	6,750,181
Hotel & restaurants	1,126,147	1,069,840	1,069,840	1,041,686	1,097,994
Transport	7,724,245	9,714,147	8,173,578	6,975,357	7,617,261
Communications	317,774	285,997	312,478	333,663	349,552
Financial services	1,449,147	1,546,405	1,439,421	1,274,082	2,032,696
Real Estate	48,030	40,967	45,675	46,146	43,321
Business Services and repair	966,610	769,534	872,764	1,182,455	910,302
Total	44,486,963	105,771,654	50,475,542	55,234,270	71,690,601
Total non-construction and off farm	31,280,382	32,153,289	33,510,937	37,241,506	34,613,958

Source: Calculated by authors

There is a pronounced difference in the total employment created using LB feeder roads, as compared to feeder roads which are EB. For EB feeder roads, the additional non-agriculture employment created would be equivalent of 44.5 million hours (22,500 FTE) and while for LB feeder roads this would be 105 million hours (52,500 FTE). In both cases the additional employment is dominated by the construction sector. For example, for LB feeder roads there is significant employment creation in the transport, (4860 FTE) and wholesale and retail sectors (3800 FTE).

5. Simulating the impacts of the New National Feeder Roads Policy

According to the new national feeder road policy and strategy, the required annual investment in Feeder roads is around USD 76 million per year for the next ten years. Based on investment of USD 35 million on feeder roads in 2011 this implies and increase in USD 41 million on feeder roads per annum. Using the decomposed SAM, we can now simulate the different employment impacts for implementing the new feeder road strategy by applying a "shock" of USD 41 million on both the feeder roads sectors. These results are presented in Table 14.

Table 14 Results from simulation of employment effects of implementing the Feeder roads strategy (Non-agriculture jobs)

Sectors	Increase in total hours worked Feeder Roads	Increase in total hours worked Feeder Roads LB
Forestry	462,952	507,754
Fishing & Hunting	273,789	301,168
Textile Manufacture	962,172	1,009,108
Wood and Paper Products Manu.	1,577,024	1,823,434
Chemical Industries	807,386	886,027
Non-metallic Products.	366,573	185,568
Furniture and other Manu.	-	-
Gas, Water & Electricity	400,416	369,615
Construction	6,083,589	33,912,176
Wholesale and Retail Trade	4,200,704	3,543,610
Hotel & restaurants	518,758	492,820
Transport	3,558,160	4,474,806
Communications	146,382	131,744
Financial services	667,547	712,349
Real Estate	22,125	18,871
Business Services and repair	445,267	354,485
Total non-construction	*14,409,256*	*14,811,358*
Total	20,492,844	48,723,535

Source: Calculated by authors

According to these results if the government implements these feeder roads using a more conventional approach, then total non-farm additional employment generated from this would be approximately 20.5 million hours or 10,250 FTEs. However, if LB techniques were to be used for all these feeder road investments, additional employment generated would be 48.7 million hours, or 24,350 FTE. In both cases around 7,300 of these FTE would be non-construction jobs generated through indirect and induced effects.

5.1 Employment effects of implementing the feeder roads strategy by gender, age and skills level

In addition to the detailed employment data by economic activities, EICV3 provides information on the percentage distribution of sectoral employment by gender, age, and skills. This section, using the percentages provided in EICV 3, estimates the proportion shares of female and youth employment in the increased total hours worked as a result implementing the feeder roads strategy. Also shows how the additional hours will be distributed based on the skills levels of workers in each sector.

As indicated in table 15, of the total 20.5 million additional increase in the hours worked using the equipment-based technologies, 5.2 million hours or 25 percent of the increased hours would be for female workers. On the other hand, if the feeder roads strategy is to be implemented using more of labour-based methods, the share of female workers in the additional hours worked would increase up to 10.3 million hours (5,100 FTE), which contributes more than 21 percent of the total additional hours worked using the LB methods. In addition to construction sector, wholesale and retail trade, textile

manufacturing, and transport sectors would constitute most of the additional hours worked by female workers. Looking at the additional hours worked by the youth, the study estimates that depending on the method used to implement the feeder road strategy, between 7 and 9 per cent of the newly created additional hours worked would be for young workers aged between 16 and 29 years.

