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The Impact of Human Capital on Improving Sustainable Rural Livelihood Using System Dynamics Approach

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ABSTRACT

Sustainable livelihood was introduced in the 1980s as a new approach to rural development to reduce and eradicate rural poverty. Achieving sustainable rural livelihoods is not possible without considering the rural livelihood assets. To understand the consequences of a change in the rural livelihood system, comprehensive and interactions-based approaches are needed to understand the complicated interactions and feedback between different factors. Accordingly, in this study, an integrated System Dynamics (SD) model was developed for sustainable rural livelihood analysis in the eastern villages of Qarabagh Ghazni, Afghanistan, where managing rural development is seriously challenging due to population growth. SD is a strong and effective approach to examine the behavior of complex systems over time. Findings illustrated that the population in the study area was increasing and the average annual population growth rate was +2.94%. Also, a significant proportion of this population was illiterate. Therefore, it seems that the requirement for skills training in this area will be higher due to population growth. An effective step can be taken to achieve sustainable rural development by increasing the skills and the desire of young people to be self-employed in rural areas. The results also showed that, by increasing per capita income in this region, the tendency to stay in the rural areas increased during the simulation period. Therefore, the government should pay special attention to increasing the household's income in order to prevent migration of the people and strengthen the desire to stay in the rural areas. The results of this research support the idea that there is the necessary potential in terms of human resources in this region to reduce poverty and improve the living conditions of people.

Keywords: Rural area, Rural development, Rural livelihood, Simulation.

INTRODUCTION

The majority of vulnerable populations live in rural areas of developing countries (Jiao *et al*., 2017). Therefore, sustainable development will not be possible if policymakers do not pay attention to rural spaces, rural livelihoods, and the facilities and rural' productive capacity (Mohammadi *et al*., 2021). In fact, the basis of economic and human development is based on sustainable livelihood. Conceptually 'livelihood' means the access to assets in the area, managing to maintain them, and including the activities needed to live and survive (Chambers, 2005). In this definition, assets are considered as natural (land and water), social (community, family and social networks), political (participation and empowerment), human (education, labor, health and nutrition), physical (roads, clinics, markets, schools and bridges) and economic (jobs, saving and credit) (Dadabhau and Kisan, 2013; Miani and Karami Dehkordi, 2021). Sustainability livelihood is a function of how people use these assets in both the short and long term in order to appropriately adapt to different shocks and stresses such as drought (Ellis,

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2000; Jirli *et al*., 2008; Scoones, 2009; Tang *et al*., 2013).

Sustainable rural development requires a transition from traditional patterns to sustainable living patterns that consider the needs of today's rural community (Mohammadi *et al*., 2021). Accordingly, paying attention to household's living conditions and their access to livelihood assets is one of the most effective opportunities to promote development plans in rural areas, especially in developing countries (Barimani *et al*., 2016; Nowruzi and Hayati, 2015).

The Sustainable Rural Livelihood Approach (SRLA) is a framework for explaining the strategies of people in vulnerable situations. The SRLA was introduced in the 1980s as a new approach to rural development and reducing rural poverty (Ellis and Freeman, 2004; But *el al*., 2015). Small (2007) described the SRLA approach as a "paradigm shift in international development thinking." It can help to assess sustainable livelihood strategy under different conditions (Byrnes, 2019). In a sustainable livelihood approach, understanding the assets of rural households, the livelihood strategies they adopt, the results they seek, and the vulnerability in which they operate are essential (Sharafi *et al*., 2018). The main idea of SRL is assets, as anything that a poor household needs to achieve and maintain an adequate income to live on. As rural household's assets increase, their vulnerability to different shocks decreases, and they would be able to adapt to different conditions (DFID, 1999; Malherbe *et al*., 2020).

In this regard, human assets are the most important household assets that enable individuals or households to pursue various livelihood strategies. It mainly denotes the amount of household labor, and their qualities including skills, knowledge, ability to work, good health, etc. (Pour *et al*., 2018). Access to different qualities and quantities of human assets can distinguish households in various livelihood strategies. For instance, low education level and lack of skill undermine household abilities to achieve well-paid jobs (Pour *et al*., 2018). Investment in human assets is one of the strategic principles of sustainable development of both individual organizations and the economy as a whole (Zubović & Vuković, 2014). Defining the concept of a human asset in the literature differs to some extent. An overall idea, however, is that human asset is a concept that views people as creators who interact with the environment by their own knowledge, skills, competencies, and experience. Slocum (1972) introduced more adequate basis for personal growth as one of the concepts of rural development. He was the first to understand that changes in rural areas need to be based on increasing knowledge base of human resources.

In order to study the status of sustainable livelihood, SRL considers rural households' activities, external intervention and their assets as a dynamic system (DIFD, 1999). In a social system, there are dynamic feedback relationships among different factors on different sides (Severi *et al*., 2012). These complexities in the social system cause policymakers to face policy resistance in managing. Addressing the complexities of the social system, a holistic approach such as System Dynamics (SD) can provide sufficient management framework based on conflict resolution approaches. System dynamics consider the interactions among different elements of different stockholders for simulating the behavior of the system and policy analysis (Frank, 2000). This helps decision-makers assess different management policies considering various aspects (e.g., economic, social, environmental, etc.) for simultaneously reducing conflicts and improving system conditions (Darbandsari *et al*., 2020). Considering all of this evidence, this paper develops an integrated SD simulation model for exploring the rural sustainability in the eastern villages of Qarabagh Ghazni Afghanistan, where managing rural development is seriously challenging due to population growth. Both qualitative and

