



## Indian Journal of Hill Farming

December 2015, Volume 28, Issue 2, Page 111-120

# Changes in Farming Systems and Livelihood Patterns in Mountainous Region of Mizoram, Eastern Extension of the Himalaya

Vishwambhar Prasad Sati

Department of Geography and Resource Management, Mizoram University, Aizawl

### ARTICLE INFO

#### Article history:

Received 2 September 2015

Revision Received 20 December 2015

Accepted 21 December 2015

#### Key words:

Farming system; shifting cultivation; cropping pattern; occupation; income

### ABSTRACT

This paper looks into the changes in farming systems and livelihood patterns in mountainous regions of Mizoram. Livelihood of the people depends on agriculture and its allied practices. We selected total five villages to conduct this study. Out of the total households (614) in the five villages, 20% households (125) were surveyed randomly. This study was conducted in August 2015. Two time series data (2004 and 2014) on changes in land-use, cropping pattern, livestock, occupation and income and fuel consumption were gathered. Changes in farming systems and livelihood patterns were experienced. Forest and barren land increased by 23.2% and 2%, respectively while, arable land decreased both under shifting and permanent agriculture. In terms of area of crops, cereals and cash crops increased under permanent agriculture whereas, rice, vegetables and orange under shifting cultivation decreased. At the meantime, production and yields of banana, lemon and ginger crops increased. A number of hens (879.8%) and cattle (157.2%) increased and pigs decreased (17.3%). Income from shifting cultivation decreased by 22.7% while, it increased by 92.9% from government services. Simultaneously, a number of people involved in shifting cultivation decreased by 17.5% and their involvement in governmental services and livestock farming increased. Fuel consumption from fuel-wood decreased by 38.2% whereas LPG consumption increased by 30.6%. While responding to the questions, the respondents (672) informed that the changes in farming systems and livelihood patterns are due to high education level, modernization and climate change.

### 1. Introduction

Agriculture is one amongst the major sources of livelihoods for the most vulnerable and rural poor people (Quiggin et al. 2010; Berger et al. 1989; Lobell and Burke 2008; Kauti 2009). The rural farmers continue to face more challenges – poor infrastructure, poverty, poor policies and poor government – that impede agricultural productivity (ROK 2007). The purpose of national agricultural policies is, therefore, to support farm livelihoods through various mechanisms (ROK 2001; Kilambya 2004). Climate change is recently experienced as a major challenge to agriculture (ROK 2007; Herrero et al. 2010). It causes negative impacts on farming systems and livelihoods (Herrero et al. 2010; IAASTD 2008).

Although, smallholders have been adapting their agriculture to the changing climate since time immemorial (McDowell and Hess 2012) yet, they are still vulnerable to climate change and variability (Hulme et al. 2001; Boko et al. 2007; IPCC 2001; World Bank 2009). Recently, climate change impact has been observed in northeast India in general and Mizoram in particular. The Indian Meteorological Department records that the amount of rainfall received by northeast India in 2006 monsoon season stands to be the scantiest for a period of 25 years, since 1982 (Das et al. 2006). Studies on rainfall and the temperature regimes of northeast India indicate that although, there is no significant trend in rainfall for the region as a whole yet, decrease in rainfall and increase in temperature was noticed (Das and Goswami, 2003; Das, 2003).

The summer monsoon rainfall is found to be decreasing over this region significantly during the last century at an approximate rate of 11 mm per decade (Mirza et al., 1998). The year 2005 saw prolonged dry periods in Mizoram with many springs and streams drying up accompanied by large scale landslides (ICIMOD, 2008). Rupa Kumar et al. (1992) concluded that a decline in rainfall by 6-8% per hundred years experienced over the north-eastern.

Expansion in cropped area into forested and woodland areas and onto steeper slopes increased soil erosion. Intensive livestock production also added water and land quality problems (Rosegrant and Hazell, 2000). Climate change will gradually further increase these risks and vulnerabilities, putting pressure on already over-stretched coping strategies and magnifying inequalities based on gender and other disadvantages (UNDP, 2007). Most Southeast Asian poor live in rural areas and rely on the agriculture sector for their livelihoods. As such, agriculture provides a safety net for the poor (ADB, 2009). Nelson et al (2009) study provides detailed estimates of the likely impact of climate change on agricultural production, consumption, prices, and trade for different regions of the world in future.

