**Livelihood Variation in Rudra Prayag District of Garhwal Himalaya: Implications for Poverty Reduction**

 **Abstract:**

Sustainable livelihoods are achieved through access to a range of livelihood resources which are combined in the pursuit of different livelihood strategies (agricultural intensification or extensification, livelihood diversification and migration). This study investigates the variations in livelihood strategies across different blocks of Rudra Prayag District to assess their impact on poverty reduction. This paper emphasizes understanding the variation in livelihood strategies within and between the blocks to understand the quality of life in the villages of the district Rudra Prayag. The study identifies factors linked to the socio-economic attributes of individuals engaged in various income-generating activities. This analysis is essential to understand the mechanism of livelihood strategy changes within and between the blocks of the district Rudra Prayag. The result of the study shows that people are mainly dependent on tourism, agriculture, animal husbandry and vegetable cultivation for their livelihood. A random sampling method was used to select the villages. Semi-structured questionnaire and interview method were used to understand the importance of resources for livelihood generation. The data gathered from each selected village was compiled and analyzed by using SPSS 16.A higher proportion of households (57.6%) of Agustmuni block depend on agricultural activities, while the majority of people of Jakholi and Ukhimath block depend on remittances (65.1) and agriculture (55.8), respectively. Analysis of the socio-economic characteristics of rural households reveals that age, labour endowment and education in terms of access to basic infrastructure are some of the barriers that poor households face to enter into high-return livelihood strategies. The study indicated that the role of assets such as social capital, land, property, savings and labour is central in determining the outcomes of livelihood activities as measured by income and well-being.

**Keywords:** Sustainable, Livelihood, Remittances, Subsistence farming

**1. Introduction:**

Uttarakhand, in spite of being a small state, has certain key features that make it distinct from other states of the country and highlight its potential for development. All the hill districts have subsistence farming as their main economic activity. Due to subsistence livelihood, migration and a remittance-based economy operate in the hill districts. They are land-locked with huge distance between the markets and resources. Because of these constraints, traditional agriculture cannot be the lead sector for development. Until recent decades, labour-intensive subsistence farming was a way of life and livelihood in the hill communities of Uttarakhand, India. However, the nature of agriculture falls far short of the expectations of the main labour force, the rural youth, leading to their mass migration to non-agricultural occupations (Rana & Bisht, 2023; Verma et al., 2022). Thus, the state faces the challenge of promoting livelihoods to minimize migration through local employment and income generation and to enhance the quality of life of people living in villages. The positive features of these hill districts are that they have enormous potential for tourism, a suitable climate for high-value agriculture, and a pleasant environment due to 60 percent forest cover. These have to be harnessed for a development strategy (Mittal *et al.*, 2008).

Many studies have focused on the analysis of livelihood strategies adopted by the rural people (Thennakoon, 2004; Shah *et al*., 2005; Adi, 2007 and Babulo *et al*., 2008). Livelihood refers to a systematic procedure of making a living on the basis of skills, resources, and feasible activities (He & Ahmed, 2022). Livelihood strategies denote the range and combination of activities and choices that people make and undertake – ways of combining and using assets in order to achieve their livelihood goals. The concept of ‘sustainable livelihoods’ is increasingly important in the development debate. Sustainable livelihoods are achieved through access to a range of livelihood resources which are combined in the pursuit of different livelihood strategies (agricultural intensification or extensification, livelihood diversification and migration). Sustainable growth requires a pool of human skills to be nurtured and developed (Das, 2024). Central to the framework is the analysis of the range of formal and informal organizational and institutional factors that influence sustainable livelihood outcomes (Scoones, 2005). The concept of sustainable livelihood approach was first introduced by the Brundtland Commission on Environment and Development in 1987 and later expanded at the United Nations Conference on Environment and Development in 1992 (IISD, 2013). As a concept, the sustainable livelihoods approach is held to provide a more rounded picture of the complexities of living and surviving in poor communities than understandings based on measures of income, consumption and employment (Brocklesby and Fisher, 2003). A livelihood comprises the capabilities, assets and activities required for a means of living, and it is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets while not undermining the natural resource base (Chambers and Conway, 1992; Scoones, 1998). The vulnerability of rural households to shocks affects their livelihood assets and options (Kalaba *et al.*, 2012). The shocks of poor households are being addressed by devising mechanisms such as selling productive assets, temporarily reducing consumption, or searching for off-farm employment to buffer their consequences (Dercon, 2002). The adverse effect of shocks is generally more severe for the poor, who are less insured against shocks and, therefore, are more likely to reduce consumption than their wealthier counterparts (Jalan and Ravallion, 1999).

