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Socio-Economic Evolution of Agricultural Landscape in Pakistani Cities: A Time Series Analysis (2012-2022)

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This study presents a comprehensive analysis of the socio-economic evolution in Pakistani cities, focusing on Sheikhupura, Nankana, Hafizabad, and Gujranwala, spanning the period from 2012 to 2022. Through a quantitative approach and time series analysis techniques, key indicators such as literacy rate, number of households, inflation, consumer price index, yield, and area under cultivation are examined to discern trends, patterns, and correlations. Data sourced from reputable databases including the Pakistan Social and Living Standards Measurement Survey and the CRS Agriculture database are meticulously analyzed using statistical software packages such as SPSS and Excel. The findings reveal dynamic trends in agricultural productivity, educational attainment, demographic shifts, and economic resilience across the studied cities. Insights from this research offer valuable inputs for policymakers, stakeholders, and development practitioners to formulate targeted interventions aimed at fostering sustainable socio-economic development and enhancing the well-being of urban populations in Pakistani cities.

Keywords: Socio-Economic Evolution, Literacy Rate, Number of Households, Inflation, Consumer Price Index, Economic Resilience.

Introduction:

Pakistan's agricultural sector remains a vital pillar of its economy, contributing significantly to the GDP and employing a substantial portion of the workforce. It accounts for 18.9 percent of the GDP and absorbs 42.3 percent of the labor force, serving as a crucial source of foreign exchange earnings and driving growth in other sectors [1]. Additionally, agriculture fulfills the basic food and fiber needs of the growing population and economy, with wheat being the primary staple food crop. Despite its significance, Pakistan has been regularly importing wheat in recent years [2]. Even amidst the ongoing structural transformation towards industrialization, the agricultural sector remains the backbone of Pakistan's economy. Employing 44.7% of the total labor force and contributing 21.8% to the GDP, it continues to be the primary source of livelihood for the majority of the rural population [3]. Fluctuations in agricultural production significantly impact employment and the balance of payments in Pakistan's economy, although agricultural growth has generally been sustainable over the years, with growth rates of 4.1% in 2002-03, 6.5% in 2004-05, and 4.7% in 2008-09 [4].

Education plays a pivotal role in determining the allocation of labor in farm activities, with off-farm activities often yielding higher returns than on-farm work. Schooling enhances farmers' efficiency in adapting to market changes, and households with higher education levels tend to allocate more resources to non-farm activities [5]. Additionally, research in agriculture significantly contributes to enhancing agricultural production, with research-induced technical changes leading to a 20% growth in agricultural production since 1965 in China. While the relationship between education and efficiency in agriculture is supported by various studies,

challenges persist, especially for small farmers in developing countries who struggle to adapt to changing global conditions due to insufficient investment in education [6] [7].

Furthermore, the agricultural sector plays a pivotal role in fostering the development of fundamental industries and other non-agricultural sectors. Agricultural products serve as crucial raw materials for various industries, generating effective demand for other industrial products and thereby facilitating economic growth within the country [8] [9]. Although Pakistan's agricultural sector growth has lagged behind that of other developing countries, sustained growth rates have been maintained through technological advancements, subsidies, and agricultural research [10] [11]. Conservation efforts for agricultural biodiversity and the maintenance of marginal production land necessitate substantial reforms tailored to local characteristics, including effective succession management of large-scale marginal production land and the promotion of rewilding processes [12]. Various factors influence farmers' decisions regarding Agricultural Land Abandonment (ALA) and Land Use Changes (LUC), including market forces, economic factors such as farm incomes, non-economic factors like place attachments and social capital, as well as other elements such as disaster events, institutional frameworks, and policy-oriented incentives [13] [14] [15].

Farmers play a crucial role as decision-makers in determining land use patterns and production systems within their communities. Several studies have explored farmers' perceptions of LUC and ALA, highlighting the complex interplay of factors shaping these decisions. For instance, research in Austria and New York revealed how climate change and rural neglect influenced farmers' decisions regarding land use, while studies in Portugal and Pakistan examined the impact of land degradation and desertification on ALA [9] [16] [17]. Understanding the drivers of land-use conversion is crucial for predicting the extent of land-use change, developing conservation plans, and formulating agricultural policies [18] [19]. While long-term landowners have been observed to abandon less valuable land, the intricate relationship between farmers and land use conversion highlights the need for further research in this area [20]. Despite extensive global research on ALA and LUC, there remains a notable gap in research on this critical topic in Pakistan. Additionally, Pakistan's agricultural sector confronts numerous obstacles and challenges, including a lack of access to credit, water scarcity, rising input costs, issues pertaining to natural resource management, and volatility in gasoline prices [21] [22].

