Objective Quality of Life in Aizawl City

- Benjamin L. Saitluanga
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Abstract : *Socio-spatial inequality is an important subject matter of human geography. Assessment of urban quality of life is significant to assess intra-urban inequality in social and environmental terms across various localities. By using principal component analysis, spatial inequality in objective quality of life in Aizawl City is measured at locality level. High ranked localities were found at central location and important junctions where buildings are mixed with both residential and commercial functions. On the other hand, the lowest ranked localities are the most peripheral localities which are mostly older settlements that have been incorporated into the city proper through legislative decisions.*

Introduction

Quality of life (QOL) is a broad and multi-faceted concept. No single discipline can deal effectively with questions about quality of life (Hill *et al.* 1973). It has been studied by a range of disciplines like sociology, geography, economics, planning, psychology and public health, among others. With its increasing popularity and widening application, QOL becomes an elusive concept, the meaning of which is very much dependent on the context within which it is used (Smith 1996). The concept is now a nebulous term, with multiple related concepts, including 'well-being', 'level of living', standard of living', and 'liveability' (Van Kamp *et al.* 2003; Craglia *et al.* 2004; Johnston 2009). Despite repeated attempts to differentiate between these terms for conceptual clarity (see Smith 1973; Van Kamp *et al.* 2003; Langlois and Anderson 2002; Andrews 2001; Bryne 2007), they are used interchangeably by some scholars (Andrews and Withey 1976; Saitluanga 2014).

Quality of urban life is becoming an important issue with increasing urbanization as the latter is usually accompanied by environmental degradation, cultural erosion and a number of social and economic problems (see Marans and Stimson 2011). Harvey (2011:232) has rightly pointed out that "if we think about the likely qualities of life in the next century by projecting forward current trends in our cities, most commentators would end up with a somewhat dystopian view". Difference in quality of urban life is generally associated with residential differentiation and spatial segregation, poverty, unemployment and a lack of adequate social and physical

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infrastructure, crime, violence, homelessness and overcrowding. Negligence of increasing disparity in quality of life may generate deep dissatisfaction and underlie episodes of social unrest and dysfunction.

In 2011, there were 82 local councils in the entire city of Aizawl City. The local council is the lowest unit of local administration and lowest unit of enumeration. They are considered as suitable units of spatial analysis due to their small size, cohesiveness and presence of sense of belongingness among its residents. From methodological point of view, small areas are appropriate sites to study intra-urban difference since patterns or degrees of inequality are more visible and the criticism of ecological fallacy is diminished at lower levels of aggregation (UNCHS 2000).

Objectives of the Study

The main purpose of the present study is selection of appropriate objective QOL indicators for the city of Aizawl and analysis of spatial inequality in QOL at locality level in the city. These will help in identifying the socio-economic and other problems faced by neighbourhood communities so that policies and programs may be taken up by the stakeholders.

Methodology

Due to unavailability of primary data for some indicator variables, random stratified sampling method was employed to generate a sample of households for the entire city of Aizawl. A sample household of 5 per cent from the total household constitutes the sample size for each locality. Before taking the actual survey, a pilot survey was undertaken first to determine appropriate variables to be included in the study. Those features which were poorly understood, difficult to interpret and were of little or no importance to the public were excluded from further analysis. Thereafter, a schedule was designed to collect objective parameters for measuring urban quality of life (Table 1).

To prevent some variables having undue influences on the analysis, indicator variables were first normalized using the minimum-maximum method which put the indicators to have an identical range (0 to1). The formula of Min-Max method is $X = 1 - [(X_{max} - X_{ij}) / (X_{max} - X_{min})]$ where X_{ij} is the value of the indicator variable i of the Local Council, X_{min} is the minimum value of the indicator variable i and X_{max} is the maximum value of the indicator variable i.

Principal component analysis (PCA) is employed here to develop a composite index of quality of life. The technique is a data reduction method used to derive a composite, smaller set of correlated but independent variables known as components from a large set of variables. Each of the components

may be thought as a 'super variable'. Mathematically, principal components are linear combinations of variables with weights in terms of their eigen vectors. These eigen vectors are derived from the correlation matrix of the variables.

$$Z_1 = a_{11}x_1 + a_{12}x_2 + \ldots + \quad a_{1q}x_q$$

$$Z_2 = a_{21}x_1 + a_{22}x_2 + \ldots + \quad a_{2q}x_q$$

$$Z_q = a_{q1}x_1 + aq_2x_2 + \ldots + \quad a_{qq}x_{qm}$$

Each principal component is a linear combination of Z's obtained as

Where *x1, x2,...,xq* are the variables (indicators), *q* the number of variables and *Zi(i=1,...,q)* represents the principal components. *aij* are the component loadings which are chosen as weights applied to the variables *xj* in the above equation so that the principal component *Zi* satisfy the following conditions:

(i) they are uncorrelated (orthogonal);

(ii) the first principal component accounts for the maximum possible proportion of the variance of the set of *xs*, the second principal component accounts for the maximum of the remaining variance, and so on until the last of the principal components absorbs all the remaining variance not accounted for by the preceding components, and

$$a_{i1}^2 + a_{i2}^2 + \ldots + a_{iq}^2 = 1$$

where i= 1,2,...,q.

Table 1. Indicators of Urban Quality of Life, Aizawl City.

