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Sectoral Contributions to Growth: A fixed price SAM multiplier analysis for Khyber Pakhtunkhwa

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Abstract

This novel study provides an estimate of provincial accounts and policies on the basis of statistical facts of FY 2015-16 through the construction of the Social accounting matrix (SAM) at provincial level, while adopting the bottom-up approach. The first of its kinds, this KP-SAM maps 64 production activities, 8 household groups and 12 factors of production. It shows service sector contributes 58%, industrial 25% and agriculture 17% to the Provincial GDP (PGDP). Moreover, it indicates livestock contributes 49% and is the driver of agriculture sector, while construction (16%) emerges as the largest valued add sector of the provincial economy. Likewise, manufactured goods are the largest category of imports (84%) while crude oil is the largest exporting commodity of the province. Non-resident sources (43.6%) are the largest source of household income while trade to GDP ratio displays that KP is an open economy. Simulations via fixed price Multiplier indicates that a shock of one billion to livestock raises (PGDP) by 1.3 billion, expands the output by 1.80 billion and demand by 2.29 billion. The construction simulation raises household income by 0.54 billion showing that it is rural income sensitive. The health shock adds 1.59 billion to output and a 2.11 billion to the provincial demand. The output-demand gap (imports) widens with shocks confirming the import dependent nature of the province. The study recommends to the government that increased investment in all the three drivers will unlock sustained economic growth. The findings of the study can be used by the policymakers and implementers to reshape the province socio-economic development landscape.

Keywords: Regional accounts, Social Accounting Matrix, Economic Outlook, Multiplier Analysis

1 Introduction

A nation's income is the sum of the market value of all economic activities taking place in all regions within that nation. Such regions, whether small or large, are dissimilar in terms of production mix, labor characteristics, and growth rates. National-level data do not reveal regional variations in resource endowments, development pri- orities, or government plans and challenges. Each region's advancement plays a vital role, although their growth trajectories differ and are influenced by national economic patterns [Brace, 1989]. State-specific characteristics, geographical positioning, and inter-regional disparities impact the job market, trade, and industrial advancement. Strengthening governance and financial frameworks, promoting private investment, and productivity

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with sub- stantial backing from the center can accelerate regional development [Ahluwalia, 2001]. For the pre-war period, the state component was dominant; however, post-war analysis indicated a strong and increasing impact on the economic growth of states from exogenous national factors [Rebeca et al., 2002].

The region of Khyber Pakhtunkhwa (KP), the North-West Province of Pakistan, stands as a pivotal federating unit of the nation, encompassing an area of 74 thousand square kilometers. Renowned for its profound cultural heritage, breathtaking tourism landscape, and archaeological marvels, the province serves as the gateway to the Central Asian Republics through its extensive 2225 km border with Afghanistan. The total populace of KP amounts to approximately 40.86 million individuals, exhibiting a growth rate of 2.38 percent annually. A substantial eighty-one percent (81%) of the province's inhabitants reside in rural areas, with an average household size of 7.83 persons. The youth population predominates in the province, underscoring a high dependency ratio [of Statistics, 2023].

2 P's Economy Recent Performance

Traditionally, regional accounts are not maintained in Pakistan, so not much is known about the real size and composition of provincial GDPs (PGDP). Historically, PGDPs have been estimated using a top-down approach, based on which KP is the third-largest economy in Pakistan with a share of about 11% in national GDP. The economic performance of the province is remarkable despite insecurity, unrest, the burden of refugees, and floods [Pasha, 2018]. An encouraging recent growth trend (over 5% for the years 2021 & 2022) is recorded by the Bureau of Statistics (BOS) KP, 2022. The most important sector of the provincial economy is agriculture, which plays a vital role in reducing poverty and ensuring food security. One-third (i.e., around 32%) of the labor force is engaged in agriculture in the province, contributing 19% to the PGDP in 2021-22 [Bureau of Statistics, 2022a]. Due to the agrarian nature of the provincial economy, growth in the agriculture sector is both important and encouraging. The provincial government is trying to modernize the sector and is focused on shifting it from traditional subsistence farming to export-oriented farming activities. The four sub-sectors of agriculture are crops, livestock, fisheries, and forestry. The highest contribution comes from the livestock and poultry sector, making this sub-sector a driver of the agriculture and provincial economy. For FY 2021-22, the sub-sector contributed 15.23% to PGDP and about 80% to the agriculture sector. The launch of the Billion Tree Tsunami project by the KP Government has contributed to the forestry sector, which has grown at a faster rate of 48% for FY 2021-22 [Bureau of Statistics, 2022a].

The agro-environment of KP is diverse, as more than twenty different vegetables and fruits are grown, coupled with immense potential for high-value crops such as horticulture and floriculture. Moreover, the livestock sector is helping to improve the well-being of rural people, as dairy products and meat continue to be the leading contributors in terms of incomes. However, the sector has faced challenges like a tight global food market, high volatility in food prices, increased population with poor purchasing ability of consumers, high input prices, and natural disasters in the province [FAO, 2012].

The industrial sector includes production activities of large and small-scale manufacturing, mining, electric- ity and gas generation, construction, and food processing. The contribution of the manufacturing sector to PGDP stood at 24.80%, while 11% of the labor force is absorbed by this sector for FY 2021-22 [Bureau of Statistics,

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2022a]. The most important sub-sector is large-scale manufacturing, which contributes 72% to the manufacturing GDP and around 8% to the PGDP. Despite power shortages, the sector grew at a rate of around 6% for the year 2021-22 [of Khyber Pakhtunkhwa, 2021a]. Textile spinning plants, the pharmaceutical sector, and the furniture industry are lucrative investment sectors. The availability of wood in the province and the potential for exports make the furniture industry a profitable industry as well.

The province of Khyber Pakhtunkhwa is endowed with a great deal of variety of minerals by nature. These include precious metals, non-metals, and materials required in construction. The key minerals of the province are coal, gypsum, granite, limestone, marble, and shale clay [of Khyber Pakhtunkhwa, 2021b]. The minerals department is working with the objective of exploring minerals with the least impact on the environment, broad- based job creation, and reduction in poverty and increasing economic growth in the province. The department has also established a model coal mine in district Nowshera for skills development of newly graduated students and mine workers. The key categories of mines existing in KP are marble and decorative stones, gemstones, phosphate and soapstone, gypsum, coal, gold, and silver [of Khyber Pakhtunkhwa, 2022].

For FY 2021-22, the commodity sector contributed 44%, while the non-commodity service sector contributed 56% to PGDP with an encouraging growth rate of 5.5% [Bureau of Statistics, 2022a]. The leading sub-sectors of the non-commodity sector are listed with their respective contributions in the following table.

Table 1: Service Sub-Sectors

Sub sector	Contribution to service sector	Contribution to GDP	Growth rate for the year 2021-22
Whole sale and retail trade	43.9 percent	24.61 percent	10 percent
Hotel and restaurants	-	-	-
Private services, Transport	16.4 percent	15.6 percent	0.8 percent
Storage and communication	-	-	-

Source: Khyber Pakhtunkhwa Development statistics. 2022

The trade of wholesale and retail, services of hotels and restaurants, insurance, housing, and government services are the key sub-sectors of the Khyber Pakhtunkhwa (KP) service sector. The service sector has proven to be both dynamic and shock-absorbing during periods of crises such as the COVID-19 pandemic. This sector plays an increasingly important role in economic activity, job provision, and absorbing labor from other sectors.