Objective:

The objective of this study is to analyze socio-economic trends in Sheikhupura, Nankana, Hafizabad, and Gujranwala from 2012 to 2022. Specifically, the study aims to examine trends in key indicators such as literacy rate, number of households, inflation, consumer price index, yield, and area under cultivation. Through quantitative analysis, it seeks to identify patterns, correlations, and the impact of socioeconomic factors on the agricultural sector. The study aims to provide insights for decision-makers and contribute to the understanding of regional dynamics for targeted development strategies.

Methodology:

The methodology employed in this research adopted a quantitative approach to investigate socio-economic trends in four cities - Sheikhupura, Nankana, Hafizabad, and Gujranwala - spanning the period from 2012 to 2022. Data for the study was sourced from reputable databases including the Pakistan Social and Living Standards Measurement Survey and the CRS Agriculture database. Key variables under scrutiny included literacy rate, number of households, inflation, consumer price index, yield, and area under cultivation.

Data Collection:

Analysis of the collected data was conducted utilizing statistical software packages such as SPSS and Excel. Time series analysis techniques were applied to uncover trends, patterns, and

correlations among the variables over the specified timeframe. The literacy rate was assessed as the percentage of individuals aged 15 and above proficient in reading and writing, while the number of households was determined by the total count within each city. Inflation was quantified as the percentage change in the Consumer Price Index (CPI) over time, with yield representing the quantity of wheat harvested per unit of land and the area under cultivation measured in thousand hectares.

Data Analysis:

Data processing involved meticulous cleaning and organization to rectify any missing values or outliers, ensuring the integrity of the dataset. Chronological ordering of the time series data facilitated trend analysis, while descriptive statistics such as mean, median, standard deviation, and range were computed to provide a summary overview. Time series techniques including trend analysis, seasonal decomposition, and forecasting were employed to discern underlying patterns and anticipate future trends. Furthermore, correlation analysis was undertaken to explore potential relationships between the variables.

Ethical Consideration:

Ethical considerations were paramount throughout the research process, with strict adherence to ethical standards to protect the confidentiality and anonymity of participants' data. Permission was obtained from relevant authorities to access and utilize the data in accordance with ethical guidelines. Limitations of the study, such as data availability, reliability, and potential biases inherent in secondary data sources, were acknowledged. Furthermore, the generalizability of the findings was recognized as being potentially constrained to the selected cities and the specified time period.

Results and Discussion:

The results revealed dynamic trends in various socio-economic indicators across the cities of Sheikhupura, Nankana, Hafizabad, and Gujranwala. Analysis of wheat yield unveils fluctuating patterns, with peaks and troughs occurring at different intervals in each city, indicating diverse agricultural productivity dynamics. Moreover, the area under cultivation of wheat demonstrates varying trends, with Sheikhupura experiencing a slight decrease until 2020 followed by a marginal increase, while Hafizabad and Nankana show relatively stable cultivation areas with minor fluctuations. Gujranwala exhibits a fluctuating trend, with a slight increase until 2017 followed by fluctuations. The study also indicates consistent growth in literacy rates across all cities throughout the study period, with significant improvements noted particularly from 2016 onwards, reflecting positive strides in educational attainment. Additionally, the number of household units witnesses steady increases in all cities, indicating population growth and demographic changes. Fluctuations in inflation and the Consumer Price Index (CPI) are observed over the years, suggesting changes in the cost of living and economic conditions. Correlation analysis reveals significant relationships between various socio-economic indicators, underscoring the interplay between factors such as literacy rates, household income, and agricultural productivity. Overall, these results provide valuable insights for policymakers and stakeholders to formulate targeted interventions aimed at promoting sustainable socio-economic development and improving the quality of life in the studied cities.