Code of Indicators	Definition of Indicators
F_Grad	Percentage of female graduate population.
Edu 12	Number of persons who have studied up to Class 12 and above/household.
Bank	Number of bank accounts/ household.
Profe	Percentage of professional and technicians from total population.
M_Grad	Percentage of male graduate population.
Computer	Number of computers/household.
Income	Average monthly household income.
4Wheel	Number of four wheel vehicles/household.
Rent	Average house rent value per household.
Electric	Average last month electricity bill.
Hospital	Number of health centers/1000 population.
Playground	Average distance to playground.
No_Agri	Percentage of workers engaged in non-agricultural sectors.
Community	Number of community owned assets/1000 population.
Bank_D	Average distance to nearest bank.
Water	Number of water connections/household.
RCC	Number of reinforced cement concrete (RCC) buildings/household.
F_Lit	Female literacy rate.

Analysis

Principal component analysis (PCA) requires computation of correlation analysis and test statistics like Kaiser-Meyer-Olkin (KMO) and Bartlett's test Sphericity to assess the appropriateness of using the technique. The correlation coefficient matrix shows that most of the variables were inter-correlated and there was no extreme multi-colinearity. The value of KMO for the selected data is 0.890 which is good enough to run PCA. The Bartlett's Test of Sphericity also showed a significance level of 0.00 and we can reject the hypothesis since the probability is less than 0.05. Then, PCA was run in the computer software Statistical Package for Social Sciences (SPSS) to extract communalities and components. Using Kaiser's criterion of taking eigenvalues more than 1, three components were extracted which altogether explain 66.75 per cent of total variation in the data set. The percentage of variation explained is considered good enough to carry forward the analysis.

After component loadings were estimated, the individual indicators with the highest component loadings are grouped into intermediate composite indicators. Since we extracted three components, there are also three intermediate composites as shown in the right-hand side of Table 2. The intermediate composites were normalized squared rotated component (factor) loadings. The squared factor loadings represented the proportion of the total unit variance of the indicator, which was explained by the component. The weights are normalized squared factor loadings and scaled to unity sum. For instance, the weight of the first variable F_Grad (0.176) is derived by the squaring of the highest loading of F_Grad variable (0.880) divided by the explained variance which is the portion of the variance of the first factor explained by the variable F_Grad. For e.g. 0.176 = (0.880 x 0.859)/4.412. In the same manner, the weights of the other variables were derived and included in the intermediate composite index.

The first column of Table 2 shows component loadings, the second column shows communalities and, the third one shows the intermediate composite indices. The first component consists of variables like percentage of female graduate (F_Grad), percentage of population who have studied up to class 12 (Edu12), number of bank account per household (Bank), percentage of population who are engaged in professional and technical works (Profe), percentage of male graduate (M_Grad), number of computer per household (Computer), and average monthly household income (Income). The component may be labelled as 'socio-economic' dimension. It is the most important component that

determines variability in objective QOL as it explains 24.51 per cent of the total variance.

The second component explains 21.92 per cent of the total variation. It includes three variables including number of four wheelers per household (Wheel4), rent value (Rent), and average monthly electricity bill per household (Electric). All the component variables have high positive loadings. Other variables that have significant loadings include Income (0.572), Computer (0.564), M_Grad (0.524), RCC (0.488), Profe (0.482), and F_Lit (0.44). This component

Table 2. Intermediate Composite Indices of Objective Quality of Life.

Variables	Components			Commu -nality	Squared Factor loadings (scaled to unity sum)		
	1	2	3		1	2	3
F_Grad	**0.880**	0.098	0.164	0.810	**0.176**	0.002	0.007
Edu12	**0.796**	0.357	0.182	0.794	**0.144**	0.032	0.009
Bank	**0.692**	0.232	0.174	0.563	**0.109**	0.014	0.008
Profe	**0.680**	0.482	0.107	0.705	**0.105**	0.059	0.003
M_Grad	**0.633**	0.524	0.197	0.714	**0.091**	0.070	0.011
Computer	**0.610**	0.564	0.346	0.810	**0.084**	0.081	0.033
Income	**0.596**	0.572	0.247	0.743	**0.081**	0.083	0.017
Wheel4	0.146	**0.828**	0.025	0.707	0.005	**0.174**	0.000
Rent	0.285	**0.816**	0.183	0.780	0.018	**0.169**	0.009
Electric	0.260	**0.767**	0.147	0.677	0.015	**0.149**	0.006
Hospital	-0.150	0.199	**0.748**	0.622	0.005	0.010	**0.153**
Playground	0.049	0.038	**0.737**	0.547	0.001	0.000	**0.149**
No_Agri	0.386	0.106	**0.698**	0.647	0.034	0.003	**0.133**
Community	-0.389	0.118	**0.657**	0.597	0.034	0.004	**0.118**
Bank_D	0.269	0.267	**0.654**	0.571	0.016	0.018	**0.117**
Water	0.456	0.301	**0.563**	0.616	0.047	0.023	**0.087**
RCC	0.320	0.488	**0.515**	0.606	0.023	0.060	**0.073**
F_Lit	0.243	0.444	**0.497**	0.503	0.013	0.050	**0.068**
% of explained variance	24.51	21.92	20.32				
Expl. Var. (Eigenvalue)	4.412	3.946	3.657				
Expl./Total	0.367	0.328	0.304				
Total Var.	12.015						

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 6 iterations.

Note: Expl.Var. is the variance explained by the component and Expl./Total is the explained variance divided by the total variance of the three components.

may be labelled 'household amenity' dimension.