The contributions of agriculture, industry, and services to the provincial economy are depicted in Figure 1.

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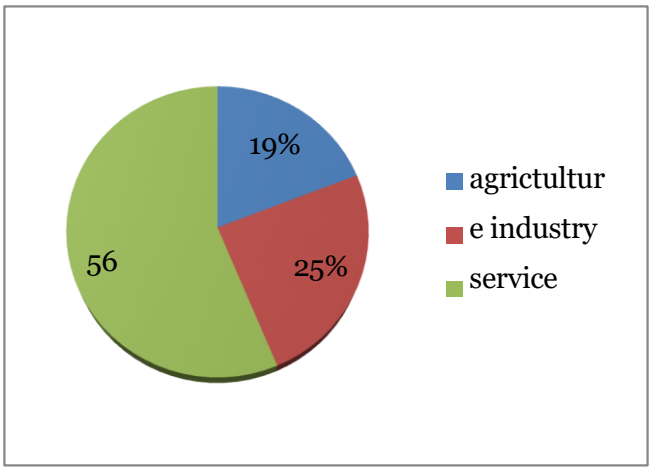

Figure 1: Contribution of Agriculture, Industry, and Services to the Provincial Economy

A comparison of the composition of sectoral contributions to the provincial economy for the study period (FY 2015-16) is presented in Figure 1. The data from the stated period shows that the composition has not changed significantly from 2015 to 2022. The non-commodity sector continues to contribute the most, followed by the industrial and agriculture sectors. The growth rate recorded was 4.36%, while remittances remained the leading source of household income.

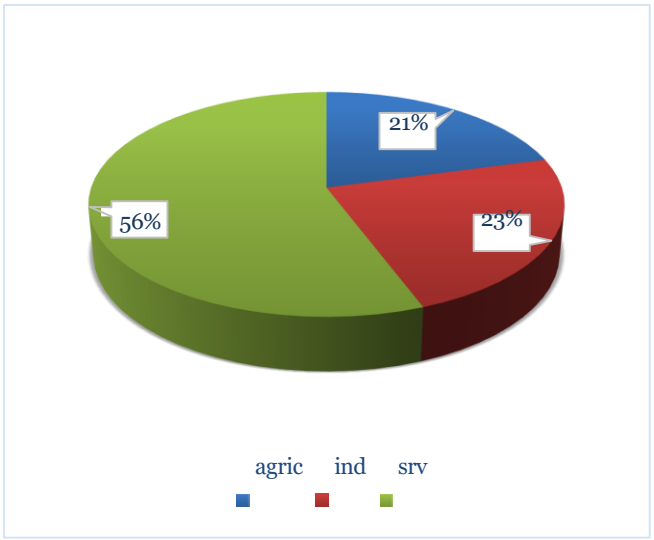

Figure 2: Sectorial Contribution to KP GDP, Source: KP Bureau of Statistics 2016

The contribution of agriculture has declined from 21% to 19% from the year 2015 to 2022, while the services and industry have witnessed a minor change only. The KP economy has grown at a constant growth rate of 5% per annum from 2000 to 2015. The key to this is the increased remittances from abroad (every 4th KP resident is abroad), Afghan transit trade, and NATO supply's boost to the transport sector [Pasha, 2015]. The growth inhibitors may be many, but the growth drivers, if

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identified and harnessed, will propel the economy to a much higher trajectory. Livestock, manufacturing, construction, and health, alongside other indicators, can play a vital role [CDPR, 2015].

2.1 Objectives of the study

This research has been undertaken with the aim of identifying and magnifying key aspects of KP Economy. Further to estimate the impact of growth drivers like livestock, Health and construction sectors on PGDP,

Household income and demand and how will it enhance the living standard of the people of the province. Further to provide an economic data base of the economy to stakeholders for upgrading the provincial status.

3 Provincial Growth drivers

The provincial economy of KP has many potential sectors. The current study is an attempt to magnify few. The true potential of sectors needs further studies and close working partnership between researchers and various government departments. The following are the targeted sectors for study based on CDPR, 2015 findings.

3.1 Livestock

Livestock has emerged as the largest sub-sector of agriculture both at the national and provincial levels. It pro- vides food, is a means of transportation, and a source of organic fertilizer to agriculture farms. The fundamental role of the livestock sector is to ensure food security, reduce poverty, and provide jobs to rural people. At the na- tional level, more than 8 million people are engaged in the sector and originate around 40% of their income from the sector. Milk is the largest agricultural commodity produced by the sector, with a production of 63 metric tons per annum [of Pakistan, 2021]. The production of milk, eggs, and mutton has a positive significant relation- ship with agriculture GDP, while beef, poultry meat, and wool have been found to have a negative insignificant relationship [Rehman et al., 2017]. The animal populations for Khyber Pakhtunkhwa are estimated as 8.84 mil- lion cattle, 3.4 million buffaloes, 10.4 million goats, and 4.22 million sheep [Baseline, 2021]. Milk and meat are the leading livestock products and are important elements of our daily diet. [Seale et al., 2003] estimated that around 27% of total household expenses are made on dairy products. The provincial production of milk is __, of which 46% is marketed domestically, while 14% is imported from Punjab and other provinces [Baseline, 2021]. The livestock sector lacks reliable information, policy formulation, and research [Jalil et al., 2009]. However, the development of the sector will play a key role in reducing poverty and uplifting the socio-economic situation of the rural people of the province.

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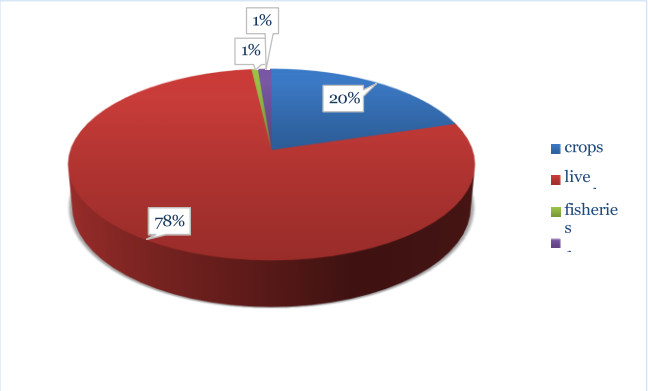

Figure 3: Provincial Breakdown of Agriculture Sub-Sectors (2015-16)
Source: BOS KP, 2016.

The provincial breakup of sub-sectors of agriculture suggests that the livestock sector is the dominant sub- sector with a contribution of 78% to agriculture. Crops contribute 20%, while fisheries and forestry contribute 1% each for the year 2015-16. The growth rate of livestock was positive (5%), while all other sub-sectors had a negative growth rate for the study period.

3.2 Health Indicators at National and Provincial Level

Human capital in the shape of good health and skillful human resources is key to economic development world- wide. Governments around the world subsidize health facilities and make spending in order to generate positive externality for poor segments and achieve Sustainable Development Goal (SDG) 3. The magnitude and type of these transfers vary from country to country. In Pakistan, health expenditure is low (0.5% of GNP) in comparison to the international standard (5%), due to which improvement in health indicators of life expectancy, infant mortality, and others is slow [Ali, 2000]. The prioritization of the health sector by the government is reflected in the increase in BHUs, RHCs, training for LHWs, critical workforce, and stagnant prevalence rate. The government of Pakistan and the World Health Organization (WHO) are jointly working for the improvement of public health with a focus on five areas: Control of communicable diseases (CD) & non-communicable diseases (NCD), promoting health through the life course, health system strengthening, and emergency responses. The federal government's Public Sector Development Program (PSDP) allocated funds to 71 projects, including the Sehat Sahulat Program, EPI, and polio eradication.