The study spanning from 2012 to 2022 in the cities of Sheikhupura, Hafizabad, Nankana, and Gujranwala unveils dyna mic trends across various socio-economic indicators. These findings underscore the intricate dynamics of agricultural productivity, literacy rates, and population growth, offering valuable insights for regional development planning and policy formulation. The yield of crops, particularly wheat, holds significant importance in the selected cities of Sheikhupura, Nankana, Hafizabad, and Gujranwala, playing a pivotal role in agricultural productivity and economic stability. Firstly, it directly influences food security, as wheat is a staple food crop in Pakistan. Adequate yield ensures a stable food supply, reducing the risk of

food shortages and mitigating the impact of price fluctuations in the market. Moreover, a high yield sustains the income of farmers, who form a substantial portion of the population in these regions, thereby supporting rural livelihoods and reducing poverty. Additionally, the agricultural sector contributes significantly to the economic growth of the country, with higher yields leading to increased farm profitability, agricultural income, and investments in rural areas. Surplus production can also be sold domestically and internationally, generating revenue and foreign exchange earnings. Furthermore, improving crop yield is essential for building resilience against climate change and other environmental challenges, ensuring long-term sustainability and food security. Lastly, monitoring and analyzing yield trends provide valuable insights for policymakers and stakeholders to formulate effective agricultural policies and development strategies, ultimately leading to more efficient resource allocation and better outcomes for farmers and the broader economy. In conclusion, enhancing crop yield through sustainable practices and supportive policies is crucial for fostering inclusive and resilient development in these cities. The yield of wheat varied across Sheikhupura, Hafizabad, Nankana, and Gujranwala over the period from 2012 to 2022. In Sheikhupura, the yield fluctuated, reaching a peak in 2015 before experiencing a significant drop in 2016. Hafizabad also saw fluctuations in wheat yield, with peaks in 2017 and 2021. Nankana exhibited a slight increasing trend in wheat yield from 2012 to 2015, followed by fluctuations in subsequent years. Gujranwala showed fluctuating wheat yield, with a peak in 2015 and significant increases in 2021 and 2022. The yield in each district fluctuated over the years. There were peaks and troughs in yield across different districts, with variations in the timing and magnitude of these fluctuations.

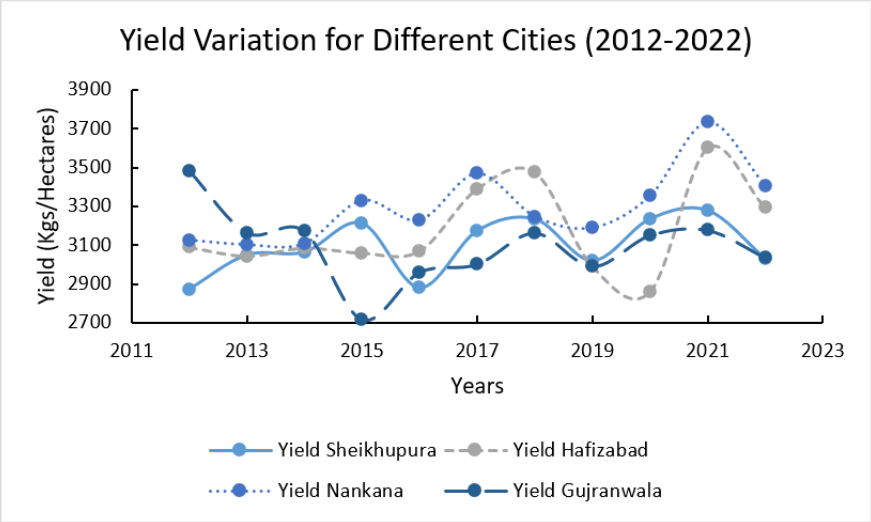

Figure 1: Comparison of Yield Variation in different cities of Pakistan.

The area under cultivation holds significant importance in the socio-economic landscape of the selected cities for several reasons. Firstly, it serves as a key determinant of agricultural productivity and food security. A larger area under cultivation implies greater agricultural output, which not only ensures an adequate food supply for the population but also contributes to economic growth through increased agricultural revenue and employment opportunities. Secondly, the area under cultivation directly influences the livelihoods of rural populations, particularly in agrarian economies like Pakistan. A larger cultivated area provides farmers with more opportunities for crop cultivation, thereby enhancing their income and livelihood security. Additionally, it fosters rural development by stimulating investments in agricultural infrastructure and supporting ancillary industries such as agro-processing and transportation.