Mizoram lies in the eastern extension of the Himalaya and forms an integral part of northeast India. It is one of the eight sister states and one amongst the biodiversity hotspots of the world. A hilly state, Mizoram mainly comprises of the high, medium and low structured hills that covers about 90% of the total geographical area. The highest area of the state (61.71%) is found below 800m altitude, comes under the low structured hills. Valley fills and flood plains occupy only 3.9% area while, area under linear ridges is 6.35%. Its eastern-central part has above 1200m height which represents 8.22% of the total area. The state is stretched between 21° 58' - 24° 35' N and 92° 15' - 93° 29' E, covering an area of 21087 km<sup>2</sup>. Average elevation of the state is 1000m while the maximum altitude 2157 m is found in Blue Mountain (Phawngpui) (ISFR 2011, sati 2014). There are eight districts and 26 rural development blocks in the state. Climatic conditions are very feasible throughout the year (annual average temperature 23°C). Eight months of a year receive continuous heavy rain and thunderstorm with 235cm mean value. The four months of winter viz. November, December, January and February are sunny and dried. Minimum temperature recedes to 14°C and maximum temperature accedes to 32°C. Forest covers about 91% area whereas arable land in only 4%. Mizoram characterises high landscape fragility. Tectonic movements are active and it falls under V seismic zone.

A very active zone 'Indo-Burmese Arc' passes through the south districts of Mizoram. The formation of Mizoram hills is quite immature. Thus, landslides and soil erosion are common. Unscientific shifting cultivation further accentuates the landscape fragility.

The term 'Mizoram' denotes to the land of the highlanders. Its mountainous part is nomenclature as 'the rolling hills'. Economy of the state is largely based upon the production of biomass based agriculture. Further, agricultural practices are carried out mainly through shifting cultivation in the hilly slope areas. Shifting cultivation is rain-fed and most of the crops are cultivated during rainy season only. A small proportion of agricultural land is spread in the lowlands (valley fill and flood plain), where permanent agriculture is practiced. Mainly, wet rice is cultivated in the lowland. Shifting cultivation has a tremendous impact on the ecology and economy of the region. It leads to degradation of landscape and low productivity of crops. Population in Mizoram is sparsely distributed. The people prefer to construct their houses on the top of the hills therefore; population concentration is higher in the high altitudes. According to the Census of India 2011, total population of Mizoram was 10, 91014. Literacy rate was 91.85% while sex ratio was 975. People living per km<sup>2</sup> were 52.

Changes in farming systems and livelihood patterns were noticed in terms of changes in land use, cropping pattern, occupation and income. The major categories of land use are arable land – shifting and permanent – land under cereal and cash crops, barren land, fallow land and community forest land. Our study shows that area under shifting cultivation has decreased. Similarly, area of permanent agriculture also decreased. However, barren, fallow and community forestland increased. Changes in occupation were also noticed. Although, farming of subsistence crops is the major occupation yet, during the recent decades, the rural people have left working in the agricultural fields and shifted to the private and governmental sectors. Therefore, a number of people decreased from agricultural field. In the meantime, a number of people have increased in rearing animals.

Mizoram characterises acute food shortage. Malnutrition and poverty is the growing and common phenomenon. This led to high infant mortality rate (35). In Saiha district, which is located in the southern part and bordered with Myanmar, infant mortality rate is above 200. Meanwhile, Mizoram has abundance of natural resources – land, water, and forest, the life sustaining layers. The geo-environmental conditions – feasible climate and panoramic landscape further characterise the state.

This paper examines changes in farming systems and livelihood patterns in Mizoram state during the period 2004-2014. It discusses the major drivers of changes and suggests the measures to enhance livelihood options through optimum use of land resources.

## 2. Materials and Methods

### Study Area

The five villages, which we have studied, are located in Aizawl district of Mizoram, northeast India (Figure 1). Altitude of these villages varies from 860m to 1472m. Similarly, area varies from 100km<sup>2</sup> to 340km<sup>2</sup>. Out of five villages, three are located on roadside and two are located three and four km far from road. In terms of their distance from Aizawl city, they are located between 10 km (lowest) and 51km (highest).

It denotes that Aizawl city has a greater impact on socio-economic development of these villages. Table 1 shows a detailed geographical description of the studied villages.

Table 2 shows climatic conditions of the case study villages. Data on annual temperature °C – minimum, maximum and average – annual average rainfall (cm) and annual average humidity (%) were gathered. The lowest average annual temperature was noticed in Hmuifang village (19.5°C). It is because of its altitude which is higher than other villages. The annual average temperature in other villages is averaged 23.5°C. Rainfall also varies from 240cm (lowest) to 270cm (highest). It was observed that the amount of rainfall is increasing with increase in altitudes. Similarly, annual average humidity (%) was noticed high in the high altitude (80%) than to the villages located comparatively in low altitudes (64%).

