



Does Flood Affect the Intensity of Livelihood Diversification? A Study in the Flood-Affected Areas of Assam, India

Ratul Kumar Lahon* and Amarjyoti Mahanta**

Abstract. *Diversification of livelihood strategies is one of the most sought livelihood strategies of the people around the globe. People diversify their livelihood due to the uncertainties prevailing around the households. In certain other cases, people diversify their livelihood due to emerging opportunities that arise due to socio-political and economic changes. The Livelihood strategy of the rural people of developing countries is a function of multiple factors ranging from access to resources and vectors of demographic, geographic, and socio-economic factors. Most of the factors are common in rural areas of India. However, in certain pockets of the country natural calamities affect the livelihood pattern of the people. Flood, being the most severe natural calamities in the state of Assam, has a significant impact on the livelihood strategies of the people of the state. With this backdrop, this study aims at constructing and comparing the livelihood diversification index in the flood-affected areas and the flood-free areas adjacent to the affected areas. The livelihood diversification index for this study is constructed using the Herfindahl-Hirschman index. The livelihood diversification index of the households of the study area is 2.4470. The study finds that the livelihood diversification index of flood-affected areas (2.5196) is significantly higher than the flood-free areas (2.2308).*

Key words: Flood, Livelihood, Herfindahl-Hirschman, Diversification.

**Ratul Kumar Lahon is an Assistant Professor in the Department of Economics, North Lakhimpur College (Autonomous), Lakhimpur and **Amarjyoti Mahanta is an Associate Professor in the Department of Economics, Dibrugarh University, Dibrugarh, Assam. The authors can be contacted at Email: ratulklici@gmail.com.*

Introduction. Reasonable and sustainable income is the prime focus in the study of livelihood security, particularly in rural areas. Variability in income flow is a major threat to poor households. Livelihood security of poor people is vulnerable and unsustainable in the developing regions. To secure a sustainable livelihood, people must have entitlement to livelihood opportunities- either alternative or supplementary (Salayo, Perez, Garces, & Pido, 2012). The term livelihood diversification refers to a process through which an economic unit like a household is involved in some economic activities and increases the shares of these activities in the total economic activities of the household. It may also be defined as a process where rural people broaden their sources of income and employment opportunities.

People diversify their livelihood strategies either due to inadequacy of traditional sources to maintain a sustainable level of income or due to opportunities emerges due to global and local changes in socio-economic sectors (Barrett, Bezuneh, Clay, & Reardon, 2001; Hussein & Nelson, 1998; Shylendra & Rani, 2005). Livelihood diversification is studied as positive or developmental perspective and negative or distressed perspective. Diversification of livelihood opportunities due to development activities like modernisation of agriculture sector, market expansion, infrastructure development, urbanisation, industrialisation etc., is termed as diversification led by growth. On the other hand, diversification of income

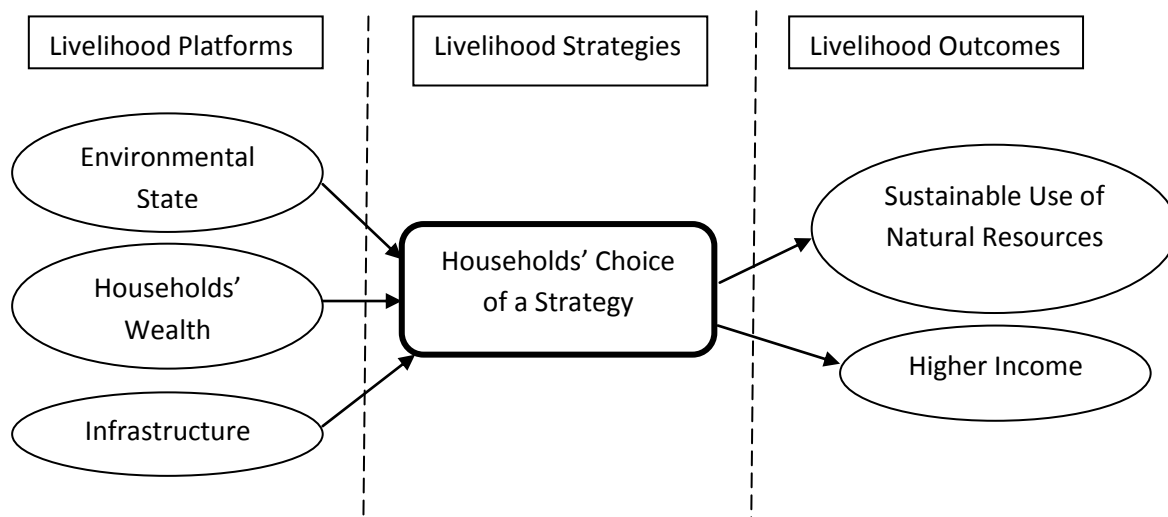
driven by forces like declining land-man ratio, depletion of natural resources, natural calamities and income fluctuation is called distressed diversification. In both phenomenon of the event, livelihood diversification is expected to provide more income.