The disease profile suggests that NCD share is 50%, while CD stands at 40%, with injuries accounting for 10% in the year 2012. High out-of-pocket expenditure (55% of the total) and the low existence of physicians (only 8.3 physicians per ten thousand) indicate the worse health condition in Pakistan [WHO, 2016].

Health was managed both at the center as well as at the provinces before the 18th amendment; however, decentralization in powers from the center to the provinces is a step towards empowering the units in terms of health systems and policies. The province of Khyber Pakhtunkhwa, after the merger with erstwhile FATA, has over a hundred rural health centers, around nine hundred basic health units, nine teaching

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hospitals, thirty district headquarter hospitals, and twenty-two Tehsil headquarter hospitals. Several BHUs have been upgraded to RHCs by the provincial government. Additionally, under the Tribal Decade Strategy, the Accelerated Implementation Program (AIP) 2019-2022 was executed in merged districts for filling the developmental gaps in the said area. The provincial ADP allocation for FY 2020-21 stands at 8.3 billion with a target of extending the program to 100% of the population of the province [of Khyber Pakhtunkhwa, 2020].

The health system in KPK is financed by government revenues, private funds, and external sources from developing partners. In fiscal year (FY) 2016, private out-of-pocket payments accounted for 72.4% of total health expenditures, followed by government revenues (16.4%) and contributions by development partners (0.9%). Between FY2013 and FY2018, the government boosted health budget allocations from 6.7% to 11.0%. The budget for SHC facilities increased more than 3.4 times between FY2013 and FY2018.15 The total provincial government budget for FY2022 is PRs1,118 billion, while the budget of the provincial Department of Health (DOH) is PRs142 billion, which is 12.7% of the total budget and shows the commitment to improving the health sector.

To help achieve Health Vision 2016-2025 and universal health coverage, a landmark initiative, the Sehat Sahulat Program, was undertaken by the PTI government. The fundamental feature of the program is the provision of necessary health services to all, irrespective of their financial position. Thus, the poor masses can get treatment in a dignified manner, free from financial worries. The key challenge to the healthcare system from the household perspective is out-of-pocket expenditure, a comparison of which for KP, Pakistan, and some other countries is shown in Table 2.

Table 2: Out-of-Pocket Expenditure on Health (% of Current Health Expenditure) for Selected Regions

Region	KP	Pakistan	LMICs	OECD
Out-of-Pocket Expenditure (%)	72.4	56.2	38.7	19.1

Source: WHO, 2016.

To counter high out-of-pocket expenditure coupled with lower per capita spending alongside high poverty levels, particularly in rural areas of the province, a Universal Health Coverage (UHC) was initiated by the KP government under the Sehat Sahulat Program in 2015 [Hassan et al., 2022]. An increased attention and research focus is therefore needed to estimate the impact of increased health spending on the sector and the economy. To counter high out-of-pocket expenditure, coupled with lower per capita spending and high poverty levels, particularly in rural areas, the KP government initiated the Universal Health Coverage (UHC) program under the Sehat Sahulat Program in 2015 [Hassan et al., 2022]. Increased attention and research focus are needed to estimate the impact of increased health spending on the sector and the economy.

3.3 Construction Sector

The other key industry present in every developmental activity is construction, which includes the creation and repair of fixed assets such as buildings, roads, and dams, etc. It has a considerable contribution to the economy in terms of output, employment, and

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income generation. The production of shelter, infrastructure, and a large number of consumer goods are also attributed to this sector. Both rural and urban people are involved, as the skills required are generally informally learned, and the work nature is laborious.

The development and pace of the construction sector have a direct link with the country's development [Baig and Hussain, 2011]. A growing construction sector has synergy effects and economic gains of poverty reduction, consumer savings, and increased investment [Nenova, 2010]. The importance of the sector is witnessed by the fact that around 40 industries run side by side with the construction industry, of which the mentionable are brick, cement, sand, timber, iron, steel, marbles and stones, plastics, sanitary works, interior decoration, transport, and many others [Rana, 2003]. The sector also contributes to the real estate, finance, and overall service sector.

Infrastructure development has been found to have both direct and indirect contributions to the economic growth of Pakistan [Haider et al., 2012]. The share of this sector stands at 2.56% of GDP, 13.4% of the indus- trial sector value-added, and an employment of 6.4 million labor force, growing at a rate of 9.8% for FY 2021 [of Pakistan, 2023].

However, rapid population growth in the country has created high demand for construction and labor force in the construction industry. Construction is a capital-intensive business and requires continuous and high- magnitude long-term debt. A landmark low-cost housing finance scheme, 'Mera Pakistan Mera Ghar,' was initiated by the federal government in order to fulfill the rising need for housing in Pakistan. Commercial banks of the country provided loans for the financing of construction and purchase of houses at subsidized rates for low to middle-income segments of the population. As a result, domestic private sector advances increased to 367 billion, which is 5% of the housing and construction portfolio [of Pakistan, 2022]. Despite difficulties, the construction sector is expected to flourish based on government backing coupled with increased demand for housing.

The construction sector is mainly driven by the Public Sector Development Program (PSDP) and private sector investment in Pakistan. The role of the China-Pakistan Economic Corridor (CPEC) is also vital, as approximately $26 billion worth of projects are completed, while its worth will increase to $62 billion. The building of the transportation network, ports like Gwadar, and industrial zones has a two-fold contribution of job creation and construction activities. The activities will modernize the infrastructure and economy of Pakistan [Irshad, 2015]. The new projects undertaken in Khyber Pakhtunkhwa are the D.I. Khan-Peshawar Motorway, Swat Expressway Phase II, and Dir Expressway. The provincial construction sector employs 15% of the labor force and contributes 2.38% to PGDP while 12.87% to provincial industrial GDP [Bureau of Statistics, 2022b]. The construction sector in KP has dual importance in the form of absorbing large and unskilled labor. The sector can contribute to reducing unemployment and poverty and hence can contribute to peace and development. A thorough research on the sector's role and contribution is of utmost importance.

KP's economy, being the third largest in the country and given the shocks over time, the development of the province underscores its people and institutions' resilience. The current pace of development is also not compatible with increasing food and job demand. An inclusive and balanced growth is, however, mandatory and needed in order to reduce poverty and unemployment and promote sustainable development. The

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principal step is to understand the complex socio-economic structure and interrelations among key economic activities existing in the provincial economy. Thus, a Social Accounting Matrix (SAM) is essential to provide detailed information on the macro level for the province and micro level for selected sectors in order to guide informed decision-making.

4 Social Accounting Matrix (SAM)

The current study will use the Social Accounting Matrix (SAM), which is a framework that captures the inter- linkages within the socio-economic system. SAM can be used to explore the impact of exogenous changes on the endogenous sections of the framework, thus it is a base for multiplier and general equilibrium analysis. The criteria for the disaggregation of accounts in SAM are the focused sectors, data availability, and the range of impacts of policy change that the researcher is interested in. To explore in-depth the issues related to income distribution in an economy, household categories are disaggregated. If the concern is the inter-sector linkages, detailed disaggregation of sectors is carried out [Thorbeck, 2000].