**Table 1.** Geographical descriptions of the case study villages

Villages	Location		Altitude (m)	Area (sq.km)	Distance from Aizawl city (km)	Distance from the road head (km)
	Latitude	Longitude				
Melriat	23°39'26" N	92°43'20" E	860	250	12	Roadside
Kelsih	23°38'04" N	92°43'20" E	880	340	15	Roadside
Hmuifang	23°44'24" N	92°75'92" E	1472	240	51	Roadside
Samtlang	23°39'22" N	92°42'13" E	933	310	10	3
Nausel	23°48'58" N	92°45'53" E	946	100	16	4

Source: Field study using GPS (August 2015)

**Table 2.** Climatic conditions, 2014

Villages	Annual Temperature (°C)			Annual Average Rainfall (cm)	Annual Average Humidity (in %)
	Minimum	Maximum	Average		
Melriat	13	35	24.0	240	64
Kelsih	13	34	23.5	245	68
Hmuifang	09	30	19.5	270	80
Samtlang	13	34	23.5	250	65
Nausel	13	34	23.5	260	65

Source: Remote Sensing Application Centre, Science and Technology, 2009, Aizawl, Mizoram

### Data Acquisition and Survey Method

In this study, we used both qualitative and quantitative methods. Data was collected through household level survey. A case study of the five villages of Aizawl districts was carried out. Random sampling method was employed and 20% households were selected from each village (Total 125 households). Data on age of the head of the family, village wise total population, family size, sex ratio and literacy rate were collected.

Similarly, data on land-use, cropping pattern, livestock farming, income, occupation and fuel-wood consumption during the period 2004-2014 were collected. Data on area under shifting and permanent agriculture were also gathered during the same period. The gathered data was calculated using excel sheet and SPSS software. Secondary data was collected from the statistical department, agricultural department and other governmental records. Table 3 shows population profile of the surveyed households.

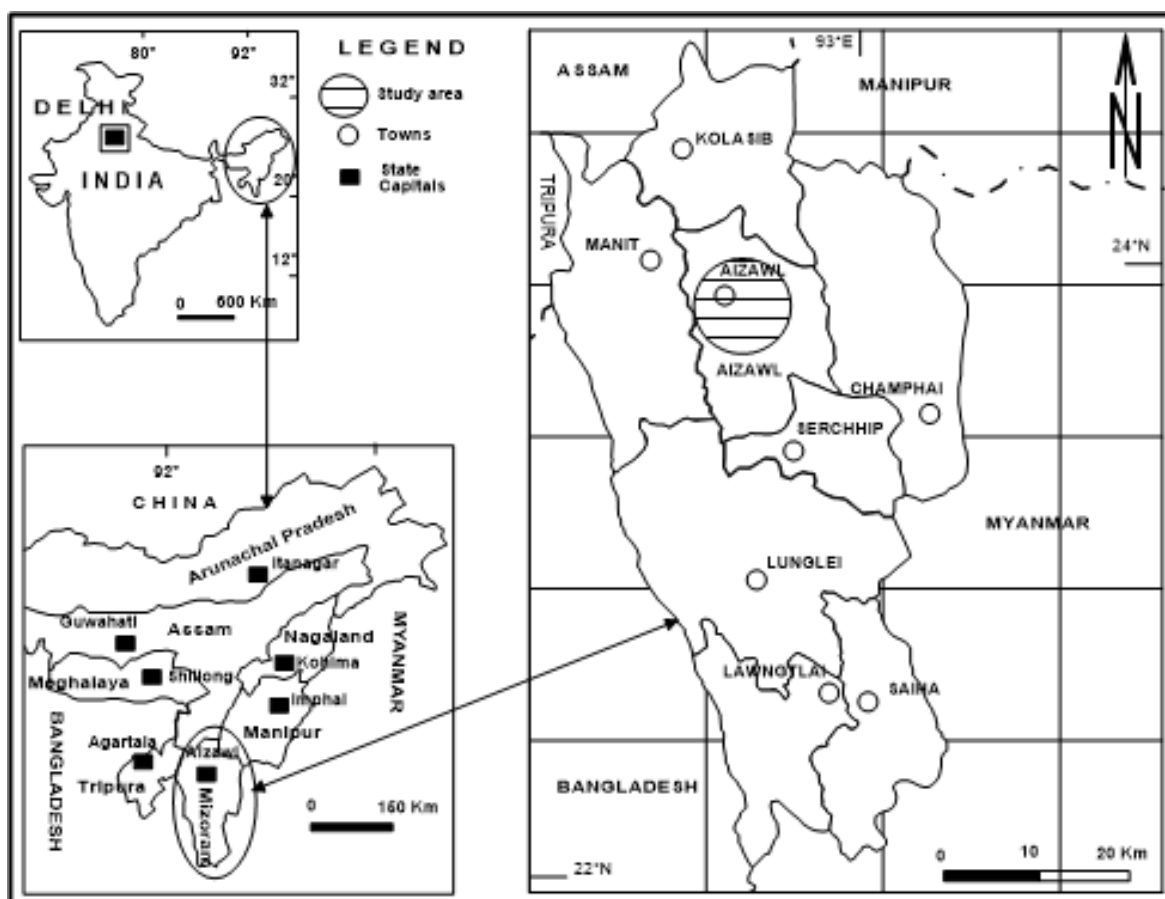


Figure 1. Location map of the study area

Table 3. Population profile of the surveyed households (20% of the total households)