The paper starts with introduction and issues relating to the topic, which is followed by brief review of literature containing issues ranging from definition and concept, trends in livelihood diversification in India as well as Assam. The section is followed by methodology of the study. In the subsequent section of the paper the findings of the study are presented. The study concludes with some policy recommendations.

Literature Review. Definition and Concept. Livelihood is broader concept dealing not only with income but also with all socio-cultural, geographic factors. It is a function of action and interaction between people and their environment (Sarkar, Wu, Alam, & Shouse, 2020). Livelihood studies focus on the material ways people produce and reproduce their household economies (McCusker & Carr, 2006). Chambers & Conway (1991) define livelihood as means of gaining a living. Earning a reasonable income is necessary to earn a livelihood. The combination of sources of livelihood and their dynamics over time determines the livelihood strategy that a household possesses.

Livelihood literature primarily includes strategies adopted by the people to earn income, sustainability of these strategies, factors determining those, etc. The livelihood of rural poor people depends upon factors like natural resources, access to financial, human, social and physical capital and institutional support etc. (King, Nelson, & McGreevy, 2019). Depending upon the nature of the economy and society, the strategies differ significantly. Researchers define livelihood strategy as a set of components like capabilities, assets and activities required for earnings (Soltani, Angelsen, Eid, Naieni, & Shamekhi, 2012). These three components act and react together, thereby are determining the livelihood strategies of the people. Livelihood strategy comprises several different activities for each given family, which may change even within a year (Sharma, 2010). The concept of livelihood strategy is depicted in figure 1 as constructed by Soltani, Angelsen, Eid, Naieni, & Shamekhi (2012).

Figure 1: Livelihood Strategies and Outcomes



Source: (Constructed by Authors based on Soltani, Angelsen, Eid, Naieni, & Shamekhi (2012)).

Figure 1 depicts that households' choice of a strategy depends upon livelihood platforms. Livelihood platform is the resource base of the households, either individual or social. Natural (environment) wealth or constraints provide a platform for the households to choose their activity. The government's policy decision supports this livelihood platform. The government offers infrastructural facilities in the form of physical and

financial infrastructure. Based on livelihood platforms, the livelihood strategies of a household are determined. This set of strategies generates a flow of income to the households. In addition to generating higher income, it also ensures optimal and sustainable use of natural resources.

Livelihood diversification is the process by which rural households build an increasingly diverse portfolio of activities to survive and improve their standard of living (Ellis, 2000). It is a dynamic process adopted by the people to earn a better livelihood. Diversification of livelihood strategy ensures income from other sources if the primary source of income fails to earn. Livelihood diversification is defined as increasing the number of activities or increasing the share of different activities in households' income. Joshi *et al.* (2003) describe-

A household with two sources of income would be more diversified than a household with just one source, and a household with two income sources, each contributing half of the total, would be more diversified than a household with two sources, with one account for 90 per cent of the whole.

Livelihood diversification concentrates on a newer and better way of earning and living. Diversification of income sources is one of the strategies households take up to play down income variability and ensure a sustainable level of income (Alderman & Paxson, 1992). The main reasons behind the diversification of economic activities are reducing risk, reaping the benefit of scope and opportunities around, fighting or coping with natural adversities etc. A diversified livelihood strategy is all the people's preferred livelihood strategy (Sarah & Lorenzen, 2016). Some studies also find that the poorer households diversify more than, the wealthier households to minimise the risk (Abdulai & CroleRees, 2001). Now a day, diversification of livelihood opportunities becomes a widespread strategy across the globe. Livelihood diversification is confined not only to rural areas of developing countries, but it is also experienced in the urban areas of developed countries (Ellis, 2000).