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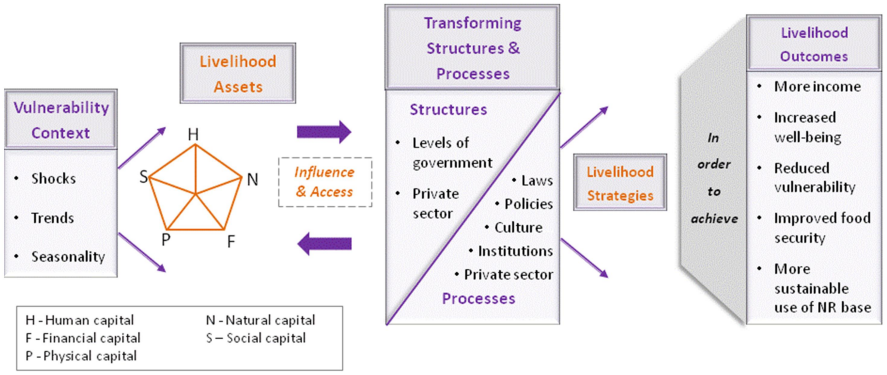

Figure 1. Source: DFID (1999). Define the figure (Figure Caption Title).

quantitative methods were used in this investigation. Put it simply, in this study, an attempt has been made to address the issue of sustainable rural livelihood by emphasizing human asset.

Although various studies have been conducted in the field of sustainable rural livelihood capital in recent years (e.g. Hickey, 2020), few of them (e.g. Faham *et al*., 2017) emphasized the approach of systemic thinking in evaluating rural sustainability. The change in rural livelihood has a dynamics behavior and there are many factors that affect its over time. Therefore, to achieve a better result in studies, it is necessary to consider factors affecting rural livelihood system, in terms of the interaction between them. SD is a methodology used to understand how systems change over time. The advantages of this method are simplicity, the ability to show the interaction between elements, high flexibility, and suitability for the qualitative and quantitative analysis of complex systems and show a system nearby the real world.

There is a large volume of published studies that have applied SRL framework to evaluate the rural development (Small, 2007; Butt *et al*., 2015; Razafimahatratra *et al*., 2017; Sharafi *et al*., 2018; Byrnes, 2019; Alves *et al*., 2019; Liu *et al*., 2020; Rahman and Hickey, 2020; Mohammadi *et al*., 2021). For instance, Sharafi *et al.* (2018) assessed sustainable livelihood capitals in rural households of the central district of Dena County. The results showed that among the five livelihood capitals, three capitals including social capital, human capital and physical capital were at an average level in terms of sustainability and two capitals, including financial capital and natural capital, were the potential at sustainability (poor) level. Liu *et al*. (2020) identified the major household livelihood strategies and their influencing factors in the typical grassland region of Inner Mongolia, so as to provide science-based suggestions for pastoral sustainability in this region. Mohammadi *et al*. (2021) designed a sustainable livelihood model with the cooperative village approach using the grounded theory method. The results showed that coping strategies and compromise strategies as strategies for achieving sustainable livelihoods have consequences such as cooperatives, sustainable development, productivity, employment, strengthening social capital and smart agriculture.

A large and growing body of literature has investigated the effect of human asset on sustainable development (Faham *et al*., 2017; Figueiro and Raufflet, 2015; Verhulst and Lambrechts, 2015; Lambrechts *et al*.,

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2013). These studies showed that higher education should create the knowledge and skills for dealing with global issues such as food security, climate change, water management, non-renewable energy management, biodiversity, health, and social inequality.

In response to the growing concerns of the community about sustainability challenges, Faham *et al*. (2017) developed a system dynamic model to develop the education for sustainable development in higher education with the emphasis on the sustainability competencies of students. In this study, the underlying research question was: What mechanisms are needed to develop education for sustainable development in higher education with the emphasis on the sustainability competencies of students? Subsequently, Zafar *et al*. (2019) investigated the effect of the amounts of natural resources, human capital, and foreign direct investment (FDI) on economic growth in the US. Results illustrated that the US must attract more FDI and human capital from other countries to ensure that established companies and new firms can innovate swiftly in support of the quality of life and sustainable development. Panzabekova *et al*. (2019) studied the effect of human capital on sustainable development using a comparative analysis of regions of the Republic of Kazakhstan. This study confirmed that human capital is the primary base for sustainable development at macro, middle, and micro levels. Rahimi and Karamidehkordi (2020) evaluated the dynamics of rural livelihood in Iran and showed that the role of natural capital in sustainable rural livelihood is more than other assets. Surveys such as that conducted by Ugnich *et al*. (2021) have shown that despite the high potential for the development of human capital, it is not always used effectively, which is reflected in the implementation of the program to achieve sustainable development goals.

Although good progress has been made in the sustainable rural livelihood approach in different studies, there are still limitations. One of the most important limitations of previous studies is that little attention has been paid to the interaction between the variables associated with each asset. This is while the basis of the framework of sustainable rural livelihood is to consider the interaction between social and economic systems. The larger system (such as social system) is complex with multiple feedback loops, non-linear relationship, and time lags between cause and effect. However, the vast majority of studies on sustainable livelihood rely on simple linear theories and models to calculate indicators of sustainability (Dyner *et al*., 2005; Ha *et al*., 2017). The complexity of social systems is familiar to all those studying in the field because of fundamentally their large number of agents and interdependent subsystems (Ha *et al*., 2017). Compared to previous studies, to achieve a better result, we designed a System Dynamics model (Ford and Ford, 1999) to study the behavior of variables in human capital system. In more detail, this could be an effective attempt to simulate accurately the components of sustainable development. Because of increasing complexity and integration of social and economic functions of human capital system, the early SRL models still needs to be developed and appropriate policies should be adopted based on the socio-economic conditions. Accordingly, this paper develops an integrated SD simulation model for exploring the human capital index in the eastern villages of Qarabagh Ghazni, Afghanistan.