****Low and declining farm productivity on one hand, and growing opportunities for employment in other part of country on the other, is encouraging more and more people to migrate to jobs outside of hill districts. Between one-third and one-half of households send migrants, and as it is mainly men who migrate,

Map 1: Study Area

this places more and more of the burden of farm labour, as well as domestic work, on women. Lack of labour, low productivity and wild animal damage are all contributing to land being abandoned, and it is said that as much as 30% of land in the hills that was once used to grow crops is no longer in production (ILSP, 2011). This study analyzes the livelihood strategy planning within the districts and implications for poverty reduction.

**Study Area**

The present study focuses on the Rudra Prayag district of Uttarakhand that falls in the Lesser and Higher Himalayan terrain. The study area is situated in the northwestern part of the Garhwal Himalayas. Administrative boundaries of the district are delimited by 30019' to 30049' N latitudes and 78049' to 79021' E longitudes. The district has four tehsils (Ukhimath, Jakholi, Rudra Prayag and Basu Kedar (newly formed) and has three development blocks, viz. Agastya Muni, Jakholi and Ukhimath and there are 688 villages in the district, out of which 35 are uninhabited (Census of India, 2011).

**2. Material and Methods**

The present study was carried out in the Rudra Prayag district of the Garhwal Himalayan region. This study was intended to address the household-level livelihood strategies and adoption patterns of different agriculture-based technologies/innovations. This study is based on primary data and analysis of these data. For the collection of primary data, a Multistage random sampling method was used, and a complete inventory was made at the household level for each selected village with the help of semi-structured questionnaires and personal interviews with local mature and knowledgeable persons. 64 villages were randomly selected from all three blocks of the district Rudra Prayag for the collection of primary data (Table 1). Primary data were collected from 604 randomly selected households between August 2014 and June 2016. Data collection on basic household attributes such as gender of household head and income, various technologies and government services used by farmers were gathered. All the respondents who participated in this study were read about the purpose of the interview verbally, and prior oral consent was obtained. The data were analyzed by using SPSS 16 software.

**Table 1: Sampling distribution in three blocks of the district Rudra Prayag on an altitudinal basis**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Block** | **Altitudes (above mean sea level (amsl)** | **Number of Villages** | **Number of Household** | **Percentage of sampling distribution (%)** |
| Agustmuni | High (>1650 amsl) | 5 | 66 | 10.93 |
| Middle (1151-1650 amsl) | 7 | 71 | 11.75 |
| Low (650-1150 amsl) | 15 | 135 | 22.35 |
| Jakholi | High (>1650 amsl) | 6 | 63 | 10.43 |
| Middle (1151-1650 amsl) | 4 | 41 | 06.79 |
| Low (650-1150 amsl) | 6 | 51 | 08.44 |
| Ukhimath | High (>1650 amsl) | 11 | 104 | 17.23 |
| Middle (1151-1650 amsl) | 7 | 56 | 09.27 |
| Low (650-1150 amsl) | 3 | 17 | 02.81 |
| **Total** | **64** | **604** | **100** |

**2.1. Determining the Livelihood Diversification Index**

Livelihood diversification, being an important livelihood strategy adopted by developing countries, is propitious in the reduction of vulnerability while ensuring food safety and reducing the threat of famine. A great interest in the practice of livelihood diversification has recently been seen in developing countries (Knutsson and Ostwald, 2006). Diversification within agriculture, combining agriculture with other activities, animal husbandry and labour are the primary methods practiced by farmers in livelihood diversification due to increasing populations, reducing agricultural productivity. Two major categories of livelihood diversification, agricultural and non-agriculture, with ten subcategories, e.g. agriculture produce sale, livestock and livestock produce sale, salaried job, wage labour, remittances, tourism, carpentry/masonry, business/trade, pensions and social benefit schemes were determining.

**2.2. Model Estimation of Livelihood Strategy Sustainability (Binary Logistic)**

In this study, logistic regression is used to describe the relationship between livelihood strategies and livelihood assets. When using the logistic distribution, we need to make an algebraic conservation to arrive at our usual linear regression equation, the logistic regression model will be (Hosmer and Lemeshow, 2000):

 **Where,** p is the probability, b0 is the constant, and bi (i=1,2,3,……m) is the regression coefficient. In practice, the dependent variable (p) is not continuous. Therefore, we convert P into the probability ratio (Ω) of non-agricultural livelihood strategies. The logistic formula is stated as follows:

**Where,** In symbol refers to a natural logarithm, and Ω is called log it (p). Then, we further obtain the following equation:

**where,** is our familiar equation for the regression line. p can also be computed from the regression equation. Therefore, if we know the regression equation, we could theoretically calculate the expected probability for a given value of Ci. Eq. (6) is transformed as follows:

**where,** exp is the exponent function, and it is opposite to the natural logarithm. We are estimating the probability (e.g. non-agriculture and agriculture strategy), because the value of Ci increased and decreased in one unit. The derivative transformation of Eq .(7) is

where exp (bj) is the elasticity of probability, and it will change when Ci increases or decreases by one unit. Here, we define exp (bj) as the sustainability of livelihood strategies to livelihood assets. The explanatory variable (Ci) includes human, natural, physical, financial and social assets. Based on Eq. (7), we can calculate the exp (bj) value. It should be noted, however, that there is a positive relationship between livelihood assets and non-agriculture livelihood strategies if the regression coefficient is negative. This means that the probability of agricultural livelihood strategies is increased by exp (bj) times as the livelihood assets (Ci) increases by one unit. SPSS 16 is used to conduct statistical analysis in this study.

**3. Results and Discussion**

The way a household copes with environmental changes and withstands stressful situations directly depends on the availability and accessibility of the livelihood assets. A livelihood strategy is, to a large extent, the ways in which livelihood assets are arranged and selected (Fang *et al.,* 2014). Therefore, it is to say that different combinations of livelihood assets result in different abilities to follow livelihood strategies. In order to further understand the determinants of each livelihood strategy and compare the differences in sustainability in three altitudinal zones within three blocks, we divide livelihood strategies into two categories- farm and non-farm strategies. Table 2 clearly illustrates that the levels of livelihood assets possessed by households are closely related to livelihood strategies. Natural and human assets have positive effects on agricultural livelihood strategies, whereas financial and social assets have positive effects on non-agricultural livelihood strategies. The sustainability of livelihood strategies to assets varies greatly between and within blocks. An econometric analysis was carried out applying data from a random sampling of 604 households in the three altitudes of three blocks in Rudraprayag district to test the hypothesis. With the help of binary logistic regression applied to the asset-explanatory variables, the primary factors that determine a household’s livelihood strategy and its reliance on asset endowments were identified. The analyses indicate that different access to or endowment of livelihood assets is an important factor that determines the choice of a household’s livelihood strategy.

**3.1. Calculating Index in the Sustainable Livelihood Framework**

Table 2 shows that the gender of the household head has the maximum weight value (0.87) within all the altitudes of three blocks, in terms of human capital in the evaluation index system of the Sustainable Livelihoods Framework for rural households. Most of the families were male-headed families. The water facilities have a maximum weight value of 0.87 because of the fact that the majority of households have their personal tap within the house, and the household which has no personal tap fetches water from a distance of less than 0.5 km with year-round availability of water in the study area. The energy availability has the maximum weight value of 0.95. This is because of the fact that around 99% of households have an electricity connection and access to LPG, but LPG use is very limited in villages due to irregular supply and comparatively high cost from urban areas (due to extra transport charges from delivery post to home). Household savings has a maximum value of 0.55, due to better facilities of banks, insurance and large population of livestock which provide income source for poor farmers round the year and also provide liquidity during emergencies or crises. The organizational membership has the maximum value of 0.49. Therefore, the education level, household assets, household income, and financial support affect the livelihood level of farmers.