Table 15 Employment effects of implementing the feeder roads strategy by gender and age (Non-agriculture jobs)

Sectors	Increase in total hours worked Feeder Roads EB		Increase in total hours worked Feeder Roads LB	
	Female	Youth 16-29	Female	Youth 16-29
Forestry	116,844	282,401	128,151	309,730
Fishing & Hunting	8,722	167,011	9,594	183,712
Textile Manufacture	542,352	19,243	568,808	20,182
Wood and Paper Products Manu.	123,433	31,540	142,719	36,469
Chemical Industries	498,502	16,148	547,057	17,721
Non-metallic Products.	135,081	7,331	68,381	3,711
Gas, Water & Electricity	82,403	100,104	76,064	92,404
Construction	1,155,882	365,015	6,443,313	2,034,731
Wholesale and Retail Trade	1,840,442	504,084	1,552,551	425,233
Hotel & restaurants	96,684	5,188	91,850	4,928
Transport	249,071	106,745	313,236	134,244
Communications	40,960	46,842	36,864	42,158
Financial services	226,966	120,158	242,199	128,223
Real Estate	3,018	-	2,574	-
Business Services and repair	93,408	53,432	74,364	42,538
Total	**5,213,766**	**1,825,244**	**10,297,726**	**3,475,984**
Total non-construction and off farm	***4,057,885***	***1,460,229***	***3,854,413***	***1,441,254***

Source: Calculated by authors

To analyse the skills composition of the additional hours worked, three skills categories were created: skilled, semi-skilled and unskilled using education level as a parameter and the results are presented in Table 16. The study found that, out of 48.7 million hours increase or 24 ,000 FTE jobs generated by the feeder road strategy using the labour-based methods, more than 85 per cent of the newly created FTE jobs would be for unskilled workers with skilled and semi-skilled employment contributing up to 8 percent and 7 per cent respectively. The strategy therefore provides an important avenue for unskilled workers, particularly for those in agriculture, to shift to the construction sector, develop sector specific skills, increase their productivity and find sustained employment in the sector. This in turn would have an important implication in the structural transformation of Rwanda's economy

Table 16 Employment effects of implementing the feeder roads strategy by skills level (Non-agriculture jobs)

Source: Calculated by authors

Sectors	Increase in total hours worked Feeder Roads EB			Increase in total hours worked Feeder Roads LB		
	Unskilled	Semi-Skilled	Skilled	Unskilled	Semi-Skilled	Skilled
Forestry	446,749	8,796	7,407	489,983	9,647	8,124
Fishing & Hunting	264,206	5,202	4,381	290,627	5,722	4,819
Textile Manufacture	813,998	58,692	89,482	853,705	61,556	93,847
Wood and Paper Products Manu.	1,334,162	96,198	146,663	1,542,625	111,229	169,579
Chemical Industries	683,049	49,251	75,087	749,579	54,048	82,401
Non-metallic Products.	310,121	22,361	34,091	156,991	11,320	17,258
Gas, Water & Electricity	231,040	94,498	75,278	213,268	87,229	69,488
Construction	5,268,388	419,768	395,433	29,367,944	2,339,940	2,204,291
Wholesale and Retail Trade	3,604,204	403,268	197,433	3,040,417	340,187	166,550
Hotel & restaurants	459,620	38,907	23,863	436,639	36,962	22,670
Transport	2,857,202	441,212	252,629	3,593,269	554,876	317,711
Communications	117,545	18,151	10,393	105,790	16,336	9,354
Financial services	229,636	190,251	247,660	245,048	203,019	264,281
Real Estate	19,603	1,659	1,018	16,720	1,415	868
Business Services and repair	394,507	33,395	20,482	314,074	26,586	16,306
Total	**17,034,029**	**1,881,609**	**1,581,301**	**41,416,679**	**3,860,073**	**3,447,547**
Total non-construction and off farm	***11,765,641***	***1,461,842***	***1,185,868***	***12,048,735***	***1,520,132***	**1,243,255**

6. Conclusions and recommendations

6.1 Conclusions on the method used

The method used in this analysis is based on established multiplier analysis together with an employment satellite account. This approach was used as it can be done using available data and makes very transparent assumptions that are easy to understand. There are still important limitations in particular for analysing the induced impacts on agriculture related employment, as it is particularly difficult to make reliable assumptions how the production of crops for domestic consumption, and especially subsistence crops would respond to changes in demand. This is compounded by other characteristics of the agriculture sector, such as the large share of the population involved, output constraints in particular availability to land and very low apparent productivity. For these reasons it was decided to discard the induced employment effects in this sector.

With regards to the particulars of the SAM, as was mentioned there are limitation on the construction sector of the SAM. These limitations do not disappear with the decomposition of the construction sector. An important constraint is the limited number of sectors in the SAM, which makes it difficult to allocate spending of construction to different sectors.

However, the approach introduced for decomposing the construction sector is believed to be useful and easily replicable in other countries, as in general data on public infrastructure investment is relatively easily obtained and easily analysed by experienced engineers or quantity surveyors active in the country. The main restriction is that it should only be used for public funded infrastructure, as some of the assumptions used would not be correct for private sector construction spending.

Despite these limitations, the method used provides important insights for policymaking, the type of employment creation strategies the Rwandan government can pursue and the scope and types of employment impacts that can be anticipated.