A SAM is a table showing transactions and transfers among economic agents in an economy during an accounting period, generally one year [Pyatt and Round, 1985]. In a SAM table, accounts are listed in columns (Expenditure) and rows (Incomes) in a square shape. Furthermore, SAM is comprehensive and encompasses all economic activities, i.e., production, consumption, and others, with a range of flexibility in the disaggregation of accounts. Household accounts are at the heart of SAM and hence a base for analysis on income distribution.

The origins of such matrix-based representation of the economy are usually traced back to Sir Richard Stone's work in the 1960s. Pyatt and Thorbeck developed the idea further in the 1970s, which is followed by [Round, 1982], [Defourny and Thorbecke, 1984], [Powell, 2000], and [Ronal Hoist and Rand, 2002]. The con- struction of SAM requires substantial effort and data, often dispersed and inconsistent in nature. SAM is helpful in understanding the national or regional economy and the inter-relationships existing among the various sectors. Thus, such structures serve as the basis for policy decisions and resource allocation.

Numerous SAMs have been developed for Pakistan at different times with different focuses but mainly for the national economy. The 1985 Pakistan Institute of Development Economics (PIDE)'s SAM for FY 1979 was the first formal attempt for the country, followed by the Federal Bureau of Statistics (FBS) SAM in 1984-85. The [Siddiqui and Iqbal, 1999] SAM was another attempt for the country with a disaggregation of the household sector into eight categories for assessing the distributional effects. [Dorosh et al., 2004] formed the SAM with the striking feature of larger disaggregation for households and production and having a regional approach with a focus on Sindh-Pakistan. Relying on the I-O matrix of Siddiqui, [Waheed and Ezaki, 2008] created a Financial SAM for the year 1999-2000. A detailed SAM for Pakistan was formulated by [Debowicz et al., 2013] with 51 production activity sectors, 27 factors of production, and 18 household groups.

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Trade, industry, and agriculture have a strong relationship with GDP growth; therefore, reliable policy measures should be used to bring positive changes in agriculture and other sectors [Anwar et al., 2015]. The main theme of this study is to suggest policy changes based on SAM multiplier analysis using the most recently available micro evidence. Recently, two regional SAMs, one each for Baluchistan and KP, have been formulated to come up with regional analysis. The purpose of this study is to highlight the key aspects of the KP economy using the first provincial Social Accounting Matrix (SAM) 2015-16. Further, to study how livestock contributes towards employment, income of the households, and PGDP. The other objectives include the study of the impact of construction and health sectors towards incomes, employment, and savings of the households. The SAM tool is helpful in recommending policy changes.

1 Research Gap

The present study is intended to fill the analytical and policy gap in the existing literature by examining key economic sectors of the KP economy. The study contributes to laying the base for informed decision-making and evidence-based policy analysis.

2 Methodology: Data & Materials

2.1 Data & Materials

One of the modern tools of economic planning and policy analysis today is SAM, which is a counterpart of Leontief Input-Output analysis [Pyatt and Thorbecke, 1976]. Moreover, the SAM system is an expansion of the input-output (I-O) model by providing details on the allocation of income and final demand while describing the economic structure of an economy [Cicowiez and S ´anchez, 2012]. The SAM provides information on the allocation of income, including government transfers and remittances, and on direct taxes rather than indirect taxes [Pyatt and Round, 1985]. In addition, this framework can serve as a base for linear multiplier analysis and Computable General Equilibrium Analysis (CGEA), measuring the effects of shocks on a wider range of economic variables [Hertel, 1990].

The KP SAM has been developed using the 2013-14 Pakistan SAM framework & input-output tables. The steps to construct SAM are enlisted below, following [Breisinger et al., 2010].

Step 1: Schematic SAM

A schematic SAM was developed to outline the basic structure of the matrix, including accounts such as activities, commodities, factors, households, and exogenous demand.

Step 2: Detailed Disaggregation of Sectors

Sectors were disaggregated based on the objectives of the study and data requirements. Table 3 presents a simplified SAM for three sectors, consisting of endogenous and exogenous accounts. The endogenous accounts include activities, commodities, factors, and households, while the exogenous accounts include government and exports.

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Table 3: Simplified Three-Sector SAM

	Activities			Commodities			Factors	Household	Exogenous Demand	Total
	Ac1	Ac2	Ac3	Co1	Co2	Co3	FK,L,O	HHo	ED	
Ac1				X1						X1
Ac2				X2						X2
Ac3					X3					X3
Co1	Z11	Z12	Z13					E1		Z1
Co2	Z21	Z22	Z23					E2		Z2
Co3	Z31	Z32	Z33					E3		Z3
FK,L,O	V1	V2	V3							V
HHo							V1 + V2 + V3			Y
ED			L1	L2			Sh			ED
Total	X1	X2	X3	Z1	Z2	Z3	V	Y	ED	

Source: Adopted from Breisinger et al., 2010.

Values

X: Total output of activities (i.e., X1, X2, and X3).

Z: Total demand of commodities (i.e., Z1, Z2, and Z3).

V: Gross factor income (household income).

Y: Gross household income (factor income).

E: Exogenous elements of demand (i.e., government spending (G), investment (I), and exports (EX)).

Ce: Household consumption expenditure.

Sh: Household savings.

Step 3: Data Collection

Data was collected from various dispersed sources. The sources for different sectors are listed in Table 4.

Table 4: Data Sources

Item	Source
Agriculture Products	Agriculture Statistics of Pakistan (2015-16), Fruits and vegetable statistics of Khyber Pakhtunkhwa (2015-16)
Crude Oil, Natural Gas and Petroleum Products	OGDC L Pakistan

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Other Minerals	Pakistan Statistical Year Book 2015-2016
Meat	Ministry of National Food Security and Research
Textiles and Related Products	Textile Commissioner's Organization, Karachi, and Government of Pakistan
Intermediate Data	Provincial Bureau of Statistics, Provincial accounts for statistical product cost 2015-16 Household Consumption Expenditures Household Integrated Economic Survey (HIES) 2015-16
Government saving, investment, Direct and indirect taxes	Khyber Pakhtunkhwa Budget White Paper 2016, KPK Budget documents

Step 4: Develop First Unbalanced SAM

An initial unbalanced SAM was developed to capture the transactions and transfers among economic agents.

Step 5: Balanced SAM Using Cross-Entropy Method

To ensure consistency in income and expenditure accounts, the SAM was balanced using the cross-entropy technique. This method minimizes the entropy distance between the prior unbalanced SAM and the final SAM, ensuring that the sum of rows equals the sum of columns. Several accounts were manually cleared at the end of this proce

Step 6: Second Unbalanced SAM

A second unbalanced SAM was developed to address further inconsistencies in the data.

Step 7: Second Balanced SAM

The cross-entropy balancing technique was applied again to minimize imbalances among various sectors, result- ing in a consistent SAM. The final SAM is micro-consistent and highly disaggregated, capturing the country's economic structure and sectoral information in an updated manner. This SAM can be utilized for policy change analysis.