 **Table 2: The effective index value of measuring indicators in the district**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Household Assets** | **Indicators** | **Agustmuni** | **Jakholi** | **Ukhimath** |
| **High** | **Middle** | **Low** | **High** | **Middle** | **Low** | **High** | **Middle** | **Low** |
| **Human Assets (C1)** |   | **0.42** | **0.40** | **0.38** | **0.36** | **0.38** | **0.44** | **0.40** | **0.36** | **0.40** |
| HHGen | 0.73 | 0.79 | 0.75 | 0.83 | 0.85 | 0.80 | 0.87 | 0.70 | 0.71 |
| HHAge | 0.54 | 0.55 | 0.58 | 0.45 | 0.47 | 0.65 | 0.55 | 0.62 | 0.50 |
| HHEdu | 0.41 | 0.37 | 0.49 | 0.30 | 0.35 | 0.40 | 0.35 | 0.36 | 0.38 |
| FamilySize | 0.17 | 0.19 | 0.16 | 0.15 | 0.18 | 0.17 | 0.16 | 0.18 | 0.17 |
| Family Labour Ability | 0.51 | 0.46 | 0.45 | 0.42 | 0.47 | 0.60 | 0.37 | 0.37 | 0.41 |
| ***Health*** | ***0.27*** | ***0.25*** | ***0.21*** | ***0.24*** | ***0.25*** | ***0.22*** | ***0.22*** | ***0.22*** | ***0.25*** |
| Family Education | 0.48 | 0.48 | 0.35 | 0.37 | 0.38 | 0.59 | 0.47 | 0.33 | 0.59 |
| Vocational Training | 0.23 | 0.14 | 0.07 | 0.14 | 0.07 | 0.06 | 0.18 | 0.09 | 0.18 |
| **Natural Assets (C2)** |   | **0.29** | **0.36** | **0.33** | **0.37** | **0.41** | **0.36** | **0.35** | **0.34** | **0.32** |
| Land Holding | 0.33 | 0.35 | 0.27 | 0.37 | 0.49 | 0.30 | 0.33 | 0.23 | 0.29 |
| Irrigated Land | 0.03 | 0.18 | 0.12 | 0.05 | 0.14 | 0.15 | 0.05 | 0.03 | 0.01 |
| ***Environmental condition*** | ***0.25*** | ***0.29*** | ***0.29*** | ***0.31*** | ***0.38*** | ***0.34*** | ***0.36*** | ***0.35*** | ***0.28*** |
| **Physical Assets (C3)** |  | **0.47** | **0.51** | **0.52** | **0.46** | **0.49** | **0.50** | **0.47** | **0.50** | **0.46** |
| House type | 0.79 | 0.81 | 0.89 | 0.78 | 0.70 | 0.84 | 0.85 | 0.90 | 0.79 |
| Toilet | 0.89 | 0.93 | 0.96 | 0.70 | 0.78 | 0.73 | 0.85 | 0.86 | 0.82 |
| ***Energy*** | ***0.85*** | ***0.95*** | ***0.94*** | ***0.71*** | ***0.80*** | ***0.92*** | ***0.81*** | ***0.91*** | ***0.79*** |
| Road | 0.33 | 0.37 | 0.39 | 0.67 | 0.35 | 0.51 | 0.38 | 0.51 | 0.29 |
| Household Assets | 0.09 | 0.11 | 0.08 | 0.09 | 0.32 | 0.11 | 0.11 | 0.12 | 0.23 |
| Transport | 0.38 | 0.43 | 0.50 | 0.37 | 0.30 | 0.29 | 0.41 | 0.45 | 0.24 |
| Communication | 0.95 | 0.94 | 0.96 | 0.73 | 0.85 | 0.90 | 0.93 | 0.82 | 1.00 |
|  |  |  |  |  |  |  |  |  |  |
| Access to Market | 0.23 | 0.53 | 0.40 | 0.44 | 0.54 | 0.43 | 0.34 | 0.43 | 0.46 |
| ***Access to Education*** | ***0.49*** | ***0.67*** | ***0.62*** | ***0.49*** | ***0.74*** | ***0.54*** | ***0.58*** | ***0.58*** | ***0.44*** |
| Access to Health facilities | 0.38 | 0.24 | 0.47 | 0.44 | 0.29 | 0.55 | 0.29 | 0.41 | 0.29 |
| Animal health care centre | 0.49 | 0.28 | 0.30 | 0.40 | 0.44 | 0.53 | 0.29 | 0.34 | 0.31 |
| Agriculture tools and equipment | 0.07 | 0.10 | 0.06 | 0.05 | 0.02 | 0.06 | 0.07 | 0.09 | 0.06 |
| Government Services (e.g. Horti/Agri) | 0.11 | 0.20 | 0.26 | 0.17 | 0.20 | 0.06 | 0.19 | 0.14 | 0.24 |
| **Financial Assets (C4)** |   | **0.41** | **0.35** | **0.34** | **0.33** | **0.35** | **0.31** | **0.41** | **0.36** | **0.40** |
| Savings | *0.49* | *0.47* | *0.45* | *0.45* | *0.48* | *0.43* | *0.55* | *0.44* | *0.48* |
| Credits | *0.42* | *0.29* | *0.29* | *0.21* | *0.25* | *0.22* | *0.37* | *0.33* | *0.43* |
| Income Sources | *0.31* | *0.30* | *0.28* | *0.32* | *0.32* | *0.27* | *0.31* | *0.32* | *0.31* |
| **Social Assets (C5)** |   | **0.36** | **0.25** | **0.32** | **0.37** | **0.36** | **0.40** | **0.40** | **0.27** | **0.25** |
| Friends/ Neighbour | 0.41 | 0.31 | 0.39 | 0.35 | 0.37 | 0.43 | 0.42 | 0.30 | 0.29 |
| Membership (SHGs, CBOs, NGOs, Farmers federation, political party etc.) | 0.36 | 0.20 | 0.33 | 0.48 | 0.49 | 0.47 | 0.46 | 0.23 | 0.35 |
| Reciprocity and Exchange | 0.32 | 0.25 | 0.24 | 0.27 | 0.22 | 0.29 | 0.31 | 0.27 | 0.12 |