The third component includes variables like average distance to nearest health centre (Hospital), average distance to nearest playground (Playground), percentage of workers engaged in non-agricultural sector (No_Agri), average distance to nearest bank (Bank_D), number of water connection per household (Water), number of reinforced cement concrete buildings per household (RCC), and female literacy rate (F_Lit). All these variables have loaded positively while community variable has negative loading. This component may be labelled as 'accessibility' dimension.

Once the intermediate composite indices have been constructed, they were aggregated by assigning a weight to each of them equal to the proportion of variance explained by the respective component. In other words, the weights assigned to the intermediate composite indices or weight of respective component

Table 3. Weights for Objective Quality of Life Variables.

Variables	Domain Weight	Weight for respective factor	Weight Score (W_{ij})	Resulting Weight (? W_i = 1)
F_Grad	0.176	0.367	0.064	0.089
Edu12	0.144	0.367	0.053	0.073
Bank	0.109	0.367	0.040	0.055
Profe	0.105	0.367	0.038	0.053
M_Grad	0.091	0.367	0.033	0.046
Computer	0.084	0.367	0.031	0.043
Income	0.083	0.328	0.027	0.038
Wheel4	0.174	0.328	0.057	0.079
Rent	0.169	0.328	0.055	0.077
Electric	0.149	0.328	0.049	0.068
Hospital	0.153	0.304	0.047	0.065
Playground	0.149	0.304	0.045	0.063
No_Agri	0.133	0.304	0.041	0.056
Community	0.118	0.304	0.036	0.050
Bank_D	0.117	0.304	0.036	0.049
Water	0.087	0.304	0.026	0.037
Rcc	0.073	0.304	0.022	0.031
F_Lit	0.068	0.304	0.021	0.028

equals the explained variance divided by total variance of each factor in Table 2. Weight Score (Wi) is obtained by multiplying the variable weight and weight of respective component. Finally, the resulting weight or final weight is obtained which is rescaled again to sum up to one to preserve comparability.

After the final weights were obtained, the rank of each Local Council was obtained by the product of normalized variable and the resulting weight. Each Local Council was ranked and mapped as per their rankings as shown in the figure 1.

Results and Discussion

Our analysis shows that Zarkawt obtained the first rank in objective QOL. Zarkawt is one of the most centrally located and most accessible neighbourhoods within the city. It is one of the oldest localities in Aizawl. This locality comprises of two adjacent hillocks - Macdonald Hill and Babutlang. The first two British Missionaries started their services from Macdonald Hill in 1894. Adjacent to this hillock in the southwestern part is another hillock called Babutlang which was a residential area for the government clerks known as *babus*. In between these two hillocks is the main Zarkawt point where a few Mizo clerks were settled. The area became one of the most prominent places in Aizawl. The first High School in Mizoram was established in this locality and a number of senior government officer quarters were also constructed. Presently, it contains several important offices and landmarks including Chief Minister's Office, Mizoram State Museum, Mizoram State Archive, and other important government offices. The most important route of the city runs across the neighbourhood and commercial activities occupy the lower floors of the buildings due to their higher bid-rent while the upper floors were residential units. The locality, therefore, is a residential cum administrative cum commercial area.

The second highest ranked locality is Tuikhuahtlang which may be described as a residential cum administrative centre. The locality lies at a hill top that overlooks many other localities. Many important bungalows and offices like Legislators' bungalow, All India Radio station and other important offices are located here. The official residence of the Governor of Mizoram is also located at a near distance.

At the bottom of the ranking lie two peripheral localities namely Rangvamual and Phunchawng. These two localities are located at a relatively far distance from the city proper in comparison to other localities. Although Rangvamual is one of the oldest localities in Aizawl, it has been failing to grow and develop due to distance effect and undue