MATERIALS AND METHODS

The Study Context and Scope

Ghazni is one of the 34 provinces of Afghanistan, located in southeastern Afghanistan. The province contains 19 districts, encompassing over one thousand villages and roughly 1.3 million people, making it the 5th most populous province. Qarabagh is a district 56 km to the

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south-west of Ghazni in eastern Afghanistan. The 1,800 km^2 area is one of the most populated at 109,000 persons; some reports count more than 218,000. The ethnic composition of the district includes *Hazaras* and *Pashtuns*. The landscape varies in different parts of the district - deserts in the southwest, plains in the southeast and mountains in the north. The district is seriously affected by drought, especially for farming and animal husbandry. Health and education need serious improvement.

The area is poor and traditionally one of out-migration to Kabul, Ghazni, Lashkar Gah, and Quetta, as well as to other countries. Most of the population are dependent on agricultural resources.

The economy is largely based on the remittances of the men who work out of the region. Agriculture is mostly based on irrigation, but production is low. Autumn wheat dominates, but spring wheat, barley, potatoes, beans, onions, carrots, turnips and fodder plants are also cultivated. Other crops like almonds, mulberries, apricots, apples and grape may be found in some areas. The studied area was shown in Figure 2.

System Dynamics Modelling

SD modeling is an iterative and feedback process to reach a new understanding of how the problem arises and then design high leverage policies for improvement (Davies and Simonovic, 2011). A four-step SD modeling process introduced by Sterman (2001) and Ford and Ford (1999) is used in this study: (1) Problem articulation; (2) Model formulation; (3) Model testing, and (4) Scenario design and simulation. The first step in SD modeling is to be specific about the dynamic problem and problem articulation (Ford and Ford, 1999). This step includes defining the problem, identifying the key variables related to the problem, such as stocks, exogenous and endogenous variables, and identifying the temporal and spatial scales to be considered (Zhuang, 2014; Layani *et al*., 2021).

The aim of model formulation is representing the structure of the problem and

Figure 2. Qarabagh, Ghazni Province, Afghanistan.

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formulating a SD simulation model of the causal theory (Sterman, 2001; Zhuang, 2014). There are several diagram tools to capture the structure of the system, including Causal Loop Diagram (CLD) and stock and flow diagram. CLDs consist of variables connected by arrows for representing the feedback structure of the system (Sterman, 2001). In spite of the fact that stock and flow and feedback are the two central concepts of system dynamic theory, CLDs are not able to capture the stock and flow structure of a system (Ford and Ford, 1999; Sterman, 2001). This is an important reason for using stock and flow diagram to represent the structure of a system with more detailed information that is shown in a CLD. In general, the stock variable is an accumulator variable (Zhuang, 2014). A stock with a single inflow and single outflow can be mathematically formulated as follows:

$$stock(s) = \int_{t_0}^{t} [Inflow(s) - outflow(s)]ds + stock(t_0)$$

Where, s any time between t_0 and t. The stocks are the key variables in the model. They represent where accumulation or storage takes place in the system. Stocks tend to change less rapidly than other variables in the system, so, they are responsible for the momentum or sluggishness in the system (Ford and Ford, 1999).

Model testing begins as the first equation is written, and it is a critical step in SD modeling (Sterman, 2001). Tests to rely on SD model can be divided into two groups: structure tests and behavior tests (Forrester, 1997). Structure tests compare the structure of the SD model with the available knowledge of the real system presented in historical data. Behavior test is to run the model and compare the results to the reference mode (historical or observed data) (A reference mode is a pattern of behavior over time). When the simulation results match the reference mode, have reached a major milestone in the modeling process. Achieving a simulation outcome that aligns with the reference mode signifies a significant accomplishment in the modeling process. (Ford and Ford, 1999). Following Kotir *et al*. (2016), Mean Relative Errors (MRE), and coefficient of determination (R^2) were applied to evaluate the performance of the model. *MRE* indicates the mean possible divergence between the observed and simulated data (Qin *et al*., 2011), the lower values of MRE indicate that the model satisfactorily fits the historical values. R^2 describes the proportion of the variance in measured data explained by the model (Kotir *et al*., 2016). (The values of R^2 range from 0 to 1, with values closer to 1 indicating that the model well simulates the system.)

$$MRE = \frac{1}{n}\sum\left(\frac{Y_i - \hat{Y}_i}{Y_i}\right) \times 100 \quad (2)$$

$$R^2 = 1 - \frac{\sum(Y_i - \hat{Y}_i)^2}{\sum(Y_i - \overline{Y_i})^2} = 1 - \frac{\sum(e_i)^2}{\sum(y_i)^2} \quad (3)$$

Where, Y_i and $\hat{Y}_i$ are the observed and simulated values of variable and $\bar{Y}$ is the average of observed values of variable. After the validation of the model, we can use this model to evaluate the impact of different scenarios designed to solve the problem (Zhuang, 2014).

In the present study, questionnaires (based on conceptual framework), interviews and observations were used to collect information and design mental model. In order to determine the validity and reliability of the questionnaire, a panel of experts and Cronbach's Alpha coefficient were used.

The statistical population in the present study was divided into the following two parts:

In the first part, the views of the villagers in the study area were examined using a simple random sampling method.

In the second part, using purposed sampling method, the necessary information was collected from key informants to reach the theoretical saturation stage.

It should be noted that in the first part, using the Cochran method, 120 people were selected as the number of study community

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and, in the second part, with 10 interviews, the researcher reached theoretical saturation.