Recent trends in Livelihood: Rural income has been considered basically as agricultural income among the researchers and policymakers. Agricultural income shares almost the entire rural income of an economy. However, recent studies find an inverse association between economic growth and the dependence of workforce in the primary sector and a direct association between economic growth and employment of workforce in the secondary and tertiary sector (Kuznet, 1974). The shift of work-force from the primary sector to the secondary sector and then to the tertiary sector and increase in the secondary and tertiary sector share in household income is a natural process of economic development.

There is substantial evidence showing an increase in the share of off-farm and non-farm income in developing countries' households' income (Gecho, 2017). Due to the unsustainable nature of income in the agriculture sector due to various reasons, the importance of off-farm and non-farm income in households' income portfolio have been increasing. On the contrary, non-farm activities have a significant impact on increasing the income of the farmers. The rural areas across the globe are no longer agriculture dominant and incomes are no longer only farm-based (Rawal, Swaminathan, & Dhar, 2008). Non-farm activities are more certain in income generation than farm activities (Swargiary & Mahanta, 2020). A combination of farming activities with non-farm activities reduces the vulnerability in households' income¹.

Studies across the globe find that rural households have a varied range of activities to generate income (Lanjouw & Sharif, 2004). Non-farm and (or) off-farm activities become a significant portion of households' labour allocation as farming can only suffice the livelihood of the poor people. Off-farm activities are now becoming the principal economic activity of households (Escobal, 2001).

¹ The off-farm and non-farm income that the households of the study area involve are – petty vending, livestock rearing, wage labour, taking private tuition

In India, too, there is a significant shift in the workforce from the agricultural sector to the non-agricultural sector since the 1990s (Ghuman, 2005). Despite growth in the farming, industrial and service sectors of the economy, the labour absorption in India is still not satisfactory. The absorption capacity of the agriculture sector is limited because there is no scope of expansion of cultivable land, and the intensity of cropping is exhausted (Hossain, 2004). Moreover, due to the fragmentation of landholdings, the farmers cannot adopt modern agricultural techniques and go for intensive cropping. These result in the transfer of the rural workforce from agriculture to non-farm activities (Chakrabarti & Kundu, 2009).

Martin & Lorenzen (2016), in their study on the livelihood diversification in rural areas of Laos, find a diversified portfolio of activities among the poor households. Across all socio-economic groups, the people of rural Laos adopt farming and off-farm activities to earn a livelihood. A critical aspect of the study is that migration remittances occupy a significant share of the household income of rural families.

Similarly, Soltani et al. (2012) find three main livelihood strategies adopted by the poor people of Iran. Those are- forest and livestock-based strategy, commercial strategy and mixed livelihood strategy. The forest and livestock-based strategy are adopted by the people who are located in marginal and distant areas. Another important finding of the strategy is that the mixed strategy adopted by the people is less sustainable.

In the Indian context, in a path-breaking study, Khan et al. (2017) study the livelihood diversification index of Indian states, using Simpson Diversification Index. The finding of the study is based on the data of NSSO, 70th round. The study finds that the livelihood diversification index of agricultural households for the country is 0.54². The country's two highly diversified states, Kerala and Punjab, have livelihood diversification indexes of 0.80 and 0.67, respectively. On the contrary, Chhattisgarh is the most specialised state, with a livelihood diversification index of 0.32. The Simpson diversification index of Assam is 0.39, which is lower than the national rate.

In the context of Assam, we can access only a few studies on livelihood strategy. In most of these studies, the construction of the livelihood diversification index is not carried out. In one of the significant studies of this kind, Swargiary & Mahanta (2020) studies the livelihood diversification among the Bodo tribes of Assam. The study was carried in the districts of Baksa, Chirang, Kokrajhar, and Udalguri. The study finds that the Simpson diversification index for the study area is 0.42. The study finds a significant difference in the mean livelihood diversification index across sectors. The degree of livelihood diversification within the farm sector is the highest, while the degree of livelihood diversification within the non-farm sector is the lowest. In another work of similar nature, Saikia (2016) studies the extent of livelihood diversification in a less developed area of the state. The Simpson livelihood diversification of the study area, i.e. Darang and Udalguri, is 0.42.

Aims and Objectives: The study aims at explaining the livelihood diversification in the flood-free and flood-prone areas taking the case of rural areas of the Dhemaji and Lakhimpur districts of Assam. The objective of the study is to determine the extent of livelihood diversification in the flood-prone areas of the sample districts. The study also aims at comparing the livelihood diversification index between flood-free and flood-prone areas and among households in various strata of socio-economic attributes.