**3.2. Analysis of the Livelihood Assets**

The data used in this study was acquired and calculated by way of a social survey that was carried out in three blocks of the district Rudra Prayag on an altitudinal basis. The objective of the investigation is households who live in different altitudinal

zones of three blocks in the district under examination and the design of the questionnaire that includes the aforementioned five livelihood assets of the household. A total of 604 questionnaires were used for the collection of data. General scores were calculated by means of an Index on the basis of the standardized process of the above data.

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| **Figure 1: Livelihood pentagons describing the status of five capital assets (human, natural, physical, financial and social) in the district Rudra Prayag on an altitudinal basis the higher, middle, lower and overall** |

The livelihood status of each block was summarized in terms of different pentagons describing the five capital assets: human, natural, physical, financialand social(Fig. 1). Marked differences were observed within and between the blocks, in particular between the three altitudinal zones. Of the five livelihood assets, in all the altitudes (high, middle, low) of district physical asset possessed the highest value (0.47, 0.51, 0.52 respectively) (Fig. 2, Table 2); however, the contributing indicators had differential share for all the altitudes. The higher physical assets index shows that the household has better access to physical assets such as Pakka houses, better toilet facilities, energy availability, access to education, market, road and other necessary infrastructural facilities. The combination of these indicators provides a higher Physical security index for higher altitude villages. This result indicated that although households were among those with low incomes and even having an income below the poverty line, their basic needs, such as home condition (almost pakka houses), household possession, and access to water resources and electricity were adequate. The infrastructural facilities in the whole block are also adequate in terms of presence/quantity, but the services are very poor in quality, e.g. health center is available but a lack of professional health service provider, almost all the villages have road facility but lack of good transport services creates health hazard and excess crop wastage. This represents that even the area has a good quantity of physical assets, but there is a strong need to strengthen the access of these services, which enhances the production and lifestyle in order to improve the livelihood of farmers. The area is under the early flooded zone, and its lower altitude was highly affected by the event, and about 17 hectares of agricultural land was washed away. Of the five livelihood capital, financial capital provided the most significant influence. The lack of financial assets would inhibit farmers to increase production scales and develop infrastructures that would, consequently, make it difficult to achieve livelihood diversification. Lending policies to farmers should produce a certain offset by improving investments, strengthening the effect of cooperative organizations and associations, and improving the financial capital of farmers overall. This would enable motivation in the improvement of other capitals, thereby contributing to the improvement of the livelihood level of farmers.

As for human assets, the highest value is observed for higher altitude (0.42) followed by middle (0.40) and lower (0.38). The quantity and quality of human assets directly determine the ability and scope of the household to control the other types of capital (DFID, 1999). Eight indicators were selected in the study to measure human assets: household size, household labour ability, gender of household head, the age of the household head, the highest education of the household head, the maximum years of education of household members and family health status. Among the indicators to represent human assets in this study is the high education level attained by household members, including the head of household (HH) affects the wellbeing of the household. The education level of HH reflects the level of awareness of the importance of higher education of children, access to information and the capability to improve family economic status. From the analysis, it was shown that a maximum of 36.6% of the HH has no qualification. The assistance, particularly in terms of financial support or subsidies were given by the government at the present time might be appropriate for the poor that have low sustainable livelihood index (SLI) in most of the livelihood’s asset. However, this kind of assistance does not guarantee the sustainability of the poor’s livelihood, otherwise, it will promote their reliance on government assistance. Assistance in terms of entrepreneurial projects or vocational training is the better safeguard to the sustainability of the poor’s livelihood. Training and intensive coaching are necessary to increase their technical knowledge and skills to ensure the sustainability of the scheme and thus the sustainability of their livelihood. Moreover, to address this problem in the long term, it is necessary to raise awareness of education among poor children.

Natural assets possessed relatively low index values in higher and lower altitudes (0.29 and 0.33 respectively) compared to physical, financial and human assets since the accessibility of financial capital requires human capital for more sustainability of natural assets and certain social capital as well. The natural asset was slightly higher (0.36) in the middle altitude. The natural asset is the strength of the mountains, but the region is vulnerable to this resource. This can be attributed to the relatively poor climatic conditions (erratic rainfall, landslide/land erosion, etc.), poor quality of soil, the lack of good access to grazing land due to protected forest, poor means for irrigation (maximum rainfed area) and the small average plot size. Thus, the diversification of traditional agriculture with high-value crops, along with water harvesting practices and the introduction of entrepreneurial activities, must not be based on land use. The home-based entrepreneurial activities such as food processing, retailing, sewing and crafts may be more appropriate. However, the agro-entrepreneurial activities might be possible with the full utilization of agricultural land in rural areas, especially in the areas that are inhabited by the poor. They can also be involved in activities within the value chain of agricultural activities, such as marketing and retailing jobs. Attention should also be given towards increasing their financial asset.