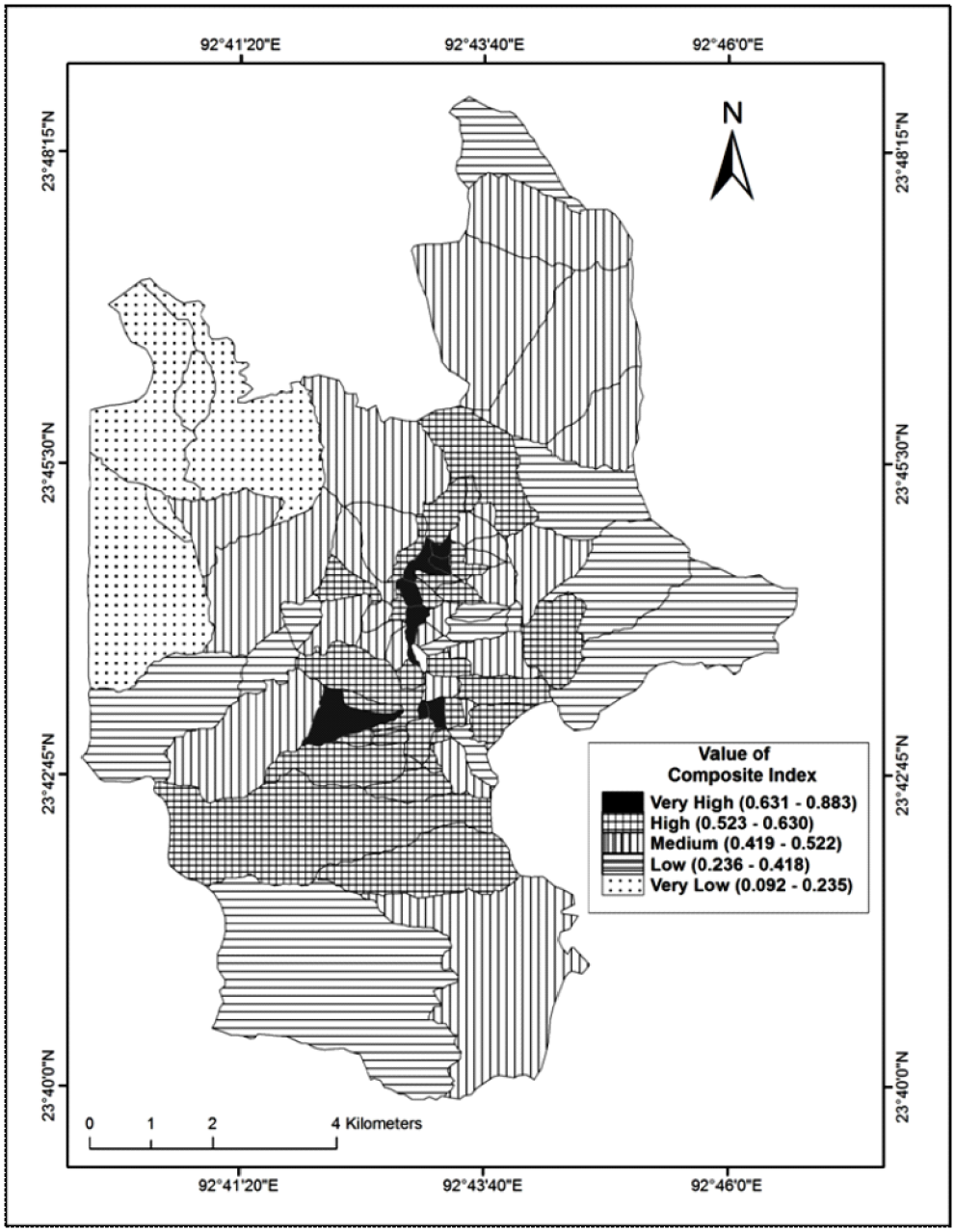

Figure 1. Composite Scores of Objective Quality of Life, Aizawl City.

Table 4. Quality of Life - Ranking and Classification of Localities in Aizawl City

Class	Localities
Very High	Zarkawt (1), Tuikhuahtlang (2), Dawrpui (3), Ramhlun Venglai (4), Bungkawn (5), Upper Republic (6), Chanmari (7), Laipuitlang (8).
High	Bawngkawn(9), Tuikual South (10), Nursery (11), Kulikawn (12), Model (13), Khatla (14), Zotlang (15), Electric (16), Ramhlun South (17), Thakthing (18), Bungkawn Vengthar (19), Ramthar (20), Dawrpui Vengthar (21), Khatla South (22), Mission Veng (23), Chaltlang (24), Republic (25), Falkland (26), Chanmari West (27), ITI (28), Chaltlang North (29), Khatla East (30), College Veng (31), Dam Veng (32), Saikhamakawn (33), Mission Vengthlang (34), Aizawl Venglai (35), Tlangnuam (36), Bethlehem (37).
Medium	Ramhlun Sport Complex (38), Bawngkawn South (39), Durtlang Leitan (40), Tuikual N (41), Venghnuai (42), Vaivakawn (43), Chawlhhmun (44), Kanan (45), Hunthar (46), Dinthar (47), Ramhlun Vengthar (48), Maubawk (49), Ramhlun North (50), Saron (51), Thuampui (52), Chawnpui (53), Edenthar (54), Ramthar North (55), Luangmual (56), Chhinga Veng (57), Durtlang (58), Mel Thum (59), Muanna Veng (60), Venghlui (61), Durtlang North (62), Bethlehem Vengthlang (63), Republic Vengthlang (64).
Low	Armed Veng (65), Govt. Complex (66), Armed Veng South (67), Salem (68), Zonuam (69), Tuithiang (70), Zemabawk North (71), Hlimen (72), Zuangtui (73), Zemabawk (74), Chite (75), Selesih (76), Lawipu (77).
Very Low	Tanhril (78), Sakawrtuichhun (79), Tuivamit (80), Rangvamual (81), Phunchawng (82).

negligence by the state government. Till 2010, there were no government owned schools in these two localities. Presently, Rangvamual has two private higher secondary schools while Phunchawng has only one. All the middle and primary schools found in these localities were government aided schools. No health centre, public library and indoor stadium were found in these two adjoining localities.

Conclusion

Broadly, the high ranked localities were found at central location and important junctions where buildings are mixed with both residential and commercial functions. On the other hand, the lowest ranked localities are the most peripheral localities which are mostly older settlements that have been incorporated into the city proper through legislative decisions. They are neither outgrowth nor outward expansion of the city. Physically, they are differentiated from the city proper by either a forest or a vacant land. They do not have adequate infrastructures and human resources to uplift their socio-economic conditions. They possess a characteristic of rural-urban fringe where economic activities range from purely rural to purely urban. Due to congestion of the city proper, suburbanisation of middle class population is taking place in certain localities while poorer non-local migrants were attracted by least developed peripheral localities like Rangvamual and Phunchawng.