Furthermore, the area under cultivation plays a crucial role in environmental sustainability and ecosystem resilience. Sustainable agricultural practices on cultivated lands can help mitigate soil erosion, conserve water resources, and preserve biodiversity. By promoting

sustainable land management techniques, cities can mitigate the adverse effects of climate change and contribute to overall environmental conservation efforts. Moreover, the area under cultivation has implications for land use planning and urban development. As cities expand and urbanize, the conversion of agricultural land for non-agricultural purposes can lead to land degradation, loss of biodiversity, and disruption of rural livelihoods. Therefore, monitoring and managing the area under cultivation are essential for maintaining a balance between urbanization and agricultural sustainability.

Overall, the area under cultivation in selected cities is vital for ensuring food security, promoting rural development, safeguarding environmental sustainability, and guiding land use planning. Effective management of cultivated lands can contribute to the socio-economic well-being of communities, enhance environmental resilience, and support sustainable development goals. The area under cultivation of wheat also showed variations across the four districts. In Sheikhupura, there was a general decreasing trend in cultivation areas from 2012 to 2020, with a slight increase in the last two years. Hafizabad and Nankana experienced relatively stable levels of cultivation area with minor fluctuations over the years. Gujranwala, on the other hand, showed a slight increasing trend in cultivation area from 2012 to 2017, followed by fluctuations in later years. The area under cultivation showed varied trends across districts. Some districts exhibited relatively stable levels of cultivation area, while others experienced fluctuations over the years.

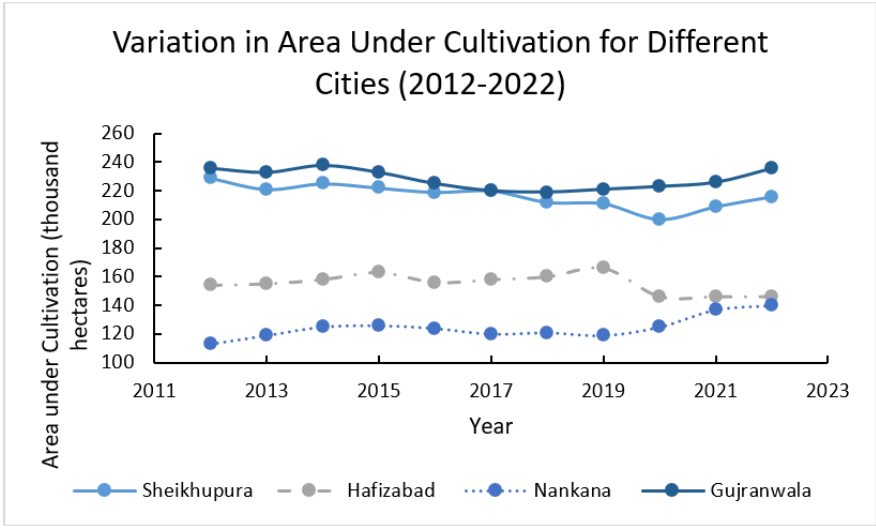

Figure 2: Comparison of Varying Cultivated Land in different cities of Pakistan.

The importance of the literacy rate in selected cities, including Sheikhupura, Nankana, Hafizabad, and Gujranwala, cannot be overstated due to its profound impact on various aspects of socio-economic development. Firstly, a high literacy rate is essential for fostering a skilled workforce and promoting economic growth. Individuals with higher levels of education are better equipped to secure employment opportunities, contribute to productivity, and drive innovation, thereby enhancing overall economic prosperity in the cities. Moreover, literacy plays a crucial role in improving public health outcomes. Educated individuals are more likely to have access to and understand vital health information, leading to healthier lifestyle choices, better disease prevention practices, and improved healthcare utilization. As a result, cities with higher literacy rates tend to experience lower rates of morbidity and mortality, contributing to the overall well-being of the population.