RESULTS AND DISCUSSION

Conceptual Framework and Casual Loop Diagram (Qualitative Analysis)

In the first step, based on the information collected from the study area and literature review, the mental model of human assets was drawn as Figure 3. The causal loop diagram of the human asset of sustainable rural livelihood has seven feedback loops. According to interviews with villagers, it was concluded that people are interested in investing more in education. It is expected that with the improvement of investment in education, the salaries of teaching staff will increase compared to other jobs. Job satisfaction of teaching staff also increases. A positive causal relationship is conceivable between the variable of increasing the job satisfaction of the teaching staff and the desire of the teaching staff to learn more. By improving educational learning, the quality of education in the study area will increase. This can contribute to the quality of graduates from schools and universities. As a result, the opportunity to enter the labor market is expected to increase as the quality of graduates improves. This variable can also have positive effects on improving labor productivity in this region. Labor is one of the important factors in the production process. Therefore, by increasing labor productivity, production can experience a growing trend in terms of both quantity and quality. It is more probable than not that the increase in production in the study area will lead to the economic growth of the region. Additionally, there is a significant positive causal relationship between sustainable rural livelihood and the economic indices. Consequently, by improving the quality of education and labor productivity in the region, the livelihood of households will be in a more favorable situation.

As can be seen from the Figure 1, if job opportunities in the region do not grow in the proportion to an increase in the number of graduates, it can lead to an increase in the unemployment rate of graduates. It is obvious that with the increase in the unemployment rate of graduates, the desire of people to continue their education in the region decreases. Therefore, it can be noted that increasing the unemployment rate can have a negative effect on sustainable rural livelihoods. Also, improving rural livelihoods can have a positive effect on human health. Therefore, increasing human health leads to

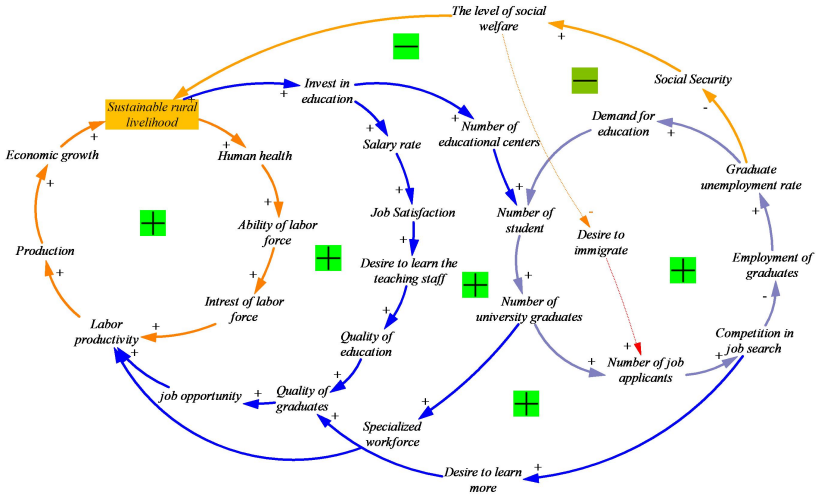

Figure 3. Casual loop diagram of human asset.

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increasing the ability and interest of the workforce. It can be expected that by increasing the health and interest of the labor force in the study area, labor productivity will also increase, which in turn can lead to more production, economic growth, and improved rural livelihood.

Stock and Flow Diagram (Quantitative Analysis)

Stock and flow (or Level and Rate) diagrams are ways of representing the structure of a system with more detailed information than is shown in a causal loop diagram. Stocks (Levels) are fundamental to generating behavior in a system, while flows (Rates) cause stocks to change. Stock and flow diagrams are the most common first step in building a simulation model because they help define types of variables that are important in causing the behavior. A stock represents a part of a system whose value at any given instant in time depends on the system's past behavior. The value of the stocks at a particular instant in time cannot simply be determined by measuring the value of the other parts of the system at that instant in time – the only way you can calculate it is by measuring how it changes at every instant and adding up all these changes. In this study, the number of population, income and number of small business is considered as stock variables. Flows represent the rate at which the stock is changing at any given instant; they either flow into a stock (causing it to increase) or flow out of a stock (causing it to decrease). In the designed stock-flow diagram (Figure 4), variables such as birth, death, migration, change in income and change in the number of business is considered as flow variables.

The variables and equations used in the designed model are presented in Table 1.

The performance of the model is discussed by comparing model outputs for the selected variables to the corresponding historical data. The key variable that demonstrates the performance of the human asset system is the population. In general, as shown in Figure 5, the model performed well in