The result showed that all respondents obtained relatively low SLI for the financial asset ranged between 0.41 for higher altitude and 0.34 for lower altitude. The lower and middle altitude has lower index values of 0.34 and 0.35, respectively, as both the altitude has highly affected by flood and their livelihood sources are destroyed due to it. Thus, approaches toward enhancing their financial status, such as encouraging them to be involved in the microcredit system and cooperative, might be alleviating the poor out of the poverty trap. The social assets which people can draw on include informal relationships of trust, reciprocity and exchange with families, friends and neighbors as well as more formalized groupings (e.g. community and faith groups). Social capital in the block shows the highest value for higher altitude (0.36) followed by lower (0.32) and middle (0.25). These results were obtained because of a lower index value of households for reciprocity and exchange and lower households’ membership of any formal and informal organization in all the three altitudes. This means a higher percentage of households that have not been members of any organization. These results indicate a need for strengthening community networks and local organizations such as Woman Union (Mahila Mangal Dal), Youth unions (Yuvak Mangal Dal), Farmer associations, etc. At the village level to reduce social capital vulnerability and livelihood sustainability are reduced through networking. This lower index is also related to the location of the villages as the lower altitude comes under the early flood zone and can be improved by social programs.

Overall, the block has a good access to physical assets (0.50) and it can be said that as the block has better availability of physical infrastructure need to be enhance the quality of services in the areas of health care, livestock improvement, agriculture extension services and market linkages of agriculture produce for enhancing income opportunities of rural poor. Human asset (0.40), the quantity and quality of human asset related to the ability of household to control and utilize the other assets. As the good quantity and quality of human asset available, scope of agriculture expansion increases and good education level of household members encourage them to diversify their income through non-agriculture activities, as the high degradation of agriculture land due to flood in the block. The financial asset (0.36), lower than the human and physical asset. Due to the flood low intake of tourists affects the livelihood opportunities in the region, so there is a need to enhance financial assets by improving entrepreneurial and other skills. Access to natural assets (0.33) is necessary for enhancing the income of poor households as they are dependent on agriculture and allied activities for income. Better social asset (0.31) provides economic security to the household and support during emergencies; this asset is very low in the study area, so it needs to be enhanced through better social networking.

Within the blocks, the physical and natural assets index was higher in all the three altitudes, and access to financial, human and social assets was considerably less than these two assets. Natural assets were good in all the altitudes with the exception of the lower altitude (0.41), which has a higher value of human asset (0.44) in terms of access to natural assets.In higher altitudes, villagers had reasonable access to the physical and natural assets but limited access to financial, human and social assets. The middle zone was characterized by low access to financial assets, reflecting the poor access to credit facilities and income sources (Table 2). The lower altitude has moderate access to all the assets except social assets.

**3.4. Livelihood Strategies**

In the analysis of income-generating activities (Table 2, Fig 2), different strategies of livelihood were identified. Sources of household income differed between the higher, middle and lower altitudes of all three blocks. In the high altitude of Agustmuni block, the majority of households depended on livestock & livestock produce (0.58) and agriculture produce sale (0.50) as their main source of income, whilst few households (0.45) depended on salaried job outside the village in the form of government or private jobs. Chaulai, potato, kidney bean and spices are the major cash crops of the region. Soil conditions are relatively good in the region, and the sale of these products provides a better income opportunity for poor farmers. Pensions (0.36), remittances (0.27) and government social benefits (0.26), mainly in the form of old-age, widow, disabled pension and food aid, were the next major activity in which the majority of households involved. Other non-agricultural activities i.e. village level business/trading (0.15), carpentry/masonry (0.12), wage laborers (0.23), tourism (0.15) involved only a few households or low index value in all altitudes of the total households of middle altitudes, households mainly dependent on salaried job and pensions, as same value observed for the both (0.49), followed by livestock & livestock produce sale (0.48), agriculture produce sale (0.35), remittances (0.32), government social benefits (0.18), wage labour, carpentry & masonry, tourism observed same value for these three (0.17) and other business/trade (0.15). Of the total households of low altitudes, majority of households dependent on salaried job (0.46), followed by livestock & livestock produce sale (0.42), pensions (0.39), tourism (0.27), remittances, government social benefits & carpentry/masonry observed same value (0.24), agriculture produce sale (0.19), other business/trade (0.17) and wage labour (0.15). In contrast, the majority of households of high altitude of Jakholi block, principally dependent on remittances and salaried job (0.65), followed by livestock and livestock produce sale (0.59), wage labour (0.32), other business/trade (0.29), government social benefits (0.27), pensions (0.16), carpentry/masonry (0.13) and agriculture produce sale & tourism (0.08) (Table 2, Fig. 2), of the total households of middle altitudes, households mainly dependent on remittances and salaried job (0.59), followed by livestock and livestock produce sale (0.51), government social benefits (0.29), wage labour, agriculture produce sale & other business/trade (0.24), pensions (0.20), carpentry/masonry (0.17) and tourism (0.10).