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Inequality in Educational Attainment Among the Social Groups of Manipur

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Abstract : *Inequalities in educational attainment among the social groups have been extensively studied from various perspectives in different field in numerous countries. This paper examines the regional differentials in educational attainment in Manipur by using composite index. The results implied that the earliest imprint of modern and traditional educational institutions in the valley areas and the regions around the area, once within the ambit of the missionary had achieved a high score index than the other region in the state. On the contrary, the study also attempts to figure out the inequality in educational attainment among the social groups by using Gini's coefficient. It turns out that certain social groups in the state have been privileged, whereas some of them are deprived of achieving the education.*

Introduction

In the present times, education has become the only key to open a society in the modern world, upward mobility and socio-economic and cultural development of a country or region. It is the most important single input to convert the human resources into human capital, for economic development, techno-logical progress and innovation, social justice and equal opportunities anywhere around the world (Reddy, 2008; Singha, 2010; Gill, 2005 *et al*).Manipur has a long history of teaching and learning. However, in older times, teaching and learning had been confined to survival economic and martial skills. There had been no formal system and scientific tradition in the region. During the British conquest, the modern education system was introduced in valley areas and the Christian missionaries brought in the same system in some part of hilly regions in the state. After Independence formal education (modern) was extended to all sections of the society, although there are still widespread disparities in terms of educational attainments and infrastructure facilities across the state. But, traditional skills survived, but its teach-learning tradition gradually has weaned away. Till date, both the modern system and traditional art of teaching and learning went side by side.The study is an attempt to find out the inequality in educational attainment in formal education among the different social groups of Manipur.

The Study Area

The state of Manipur lies between 93°03'E and 94°78'E longitudes and 23°68'N and 25°85'N latitudes (Horam and Rizvi, 1998). It is situated in the easternmost part of the North-Eastern hilly

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region of India. It is a landlocked isolated hilly state, having a distinct geographical entity. It is almost rectangular in shape with a valley encircled by hill ranges. This small valley spreads over an area of 2007 km^2 which is about nine per cent of the total area of the state. The total area of the state is 22,327 km^2 making only 0.68 per cent of the total area of the Indian Union. As such, it is one of the smallest states in India. In terms of population, in 2011, the state has recorded 2,721,756 persons. This population size of the state is just 0.22 per cent of the total population of the country. The average elevation of the valley is 790 meters above the mean sea level. The hilly region comprises five districts namely Senapati, Tamenglong, Churchandpur, Chandel and Urkhul, while the districts of Bishnupur,Thoubal, Imphal West and Imphal East are situated in the valley. The nine districts of the state comprise 38 sub-divisions, 34 development blocks (9 community development blocks in valley and 25 tribal development blocks in the hills), 33 towns and 2,391 villages.

Objectives

The main objective of this study is to find out regional differential in educational attainment in the state. In this study an attempt is made to examine the social groups that are deprived of or in the privileged position with respect to educational attainment.

Database and Methodology

The present study is based on primary source data. An extensive field survey of educational levels among the social groups have been conducted with a detailed questionnaire from each sub-division of the state. The field work was conducted during June 20, 2013 to 31 August, 2013.

Apart from percentage of persons who have been only literate (informally) and educated at certain level, it was intended to know the relative position of different districts/sub-divisions in terms of overall educational attainment by devising some single measure or index. The variables were made scale free so that the magnitude of their values does not deter comparison of units of observation or influence values of index in favour of variables having large values.

However, generally all variables are not equally important in their contribution to the index representing the overall situation of a multi criteria construct as in the case at hand. It leads to the problem of assigning weights to constituent variables. There are also a number of methods (Stillwell, Seaver and Edwards 1981; Zionts 1989; Zopounidis and Doumpos 2002) to derive weights for variables objectively as well as subjectively. More cautious approach was used to derive weights for different levels of educational attainment. The

approach adopted is a variant of 'expert opinion' approach. In the present analysis, education' is considered affecting all spheres of life. It is why it is thought judiciously to carry out a very small opinion survey of 82 people, half men and half women,from all walks of life regarding how people (adult men and women) assess different levels of education inter alia sduring field survey to collect information on educational standards of different socio-cultural groups in Manipur.

The experts have been requested to assign a rank to the six levels of educational attainments i.e. Literate without Education Level; Below Primary, Primary, Middle School; Marticulation and Higher Secondary; Non-Technical Diploma or Certificate Not Equal to Degree; Technical Diploma or Certificate not equal to Degree and Graduate and above. The rank must be given from 0 to 10 considering how strongly they feel about skills, utility to society and capability to take correct or better decision in family, community and societal matters by those who have attained these levels of education. Means of the ranks given by these people (Appendix-II) are added together and individual means of ranks are divided by the sum of means of ranks given to different levels of education so that sum of weight per convention is unity (1.0):

In order to make values of educational attainment free of scale so that they may be added after applying their respective weights, method given below is employed:

$$\omega j = \frac{\varpi j}{\sum \varpi j}$$

Where,

ϖj is mean rank of educational level j;

$\sum \varpi j$ is sum of all level of educational levels;

ωj is the weight that is associated with educational level j;

j = 1,2,3...m;

m = total number of educational levels

In order to make values of educational attainment free of scale so that they may be added after applying their respective weights, method given below is employed:

$$\sigma i = \frac{Xi - Min}{Max - Min}$$

Where,

Xi are values of educational level x;

Min is minimum value of variable Xi; and

Max is maximum value of variable Xi.

σi are standardised values of educational level x; and

i = 1, 2, 3. . . , n;

n = total number of units of observation.