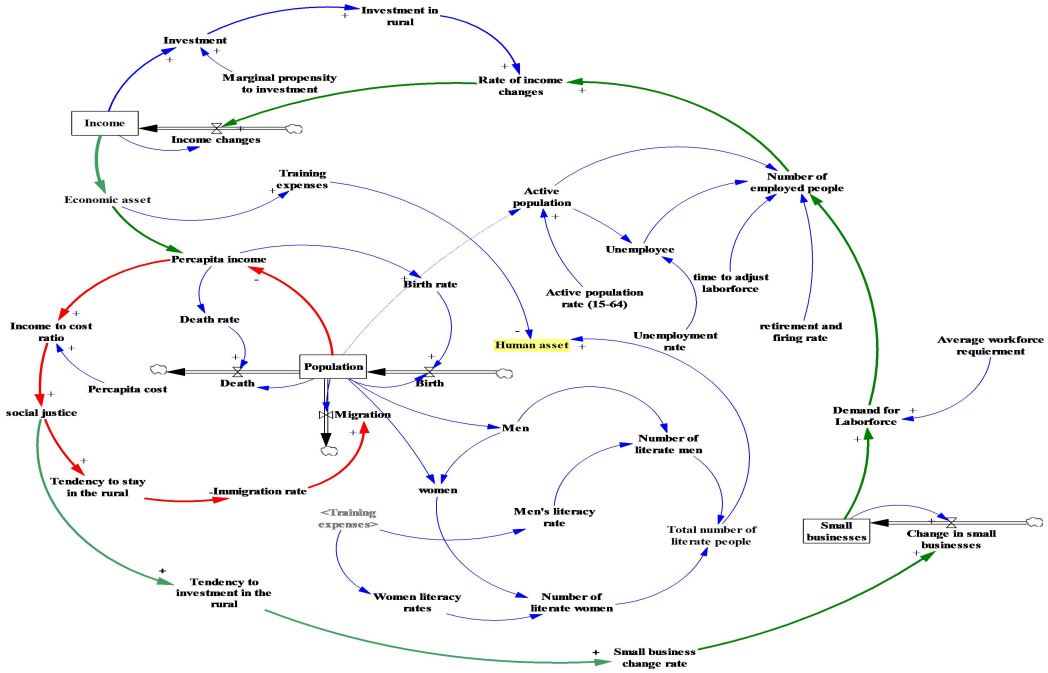

Figure 4. Stock-Flow diagram of human asset .

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Table 1. Variables and equations used in the Stock-Flow diagram.

Variable	Type	Equation
Income	Stock	$=\int \text{income change.dt} + 1.6\times10^{6}$
Income change	Flow	= (Income×Rate of income changes)
Rate of income change	Supplementary	Lookup (Investment in rural/Number of employed people)
Investment	Supplementary	Income × Marginal propensity to investment
Marginal propensity to investment	Rate	0.1615
Economic asset	Supplementary	Income
Training expenses	Supplementary	Economic asset×0.145
Per capita Income	Supplementary	Economic asset/Population
Population	Stock	$\int (\text{birth} - \text{deathi} - \text{migration}).\text{dt} + 2731$
Death	Flow	Population×Death rate
Birth	Flow	Population×Birth rate
Migration	Flow	Population×Immigration rate
Birth rate	Rate	Look up (Per capita income)
Death rate	Rate	Look up (Per capita income)
Immigration rate	Rate	Look up (Tendency to stay in the rural)
Tendency to stay in the rural	Supplementary	0.219×Social justice
Social justice	Supplementary	Look up (Income to cost ratio)
Tendency to investment in rural	Supplementary	0.189×Social justice
Small business change rate	Supplementary	0.002×Tendency to investment in the rural
Small business	Stock	$\int (\text{Change in small business}).\text{dt} + 10$
Demand for labor force	Supplementary	Small businesses×Average workforce requirement
Number of employed people	Supplementary	(Active population - Unemployed) + (Demand for Labor force/time to adjust labor force)-((Active population-Unemployed)+(Demand for Labor force/time to adjust labor force))*retirement and firing rate
Unemployment rate	rate	0.1471
Active Population	Supplementary	Population*"Active population rate (15-64)"
Unemployed	Supplementary	Active population×Unemployment rat
Number of literate men	Supplementary	Men×Men's literacy rate
Number of literate women	Supplementary	Women×Women literacy rates
Men literacy rate	Supplementary	Look up (Training expenses)
Women literacy rate	Supplementary	Look up (Training expenses)
Human asset	Supplementary	Total number of literate people/Training expenses

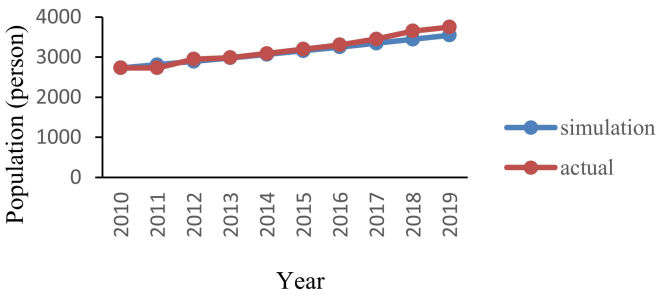

Figure 5. Comparison of historical and simulated population (person).

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comparison to the historical data. The simulated results follow the same trend as the observed date, indicating that the model is well calibrated. The statistical values for MRE and R^2 show that the model satisfactorily fits the historical values. Predictions for population have low values of mean relative errors (MRE= 1.06%) and the value of R^2 is calculated around 0.98.

Simulation Results and Analysis

Population: The simulation results of the population variable are shown in Figure 6. As can be seen at the beginning of the study period, the population in the study area is 3,652 people. This variable increases to 5,647 at the end of the simulation period with a positive growth rate. The average rate of population change during the simulation period is calculated to be 2.94%. Overall, 51% of the population are men and 49% are women. Population is affected by birth rate, mortality rate and migration rate in the study area. Due to population growth, the number of available labor, as the most important input in the production process, is expected to increase.

Based on Figure 7, at the beginning of the study period, 1,635 person of the population living in the study area are literate. According to the results, the number of literate people will increase to 3,197 at the end of the study period. The average annual percentage change of this variable is predicted to be +4.57%. Another important finding is that 73 percent of literate people is related to men and 27 percent is related to women at the study area. Under these circumstances, it seems that special attention should be paid to increasing the professional skills of the residents of this area. By improving the skills according to the available physical assets, an effective step can be taken to increase income and

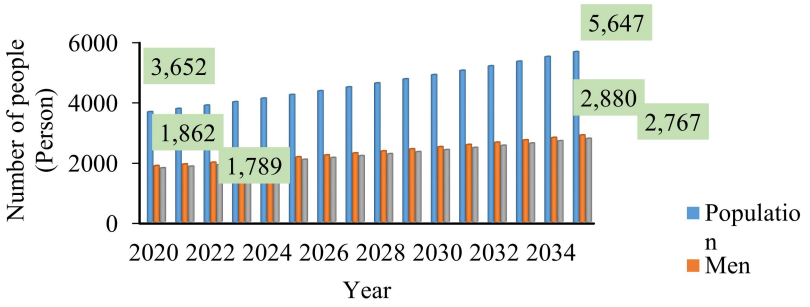

Figure 6. Population variable simulation results (person).