Name of village	Total household*	Surveyed households	Age**	Total population	Family size	Sex ratio	Literacy (%)
Melriat	199	40	53.1	222	5.6	943	82.4
Kelsih	149	30	56.6	156	5.2	1016	87.2
Hmuifang	53	12	47.1	58	4.8	908	91.4
Samtlang	152	30	59.9	161	5.4	952	85.1
Nausel	61	13	48.3	75	5.8	914	74.7
Total	614	125	53.0	672	5.4	947	84.1

Source: \*COI, 2011; \*\*Mean value of age of the head of the family; Field survey (August 2015)

We have asked questions from the head of the family on impact of education, climate change and modernization on farming systems and livelihood patterns (Table 4). About 92.7% heads of the family believe that they have noticed changes in farming systems and livelihood patterns. In terms of the major drivers of these changes, about 87.8% heads of the family responded that education is the main driver. Mountain farming systems and livelihood patterns are most vulnerable to climate change worldwide. Climate change impact was also experienced in the present study villages as about 49.6% people responded that they have observed climate change impact on farming systems and livelihood patterns.

Table 4. People's response to changes in agricultural and livelihood patterns (N=123)

Questions	Answer (%)	
	Yes	No
Are there changes in agricultural and livelihood patterns noticed?	92.7	7.3
Are these changes experienced due to spread of education?	87.8	12.2
Are these changes noticed due to climate change?	49.6	50.4
Are these changes observed due to modernization?	100	-

Source: Field survey (August 2015)

### 3. Results

#### Land Cover Change (2004-2014)

Percentage of changes in land cover during the period 2004-2014 is presented in table 5. The major categories of land use are arable land that includes shifting and permanent agriculture and land under cereals and cash crops, barren land, fallow land and community forest land. It shows that about 41.1% area under shifting cultivation has reduced in all villages, varies from 12.5% to 54.5% in different villages. A difference of -2% was registered in area of permanent agriculture. Similarly, 20% area decreased under barren land. On other hand, area increased under fallow land (2%) and community forest land (23.2%). Area of cereals and cash crops under permanent agriculture also increased about 38.5% and 5.9% respectively.

#### Changes in Cropping Pattern

#### Changes in Area under Shifting and Permanent Agriculture

Table 6 presents descriptive statistics of changes in area under shifting and permanent agriculture. Minimum, maximum, mean value and std. deviation is calculated using SPSS software. Both minimum and maximum values of area under shifting and permanent agriculture decreased during the period 2004-2014. Similarly, mean value of area under shifting and permanent agriculture reduced. Change in reduction of area of shifting cultivation is higher than area of permanent agriculture.

#### Changes in Area under Cereals and Cash Crops

Area under cereals and cash crops and changes during the period 2004-2014 is shown in table 7. It shows that area under cash crops is higher than cereals. When we look into the changes in area under both crops it is higher under cereal crops (38.5 % increases) than to cash crops i.e. 5.9 % only. As a whole, area of cereals and cash crops under permanent agriculture is increasing.

**Table 5.** Land cover changes (percentage of geographical area), 2004-2014

Villages	Arable land		Barren land	Fallow land	Forestland (Community)
	Shifting	Permanent			
Melriat	-34.0	13.9	16.7	-40	20.6
Kelsih	-51.6	3.8	-100	50	173.3
Hmuifang	-54.5	0	0	0	100
Samtlang	-51.4	-12.2	0	30	10.9
Nausel	-12.5	0	0	-12.5	0
Total	-41.1	-2	-20	2	23.2

Source: Field survey (August 2015)

**Table 6.** Changes in area under shifting and permanent agriculture (N=5 villages)

Variables	Year	Minimum	Maximum	Mean	Std. Deviation
Area under Shifting cultivation (Ha)	2004	8	23.5	13.4	6.4
	2014	0	15.5	7.9	4.5
Area under permanent agriculture (Ha)	2004	1	39.2	16.7	14.9
	2014	1	34.4	16.4	13.3
Total	2004	9	50.1	30.1	17.5
	2014	8	39.7	24.3	14.4

Source: Field survey (August 2015)