6.2 Conclusions relevant to policy making

The construction sector has strong multipliers in the Rwandan economy, and thus provides an important tool for the government to be able to stimulate the economy and enhance job creation. The results of the analysis show that an increase in infrastructure investment of 1 per cent of GDP would increase total economic output by between 2.8 per cent, GDP by approximately 1.6 per cent when taking both the indirect and induced effects into account but (discarding indirect and induced effects in the agriculture sector). Furthermore, total household income would increase by 1.9 per cent, and 18,400 FTEs would be created within the construction sector and additional non-agriculture employment created outside construction would be approximately 17,800 FTEs created. As a rule of thumb, the analysis shows that in general, for every job created in the construction sector, one additional job is created in other related sectors.

Applying the same approach to the four newly introduced subsectors shows that the macro economic effects do not differ substantially between the different subsectors but that there is a major impact on the employment created. The results are summarised in table 15 and show that if this amount were to be spend on the difference subsectors, the employment impact would be biggest for the LB feeder road sector with the LB feeder road sector generating almost 53,000 additional FTEs of employment.

Table 157 Summary of key results

Multiplies and Effects	Feeder roads EB	Feeder roads LB	National roads	Government buildings
Output multiplier	2.9	2.8	2.9	3.0
Value-added (GDP)	1.5	1.6	1.4	1.5
Income multiplier	1.9	1.9	1.8	1.9
Total off-farm Employment (FTE)	22,200	52,900	25,200	27,600
Non construction off-farm employment	15,600	16,100	16,800	18,600

Source: Calculated by authors

However, it should be pointed out that most of the additional employment created is within the construction sector itself, and that outside the construction sector, the additional non-farm employment created is almost similar for all the subsectors.

It is also important to note that the creation of this additional employment will manifest itself in different ways. Given the low rate of unemployment, and high rate of underemployment in rural Rwanda, the most likely effect is that underemployed agriculture workers will work additional hours in construction, or some agriculture workers shift to construction completely and the remaining agriculture workers increase the hours worked in agriculture. However, neither of these effects would impact on the employment or unemployment rate in rural areas. Rather the main effect would be on underemployment through an increase of the total hours worked.

Finally a simulation of the employment impact of the new feeder roads strategy shows that if LB methods were applied consistently in the implementation, approximately 24,400 additional FTE of non-farm employment would be created annually as opposed to only 10,200 FTE if this feeder road strategy was to be implemented without using LB methods. These estimates compare well with the results of similar analysis in other countries.

Key messages to be highlighted from the findings

***For every job created in the construction* sector** in general, ***one additional job is created in other non-agriculture sectors of the economy*.**
For every ***USD 1 million the government invests in feeder roads, between 250 and 600 full time of equivalents of employment*** can be created, depending on the methods if implementation chosen by the authorities.
The recently adopted National Feeder Road Policy and Strategy has the ***potential to create between 10,000 and 24,000 additional FTE of non-agriculture employment per annum*** and this will depend on the extent to which labour-based methods of construction will be used.
The use of labour based methods supports ***structural transformation of the Rwandan economy*** by enabling ***unskilled underemployed rural workers to shift from the agriculture sector into the more productive construction sector,*** increasing their contribution to economic output and GDP as well as their own income.

6.3. Recommendations

Investment in infrastructure in general creates significant employment in the construction and related sectors and the government should continue to use infrastructure investment as a vehicle for job creation.

The direct (construction sector) employment created differs significantly depending on the nature of infrastructure invested in as well as the approach and technologies chosen to implement. These differing effects are driven by the differences in inputs, in particular labour inputs the different sectors require. Given the structure and nature of the Rwandan rural labour market (high underemployment, low skills, low productivity), it is highly recommended that in all rural areas, approaches and technologies that require higher labour inputs are used as often as possible so as to maximize the construction sector employment outcomes of these investments.

Adopting this approach would also accelerate structural transformation in Rwanda by attracting workers from lowest-productivity agriculture sector to the higher productivity construction sector. Given the need for sustained infrastructure investment in Rwanda for the coming decades, the construction sector therefore provides an important avenue for current agriculture workers shift to the construction sector, develop sector specific skills, increase their productivity and find sustained employment in the sector. To facilitate this, it is recommended that the infrastructure investment strategy is aligned with a construction sector skills development strategy that specifically includes rural workers and that the government aims increase infrastructure investment, but also reduce volatility of overall construction sector investment.

Specifically, to the feeder road policy, it is recommended that the labour-based construction option is chosen and that the Rwandan government investigates and addresses any constraints that may hamper this. In discussions with stakeholders to possible such constraints were identified, namely procurement and capacity/ skills among small contractors. It is recommended that these are investigated and addressed as part of the overall feeder road strategy implementation.