Table 3.1: SAM Table

The SAM table manifests a system of linear equations describing the relationships between economic sectors. The total output produced by a sector is consumed as input or output by other sectors or internally by the sector itself. The total demand for each sector is given by:

$$Z1 = \alpha_{11}X1 + \alpha_{12}X2 + \alpha_{13}X3 + \gamma_1 Y + E1,\ Z2 = \alpha_{21}X1 + \alpha_{22}X2 + \alpha_{23}X3 + \gamma_2 Y + E2,$$
$$Z3 = \alpha_{31}X1 + \alpha_{32}X2 + \alpha_{33}X3 + \gamma_3 Y + E3, \quad (1)$$

As gross output X is part of total demand:

$$X1 = \beta_1 Z1, \quad X2 = \beta_2 Z2, \quad X3 = \beta_3 Z3, \quad (i)$$

where $\beta_1, \beta_2, \beta_3$ are the shares of domestic output. Here, α_{ij} and β_i $(i, j = 1, 2, 3)$ are technical coefficients.
Household income depends on the share of factor income earnings:

$$Y = \upsilon_1 X1 + \upsilon_2 X2 + \upsilon_3 X3, \quad (ii)$$

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where v_1, v_2, v_3 represent value added from all three sectors. Substituting $X1, X2, X3$ from (i) into (ii) yields:

$$Y = v_1\beta_1 Z1 + v_2\beta_2 Z2 + v_3\beta_3 Z3.$$

(iii) Substituting (i) and (iii) into equations (1) and rearranging gives:

$$(1 - \alpha_{11}\beta_1 - \gamma_1 v_1\beta_1)Z1 + (-\alpha_{12}\beta_2 - \gamma_1 v_2\beta_2)Z2 + (-\alpha_{13}\beta_3 - \gamma_1 v_3\beta_3)Z3 = E1,$$
$$(-\alpha_{21}\beta_1 - \gamma_2 v_1\beta_1)Z1 + (1 - \alpha_{22}\beta_2 - \gamma_2 v_2\beta_2)Z2 + (-\alpha_{23}\beta_3 - \gamma_2 v_3\beta_3)Z3 = E2,$$
$$(-\alpha_{31}\beta_1 - \gamma_3 v_1\beta_1)Z1 + (-\alpha_{32}\beta_2 - \gamma_3 v_2\beta_2)Z2 + (1 - \alpha_{33}\beta_3 - \gamma_3 v_3\beta_3)Z3 = E3.$$

Converting this into matrix form and simplifying yields:

$Z = (I - M)^{-1}E,$ Unconstrained Multiplier.

as:

In words, Total Demand = Multiplier Matrix × Exogenous Demand. The constrained multiplier is presented

$$\begin{matrix} ZI \\ E1 \end{matrix} = (I - M)^{-1}_{E1} B \begin{matrix} E1 \\ E \end{matrix}, \quad \text{(Adopted from Breisinger et al., 2010).}$$

3 Assumptions of SAM Multipliers

The SAM multiplier estimates the effects of a policy change or shock to the economy. However, the multiplier is based on certain assumptions. The key assumption is the existence of excess capacity in all sectors and unemployed factors, which creates an opportunity for increased production in response to higher demand. If capacity constraints exist, the multipliers will overestimate the total effects. Another source of overestimation is the assumption of fixed prices and non-substitution effects, indicating that changes in demand lead to changes in physical output (real output changes) rather than nominal or price-induced changes. Similarly, linkage effects are linear, and no behavioral changes are assumed, as input coefficients remain independent of exogenous demand changes.

The endogenous responses are limited, as shocks to exogenous accounts and changes in leakages to the exogenous accounts from endogenous accounts are the only responses captured by the multiplier. In practice, other responses may also occur.

The KP SAM disaggregates sectors of economic activity, factors of production, and household groups in ways not considered in previous SAMs for Pakistan. This disaggregation allows tracing the direct and indirect effects of potential scenarios through production and consumption linkages and can capture distributional effects.

3 Results and Discussion

Key Features of KP SAM 2015–16

The first subnational SAM for Khyber Pakhtunkhwa (KP) was developed by Pakhtunkhwa Economic Policy Research Institute (PEPRI) team, which included the

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authors of the study. A series of meeting were held which decided that the SAM 2015-16 Will includes 64 activity sectors, 12 factors, and 8 household groups in the following categorizations.

I. Activities

Agriculture (22): Wheat irrigated, wheat non-irrigated, rice irri, rice basmati, sugarcane, maize, oilseeds, tobacco, other field crops, forestry, potato, onion, tomato, other vegetables, peach, plum, apple, other fruits, cattle, milk, poultry, and fishing.

Industry (30): Crude oil, natural gas, other mining, meat, dairy, vegetable oils, wheat milling, refined sugar, other food, cotton gin (lint), cotton spin (yarn), cotton weave (cloth), garments, other textiles, leather, wood, petroleum, fertilizers, chemicals, cement, baked construction items, metals and metal prod- ucts, appliances, machinery, vehicles, other manufacturing, electricity, and electricity distribution, and construction.

Services (12): Trade, restaurants, transport, financial services, business services, services of real estate agents and housing cooperative societies, dwelling, public services, healthcare, education, services of do- mestic staff, and all other services.

II. Commodities

Agriculture (21): Wheat, rice-irri, rice-basmati, sugarcane, maize, oilseeds, tobacco, other field crops, forestry, potato, onion, tomato, other vegetables, peach, plum, apple, other fruits, cattle, milk, poultry, and fishing.

Industry (30): Same as the industry activities listed above.

Services (13): Trade, restaurants, transport, financial services, business services, services of real estate agents and housing cooperative societies, dwelling, public services, healthcare, education, domestic services and other services.

III. Factors

Labor (5):

- Labor (very small farmer)
- Labor (small farmer)
- Labor (other)
- Labor (low skill)
- Labor (high skill)

Land (3):

- Land (very small farm)
- Land (small farm)
- Land (other)

Other Factors (4):

- Capital livestock

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- Capital agriculture
- Capital formal
- Capital informal

IV. Enterprises (3)

Agriculture enterprises

Formal enterprises

Informal enterprises

V. Household (8)

Rural 1 / Urban 1 (annual income below 150k)

Rural 2 / Urban 2 (annual income between 150k–300k)

Rural 3 / Urban 3 (annual income between 300k–600k)

Rural 4 / Urban 4 (annual income above 600k)

VI. Institutions Accounts (12)

Government, Subsidies, Changes in stocks, Savings–investment, Hydel profits, Sales tax excise, Sales tax GST on domestic, Sales tax on imports, Sales tax surcharges, Import duty, Export tax, Export duties, Rest of the world

MACRO SAM

Table 4 shows the macro SAM for KP constructed for the year 2015–16. The rows indicate income, while the columns show the expenditure of each listed item. Nine rows and columns have been included to present the SAM in a square form, which comprises activities, commodities, transaction costs, factors, households, government, savings and investment, taxes, and the rest of Pakistan and the world.

Column 1: Domestic Production

Column 1 includes domestic production and factor value added, arriving at a value of 4487.6 million, which is matched by the value in row 1. This value mainly comes from the production of commodities by firms and slightly from government subsidies.

Column 2: Total Domestic Production

Column 2, row 1, represents the total domestic production, to which imports, transaction costs, and other items are added. This is matched by commodity demand, which is the sum of household, government, investment, and export demand.

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Column 4: Factors

Column 4, titled **Factors**, indicates how factor earnings are channeled into households (wages) and enterprises (capital earnings). The counterpart row includes factor income received by households, distributed profits from enterprises, government transfers, and key inflows in the form of remittances.