² SID ranges from 0 to 1

Methodology: The study is conducted in the Lakhimpur and Dhemaji districts, the two highly flood-affected districts of Assam. Both districts are predominantly flood-affected and no of industries and factories in both districts are very less.

Sampling Design: Nine development blocks are selected from the two districts purposively based on the occurrence and damages of floods in recent times. From each development block, three flood-affected villages and one flood-free village are selected randomly. From each village, a proportionate number of households (10% of total household of the village) are taken randomly for the study. For comparative analysis of flood-affected and flood-free areas, one flood-free village from each development block is selected randomly.

Tools of Data Analysis: The extent of livelihood diversification is measured using diversification index, Gini Coefficient and income share of a particular sector in total income; among these researchers (Kimenju & Tschirley, 2008; Abdulai & Crole Rees, 2001; Rawal, Swaminathan, & Dhar, 2008; Block & Webb, 2001; Heubach, Wittig, Nuppenau, & Hahn, 2011) use diversification index more than the other two. For this study, the extent of diversification is measured using the inverse of the Herfindahl-Hirschman index. The Herfindahl-Hirschman index is shown in the following equation:

$$\text{Diversification Index} = \frac{1}{\sum_{i=1}^N (S_i)^2} \dots\dots\dots(1)$$

Where:

S_i = proportion of total income from source i

N = number of income sources

In equation 1, households earn total income S_i from N number of sources.

$$\sum_{i=1}^N S_i^2 = \left(\frac{I_1}{T}\right)^2 + \left(\frac{I_2}{T}\right)^2 + \left(\frac{I_3}{T}\right)^2 + \dots + \left(\frac{I_n}{T}\right)^2 \dots\dots\dots(2)$$

Where $I_{1\dots N}$ is the total income from i^{th} Sector.

The findings of the study are further analysed among various groups and strata. The groups and categories are made based on households’ characteristics like income and other attributes. Households are divided into four clusters using K-mean cluster analysis. K mean cluster analysis was first used by James MacQueen in 1967. The K-Means clustering algorithm is a partition-based cluster analysis method. According to the algorithm we firstly select k objects as initial cluster centers, then calculate the distance between each cluster center and each object and assign it to the nearest cluster, update the averages of all clusters, repeat this process until the criterion function converged (Vora & Oza, 2013)

Discussion and Findings: Barring a few, all the households are earning their livelihood from more than one activity. Households adopt more than one activity– either as principal or supplementary to minimise the risk of income failure. Table 1 shows the number of activities the households are pursued in the study area-

Table 1: Households by Number of Activities Pursued

Number of Activities	Number of Households	Per cent	Cumulative Percent
1	12	3.0	3.0
2	45	11.4	14.5
3	163	41.4	55.8
4	128	32.5	88.3
5	41	10.4	98.7
6	5	1.3	100.0
Total	394	100.0	

Source: Authors' calculation

The average number of activities in which sample households are engaged is found to be 3.4. It is clear from table 1 that more than 85 per cent of the households earn their income from more than two activities. It is found that 163 Households out of 394 surveyed households (41.4 per cent) are engaged in three income-generating activities while only 12 households are concentrating on only one activity, and five households are engaging in as much as six activities. More than 70 per cent of households have three and four income-generating options. Only three per cent of the surveyed households are concentrating on only one activity. This shows that the households of the study area opt for diversified livelihood strategy.

Extent of Livelihood Diversification in the Study Area: The livelihood diversification index³ of the study area is found to be 2.4470. The most diversified household in the study area has a livelihood diversification index of 5.18, while the least diversified households have an index value of one. The livelihood diversification index is also constructed for both the districts considered for the study. The livelihood diversification index for the Dhemaji district is 2.4365 and for the Lakhimpur district is 2.4601. The extent of diversification of livelihood in the Lakhimpur district is slightly more than the Dhemaji district. However, the difference is statistically not significant.