Hence,

CIi = Composite index of educational level

$$CIi = \sum_{i,j}^{m} \omega j \sigma i, j;$$

In order to workout inequality in educational attainment by ethnic/social groups (non-scheduled population, scheduled castes, scheduled tribes, Muslims and Christians), following form of Gini's coefficient has been used:

Where,

$$I_{in} = \frac{\rho ij^{I} ij}{\frac{1}{m} \sum_{j}^{m} = 1 \rho ij^{I} ij} - 1$$

I_{in} is index of inequality, ρj is percentage proportion of population of group j, I_j is index of educational attainment of group j and m is number of groups in which a population is divided. If index of inequality is one (1.00) or close to it, the group is not deprived, a group is deprived, if its value is negative, a positive value certainly indicates privileged position of a group in respect of educational achievement.

For the purpose of study,one sample village was surveyed each from 38 sub-divisions of the state and three sample urban towns which it differs in the population size i.e., Low, Medium and High. A simple random sample of households head has been interviewed with structure questioners in open-end questions. In this, a total of 1044 sample households have been chosen for in-depth interviewed on questions related with educational achievements. Out of these total households, 6,095 respondents have responded on this regard. Furthermore, the respondents have also been given the assurance that these data they will be used for the purpose of the research and the identities of the respondents will be confidential. The objectives are to determine the respondents' satisfaction and dissatisfaction on education attainments in Manipur.

Profile of Respondents

Social Groups

Table 1 shows the religious groups of the respondents. Of these 1044 sample households, 466 (44.64 per cent) have been scheduled tribes; 351 (33.62 per cent) of the have been caste Hindu; 132 (12.64 per cent) are scheduled castes; 84 households which comprise of 8.05 per cent have been Muslims and 11 households that make only 1.05 per cent is formed "Other" i.e. religion not stated. Out of 6095 respondents, 3027 (49.67 per cent) have been scheduled tribes; 1750 (28.71 per cent) have been caste Hindu; 713 (11.70 per cent) have been responded from scheduled castes, while 539 (8.84 per cent) have been Muslim respondents and 66 (1.08) are responded from Other religious groups.

Rural and Urban

In Table 2, the distribution of households of respondents is shown by residence (rural/urban). Of the total 1044 households 710 i.e. 68.01

Table 1. Distribution of Sample Households by Religion*

Religion	No. of Households	% of HH	Member of Households	% of Member of Households
Scheduled Castes (Hindu)	132	12.64	713	11.7
Caste Hindu (Hindu)	351	33.62	1750	28.71
Scheduled Tribes (Christian)	466	44.64	3027	49.67
Muslim	84	8.05	539	8.84
Others	11	1.05	66	1.08
Total	**1044**	**100.00**	**6095**	**100.00**

*Excluding 0-6 year's age groups.

per cent have been residents of rural areas; while only 334 households making 31.99 per cent of the sample households have been residing in cities and towns. As far as number of respondents by residence is concerned (excluding children aged up to 4 years), 4310 (70.71 per cent) respondents have been residents from rural areas, while 1785 (29.29 per cent) have been residents of cities and towns.

Location: Terrain Types

Geographically, Manipur can be classified into hill and valley regions. People settle in various parts of the state with different degree of concentration over space. The nature of roads accessibility, communication system, distribution of educational infrastructural facilities is not similar in various parts of the state. That is why, to have better understanding in the spatial disparities of education in wider range of the study areas the settlements regions are re-classified into three types, such as Hill, Slope (foothill) and Valley regions and the data is gathered from these different physical terrains of the state, as shown in Table 3.

Out of the total, 282 households have been interviewed from Hill region which comprise 27.01 per cent of the total households, 167 from Slope which makes 16.00 per cent of the households and the largest of 595

Table 2. Distribution of Sample Households by Residence*

Residence	No. of Households	% of HH	Member of Households	% of Member of Households
Rural	710	68.01	4310	70.71
Urban	334	31.99	1785	29.29
Total	1044	100.00	6095	100.00

*Excluding 0-6 year's age groups.

households that represent 56.99 per cent of the households have been interviewed from Valley region of the state. In the case of number of respondents, 1986 (32.58 per cent) have been recorded from the Hill; 954 (15.65 per cent) have been surveyed from Slope, while the maximum of 3155 respondents (51.77 per cent) have been collected from Valley part of the state.

Educational Attainment Levels of the Respondents

The index of educational levels achieved by the respondents in sub-division level is revealed in Figure 1. The high score in the index of educational attainment is observed in 13 sub-divisions and it is mostly confined in and around the central valley districts, which to some extent two districts extend the southern and one district in the northern part of the state. Out of these 13 sub-divisions, 11 sub-divisions adjoin their boundaries forming one large contiguous region while two districts are observed in two separate part of the state, one in the north and the other one in east. Imphal, the capital of the state is located in the valley and the seat of power of erstwhile sovereign kingdom of Manipur. As such, most of modern and traditional educational institutions has established on this region. Consequently, rural population of this region has scored high on the index of educational level while the hill sub-divisions which come under this category had been the focus of missionary activity from the very beginning and number of new educational institutions has set up by the state government.

On the contrary, the medium level of educational attainment has been observed in 15 sub-divisions. Of these 15, 4 sub-divisions have noticed at valley part of the state and remaining 11 sub-divisions are noted on hill and they are seen in four parts of the state that is, 2 in southwestern, 3 in southeastern, 3 in northeastern and 3 in northern part of Manipur. The educational level of this region can again be attributed to the work of missionaries and the closeness to

Table 3. Distribution of Sample Households by Terrain Type*

Terrain	No. of Households	% of Households	Member of Households	% of Member of Households
Hill	282	27.01	1986	32.58
Slope	167	16.00	954	15.65
Valley	595	56.99	3155	51.77
Total	**1044**	**100.00**	**6095**	**100.00**

*Excluding 0-6 year's age groups.

the seat of power.