Column 5: Household

The household column (Column 5) shows the scale of personal consumption, savings made (220 million), and transfers to the rest of Pakistan and the world.

Row 6: Government

Row 6 shows the revenues received by the government and transfers from the rest of the world (official grants). Government savings are recorded in row 7 of column 6, which is the difference between total income and current expenditure.

Row and Column 7: Saving-Investment

The economy's saving-investment data is shown in row and column 7. The sum of households', firms', gov- ernment's, and foreign savings constitutes total savings. These savings are allocated to investment to achieve saving-investment equality.

Row 8: Tax Payments

Tax payments are recorded in row 8, which consists of import tariffs, indirect taxes on commodities, and income taxes. All taxes are transferred to the government, as indicated in column 8.

Row and Column 9: External Balance

The all-important last column and row show the external balance. Import payments and transfers by households and government are recorded in row 9, while payments from the rest of the world in the form of export payments and transfers from abroad to households and enterprises are documented in column 9. The difference between inflows and outflows is external savings or the current account balance and is recorded in row 7, column 9.

Table 5: MACRO SAM KHYBER PAKHTUNKHWA

	Activities Ca1	Commodities Cc2	Transaction Cost Ct3	Factors	Households Ch5	Government	Savings/Investment Cis7	Tax C	Rest of Pak & World Crw9	Total

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				Cf 4		**Cg6**		**T 8**		
Activities Ra1		4484.7				2.9				4487.6
Commodities Rc2	1922		285.6		1972.7	252.1	110.2	0	1399.8	5942.3
Transaction Cost Rt3		285.6								285.6
Factors R4f	2565.6			858.4		77.4			47.8	3549.2
Households R5				1494.1		51.1			715	2260.2
Government R6		9.7		99.2	2.1	2.9	45.1	190.7	239.7	589.3
Savings/ Investment R7				20.3	220.2	18	21.4			279.9
Tax R8		77.7		67.4	45.5					190.7
Rest of World R9		1084.6		1009.8	19.7	184.9	103.3			2402.3
Total	4487.6	5942.3	285.6	3549.2	2260.2	589.3	279.9	190.7	2402.3	

Source: Author's calculation from KP SAM 2015–16

Sectoral Contribution to KP GDP

Figure 4 indicates the contribution of agriculture, industry, and services sectors in the KP GDP based on SAM data. The provincial economy is service-led with a contribution of 58%, followed by industry at 25% and agriculture at 17%, as depicted by the GVA Figure. The provincial government estimated GDP contributions for FY 2015-16 to be 21% for agriculture, 23% for industry, and 56% for services (BOS KP GDP estimates, 2017). Agriculture continues to be a major source of rural employment, engaging a significant number of women and children.

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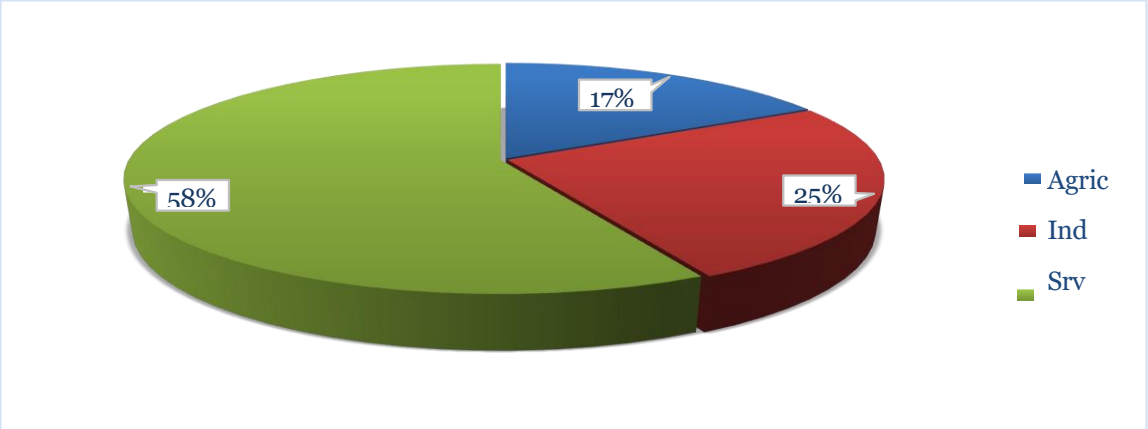
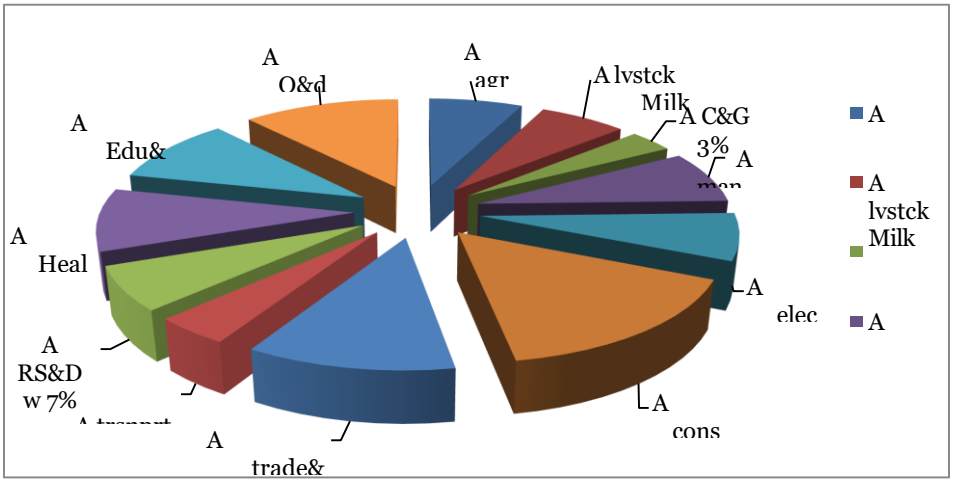


Figure 4: Sectoral share in KP GDP
SOURCE: Author's estimation from SAM KP

The evidence shows that agriculture's contribution to GDP is on the decline, despite the fact that the sector still has significant room for growth by increasing productivity and adopting cutting-edge agricultural technologies. Agriculture's efficiency in KP has increased in recent years; however, threats such as climate change, insect attacks, water scarcity, and other factors have prevented agricultural production from reaching its full potential. Increased allocation to the agriculture sector will have a positive impact on both the sector and the provincial economy.

SAM KP has been disaggregated into 12 activities; livestock has been separated from other agricultural activities due to its significant contribution to agriculture and provincial GDP. Other notable disaggregation include the separate activity listing of the construction and health sectors to observe the impact of policy changes on these sectors. Some sectors are not disaggregated, as the study focuses on health, construction, and livestock. Figure 5 indicates the breakup of KP GDP based on the 12-sector disaggregation and added value. The largest value-added contribution comes from construction (16%), followed by domestic and other services (12%).

Figure 5: Provincial Value Add



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Source: Author calculations from KP SAM 2015

Agriculture has contributed more to developing countries than to developed ones, and increased agricultural productivity is regarded as a key factor for the sector (Arendonk, 2015). The disaggregation of the agriculture sector shows that the greatest contribution comes from livestock (49%). The KP agriculture sector relies heavily on livestock, manufacturing on construction, and services on trade and restaurants. The construction industry absorbs a large portion of the youth population and unskilled workers.