For further analysis of the degree of livelihood diversification, the households are classified into four categories as per their degree of livelihood diversification. Households are classified as least diversified households, moderately diversified households, highly diversified and extremely diversified households. For this study, the minimum possible value of the livelihood diversification index is one, and the maximum potential value is seven. Households are classified based on the livelihood diversification index's mean (\bar{X}) and standard deviation (σ). The mean and standard deviation of livelihood diversification is 2.447 and 0.7831, respectively. The least diversified category includes households with livelihood diversification index between one to $\bar{X}-\sigma$; the moderately diversified category includes households with livelihood diversification index between $\bar{X}-\sigma$ to \bar{X} ; the highly diversified category includes households with livelihood diversification index between \bar{X} to $\bar{X}+\sigma$, and the extremely diversified category includes households with livelihood diversification index between $\bar{X}+\sigma$ and seven. The classification of households as per their degree of livelihood diversification is shown in Table 2

Table 2 shows there are 74 households with a livelihood diversification index of less than 1.6639. The annual average income of the least diversified households is Rs. 267945. The moderately diversified families (160) earn Rs. 210444 annually. The livelihood diversification index of moderately diversified households is 1.6924. The highly diversified households make Rs. 101384 annually with a livelihood diversification index of 2.5325. The livelihood diversification index of extremely diversified households is 3.58, with an annual average income of Rs. 170458. To find any statistically significant difference in average yearly income among four categories of households, we use the analysis of variance (ANOVA) test. The value of F is 6.426, and it is significant at the 0.01 level.

³ The livelihood diversification index ranges between 1 and number of activities considered for the study.

Table 2: Classification of Households as per Degree of Livelihood Diversification

Index Value	Diversification Status	No of Households	Number of Activities	Livelihood Diversification Index	Average Income (INR)
$1 \leq 1.6639$	Least Diversified	74 (18.78)	1.85	1.0343	267945
$1.664 < 2.447$	Moderately Diversified	160 (40.61)	3.17	1.6924	210444
$2.4471 < 3.2301$	Highly Diversified	99 (25.13)	3.59	2.5325	101384
$3.2302 < 7.00$	Extremely Diversified	61 (15.48)	4.18	3.58	170458
Total		394 (100)	3.40	2.447	189593.91

Source: Authors' calculation

*Figures in the brackets are the percentage of total

As flood can have a dominant impact on the degree of livelihood diversification, the extent of diversification of livelihood is examined separately for flood-affected and flood-free areas. The livelihood diversification index in the flood-affected area is 2.51961, while the index for the flood-free area is 2.2308. The livelihood in the flood-affected areas is more diversified than that in the flood-free areas. The t-test is used to test whether the difference in the extent of livelihood diversification between flood affected and flood free area is significant or not. The result of the t-test is shown in Table 3

Table 3: Comparison of Mean Livelihood Diversification Index between Flood-Affected and Flood Free Area

	Nature of Area	Number of Households	Mean	Std. Deviation	Std. Error of Mean	t statistic
Livelihood Diversification Index	Flood-Affected	295	2.5196	0.8627	0.0502	t = 3.090 p = 0.002
	Flood Free	99	2.2308	0.5978	0.0600	
	Total	394	2.4470	0.8134	0.0410	

Source: Authors' calculation

The t-test results confirm that the difference in mean livelihood diversification index between flood-affected and flood-free areas is statistically significant at a one per cent level of significance. The analysis of livelihood diversification between flood-free and flood-prone areas shows a significant difference in mean livelihood diversification between flood-free and flood-prone areas. The households in the flood-affected areas are more diversified than the households in the flood-free areas.

To categorise the households as per the economic activity, they are involved in, the sample households are clustered using K mean cluster analysis. The sample households are grouped using cluster analysis, and then the livelihood diversification index is constructed for the clusters separately. The results of the K mean cluster analysis are as follow-

Table 4: Cluster wise Annual Households' Income

Income Sources	Annual Households' Income			
	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Paddy Cultivation	24662.07	7940.00	30760.87	18058.44
Cash Cropping	15755.94	27000.00	95034.78	14963.64
Livestock Rearing	10970.11	7600.00	13134.78	10649.35
Non-Industrial Wage Labour	20328.74	1500.00	4782.61	4615.58
Migrant Remittances	12613.03	26400.00	22260.87	261740.26
Other Activities ⁴	15945.59	26800.00	105952.17	12649.35
Petty Vending	17187.74	413600.00	23695.65	6350.65