Form a policy perspective it also recommended that the Rwandan government adopts employment targets for its infrastructure investments, and that the results for this paper are used to set these targets. This should be done in conjunction with improving labour market information of construction sector and its sub-sectors. This would involve improving the employment data collection, analysis and monitoring in the construction, and in particular introduce employment related reporting on publicly funded projects.

Finally, the method applied in this paper appears to be very useful tool to conducted employment impact assessment in the construction sector. However, if the method is to be adopted further analysis, it would be important to consider the following issues: First, the social accounting matrix (SAM) of Rwanda for the year of 2014 needs to be completed with emphasis on the construction sector. The emphasis should be given both from input providing sectors side, and the allocation of construction sector output which is provided to other sectors. Second, data collection for decomposing construction sector into different sub-sectors needs to be strengthened further.

References

Angga, p.; Xinshen, D. 2014. "A 2011 social accounting matrix (SAM) for Rwanda" (Washington, DC: International Food Policy Research Institute). http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/128890/filename/129101.pdf

Bellú, L. 2012. "Social accounting matrix (SAM) for analysing agricultural and rural development policies: Conceptual aspects and examples", module No. 130 (Rome, FAO)

Charpe, M. 2017. "Sectoral employment multipliers in Rwanda: Comparing local multipliers and input-output analysis", unpublished document (Geneva, ILO)

MINECOFIN. 2014. Design of Five-Year National Employment Programme (NEP), Ministry Of Finance and Economic Planning (Kigali, Government of Rwanda)

MINECOFIN. 2017. Budget Framework Paper 2017/2018-2019/2020, Ministry Of Finance and Economic Planning (Kigali, Government of Rwanda)

MININFRA. 2017. National feeder roads policy and strategy, Ministry of Infrastructure (Kigali Government of Rwanda)

National Institute of Statistics of Rwanda (NISR), EICV4 - Economic activity thematic Report, Government of Rwanda, Kigali, March

National Institute of Statistics of Rwanda (NISR) 2016, Labour Force Survey 2016 Pilot report, (Kigali, Government of Rwanada)

OECD, 2002. "Measuring the non-observed economy: A handbook" (Paris, OECD Publications Service)

Round, J. 2003. "Social accounting matrices and SAM-based multiplier analysis", In: Bourguignon, F., Pereira Da Silva, L.A. (Eds.), *The impact of economic policies on poverty and income distribution: evaluation techniques and tools*, (Washington, D.C The World Bank) pp. 301–320.

Vadiya, K. 2017. "Review of impacts on roads sector investments on employment", STRENGTHEN Series Publication Number 2 (Geneva, ILO)

Sempundu, T. 2017. SAM Table Estimation Approach (2017), Strengthen Project Report, Kigali, Rwanda

Annex 1. Approach for estimating the construction subsector inputs for the decomposed SAM.

Data collection and analysis

Executed contracts Bills of quantities were collected from known contractors who implemented the building and roads projects.

One (1) out of the consulted five (5) contractors had unit rate cost breakdown which is not founded, cannot be used. This is confirmed by the statement in Toolset for Analysis of Rates for Road and Bridge Works in Rwanda, and April 2016: *"Past experience has shown that many road projects in Rwanda have suffered for time and cost over-run. Some of the reasons for this drawback are directly connected with* ***inaccurate cost estimates****. In particular for Rwanda the main problems have been identified in the* ***lack of a structured database****,* ***unrealistic cost estimates*** *and* ***inappropriate analysis****, which in turn have translated into: High tender premium paid to contractors; Uncertainty about* ***rates of labour****,* ***material and equipment*** *and Unexpected* ***increase of unit costs*** *".*

In the absence of such guidelines, UNOPS, Building realistic Unit rates, 22nd October 2012, guideline was consulted in order carry out the analysis of built up rates (Executed contracts' rates) and evaluate unit costs with reference to local market conditions at the time of works execution. Then the consultant allocated the main sector benefiting from the construction accordingly.

According to this guideline , a **"Unit rate"** of any construction project comprise of						
Direct Cost			**Indirect Costs**			
Material	**Equipment /tools**	**Labour**	**Overhead**	Profit margin (10per cent)	Price escalation (3per cent)	Taxes (VAT)
- Forestry; - Textile and clothing; - Wood, paper and printing; - Chemicals; - Non-metalic minerals; - Furniture and other manufactured products; - Wholesale and retail trade; - Hotels and restaurants;	- Transports; - Repair; - Capital - Non-Agriculture;	- Unskilled; - - Skilled; - - Highly skilled	- Electricity, gas and water - Communication - Finance and insurance - Real estate - Business services			

Table 1: Unit rate cost breakdown, with the main sector benefiting from the construction added by the consultant. Source: UNOPS, Building realistic Unit rates, 22nd October 2012.