KP is a small open economy, primarily trading with Punjab, Afghanistan, and the rest of the world (ROW). Figure 6 lists the key imports and exports of the province, indicating that manufactured goods (84%) constitute the largest import category. This is due to the province's high dependency on Punjab and the rest of the world for manufactured goods, as well as its weak industrial base. The other key import category is agricultural goods, mainly wheat and other crops imported from Punjab and the rest of the world. The province's exports are dominated by electricity production and distribution, followed by trade and restaurant businesses. Due to its scenic values, KP has significant potential for tourism, contributing to the high value added in the restaurant sector. Seven out of twelve sectors have more exports than imports.

Import Penetration Ratio and Export Intensity

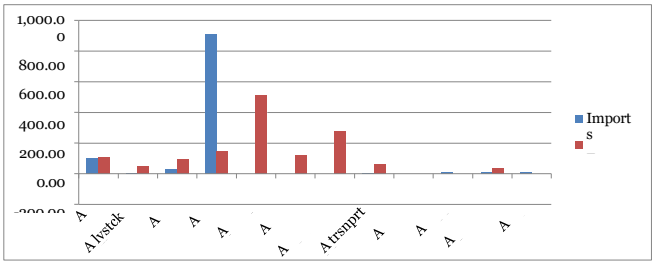

Figure 6: Imports and Exports of KP (Billions) KP SAM 2015.

The relative importance of imports and exports for various commodities is indicated by the import penetration ratio (IPR) and export intensity (EI). The IPR, defined as the ratio of imports to total demand, has an overall value of 0.18. Sector-wise values suggest that the manufacturing sector (0.51) faces the toughest competition, followed by agricultural commodities (0.23). The EI values show that the crude oil and gas sector is the largest exporting sector, followed by electricity production and generation.

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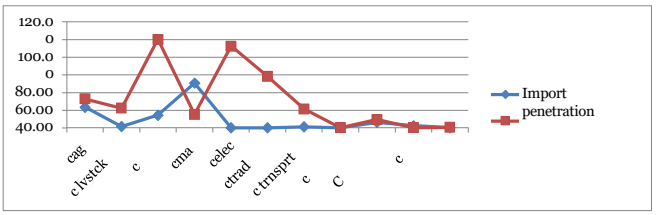

Figure 7: IPR & EI
Source: Author calculations from KP SAM 2015.

The all-important household consumption pattern is described in the following section. The demand share figure shows the various demand heads for all commodities in the province. Manufactured goods are largest category of consumption followed by Domestic and other services.

Household Expenditure and Savings

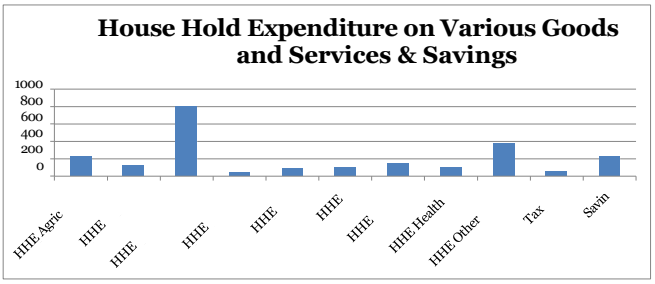

Figure 8: Household Expenditure on Various Goods
Source: Author calculations from KP SAM 2015

The household section and their expenditures are described in the following section. Table 6 shows the various demand heads for all commodities.

Table 6: Household Expenditure on Various Categories of Goods/Services and Savings

Category	Expenditure (PKR Billion)
Manufactured Goods	1500
Domestic and Other Services	1200
Agricultural Goods	800
Savings	200

Source: Author's Estimation from SAM KP.

Household expenditure on various commodities shows that consumers spend mostly on manufactured goods and domestic and other services. Rural households also spend a significant portion of their income on manufactured goods. The savings-to-GDP ratio stands at 9%, while private consumption is very high at 91%.

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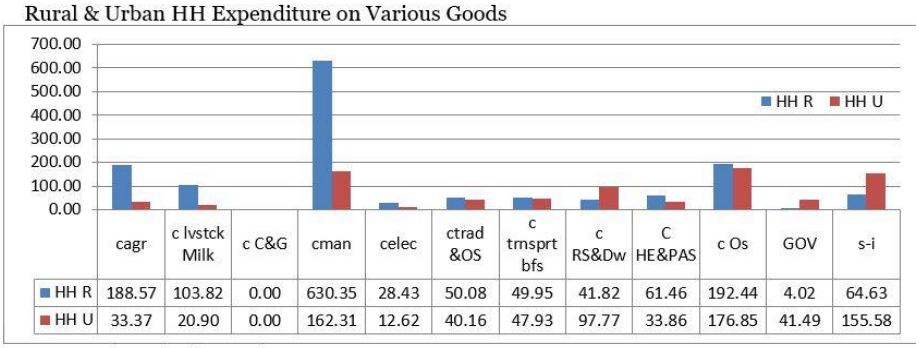

	cagr	c lvstck Milk	c C&G	cman	celec	ctrad &OS	c trnsprt bfs	c RS&Dw	C HE&PAS	c Os	GOV	s-i
HH R	188.57	103.82	0.00	630.35	28.43	50.08	49.95	41.82	61.46	192.44	4.02	64.63
HH U	33.37	20.90	0.00	162.31	12.62	40.16	47.93	97.77	33.86	176.85	41.49	155.58

Source: Author calculations from KP SAM 2015

Total household and enterprise expenditures on activities are estimated at PKR 4487 billion. Out of this, 43% was utilized for intermediate demand for inputs, while the rest (57%) was paid to factors of production. The activities' earnings are matched by the total expenditure on them, as the total output was sold in the market.

Factor Earnings

Table 7 shows the distribution of factor earnings across households, capital, government factors, and the rest of the world (ROW).

Table 7: Factor Earnings (PKR Billion)

	Labor	Capital	Gov. Factors	ROW	Total
Household Rural	318.46 (26.3%)	258.03 (21.3%)	31.46 (2.6%)	602.06 (49.8%)	1210.01
Household Urban	278.99 (65.0%)	17.81 (4.15%)	19.66 (4.58%)	112.94 (26.30%)	429.40
Total	597.45 (36.4%)	275.84 (16.8%)	51.12 (3.12%)	715.00 (43.6%)	1639.41

Source: Author's calculations from SAM KP.

The most important source of income is ROW (remittances, 44%), while labor earnings (36%) stand as the second most important source. Based on high flow of remittances the province is termed as remittance driven economy. The provincial government has to work out the facilitation of better utilization of these remittances for job creation and business facilitation.

Some key Indicators

Some of the Key economic indicators derived from SAM are as follows:

Trade-to-GDP ratio: 18 billion (93.52%, imports plus exports as a share of GDP).

Fiscal balance-to-GDP ratio: 0.68%.

Current account-to-GDP ratio: 0.0%.

Private savings-to-investment ratio: 78.7%.

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The trade-to-GDP ratio indicates that KP is an open economy.

4 Results of Multiplier Analysis

A fixed-price multiplier analysis was conducted to calculate the indirect and induced effects of an exogenous shock to the KP economy, which is small and relatively open to the surrounding economic environment [Zhou, 2018]. Table 8 shows the results of the 12-sector KP SAM model under three different scenarios.