**Figure 2: Shows the variation in livelihood strategies in three altitudes of Agustmuni block**

**3.5. Relationship between Livelihood Capitals and Livelihood Strategy Choice**

A multivariable livelihood strategy is one in which the allocation of asset use and managerial choice are made in order to achieve livelihood objectives that include management, investment, and bearing of arrangements. This study analyzed the relationship between the choice of livelihood strategy and livelihood asset by way of binary logistic regression. In order to analyze the influence of all five livelihood assets on the choice of livelihood strategies, this study designated all five livelihood assets as regressive independent variables and designated livelihood strategies as regressive dependent variables in order to analyze them by means of binary logistic regression. Independent variables of regression were used with the forward LR method that is based upon P<0.1. The results are shown in Table 3. The livelihood strategies were divided into agriculture and non-agriculture and presented as agriculture, 1 and 0 otherwise. All five indexes adopted by way of binary logistic regression represent the status of livelihood assets. Results coinciding with the analysis are carried out.

 **Table 3: Relationship analysis between livelihood assets and livelihood strategies**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Assets** | **Regression coefficient (B)** | **Standard error (S.E.)** | **Wald test** | **Significance**  | **Exp (B)** | **95.0%CI for Exp(B)** |
| **Lower**  | **Upper**  |
| Human asset | 1.665 | 0.887 | 3.526 | 0.060 | 5.286 | 0.930 | 30.055 |
| Natural asset | -0.855 | 0.843 | 1.029 | 0.310 | 0.425 | 0.081 | 2.219 |
| Physical asset | -2.431 | 1.067 | 5.191 | 0.023 | 0.088 | 0.011 | 0.712 |
| Financial asset | -6.239 | 0.791 | 62.278 | 0.000 | 0.002 | 0.000 | 0.009 |
| Social | 0.619 | 0.325 | 3.637 | 0.057 | 1.857 | 0.983 | 3.508 |
| Constant  | 3.792 | 0.699 | 29.405 | 0.000 | 44.356 |  |  |
| Percent concordant = 78.7, -2 Log likelihood = 67.489, Cox & Snell R2 = .383, Hosmer and Lemeshow Goodness-of-Fit Test = 0.55 (.79), Nagelkerke R2 = 0.59 |

As shown in Table 3, a particularly close relationship exists between livelihood strategies and livelihood assets. The results demonstrate that the association between natural assets and farm strategy is generally positive. Households with higher level of proximate natural assets are more likely to engage in farm activities. In contrast to natural assets, households which have better access to financial assets improve their access to better non-farm opportunities. This implies that financial asset is an important driving force for rural households to choose non-farm livelihood strategies. From the analysis perspective, an increment of one unit of natural asset should reduce the occurrence of choosing non-agricultural activities by 0.855 times. While an increment of one unit in financial asset should decrease the occurrence of choosing agricultural activities by 6.239 times. An increment of one unit in physical assets should reduce the occurrence of choosing agricultural activities by 2.431 times. With an increase in natural assets, farmers tend to engage in agricultural production and make farming or animal husbandry the primary source of household livelihood. The abundance of natural assets tends to make farming a more profitable enterprise overall. However, with an increase in financial assets, farmers tend to engage in non-agricultural production and rely on outside enterprises or engage in household sideline production as a way to supplement income and to achieve livelihood diversification. Farmers with access to more financial assets tend to engage in secondary and tertiary sources to gain more revenue that is redirected into technology, equipment, or infrastructure to be cycled back into production.