The consultant carried out the breakdown of the contracts Unit rate, with intense consultation and collaboration with the contractors who implemented those projects, and the following steps were followed:

- *Step 1: Get the Unit rate without VAT for every Bill of Quantities (BoQ) item;*
- *Step 2 :Allocation /Estimation of resources (Material , Labour, equipment) for every BoQ item; This was done taking into consideration the outputs of work based on the resources deployed, their hourly /daily rates, applying the labour-prevailing market rates , Equipment: Prevailing rental rates – Materials Prices ,and thorough estimation of quantities of materials required (gravel, fuel, cement, steel , etc);*
- *Step 3 : The results of step two were applied to the total contract quantities ;*

- *Step 4 : The subsequent cost for labour (unskilled, skilled and highly skilled), material and equipment , were recorded for each BOQ item in accordance with* ***Annex 1.B guiding the resources allocations in the*** *sectors benefiting from the construction sectors;*
- *Step 5: The total cost for each of the sectors benefiting from the construction sectors was divided by the total contract amount without VAT to obtain the relevant per cent to be forwarded in the SAM table.*

The filled SAM table was verified to match with the 2011 budget figures.

Note:

The consultant was not able to find inputs for the "Construction" as the project contracts being used are construction, it is the same case for capital - Sector Specific. In this regards figures estimated by the team of experts were adopted.

Annex 1. B: Inputs details used in filling the SAM table per cent for Buildings.

All definitions below are based on ISIC Rev.4 of Rwanda classification manual. Where a definition exist it was kept, where it does not, the consultant added it accordingly and where the reality shows that an item needs to be moved from one sector to another it was done so.

DIRECT COST

LABOR

I. **Unskilled** : Labourers / Aides - Maçons (2000 – 2500 FRW/day)/ All casual labourers

II. **Skilled** (Net salary per month for site foreman A0 (250,000 - 400,000 FRW) Masons (4000 – 5000 FRW) Foremen/Captas (6000 – 8000 FRW) Technicians : Construction (8000 - 15000), Electricians (7000 – 10000FRW), Plumbers (5000 – 8000 FRW);

III. **High Skilled** (Net salary of Engineer Bsc, with at least 5 years' experience = 800,000 - 1,200,000 FRW): Civil, Electrical and mechanical;

MATERIAL

IV. **List of materials listed in Whole sale and retail trade**

1 MDF Panels
2 Terrazzo strips
3 Equipment and machinery used in applying master top
4 Floor tiles
5 Wall tiles
6 Gypsum ceiling
7 Other hardware store items (welding rods, cutting disc,)
8 Locks and handles and hinges for doors
9 Worktops + MDF
10 Granito fabricated tops
11 All Electrical installation equipment and accessories (Cables, sockets, switches, lamps, fire alarms, firefighting equipment,)
12 All Plumbing installation equipment and accessories and appliances
13 Mechanical Ventilation system materials
14 Garden sprinkling system from the treated water

Metallic

15 Site Installation - Steel Tubes and sheets
16 Picks, hoes, excavations
17 Steel bars used in reinforced concrete
18 Steel tubes : to balconies , Stair
19 Metallic doors & Windows
20 Door & Window frames
21 Fittings and fixtures
22 Roofing sheets
23 Structural steel truss structure with steel tubes

V. **List of materials listed in Wood, Paper, printing**

1 All timbers used in construction of fence and site installation
2 All stakes used in stakeout
3 Printing of execution and working drawings
4 All timbers used in formworks of all concrete
5 Wood - Libuyu types used as frame on MDF work
6 Libuyu used as wood hand rail: to balconies and Stair
7 Flush doors
8 Libuyu used on work top structure

9 Wood used on Washing up cabinets

VI. **List of materials listed in Furniture and other manufactured products**
1 Damp - proof membranes
2 Forming materials used for Terrazzo
3 Fittings and fixtures
4 Washing up cabinets

VII. **List of materials listed in Forestry**
1 Site clearance and reconditioning
2 Reconditioning of site quarries and dumping areas

VIII. **List of materials listed in Textile &Clothing**
1 (Helmets, jackets, gloves, shoes, blankets used in concrete curing ….)
2 Shower Curtains

IX. **List of materials listed in Chemicals**
1 Anti - termite treatment
2 Adjuvants (admixtures to cement for concrete, plastering…)
3 All paints
4 admixtures to terrazzo
5 Epoxy master top
6 Varnish

X. **List of materials listed in Non Metallic Minerals**
1 Cements
2 Sand
3 Crushed Aggregates
4 Stones
5 Burnt clay bricks
6 Terrazzo aggregates
7 Glasses (for door and windows)
8 Mirror Glasses

EQUIPEMENT

I. Capital - Non Agriculture
- All transport done using the contractor's Owned equipment
- All owned equipment by the contractor used to execute all equipment based works.