Livestock Scenario

A one billion increase in livestock demand results in a 1.30 billion increase in GDP. It further causes livestock output to increase by 0.94 billion and trade and restaurants by 0.16 billion. Livestock has strong linkages with agriculture and trade & restaurants sectors. The output multiplier is 1.80 billion, meaning that a 1 billion increase in demand leads to an 80% expansion in output. The total demand change (2.29 billion) is greater than the output increase (1.80 billion), implying that imports of livestock to the province will also rise. This is indicated by the fact that manufacturing output has expanded by 0.17 billion, while demand has expanded by0.47 billion, showing the high import intensity of the KP economy. As a result of increased livestock demand, rural household income has increased by 0.39 billion, while urban household income has risen by 0.32 billion. Agriculture, via livestock, has strong linkages with the rest of the economy, as many industries and institutions use a large share of domestically produced goods and services. Expanding agricultural export demand will have a positive impact on farmers' income, who supply intermediate inputs. The positive impact on rural household income will help reduce poverty in KP. The expansion in the livestock sector will lead to stronger consumption linkages and fewer leakages. The investment areas are Broiler and layer farms in Peri-urban areas Vaccination and disease control services Feed mills and hatchery investments, artificial insemination services and embryo transfer technology for elite livestock. The foreign and local investment can be in leather and by products, tanneries and leather in Peshawar and Bannu districts, wool processing from chiral and Kohistan regions and others.

Construction Scenario

The second simulation of construction indicates that a 1-billion increase in construction demand adds the same to the provincial GDP. The total demand of 2.98 billion exceeds the output level of 2.40 billion by about half a billion rupees, showing the import-dependent nature of the KP economy. Household income rises as a result of increased construction activities by about 0.54 billion, with almost the same ratio among rural and urban categories. However, the rural income multiplier is slightly higher than the urban, indicating that rural income is more sensitive to external shocks and has a positive effect. Labor income will rise by about half the magnitude of the exogenous shock, and the category of factors (land and capital) has witnessed a rise of about half a billion. As a closely related sector, real estate and dwelling are of great importance. A 2-billion exogenous shock to the sector adds about 2.90 billion to provincial GDP and an expansion of 3.45

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billion in output. However, the demand multiplier of 4 billion exceeds the output level by only 0.56 billion, indicating that a small portion of the demand will be provided by the rest of Pakistan and the world. The study recommends formalizing and documenting the sector with increased access to financing for small builders. The sector has a great potential of investment in the mid-range housing colonies, vertical housing apartments, solar-powered buildings, Insulated, energy-efficient homes and Wastewater recycling in construction.

Health Scenario

An increased demand expenditure of 1 billion in the health sector yields a rise in GDP multiplier of 1.03 billion, output by 1.59 billion, and income by 0.58 billion. This baseline shock indicates that a certain portion of health services will be provided by the rest of Pakistan and the world. In comparison to the WHO standards of 86$ per capita health spending, the people of KP gets only $ 18 per capita spending of the KP government's budget, indicating low investment in health sector. The study therefore recommends increased investment in the sector which will not only increase the accessibility to Health care but also help achieve SDGs. The key investment areas can be Sehat Sahulat Program and the revamping secondary health care (RSHC).

Table 8: Multiplier Results

Activities	A Livestock & Milk Scenario	A Construction Scenario	A Health Scenario
Activity Agriculture	0.091189	0.057571	0.049869
Activity Livestock	0.935873	0.062113	0.046464
Activity Crude Oil	0.006173	0.009697	0.005343
Activity Manufacturing	0.176509	0.314812	0.173274
Electricity	0.042142	0.054202	0.029821
Construction	0.009953	1.202249	0.018120
Trade and Restaurants	0.159260	0.251310	0.152518
Transport Business Finance Service	0.171935	0.280577	0.130154
Real Estate & Dwellings	0.050173	0.040281	0.040804
Health	0.009675	0.007471	0.823800
Education and Public Administration	0.020740	0.018874	0.019873
Other and Domestic	0.124401	0.096820	0.101157
Commodity Agriculture	0.146837	0.092705	0.080302
Commodity Livestock	1.060516	0.070386	0.052653
Commodity Crude Oil	0.009839	0.015456	0.008516
Commodity Manufacturing	0.469904	0.838092	0.461290
Electricity	0.042541	0.054715	0.030103
Construction	0.009954	1.202424	0.018123
Trade and Restaurants	0.159260	0.251310	0.152518

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Transport Business Finance	0.174148	0.284188	0.131829
Real Estate & Dwellings	0.050173	0.040281	0.040804
Health	0.011857	0.009156	1.009593
Education and Public Administration	0.022249	0.020247	0.021319
Other and Domestic	0.127901	0.099545	0.104004
Transaction Cost	0.172735	0.095271	0.058001
Labor	0.464976	0.479085	0.580477
Capital + Land	0.831743	0.499507	0.451784
HH Rural	0.388749	0.295110	0.312311
HH Urban	0.324663	0.248981	0.264961
Enterprises	0.454598	0.273011	0.246927
Government	0.117367	0.092970	0.075864
Agric. Subsidy	0	0	0
Saving – Investment	0.088539	0.066143	0.069375
Hydel Profit	0	0	0
Rest of the World	0.794094	0.840888	0.854762
GDP Multiplier	**1.296719**	**0.978592**	**1.032260**
Output Multiplier	**1.798024**	**2.395978**	**1.591197**
Income Multiplier	**0.713411**	**0.544091**	**0.577272**
Demand Multiplier	**2.285180**	**2.978504**	**2.111052**

Source: Source: Author calculations from KP SAM 2015

5 Conclusion and Recommendations

A SAM is an accounting database of an economy represented in the form of a square table. In Pakistan, regional accounts are not maintained, making the true economic picture of a particular region like KP unclear. The current study is an attempt to create the first provincial SAM, with the objective of highlighting key aspects of the KP economy and assessing the impact of the livestock, construction, and health sectors on the provincial economy.

The study reveals that the KP economy is service-led, with a contribution of 57%, followed by industry at 25% and agriculture at 17%. The largest value-added contribution comes from construction (16%), followed by domestic services (12%). The largest sub-sector of the agriculture sector is livestock, with a contribution of 49%. The total value of imports to the provincial economy is 1084.6 billion, while exports to the rest of the world (ROW) are 1399 billion. The import penetration ratio stands at 0.18, with the manufacturing sector facing the toughest competition, while crude oil and gas are the largest exporting sectors. Households spend most of their income on manufactured goods and derive most of their income from remittances. The trade-to-GDP ratio indicates that KP is an open economy.

The fixed-price multiplier analysis suggests that a 1-billion exogenous shock to the livestock sector causes GDP to rise by 1.30 billion, while imports to the province will rise by 0.49 billion. The increase in household income will help reduce poverty. The construction scenario indicates that

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the sector can absorb unskilled workers and will add PKR 0.54 billion to household income. The increased demand for health will add 1.03 billion to GDP and 0.58 billion to household income.

The study recommends that certain sectors of the KP economy are key to its growth and require better resource allocation. Increased exports or government spending in the livestock, construction, and health sectors will boost these sectors and the provincial economy. This will help improve household income and reduce poverty levels in rural areas of the province.

CRediT authorship contribution statement

Zahoor Ul Haq's contribution: SAM disaggregation, household section data estimation, hydel profit data, and balancing the final SAM.

Zia Ud Din's contribution: SAM data collection, data entry, multiplier estimation, and write-up.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this research paper.

Data Availability

The detailed SAM table and accounts information are available on request.

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