**Table 7.** Changes in area of cereal and cash crops under permanent agriculture 2004-2014

Villages	Area under cereal crops (Ha)			Area under cash crops (Ha)		
	2004	2014	Change (%)	2004	2014	Change (%)
Melriat	1.8	2.3	27.8	9.6	10.1	5.2
Kelsih	-	-	-	11.1	13.8	24.3
Hmuifang	-	-	-	1	2.2	120
Samtlang	11.5	16.5	43.5	12	11	-8.3
Nausel	1	1	No change	7	6	-14.3
Total	14.3	19.8	38.5	40.7	43.1	5.9

Source: Surveyed by author (August 2015)

### Village-Wise Changes in Area, Production and Yield of Crops under Shifting Cultivation

Village wise study on percentage of changes in area, production and yield of paddy and vegetables under shifting cultivation during 2004-2014 is shown in table 8. All five villages observed decrease in area of paddy from 25% to 78%. Average decrease in area was 58%. In term of production, except Nausel village which noticed a slight increase in production, other villages observed decrease in production of paddy crop. In a nutshell, production and yields of paddy in the study area decreased 77.1% and 45.8 % respectively. Vegetable crops have also experienced decrease (15.8%) in area in all villages. Meanwhile, production and per ha yields of vegetable crops increased as 0.004% and 86.7% respectively.

### Changes in Area, Production and Yields of Food, Fruit and Vegetable Crops

Table 9 shows changes in area, production and yield/ha of food, fruit and vegetable crops in 2004-2014. Paddy grows under both shifting and permanent agriculture. It was noticed that paddy losses its area, production and yield under shifting cultivation. About 58% area, 77.1% production and 45.8% yield decreased. However, paddy under permanent agriculture gains its area and production i.e. 33.3 % and 30.1 %. In terms of yields, a decrease of 2.4 % was noticed. Vegetables are mainly grown under shifting cultivation. A decrease in area of vegetable crops (15.8 %) was noticed. But in terms of production and yields, it increased (0.004 % and 86.7 % respectively). Area under all fruits such as banana, lemon, ginger and orange, grown in these villages, increased from 28 % of ginger to 50 % lemon. Similarly, production and yields of these fruits increased except orange which production and yields decreased (24.4% and 46.9% respectively).

**Table 8.** Percentage of changes in area, production and yields of crops under shifting cultivation 2004-2014

Village	Paddy			Vegetables		
	Area	Production	Yield per Ha	Area	Production	Yield per Ha
Melriat	-44.4	-81.5	-66.7	-23.0	0.005	34.8
Kelsih	-78.7	-83.8	-23.8	-20	0.032	157.8
Hmuifang	-56.9	-56.6	0.7	-	-	-
Samtlang	-74.5	-45.6	113.6	No change	No change	No change
Nausel	-25	4.2	38.9	-14.3	0.009	No change
Total	-58	-77.1	-45.8	-15.8	0.004	86.7

Source: Field survey (August 2015)

**Table 9.** Changes in area, production and yields of food, fruit and vegetable crops (2004-2014)

Crops	Area		Production		Yield/ha	
	Ha	%	Kg	%	Kg	%
Paddy (Shifting)	-26	-58.0	-80341	-77.1	-1071.6	-45.8
Paddy (Permanent)	5	33.3	6600	30.1	-35	-2.4
Vegetable (Shifting)	-3.7	-15.8	21191	0.004	1373.22	86.7
Banana	4.35	45.5	32760	410	2095	250.4
Lemon	0.5	50.0	400	200	400	200
Ginger	0.7	28.0	119800	9215	37323.7	7177
Orange	1.7	42.5	-19700	-24.4	-9473.3	-46.9

Source: Field survey (August 2015)

### Changes in Livestock Farming

Livestock farming plays an important role in the economy and livelihood of the farming community, and it is one of the major economic activities and sources of income.

Pig, hen and cattle are the main livestock reared and pork and rice are the main food. Data on number of livestock in 2004-2014 and changes is shown in table 10. A decrease of 17.3% in number of pig and an increase of 879.8% and 157.2% in hen and cattle population was noticed.

**Table 10.** Changes in livestock farming

Livestock	Number			
	2004	2014	Change	%
Pig	139	115	-24	-17.3
Hen	213	2087	1874	879.8
Cattle	14	36	22	157.2

Source: Field survey (August 2015)

### Changes in Source of Income

The major sources of income are from farming, government and private services, forest products, trading and animal husbandry (Table 11). Income from government service represents 32.7%, and from agriculture and livestock, it is 29.5% and 19.9%, respectively (2014). Forest products and animal husbandry also contribute substantially in generating income. Changes in income earned from the different sources during the period 2004 and 2014 were noticed. A decrease of 22.7% income was noticed from shifting cultivation. Income from other sources increased by 66.9% in permanent agriculture, 400% in forest products, 140% in trading and 113.3% in animal husbandry.