II. Transport
- All Transport done by subcontractors and Storage
- Renting of machinery and equipment without operator and household goods[2]

III. Repair
- Repair of fabricated metal products, and equipment
- Repair of machinery
- Repair and maintenance of non-automotive engines, e.g. ship or rail engines
- Repair and maintenance of construction machinery
- Repair of other equipment

INDIRECT COST

Head office overhead Project Overhead

IV. Electricity, gas and water (1.5per cent for equipment based and **#1per cent** for labour based roads works.)

[2] *In the definitions based on ISIC Rev.4 of Rwanda classification manual this item is part of real estate.*

- Electric power generation, transmission and distribution
- Manufacture of gas; distribution of gaseous fuels through mains
- Steam and air conditioning supply
- Water collection, treatment and supply
- Sewerage

V. **Business Services (4per cent** for equipment based and **#3per cent** for labour based roads works.)
- Legal, auditing, accounting and tax consultancy activities
- Architectural and engineering activities and related technical consultancy
- Technical testing and analysis
- Office administrative and support activities
- Photocopying, document preparation and other specialized office support activities
- Specialized design activities
- Other business support service activities(Design, Supervision, management)

VI. **Communication (1.5per cent** for equipment based and **#1per cent** for labour based roads works.)
- Wired telecommunications activities
- Wireless telecommunications activities
- Satellite telecommunications activities
- Other telecommunications activities

VII. **Real estate (3.5per cent** for equipment based and **#4per cent** for labour based roads works.)
- Real estate activities with own or leased property
- Real estate activities with own or leased property
- Activities of real estate agents and brokers
- **Site offices and site staff houses renting;**

VIII. **Finance and insurance (4.5per cent** for equipment based and **#6per cent** for labour based roads works.)
- Monetary intermediation
- Central banking
- Other monetary intermediation
- Financial leasing
- Credit granting/ **Credit line**
- **Life insurance**
- Non-life insurance
- **Pension funding**
- Activities auxiliary to financial intermediation, insurance and pension funding
- Risk and damage evaluation
- Activities of insurance agents and brokers
- **All risk insurance of the site**
- **Advance and performance guarantee.**

IX. **Profit margin #10 per cent** for equipment based and **#1per cent** for labour based roads works.

X. **Value Added Tax (VAT) #18 per cent for both** equipment based and **#1per cent** for labour based roads works.

XI. **Price escalation #3 per cent** [3]for equipment based and **#1per cent** for labour based roads works.

[3] ***Justification of Price fluctuation of 3% adopted from the UNOPS for Rwanda:*** *Changes in material and labor market conditions are commonly ranked as one of the most significant risk factor for cost overruns. The increase of costs of materials and fuels markedly impacts the overall price of contract items. In this respect, the condition of the domestic construction market is not only a result of local factors but is also affected by global*

Annex 2: Inputs details used in filling the SAM table per cent **Roads Contract**s "**Labour based**" and **equipment based**: Feeder Roads and National Roads.

DIRECT COST

LABOR

XII. Unskilled: Non specialized person who can do any work
- Low causal labour /Aide Macon

XIII. Skilled :
- Macon
- Carpenter
- Still bender
- Plumber
- Surveyors
- Truck conductors
- Machines conductors – water truck , compactor
- All technician with Secondary school levels (who work as supervisors)

XIV. Highly skilled
- Site Engineer
- Project Manager
- All Engineers with BSC or Above / High education level

MATERIAL

XV. Wood, Paper, printing
- Sawmilling and planning of wood
- Manufacture of products of wood, cork, straw and plaiting materials
- Manufacture of builders' carpentry and joinery
- Printing
- Service activities related to printing
- All that related to wood/timber used in the project

XVI. Wholesale and retail trade
- Wholesale of **metals** and metal ores
- Wholesale of **construction materials**, plumbing and heating equipment and supplies
- Retail sale of automotive **fuel**
- **All tools** used in LBT roads works

XVII. Non - metallic minerals
- Gravel needed for filling and wearing course construction (lateritic material)
- Cement motor and concrete inputs: Sand, Stone, Mixing water.

XVIII. Chemicals
- Paint for road marking and signs

macroeconomic conditions and supply/demand balance around the world. ***Fluctuations of the local currency****,* ***global oil demand*** *and* ***world prices*** *are some of the macroeconomic factors that govern* ***the prices of materials. In fact the inflation rate at the end of August 2017 was 3.2.***

EQUIPEMENT

XIX. Capital - Non Agriculture

- All transport done using the contractor's Owned equipment
- All owned equipment by the contractor used to execute all equipment based works.