Source: Authors' calculation

The cluster analysis data in table 4 shows that, in the first cluster, the dominant source of income is paddy cultivation. From the discussion in the study area, we found that most paddy growers work as daily wage labourers during the lean season. In the second cluster, the dominant income is Petty Vending. In the third cluster, most of the income comes from cash crops and miscellaneous activities. As the income in other categories comes from different undefined works, cash cropping may be taken as dominant economic activity in the third cluster. In the fourth cluster, the dominant income source is migration remittances. Hence, from the cluster analysis, four distinct income sources are arrived at. These are paddy cultivation, a petty vending, mixed strategy which includes cash crop plus miscellaneous income and migration remittances. In the following part livelihood diversification index is constructed separately for each cluster which analyses how dominant economic activity for a household is. A lower livelihood diversification index means the major economic activity provides either sufficient income or the absence of other choices with the people. The livelihood diversification indices of each category of occupational choice are shown in table 5

Table 5: Livelihood Diversification Indices for Different Occupational Choices

Cluster	Income Sources	Diversification Index	Average Income (Rs.)
Cluster 1	Paddy Cultivation	2.438588	117463.22
Cluster 2	Small Business	1.502297	510840.00
Cluster 3	Cash Cropping	2.188916	295621.74
Cluster 4	Industrial Wage Labour	1.573724	329027.27

Source: Authors' calculation

Table 5 shows that households with paddy cultivation and daily wage as a dominant economic activity are highly diversified with a livelihood diversification index of 2.438588. In contrast, the households with small businesses as a dominant activity are least diversified with a livelihood diversification index of 1.502297. The livelihood diversification index for households as cash cropping and industrial wage labour as dominant strategy is 2.188916 and 1.573724, respectively. It is clear from the table that the higher the livelihood diversification index lower is annual average household income.

There is an association between the level of income and degree of livelihood diversification. Livelihood literature finds that in many cases, poorer households are more diversified (distressed diversification), and in some other cases, richer households are more diversified (induced diversification). However, in some other cases, the poorer are concentrated in one or two activities due to limitation of resources and other

⁴ Other activities include income earned from tuition, petty contract, and other sources not defined in the study.

constraints, and richer households are focused on fewer activities due to reasonable and sustainable income flow from these activities. The extent of livelihood diversification across income quartiles are shown in table 6

Table 6: Livelihood Diversification Index across Income Quartiles

Quartile	Index	Number of Households
Poorest	2.4017	98
Second	2.7220	99
Third	2.4930	100
Richest	2.1648	97
All	2.4470	394

Source: Authors' calculation

From table 6, it is clear that the richest quartile of households is least diversified (2.1648), and the second quartile of the households is highly diversified (2.7220). The study of the livelihood diversification index in Darrang and Udalguri district of Assam by Saikia (2016) also finds the same conclusion. The livelihood diversification index for the poorest quartile and third quartile of households is 2.4017 and 2.4930, respectively. The association of income level and degree of livelihood diversification is tested using ANOVA. The result of ANOVA is represented in table 7.

Table 7: Income Quartiles and Degree of Livelihood Diversification

Income Quartile	Number of Respondents	Percentage	Livelihood Diversification Index	F- Value
Poorest	98	24.87	2.4017	8.904 p=0.000
Second	99	25.13	2.7220	
Third	100	25.38	2.4930	
Richest	97	24.62	2.1648	
Total	394	100	2.4470	

Source: Authors' calculation

Table 7 shows an association between the degree of livelihood diversification and the income quartiles of the households ($F=8.904$, $p=.000$).

The study's findings suggest that the households with concentrated portfolios earn better livelihood in terms of income earnings. The households in the richest quartile of income are the least diversified, with a livelihood diversification index of 2.1648.

Conclusion: The study tries to find out the nature and extent of livelihood diversification in the flood-affected areas of the Dhemaji and Lakhimpur districts of Assam. The study finds that the households in the study area are moderately diversified. However, the scope and pace of livelihood diversification is still limited and towards lower end jobs. Hence, proper initiatives should be taken to support the people to diversify more and into better avenues. The poor people should be encouraged and supported to diversify their income sources. Government should provide institutional supports for extending the scope for adopting new livelihood activities at the micro-level. People, very often, are forced to diversify without considering the effectiveness of the new activity. A micro-level plan can help in identifying prospective diversification strategies. There should be a strong focus on the livestock sector as a livelihood option. The study area is known for livestock farming. However, still, no scientific way of livestock farming is experienced in the locality. Adoption of the modern way of farming and proper marketing will result in higher income for the people.

To find proper policies for the households in the path of livelihood diversification, one should have to study the determinants of livelihood diversification. Further research in this context will serve as a base for the policy formulation in livelihood diversification.

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