**3.5. Variation in Livelihood Strategies within District**

Limited accessibility to assets is identified as a universal challenge faced by rural households in mountain areas. However, livelihood assets are likely to have a significant effect on the livelihood options, although the effect on different types of communities/settlements varies. The probability of agricultural livelihood strategies is reduced by 6.239 times as the financial asset increases by one unit. Results show that the households of higher altitudes depend on agriculture and allied activities (0.50 and 0.58) for livelihood. Closely and symbiotically interlinked, both of them are deeply dependent on the neighbouring forests and ecosystems for sustenance and viability. Land resources were high (0.33) in the region but lower than middle altitude due to its rich vegetational (mainly oak forest) surroundings, which create wonderful nutrient cycles and micro-climate for crops and enhance livelihood security and accessibility. As the forest resources are low (0.10), people are willing to rear one or more cattle and buffaloes due to its social acceptance and feeding them by waste land grasses, village forest, agroforestry system with forest resource. The dependency on agriculture and allied activities is also due to a lack of non-agriculture income sources and low physical assets, and higher human assets (family labour ability 0.51). Amaranths, potatoes, pulses (kidney bean, soybean, etc.), fruits, vegetables, spices and milk and milk products are the main cash-generating options of the households.

In the middle altitude, peoples depend on non-agricultural activities e.g. salaried job and pensions, obtained same value (0.49). As the higher value of natural assets (0.36) was recorded for middle altitudes, people depend on non-agricultural livelihoods due to high accessibility of physical and human assets (high family education level 0.48) and rainfed agriculture. Uncertain environmental conditions caused insecurity in production. The irrigated land was higher (0.18) compared to the other two altitudes but was owned by only a few villages. Due to the poor access to government services (0.20) for agriculture promotion, lack of improved tools, timely delivery of improved agriculture input, poor environmental condition reduces the scope of agriculture expansion in the region. Accessibility to forest resources was also higher (0.38) in the region, which makes livestock rearing the second most important livelihood strategy in the region.

In the lower altitude, salaried job was also the main occupation; this may be due to the high physical asset (0.52), higher education level of the household head and lack of agriculture expansion facilities. As the irrigated land was higher 0.12 than high altitude but due to erratic rainfall mostly land converted into rainfed year by year and interns unable to provide sufficient food for household consumption. This situation compels people to search for secure income sources in urban and semi-urban areas.

**4. Conclusion**

The amount of natural assets and financial assets endowed by farmers affected the choice of livelihood strategies to a certain extent. It can be concluded from the correlation coefficient values that the influence of financial and physical assets on the choice of livelihood asset was significant. The target of this investigation was to reveal the differences of livelihood strategies within and between the blocks, and it was found in all the three blocks that those households were more affluent that have expanded into other non-farm employments and do not solely rely on the land as their primary means of livelihood. Therefore, the influences of human assets, natural assets, and social assets on livelihood strategy options are insignificant. As the different livelihood activities have different requirements, a general principle is that those farmers who are amply endowed with assets are more likely to make positive livelihood choices.

This study shows how the residents of the district Rudra Prayag obtain their livelihood from various livelihood activities; an increasing livelihood diversification among the residents was observed in this study area and how these relate to assets and access within the livelihood framework. The implications for policy reform are numerous and need attention from both state and national institutions. Among the respondents, activities being engaged in are categorized into agricultural and non-agricultural. Agricultural activities are basically agriculture and allied activities, while non-agricultural activities are salaried jobs, trading, tourism, local small entrepreneurs, etc. that generate income or support for households. Internal household dynamics based on age and household education are shown to positively affect the livelihood outcomes (income and well-being). Then, the study indicates that the role of assets such as social capital, land, property, savings and labour is central in determining the outcomes of livelihood activities as measured by income and well-being. The findings of this study are the following recommendations:

1. Government needs to encourage efficient and sustainable use of the existing cultivable land, by further investing in agricultural research, extension and development, with a view to increase the agricultural output as well as the corresponding income for households that take to farming as a major or alternative means of obtaining livelihood.
2. In addition, the government should encourage existing social organizations (thrift and credit societies) in the communities to be formally integrated into legal and functional rural banking activities.
3. There is also a need for the provision of basic infrastructural facilities such as good and accessible roads, potable water, health care centers, storage facilities, market, and electricity supply among others by the government. This will ensure proper preservation of the perishable agricultural produce as well as unsold stocks, minimize costs of transportation to the market which is very far from the communities, ensure good health status of the community members, then make access to the communities easy by the prospective customers and in the long run, guarantee optimal livelihood outcomes (income generated and well-being among others).
4. **Availability of data and material**

All relevant data and material are presented in the Research Review Paper.

1. **Consent for publication**

Not applicable.

1. **Ethics approval and consent to participate**

Not applicable

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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Details of the AI usage are given below:

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