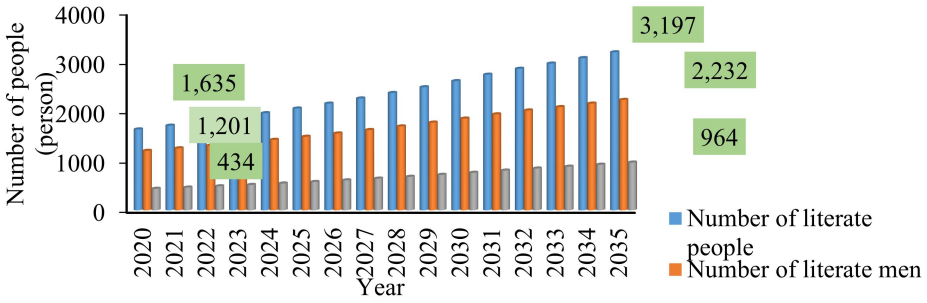

Figure 7. Simulation results of the number of literate people (person).

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sustainable livelihood.

Employment situation: The simulated active population (15-64 age) and number of employed people at the study area is reported in Figure 8. It can be seen from Figure 8 that active population will increase from 1845 people in 2020 to 2853 people at the end of simulation period. The results, indicate that the number of employed people in the simulation period has a growing trend. This variable is 1291 at 2020 and increases to 1987 at the end of the period. The average annual growth rate of this variable during the years 2020-2035 is equal to 2.94%.

Labor, capital, and natural resources are the three essential components in the production of goods and services in an economy. The quantity and quality of labor that individuals supply is an important factor in determining the economy's level of production and rate of growth. Also, this result can be examined from two aspects. On the one hand, it seems that there is the necessary potential (labor force) in the region for changes in production and the move towards sustainable livelihoods. On the other hand, there is a risk of rising unemployment in the region if it is not possible to provide employment for the active labor force. Therefore, increasing skills training and encouraging self-employment and reducing administrative bureaucracy can be considered by policymakers.

Income: Changes in population at the study area is also a function of per capita income in human asset system designed. Therefore, Figure 9 shows that there has been a slight increase in per capita income, the same as population. As shown in Figure 9, per capita income at the beginning of the simulation period is $618.53, which increased by 5.43% at the end of the period to $652.14.

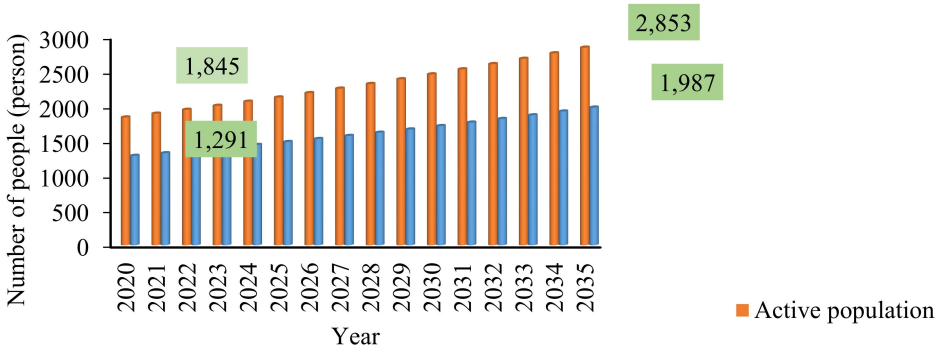

Figure 8. Simulation results of the active and employed people (person).

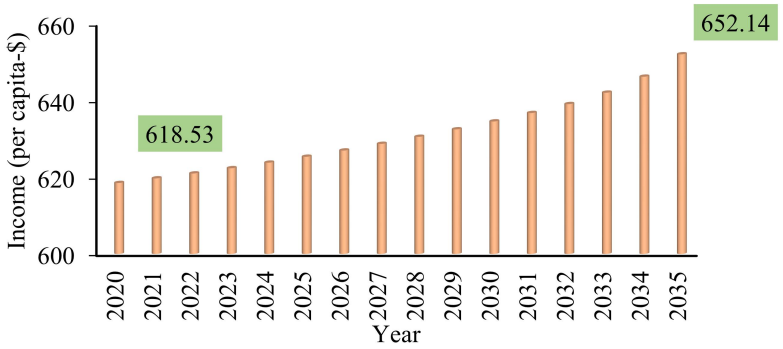

Figure 9. Simulation results of per capita income ($).

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Therefore, improving per capita income can have a positive effect on population growth rate. The hypothesis that the population size is a function of income has deep roots in economics and can be traced back at least to Malthus (1798) who postulated that the increase of population is limited by the means of subsistence.

Training expenses: Another important variable in the designed human asset system is the training expenses. The result of Figure 10 confirms that an increase in income can increase the training expenses. In other words, the amount of training expenses increases from 328.73 thousand dollars in 2020 to 536.01 thousand dollars at the end of simulation period. The average annual changes of this variable during 2020-2035 will be +3.30 percent.

Increasing economic growth and development along with increasing labor productivity and reducing poverty and better distribution of income is one of the goals of policymakers. Investment in education can meet these goals. Investing in education leads to a more equitable distribution of income, both through monetary returns and through non-monetary effects, reducing poverty, and each individual's income is affected by the cost of investing in education and its rate of return. Many theoretical issues (Nademi and Jalili Kamju, 2019; Zuluag, 2007) emphasize that education can directly affect the process of technology change and economic growth, and in this way can also be effective in reducing poverty.