XX. Transport

- All Transport done by subcontractors and Storage
- Renting of machinery and equipment without operator and household goods[4]

XXI. Repair

- Repair of fabricated metal products, and equipment
- Repair of machinery
- Repair and maintenance of non-automotive engines, e.g. ship or rail engines
- Repair and maintenance of construction machinery
- Repair of other equipment

INDIRECT COST

Head office overhead Project Overhead

XXII. Electricity, gas and water (1.5per cent for equipment based and **#1per cent** for labour based roads works.)

- Water collection, treatment and supply
- Sewerage

XXIII. Business Services (4per cent for equipment based and **#3per cent** for labour based roads works.)

- Legal, auditing, accounting and tax consultancy activities
- Architectural and engineering activities and related technical consultancy
- Technical testing and analysis
- Office administrative and support activities
- Photocopying, document preparation and other specialized office support activities
- Specialized design activities
- Other business support service activities(Design, Supervision, management)

XXIV. Communication (1.5per cent for equipment based and **#1per cent** for labour based roads works.)

- Wired telecommunications activities
- Wireless telecommunications activities
- Satellite telecommunications activities
- Other telecommunications activities

XXV. Real estate (3.5per cent for equipment based and **#4per cent** for labour based roads works.)

- Real estate activities with own or leased property
- Real estate activities with own or leased property
- Activities of real estate agents and brokers
- **Site offices and site staff houses renting;**

XXVI. Finance and insurance (4.5per cent for equipment based and **#6per cent** for labour based roads works.)

- Monetary intermediation

[4] *In the definitions based on ISIC Rev.4 of Rwanda classification manual this item is part of real estate.*

- Central banking
- Other monetary intermediation
- Financial leasing
- Credit granting/ **Credit line**
- **Life insurance**
- Activities auxiliary to financial intermediation, insurance and pension funding
- Risk and damage evaluation
- Activities of insurance agents and brokers
- **All risk insurance of the site**
- **Advance and performance guarantee.**

XXVII. **Profit margin #10 per cent** for equipment based and **#1per cent** for labour based roads works.

XXVIII. **Value Added Tax (VAT) #18 per cent for both** equipment based and **#1per cent** for labour based roads works.

XXIX. **Price escalation #3 per cent** for equipment based and **#1per cent** for labour based roads works.

Annex 3 Estimated infrastructure budget 2017/18

THEMATIC AREA	EDPRS SECTORS	Budget(RWF)
Economic Transformation	Education	1,279,333,056
	Transport	144,712,612,779
	Urbanization and Rural Settlements	9,375,316,056
	Energy	90,922,368,184
	ICT	10,382,609,780
Rural Development	Urbanization and Rural Settlements	1,761,766,632
	Transport	85,591,660,547
	Water and Sanitation	39,526,868,648
	Energy	10,330,719,311
	Education	89,010,860,568
	ICT	4,995,976,452
Productivity and Youth Employment	ICT	4,995,976,452
Total Infrastructure Budget		**492,886,068,465**
Total Budget	All thematic areas	**2,094,910,480,544**
% Infrastructure		23.5

Source: Extracted from Budget Framework Paper 2017/2018-2019/2020

Annex 4. Aggregated SAM for Rwanda

Aggregated Rwandan Social Accounting Matrix 2011

	Activities	Commodities	Factors	Households	Government	S&I	Row	Total
Activities		5349157						5349157
Commodities	1754249			3206265	539309	807750	580286	7670170
Factors	3594908							3594908
Households			3509632		89060		129948	3728640
Government		316398	2713	210770	527168		433588	1490638
S&I				311604	330237		165908	807750
Row		1222304	82563		4863			1309730
Total	5349157	7670170	3594908	3728640	1490638	807750	1309730	

Pradesha and Diao, 2011

Annex 3. Leontief multipliers analysis

A simple SAM structure

	Activities	**Commodities**	**Factors**	**Households**	**Government**	**S&I**	**RoW**	**Total**
Activities	A11	A12	A13	A14	A15	A16	A17	X_i
Commodities	A21	A22	A23	A24	A25	A26	A27	X_i
Factors	A31	A32	A33	A34	A35	A36	A37	X_i
Households	A41	A42	A43	A44	A45	A46	A47	X_i
Government	.	.	.	.	.	.	.	
S&I	.	.	.	.	.	.	.	
RoW	.	.	.	.	.	.	.	
Total	X_j	X_j	X_j	X_j	X_j	X_j	X_j	

Each element in SAM is represented as A_{ij}, where i= 1, 2, 3...n is the row elements of the SAM, j =1, 2, 3…n represents the column elements. For instance, in the Rwandan SAM table 2, A_{22} = 1754249 which is an intermediate consumption paid by commodities to activities, and A_{45} = 89060 which is an income received by households form the government.