Furthermore, literacy is closely linked to social empowerment and civic engagement. A literate population is better positioned to participate in democratic processes, exercise their rights and responsibilities, and advocate for social justice and equity. This fosters a more inclusive and participatory society, where individuals are empowered to voice their opinions,

contribute to community development initiatives, and hold policymakers accountable for their actions. In addition, a high literacy rate is instrumental in reducing poverty and inequality within the selected cities. Education serves as a pathway out of poverty, enabling individuals to break the cycle of intergenerational poverty, access higher-paying jobs, and improve their standard of living. By investing in education and promoting literacy, policymakers can address socioeconomic disparities and create more equitable opportunities for all residents.

Overall, the importance of the literacy rate in selected cities lies in its capacity to drive economic growth, improve public health outcomes, empower individuals, and reduce poverty and inequality. Therefore, efforts to enhance literacy rates through targeted interventions in education and literacy promotion are essential for fostering sustainable development and improving the quality of life for all residents in the cities. The literacy rate in all four districts showed a positive trend, indicating consistent growth in literacy levels from 2012 to 2022. In Sheikhupura, Hafizabad, Nankana, and Gujranwala, literacy rates increased steadily over the years, with some districts experiencing significant jumps in certain years, such as Hafizabad between 2016 and 2017. Literacy rates generally showed an increasing trend across all districts over the specified time period. There were consistent growth and improvement in literacy rates from 2012 to 2022.

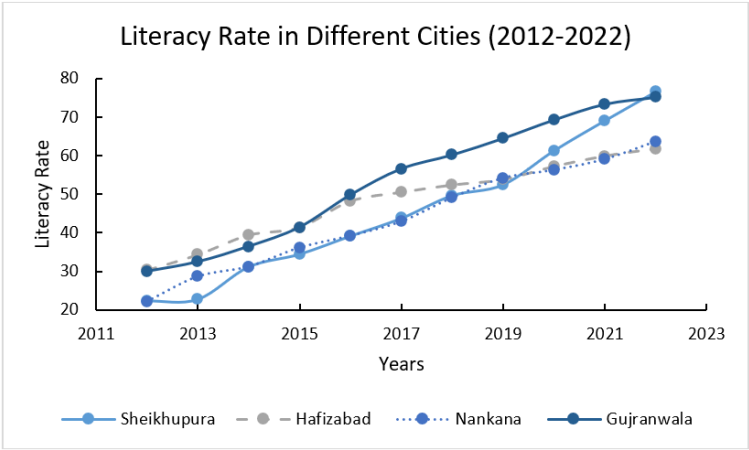

Figure 3: Comparison of Varying Literacy Rate in different cities of Pakistan.

The number of households in selected cities holds significant importance for several reasons. Firstly, it serves as a fundamental demographic indicator, providing insights into population dynamics and growth trends within urban areas. As the number of households increases, it indicates population growth, which can have implications for urban planning, resource allocation, and infrastructure development. Understanding the distribution and size of households allows policymakers to anticipate and address the evolving needs of residents, such as housing, utilities, and public services.

Moreover, the number of households plays a crucial role in socio-economic analyses, particularly in assessing household income, poverty levels, and standard of living. A higher number of households may indicate greater economic activity and employment opportunities within a city, leading to improved livelihoods for residents. Conversely, a large number of households coupled with low-income levels may signal socio-economic challenges such as poverty and inequality, necessitating targeted interventions to address disparities and improve living conditions.

Additionally, the number of households influences consumer behavior and market demand, impacting local businesses, industries, and the overall economy. Changes in household sizes and compositions can affect consumption patterns, housing preferences, and demand for goods and services, thereby shaping market dynamics and economic growth trajectories. Furthermore, demographic changes in household structures, such as aging populations or shifts

in family sizes, have implications for social welfare policies, healthcare systems, and elderly care services. Understanding these demographic trends enables policymakers to develop appropriate strategies to support vulnerable populations and promote social inclusion.

In summary, the number of households in selected cities serves as a crucial indicator of population dynamics, socio-economic conditions, and urban development. Its analysis provides valuable insights for policymakers, researchers, and stakeholders to formulate effective strategies for sustainable growth, equitable development, and improved quality of life in urban areas.

Regarding the number of households, all four districts witnessed an increase in the number of household units over the specified period. In Sheikhupura, Hafizabad, Nankana, and Gujranwala, there was a steady rise in the number of household units, with fluctuations observed in some years. Overall, there was a positive trend in household numbers across these districts, reflecting population growth and demographic changes over time. The number of household units increased steadily over the years in most districts, with fluctuations in some years. Overall, there was a positive trend in the number of household units across the districts.