**Table 11.** Sources of Income and changes in 2004-2014

Sources	Income (Rupees)			
	2004 (%)	2014 (%)	Change	%
Shifting cultivation	905700 (24.5)	699800 (12.6)	-205900	-22.7
Permanent agriculture	565000 (15.3)	943000 (16.9)	378000	66.9
Government services	943000 (25.5)	1817000 (32.7)	874000	92.9
Private services	754000 (20.4)	968000 (17.4)	214000	28.4
Forest products	1000 (0.03)	5000 (0.09)	4000	400
Trading	10000 (0.3)	24000 (0.4)	14000	140
Animal husbandry	518000 (14)	1105000 (19.9)	587000	113.3
Total	3696700 (100)	5561800 (100)	1865100	50.5

Source: Field survey (August 2015); Note: Figures in parenthesis are the percentage

### Changes in Occupational Pattern

Practicing agriculture, rearing livestock and working in public and private sector enterprises are the major occupational pattern in these villages (Table 12).

The highest number of people is engaged in practicing agriculture. Animal husbandry followed it. A few people are also involved in public and private sector enterprises. Occupational pattern has been changed during the period 2004-2014. The study shows that the people involved in practicing agriculture decreased by 17.5%. However, an increase was observed in number of people engaged in private enterprises, daily wages, animal husbandry and government services.

**Table 12.** Changes in occupational pattern

Occupation	People involved in different activities			
	2004 (%)	2014 (%)	Change	%
Farming	97 (62.6)	80 (49.1)	-17	-17.5
Government service	9 (5.8)	12 (7.4)	3	33.3
Animal Husbandry	32 (20.6)	43 (26.4)	11	34.4
Private services	10 (6.7)	18 (11)	8	80
Daily Worker	7 (4.5)	10 (6.1)	3	42.9
Total	155 (100)	163 (100)	8	5.2

Source: Field survey (August 2015); Note: Figures in parenthesis are the percentage

### Changes in Fuel Consumption

Table 13 presents changes in fuel consumption in the study villages. Mainly, fuel-wood and LPG are consumed for cooking purposes. Dependency on forest for fuel-wood was higher during the past but, it decreased by 38.2% till 2014. Simultaneously, LPG demand increased by 30.6% cylinder/month. Although, dependency on fuel-wood has decreased yet, a large group of people still depends on it.

**Table 13.** Changes in fuel consumption

Fuel consumption				
	2004	2014	Change	%
Fuel-wood (Kg/day)	3320	2051	-1269	-38.2
LPG (No. of Cylinder/month)	88.2	115.2	27	30.6

Source: Field survey (August 2015)

#### 4. Discussion

Mizoram has been experiencing changes in farming systems and livelihood patterns from the recent past. Land use pattern has been changed. It was noticed from the study that along with decrease in arable land (43.1%) and barren land (20%), there was a substantial increase in community forestland (23.2%). Cropping pattern – area, production and yields of crops – during the period 2004-2014 has been changed. A decrease in area (58%), production (77.1%) and yields (45.8%) of paddy under shifting cultivation was noticed. Similarly, area of vegetables that grow under shifting cultivation decreased (15.8%). Contrary to it, an increase in area (33.3%) and production (30.1%) of paddy under permanent agriculture was observed. However, its yields decreased by 2.4%. The whole state of Mizoram has also experienced a decrease of 58.1% area under shifting cultivation during the period 1997-2011 (Statistical Hand Book of Mizoram, 2012, Sati, 2014). Meanwhile, area of cereals and cash crops under permanent agriculture has increased. A decrease in shifting cultivation and increase in permanent agriculture was experienced mainly due to new land use polity of the State government.

Changes in occupational pattern were noticed. A number of people involved in practicing agriculture decreased by 17.5%. Meanwhile, the people involved in private/government job, daily wages and livestock farming increased during the period 2004-2014. Decreasing number of people in farming sector is due to decrease in area, production and yields of crops mainly under shifting cultivation. Contrary to it, increase in number of people involved in private sector (80%) is due to sprawl of Aizawl city and increase in number of secondary and tertiary activities.

Annual income from different activities has increased by 50.5%, except from shifting cultivation, where it decreased by 22.7 %. We observed that output from agricultural activities is decreasing. A trend was noticed regarding increased involvement of the people in service sector both in public and private because of the high returns. Similarly, income from animal husbandry is increasing.