The sum of column cells represents total payment made by a given sector j which is denoted as X_j .

$$X_j = \sum_{j=1}^{n} A_{ij}$$

Likewise, the sum of rows represents total income received by given sector i, or in other words the total output of a given sector i, and represented as X_i .

$$X_i = \sum_{i=1}^{n} A_{ij}$$

As indicated earlier, in every standard SAM, the sum of the row elements of a given account or sector should be equal to the column sum of the account.

$$X_j = \sum_{j=1}^{n} A_{ij} \quad = \quad X_i = \sum_{i=1}^{n} A_{ij}$$

Based on these two equations, we can now compute the proportional ratio of each input used to produce the total output of a given sector j. This is often referred to as technical coefficient, which is a ratio of inputs required to generate one unit of production of a given sector j. This ratio is given by the quantity of specific inputs A_{ij} which is required for production of sector j divided by the total expenditure X_j of sector j. This proportion is represented as a_{ij}.

$$a_{ij} = \frac{A_{ij}}{X_j}$$

Since, this ratio shows the proportion of input required to generate one unit of production in a given sector$j$, the sum of total a_{ij} should be equal to 1. This is especially should always be the case if the whole SAM is being considered in the analysis instead of the input-output table.

$$\sum_{j=1}^{n} a_{ij} = 1$$

In the Rwandan specific example as previously presented in table X, we will have technical coefficient matrix as follows. In most SAM and input-out based multiplier analysis this matrix is referred to as the *A matrix*.

Technical Coefficients Matrix (Matrix A)

	Activities	Commodities	Factors	Households	Government	S&I	Row
Activities	a11	a12	a13	a14	0	0	0
Commodities	a21	a21	a23	a24	0	0	0
Factors	a31	a32	a33	a34	0	0	0
Households	a41	a42	a43	a44	0	0	0
Government	a51	a52	a53	a54	0	0	0
S&I	a61	a62	a63	a64	0	0	0
Row	a71	a71	a73	a74	0	0	0
Total sum	1	1	1	1	0	0	0

To compute SAM based multiplier analysis, one or more accounts in the Technical coefficient matrix should be an exogenous account. Traditionally, the Government account, saving and investment account, and rest of the world accounts of the SAM are considered to be exogenous. This is because the expenditure from these three accounts is exogenous (Round 2003). Determining our exogenous accounts will also make the matrix invertible in order to calculate multipliers. In order to compute the Leontief inverse, identity matrix[5] we have created an identity matrix which is identical to the matrix to the technical coefficient matrix.

[5] An identity matrix is a square matrix (with same number of rows and columns) with 1 in all of its diagonal cells and zero elsewhere. It has properties identical to those of the number 1 in scalar algebra. In scalar algebra any number multiplied by 1 remains unchanged. In the same way any matrix multiplied by an identity matrix remains unchanged.

Identity Matrix (Matrix ***I***)

	Activities	Commodities	Factors	Households	Government	S&I	Row
Activities	1	0	0	0	0	0	0
Commodities	0	1	0	0	0	0	0
Factors	0	0	1	0	0	0	0
Households	0	0	0	1	0	0	0
Government	0	0	0	0	1	0	0
S&I	0	0	0	0	0	1	0
Row	0	0	0	0	0	0	1

From these two matrixes we can now calculate the conventional Leontief inverse in order to understand compute output, GDP multipliers and income multipliers. The Leontief multipliers are presented in the table 8 below.

$$L_a x = (I - A)^{-1} * x$$

$L_a x =$ Leontief inverse SAM multipliers
$(I - A)^{-1}$ = The inverse of identity matrix (***I***) minus the technical coefficient matrix (***A***).
x = **T**he vector of exogenous injections

Leontief inverse SAM multipliers

	Activities	Commodities	Factors	Households	Government	S&I	Row
Activities	L11	L12	L13	L14	0	0	0
Commodities	L21	L21	L23	L24	0	0	0
Factors	L31	L32	L33	L34	0	0	0
Households	L41	L42	L43	L44	0	0	0
Government	L51	L52	L53	L54	0	0	0
S&I	L61	L62	L63	L64	0	0	0
Row	L71	L71	L 73	L74	0	0	0

Output multiplier = $L21$,

GDP multiplier (Value added) = $L31$

Income multiplier= $L41$

For more information, visit our website:
www.ilo.org/strengthen
International Labour Office
Development and Investment Branch
4 Route des Morillons
CH-1211 Geneva 22
Switzerland
Email: devinvest@ilo.org

This publication has been produced with the assistance of the European Union. The contents of this publication are the sole responsibility of the ILO and can in no way be taken to reflect the views of the European Union.

ISSN 2519-4941