Low score on the index of educational attainment is observed in 10 sub-divisions. Out of 10 sub-divisions, 8 sub-divisions are observed on hill and these regions have a very rugged topography and were not accessible to missionaries. Therefore, this region lagged behind from other regions, while 2 sub-divisions which are seen under low score from the valley have been surveyed from extremely rural areas of the sub-divisions.

Ethnic Differentials in Educational Attainment by Respondents

A cursory examination of Figures 2, 3, 4 and 5 and Table 1 indicates that there are wide ranging differentials in educational attainments by ethnic groups in Manipur across sub-divisions. These differentials are worked out

Table 4. Educational Levels in Manipur, 2012

Sl. No.	Sub-Divisions	Index of Education	Sl. No.	Sub-Divisions	Index of Education
1.	Tipaimukh	0.200	20.	Kamjong Chassad	0.176
2.	Thanlon	0.199	21.	Pungyar Phaisat	0.175
3.	Churachandpur North	0.292	22.	Ukhrul South	0.282
4.	Churachandpur	0.161	23.	Nambol	0.183
5.	Singhat	0.289	24.	Bishnupur	0.115
6.	Machi	0.203	25.	Moirang	0.145
7.	Tengnoupal	0.125	26.	Tamenglong West	0.146
8.	Chandel	0.216	27.	Tamenglong North	0.099
9.	Chakpikarong	0.096	28.	Tamenglong	0.092
10.	Jiribam	0.095	29.	Nungba	0.300
11.	Sawombung	0.359	30.	Sadar Hill West	0.217
12.	Porompat	0.289	31.	Saitu Gamphazol	0.357
13.	Keirao Bitra	0.183	32.	Sadar Hill East	0.150
14.	Lamshang	0.236	33.	Mao-Maram	0.323
15.	Patsoi	0.237	34.	Paomata	0.174
16.	Lamphelpat	0.229	35.	Purul	0.164
17.	Wangoi	0.259	36.	Lilong	0.178
18.	Ukhrul North	0.115	37.	Thoubal	0.348
19.	Ukhrul Central	0.189	38.	Kakching	0.186