Livestock farming is one amongst the major economic activities. It has third place in earning income. Since, meat is the main food habit of the people thus, every household reared animal. Our study shows that poultry and cattle farming are increasing. In the meantime, a decrease of 17.3% was noticed in piggeries.

Dependency on fuel-wood consumption has decreased by 38.2 % during the period 2004-2014. Meanwhile, a large number of people still depend on fuel-wood. The main reason is that fuel-wood is easily available in the forest, located in nearby to villages. Every village has its own community forestland where people can obtain fuel-wood easily. An increase of 30.6% in LPG consumption was also noticed in the study villages.

Changes in land use categories are driven by the NLUP initiatives of the State government. Decreasing production pattern of crops from *jhumland* also resulted in these changes. As, shifting cultivation leads to enormous soil erosion and low soil fertility, decrease in production and yields of crops is spontaneous. Job opportunities in public and private sectors enterprises attracted the educated youth. These villages are located in surrounding of Aizawl city, which is the largest city of Mizoram state. Aizawl city has plenty of job opportunities mostly in private sector companies and the educated youths of the villages prefer to work in these companies rather to work in the agricultural fields. This was also resulted in decrease in area under shifting cultivation. Climate change is also noticed as a driving force that decreased arable land, production and yields of crops. While asking the respondents about climate change impact on farming systems and livelihood patterns, 49.6% people responded yes. They further explain that decline in crops production and productivity is due to climate change and thus, the educated youth have moved to the tertiary sector for better earning.

#### Conclusions

Changes in agricultural and livelihood patterns were largely noticed in Mizoram. A decrease in area of crops under shifting cultivation was mainly due to low production and yields of crops and implementation of the new land use policy. Changes in occupation from primary sector to tertiary sector were due to more opportunities in service sector in terms of income and employment. The three factors – NLUP, high level of education and modernization were noticed for changes in land cover, cropping pattern, occupation and income. Further, the impact of climate change was also noticed mainly in the farming system. Paddy production has decreased. Meanwhile, area and production of vegetables have increased. Mizoram has abundance of natural resources such as land, forest and water and they are unused largely. In terms of economic development, the whole state is underdeveloped. If the land resources are used properly, economic development can be attained.



The villages which we selected for the study have suitable agro-ecological conditions that can be harnessed for growing various crops mainly fruits and vegetables. Dairy farming has high potential and it can be developed for enhancing livelihoods. Industrial development is lagging behind. Macro-level industries cannot be established due to fragile and undulating terrain and lacking infrastructural facilities. Village level forest based small-scale industries can be setup to augment employment and generate income. Value addition of agricultural and horticultural products and use of non-timber forest products will further enhance the possibilities of economic development. Climate change can be adapted and resilient through growing crops according to the changing climatic conditions. Sustainable livelihood, therefore, can be attained through optimal use of resources and climate. A shift towards cash crops, minimizing shifting cultivation, harnessing agro-ecological conditions, introduction to eco-tourism and better use of water and forest resources will surely reduce poverty and enhance sustainable livelihood.