Social security and human capital: Based on the structure of the designed human asset system, it can be expected that, with the improvement of the income in the rural, the social security index will be in a better situation. As can be seen in Figure 11, the index of social justice at the beginning of the period is equal to 3.01, which increases to 3.63 in 2035. The average annual rate of change of this variable in the study area is equal to + 1.22%. Social justice is a fundamental criterion in legislation and regulation and one of the highest goals of all governments and political governments in the contemporary world. The connection between social justice and sustainable livelihood has strengthened over the years. It has become clear to activists and governments that one cannot exist without the other. When a society is just, it protects and respects everyone's human rights. Improving this index can help the tendency to stay and participate in economic activities in the rural community.

As shown in Figure 11, a positive correlation was found between social justice and tendency to stay in rural area. Thus, this variable also increases with a growing trend from 0.57 in 2020 to 0.69 in 2035. The annual change rate of this variable at the end of the study period is higher than the beginning of the period. This is a remarkable outcome. Similarly, the variable of tendency to invest in the rural area during the study period has a growing trend. These results are in line with those of previous studies such as Motiee Langroodi *et al*. (2011). With a decrease in the desire to live in rural areas, and as a result of increased migration to cities, there is a stagnation in agricultural activities and rural livelihood economy.

Finally, the simulated values for the human asset index is shown in Figure 12. Social development is a product of individual development and vice versa. Accordingly, the variable of human assets in this study is defined as the ratio of the number of literate people per year to investment in education. Figure 12 shows that this variable equals to 4.97 at the beginning of the simulation period and, with annual growth of 1.22%, reached the peak of about 5.967 in 2035. Then, it will decrease by 0.05% and reach 5.964 in 2035. Considering that one of the elements of SRLA is the human asset index, improving this index can have an effect on sustainable rural livelihood. Improving the human asset in rural area can be effective in achieving higher and more sustainable levels of human welfare and well-being. This finding is also reported by Sajasi ghidari *et al*. (2013). To maintain and increase human asset, it

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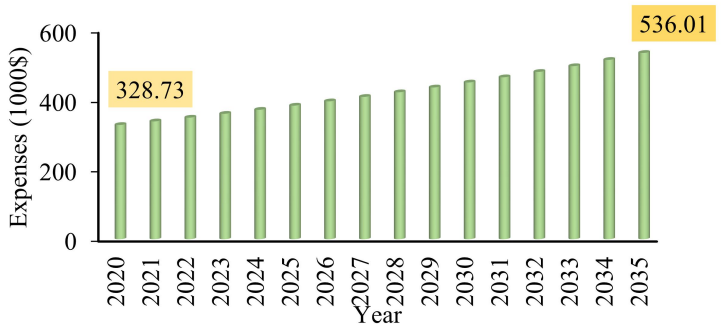

Figure 10. Simulation results of training expenses (1000$).

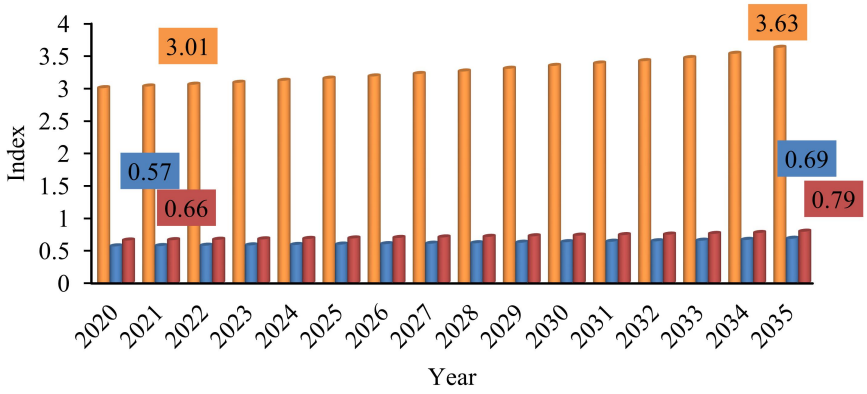

Figure 11. Simulation results of the social justice, tendency to stay in, and tendency to invest in the rural area.

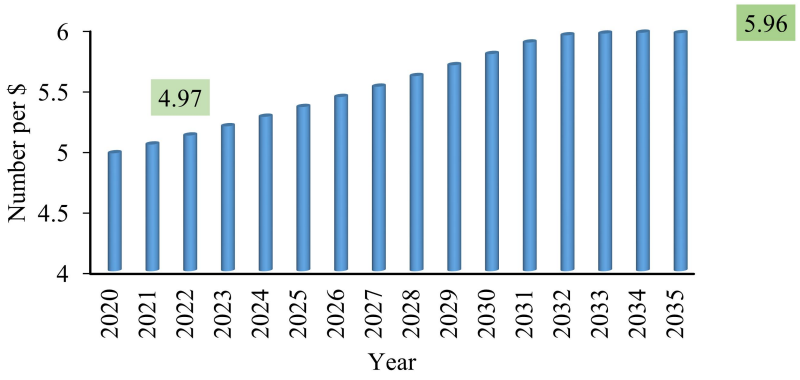

Figure 12. Simulation results of human asset.

requires attention to appropriate educational infrastructure. Because through proper education, the possibility of developing creativity and the level of individual and social skills increases. When human asset increases in areas such as science, education, and management, it leads to increases in innovation, social well-being, equality, increased productivity, improved rates of participation, all of which contribute to economic growth. Increases in economic growth tend to improve the quality of life for a population.