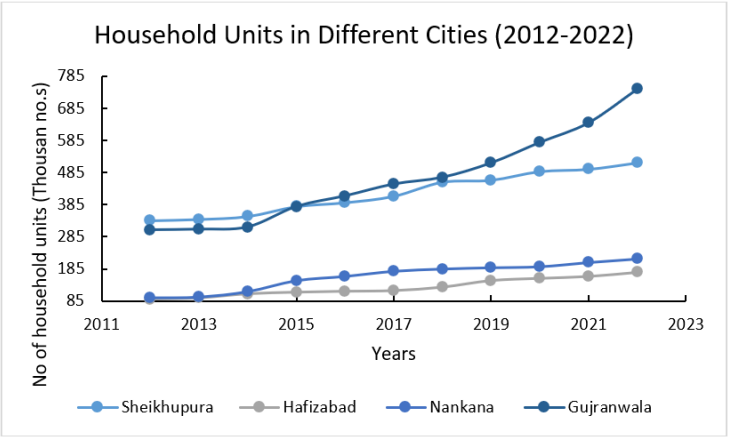

Figure 4: Comparison of Varying Household Units in different cities of Pakistan.

Discussion:

The discussion of the socio-economic evolution in Pakistani cities, particularly Sheikhupura, Nankana, Hafizabad, and Gujranwala, from 2012 to 2022, uncovers significant insights into the changing landscape of these regions. Analysis of wheat yield across the cities reveals nuanced patterns, indicative of the varied agricultural practices and climatic influences unique to each locality. While Sheikhupura and Gujranwala may experience similar peaks in yield during certain years, the underlying factors contributing to these peaks likely differ, such as differences in soil quality, irrigation infrastructure, or adoption of modern farming techniques. Understanding these localized dynamics is crucial for tailoring agricultural interventions and optimizing productivity in each city.

Similarly, the trends in the area under cultivation of wheat underscore the complex interplay of socio-economic and environmental factors shaping land use patterns. While some cities may exhibit stable cultivation areas, others may experience fluctuations influenced by factors like urbanization, land tenure systems, or government policies promoting alternative land uses. Exploring the drivers behind these trends can provide valuable insights into the competing demands for land and inform sustainable land management practices conducive to long-term agricultural resilience.

The consistent growth in literacy rates observed across all cities highlights the progress made in educational attainment over the past decade. Beyond the quantitative increase in literacy rates, it is essential to delve deeper into the qualitative aspects of education, such as the equitable distribution of educational resources, the relevance of curricula to local contexts, and the effectiveness of pedagogical approaches. Addressing disparities in access to quality education

and enhancing educational outcomes for marginalized communities are critical priorities for ensuring inclusive socio-economic development and reducing intergenerational inequalities.

Furthermore, the steady increase in the number of household units across the cities reflects broader demographic trends and migration patterns characteristic of urbanizing regions. As cities continue to attract populations seeking economic opportunities and better living standards, policymakers must anticipate the evolving needs and challenges associated with urban growth. Investments in affordable housing, urban infrastructure, and social services are essential for promoting inclusive urban development and improving the overall quality of life for residents.

The fluctuations in inflation and the Consumer Price Index (CPI) underscore the vulnerability of these cities to macroeconomic shocks and global market dynamics. While inflation may erode purchasing power and strain household budgets, it also presents opportunities for promoting local entrepreneurship, value addition in agriculture, and import substitution strategies. Enhancing resilience to economic volatility requires a multifaceted approach encompassing fiscal policy reforms, diversification of economic activities, and strengthening social safety nets to cushion vulnerable populations from adverse economic impacts.

Conclusion:

The socio-economic evolution of Pakistani cities from 2012 to 2022 reflects a complex interplay of localized dynamics, global trends, and policy interventions. By leveraging data-driven insights and adopting a holistic approach to development planning, policymakers can foster sustainable growth, enhance resilience to external shocks, and improve the well-being of urban populations across these cities. Continued research, stakeholder engagement, and evidence-based policymaking are essential for addressing emerging challenges and seizing opportunities for inclusive and equitable development in Pakistani cities.

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