## References

- ADB. (2009). Economics of climate change in South East Asia, a regional review. Manila: Asian Development Bank
- Below, T., Artner, A.; Siebert, R., Sieber, S. (2010). Micro-level Practices to Adapt to Climate Change for African Small-scale Farmers: A Review of Selected Literature; IFPRI Discussion Paper 00953; International Food Policy Research Institute (IFPRI): Washington, DC USA.
- Berger, P. (1989). Rainfall and Agroclimatology of the Laikipia Plateau, Kenya; *Geographica Bernensia*: Bern, Switzerland, Volume A7.
- Boko, M., Niang, I., Nyong, A., Vogel, C., Githeko, A., Medany, M., Osman-Elasha, B., Tabo, R., Yanda, P. Africa. (2007). In *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*; Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J., Hanson, C.E., Eds.; Cambridge University Press: Cambridge, UK, pp. 433–467.
- Das Anup, P.K. Ghosh, B.U. Choudhury, D.P. Patel, G.C. Munda, S.V. Ngachan and Pulakabha Chowdhury, (2006). Climate change in northeast India: recent facts and events-worry for agricultural management, ISPRS Archives XXXVIII-8/W3 Workshop Proceedings: Impact of Climate Change on Agriculture.
- Das, P.J. and Goswami, D.C., (2003). Long-term variability of rainfall over northeast India. *Indian Journal of Landscape Systems and Ecological Studies*, 26(1):1-20. 8.
- Das, P.J., (2004). Rainfall Regime of Northeast India: A Hydrometeorological Study with Special Emphasis on the Brahmaputra Basin. Unpublished Ph.D. Thesis. Gauhati University (accessed October 25, 2009).
- Herrero, M., Ringler, C., van de Steeg, J., Thornton, P., Zhu, T., Bryan, E., Omolo, A., Koo, J., Notenbaert, A. (2010). Climate Variability and Climate Change and their Impacts on Kenya's Agricultural Sector; International Livestock Research Institute (ILRI): Nairobi, Kenya.
- Hulme, M., Doherty, R., Ngara, T., New, M., Lister, D. (2001) African climate change: 1900–2100. *Climate Res.* 17, 145–168.
- IAASTD. (2008) Executive Summary of the Synthesis Report of the International Assessment of Agricultural Knowledge, Science and Technology for Development; IAASTD: Johannesburg, South Africa.
- ICIMOD, (2008) Recorded proceedings of the two day 'Climate Change and Vulnerability of Mountain Ecosystems in the Eastern Himalayan Region, North-East India & Bhutan Stakeholders Workshop' 11-12 March, 2008, Shillong, Organised by International Centre for Integrated Mountain Development Kathmandu, Nepal.
- IPCC (2001). *Climate Change 2001: Impacts, Adaptations and Vulnerability. Summary for Policymakers*; International Panel on Climate Change: Geneva, Switzerland, World Bank. *Climate Change and Development*; World Bank: Washington, DC, USA, 2009.
- ISFR (2011) Indian State Forest Report, Forest of Mizoram, FRI, Dehradun, India
- Kauti, M.K. (2009) Rural Livelihood Security Assessment for Smallholders Undergoing Economic Changes and Agro-Climatic Events in Central Kenya; Research Institute for Humanity and Nature (RIHN): Kyoto, Japan.
- McDowell, J.Z., Hess, J.J. (2012) Accessing adaptation: Multiple stressors on livelihoods in the Bolivian highlands under a changing climate. *Global Environ. Change*, 22, 342–352.
- Kilambya, D.W. (2004) Review of Current Agricultural Research Challenges and Opportunities in Kenya and High Priority Areas for Research, Commodities and Thematic Areas; The Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA): Nairobi, Kenya.

- Lobell, D.B., Burke, M.B. (2008) Why are agricultural impacts of climate change so uncertain? The importance of temperature relative to precipitation. *Environ. Res. Lett.* 3, doi: 10.1088/1748-9326/3/3/034007.
- Mirza, M.M.Q., Warrick, R.A., Ericksen, N.J. and Kenny, G.J., (1998) Trends and persistence in precipitation in the Ganges, Brahmaputra and Meghna river basins. *Hydrological Sciences-Journal-des Hydrologues*, 43(6):845-858.
- Nelson, G.C. M.W. Rosegrant, J.Koo, R.Robertson, T.Sulser, T.Zhu, C.Ringler, S.Msangi, A.Palazzo, M.Batka, M.Magalhaese, R.Valmonte-Santos, M.Ewing and D.Lee. (2009) *Climate Change. Impact on Agriculture and Costs of Adaptation*, IFPRI Food Policy Report, Washington, D.C.: International Food Policy Research Institute.
- Quiggin, J., Adamson, D., Chambers, S., Schrobback, P. (2010) Climate change, uncertainty, and adaptation: The case of irrigated agriculture in the Murray-Darling Basin in Australia. *Can. J. Agri. Econ.* 58, 531–554.
- ROK (2007) *National Policy for the Sustainable Development of Arid and Semi Arid Lands of Kenya*; Office of the President, Special Programmes National, Government Printers: Nairobi, Kenya.
- ROK (2007) *National Development Plan 2002–2008*; Republic of Kenya (ROK), Ministry for Planning, Government Printers: Nairobi, Kenya, 2001.
- Rupa Kumar, K., Pant, G.B., Parthasarathy, B. and Sontakke, N.A. (1992) Spatial and subseasonal patterns of the long-term trends of Indian summer monsoon rainfall. *International Journal of Climatology*, 12, 257-268.
- Rosegrant, M.W. and P. Hazell (2000) *The Transforming the Rural Asian Economy: The Unfinished Revolution*, New York: Oxford University Press.
- Sati, V. P. (2014) Diversity, Use Pattern and Management of Forest Resources in the Eastern Himalaya: A Case Study of Mizoram, India. *Journal of Forest*, Vol. 1(1), 1-10; 2409-3807 (online)
- Tubiello and Rosenzweig (2008) provides framework of exposure, sensitivity and adaptation for assessing vulnerability in agricultural sector.
- Tubiello, F.N., and C. Rosenzweig, (2008) —Developing climate change impact metrics for agriculture. *Integrated Assessment Journal*. 8 (1): 165-184.
- UNDP (2007) *Fighting Climate Change: Human Solidarity in a Divided World*. Human Development Report, 2007/08. New York: Palgrave Macmillan