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CONCLUSIONS

Sustainable livelihoods have been proposed in some developing countries to reduce and control pervasive poverty. Some countries have taken appropriate practical efforts to eliminate and control rural poverty in the undertaking of their sustainable rural livelihoods approach, with satisfactory results. Afghanistan is one of the developing countries where 71% of the population lives in rural areas. Rural people in this country face many livelihood problems. Poverty reduction, rural development, and sustainable rural livelihood remained the major aim of various governments in Afghanistan since 1950. However, the efforts made in these years to ameliorate poverty in these areas have not been enough. Consequently, significant share of the rural society is living below the line of poverty. Recently, the concept of sustainable rural livelihoods has become increasingly important in research about regional development, poverty alleviation, rural agricultural development, and rural resource management. This approach suggests that rural people's ownership and access to some livelihood assets may have a positive impact on their strategies for dealing with vulnerabilities and risks. Accordingly, the aim of the present research was to develop an integrated system dynamics simulation model for exploring the rural sustainability in the eastern villages of Qarabagh Ghazni, Afghanistan, where managing rural development is seriously challenging due to population growth. This study has shown that the population in the study area is increasing, such that the average annual rate of population change during the simulation period is calculated to be 2.94%. It seems that population growth will have negative consequences regardless of the existing infrastructure of a region, economic growth, labor market potential, quality of education, and access to health facilities. In other words, an opportunity becomes a threat.

The second major finding was that a significant proportion of this population is illiterate. Therefore, it seems that due to population growth, the need for skills training in this area will be more than before. By increasing the skills and increasing the desire of young people to be self-employed in rural areas, an effective step can be taken to achieve sustainable rural development. This is important because the share of the active population in the total population is about 50%. The results of the research confirm that per capita income is increasing. Increasing income in the study area can increase the tendency to stay in rural areas. The results of this study also showed that the variable of tendency to stay in the rural area increases during the simulation period. Therefore, the government should pay special attention to increasing the household's' income in order to prevent the migration of the people and strengthen the desire to stay in the rural area. Due to the existence of physical assets such as agricultural land and human assets such as active labor, improving on-farm and off-farm activities, the organization of cooperatives, the improvement of partnership work, as well as the creation of home-based jobs can be considered by the government to improve the income of rural residents.

One of the issues that can be effective in the field of sustainable rural development is supply chain management. Because the villagers can produce agricultural products but are not able to sell their own products. Therefore, establishing cooperatives and helping the supply chain of agricultural products can play an effective role in improving the income of villagers and staying in the village and reducing migration to the city.

The results of this research support the idea that there is the necessary potential in terms of human resources in the region to reduce poverty and improve the living conditions of people. Finally, our study is the first attempt to model sustainable rural livelihoods in the eastern villages of

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Qarabagh, Ghazni, Afghanistan, with an emphasis on human assets and system dynamics model. There are, however, some limitations in our study that could be addressed in order to add more precision to our results. This paper has focused on human assets in baseline social conditions. Further research can also focus on different social conditions (such as different population growth rates) along with paying attention to other assets in this region.

It is clear that human capital is different from tangible monetary capital and the reason for that is the extraordinary characteristic of human capital for massive growth over a long period of time. The growth of tangible monetary capital is not always linear due to business cycle shocks. During the period of success, money capital grows at a relatively higher rate, while during the period of economic crisis and recession, there is a decrease in the speed of monetary capital. On the other hand, human capital has a uniformly increasing growth rate over a long period of time, because the foundation of this human capital is built by educational and health inputs. Considering the profound changes that have occurred in Afghanistan, human capital can play a key role in one of the five assets of the sustainable rural livelihood framework and as can be seen in the cause and effect diagrams, the mentioned elements have been effective on sustainable rural livelihood.

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تاثیر سرمایه انسانی بر بهبود معیشت پایدار روستایی با استفاده از رویکرد پویای سیستم

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چکیده

معیشت پایدار در دهه ۱۹۸۰ به عنوان رویکردی جدید در توسعه روستایی برای کاهش و ریشه کنی فقر روستایی معرفی شد. دستیابی به معیشت پایدار روستایی بدون در نظر گرفتن سرمایه های معیشتی روستایی امکان پذیر نیست. برای درک پیامدهای تغییر در نظام معیشت روستایی، رویکردهای جامع و مبتنی بر تعامل برای درک تعاملات پیچیده و بازخورد بین عوامل مختلف مورد نیاز است. بر این اساس، در این مطالعه، یک مدل دینامیک سیستم یکپارچه (SD) برای تجزیه و تحلیل معیشت روستایی پایدار در روستاهای شرقی قره باغ غزنی افغانستان که مدیریت توسعه روستایی به دلیل رشد جمعیت به طور جدی چالش برانگیز است، ایجاد شد SD .یک رویکرد قوی و موثر برای بررسی رفتار سیستم های پیچیده در طول زمان است. یافته ها نشان می دهد که جمعیت منطقه مورد مطالعه رو به افزایش است و میانگین نرخ رشد سالانه جمعیت ۲/۹٤% است. همچنین بخش قابل توجهی از این جمعیت بی سواد هستند. بنابراین به نظر می رسد با توجه به رشد جمعیت، نیاز به آموزش های مهارتی در این زمینه بیشتر باشد. با افزایش مهارت ها و تمایل جوانان به خوداشتغالی در روستاها می توان گام موثری برای دستیابی به توسعه پایدار روستایی برداشت. همچنین نتایج نشان داد که با افزایش درآمد سرانه در این منطقه، تمایل به ماندن در روستا در طول دوره شبیه‌سازی افزایش یافت. بنابراین دولت باید برای جلوگیری از مهاجرت مردم و تقویت میل به اقامت در روستاها به افزایش درآمد خانوار توجه ویژه داشته باشد. نتایج این تحقیق مؤید این ایده است که پتانسیل لازم از نظر نیروی انسانی در این منطقه برای کاهش فقر و بهبود شرایط زندگی مردم وجود دارد.

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