Source: Based on survey data

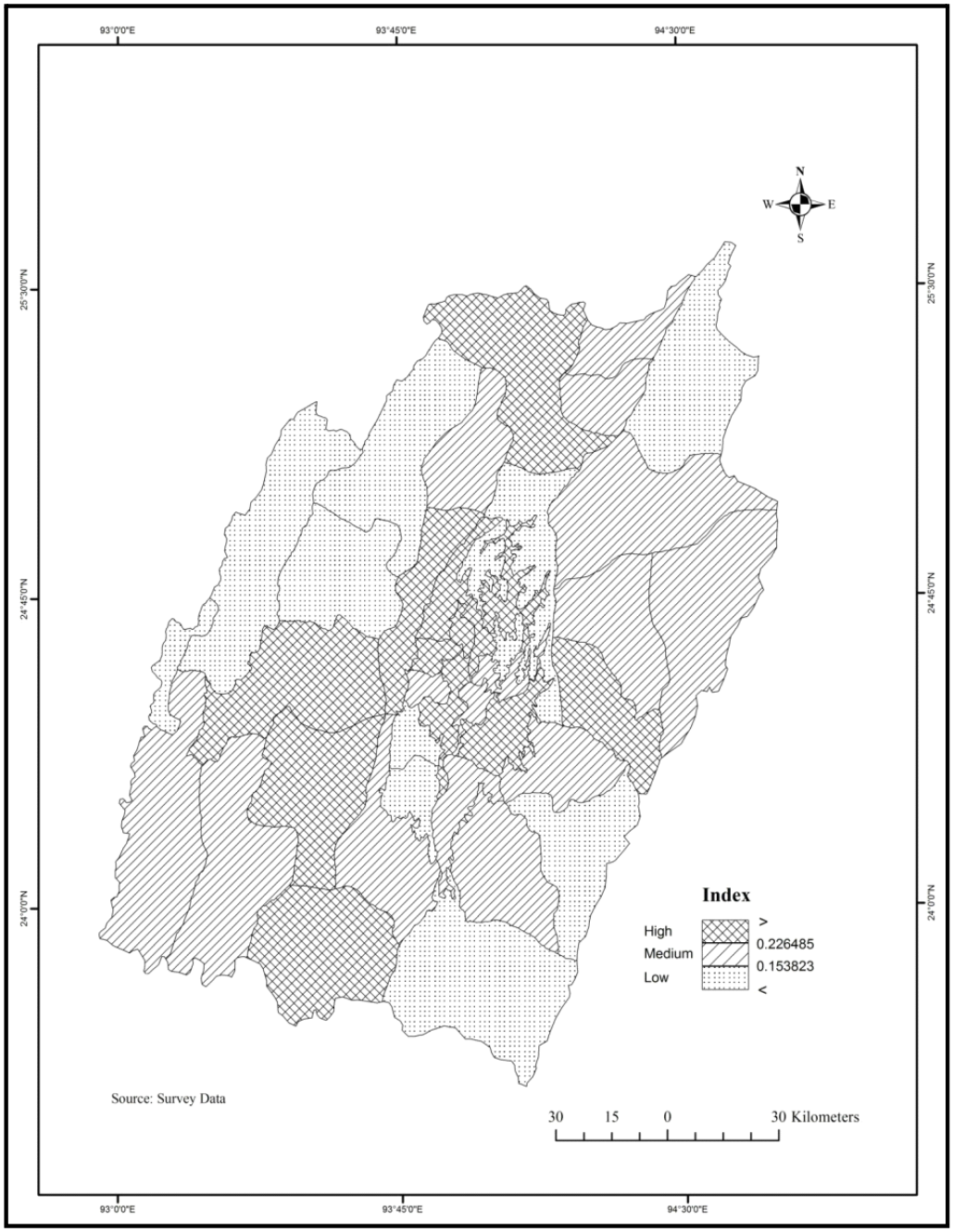

Figure 1. Educational Levels in Manupur, 2012

using method of index of inequality as discussed earlier. The values of inequality or differentials for four ethnic groups of caste Hindus, scheduled castes,scheduled tribes and Muslims have been pooled together and mean and standard deviation have been computed. As theoretically expected, mean turned out as zero, while value of standard deviation has been 0.708294. This standard deviation value has been divided into half and addition as well as subtraction of this half standard deviation has defined various levels of privilege and deprivation.

In spite of a share of second highest numbers in the sample (28.71 per cent), the caste Hindus have turned out the largest beneficiary of education. Out of 38 sub-divisions of the state, twenty or 52.63 per cent are found highly privileged and in only two marginally deprived. In 36 out of 38 or 94.74 per cent sub-divisions they are found in all the categories of privileged in attainment of education. On the other hand, the ethnic group that makes an overwhelming majority in the sample (49.66 per cent) that is, scheduled tribes show a mixed pattern with a strong tendency towards privilege. They show an extremely privileged position in educational attainment in 3(7.89 per cent) sub-divisions, a highly privileged position in 8(21.05 per cent) subdivisions, in 14(36.84 per cent) sub-divisions they are privileged, in 9(23.68 per cent) sub-divisions. Scheduled castes are on the other hand marginally privileged in terms of educational attainment, while they are marginally deprived in this respect in only 4(10.58 per cent) sub-divisions.

In contrast to caste Hindus and scheduled tribes, scheduled castes that form 11.70 per cent are found deprived in educational attainment in all the 38 sub-divisions of the state. They are marginally deprived in 12(31.58 per cent) sub-divisions, deprived in 19(50.00 per cent) sub-divisions and highly deprived in 7(18.42 per cent) sub-divisions. Deprivation in terms of educational attainment is more striking in the case of Muslimswho despite having their presence in 33 sub-divisions are represented only in 8.85 per cent of all the respondents in the total sample. It needs emphasis that in all the sub-divisions of their presence, they are educationally deprived. In 17(51.52 per cent) of sub-divisions of their presence they are highly deprived, in 13 (39.39 per cent) sub-divisions, they are deprived and in only three (03), they are marginally deprived.

Figure 2 depicts regional patterns of privilege and deprivation in educational attainment of caste Hindus. Their region of extreme privilege is mainly concentrated in the valley and adjoining hilly tract except for a large isolated sub-division in extreme south-east. The region of high privilege is quite

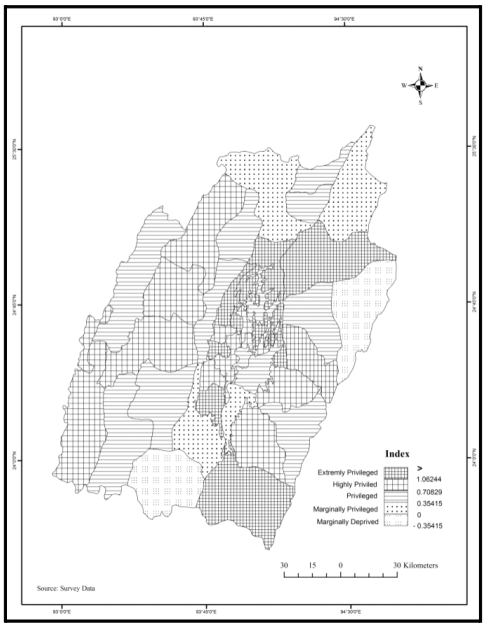

Figure 2. Differentials in Educational Attainment among Caste Hindu, Manipur, 2012

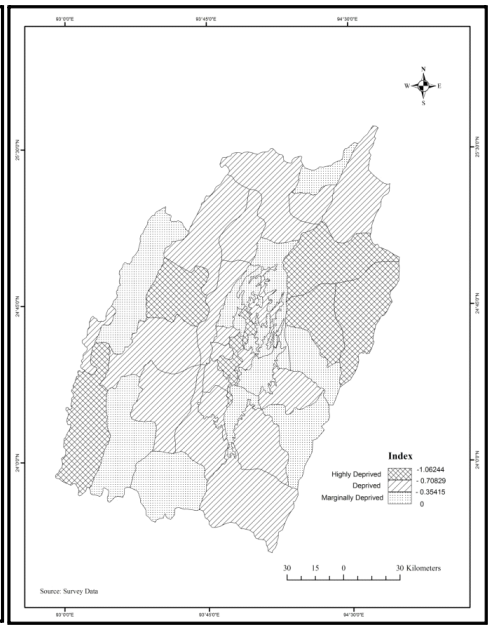

Figure 3. Differentials in Educational Attainment among Schedule Caste, Manipur, 2012

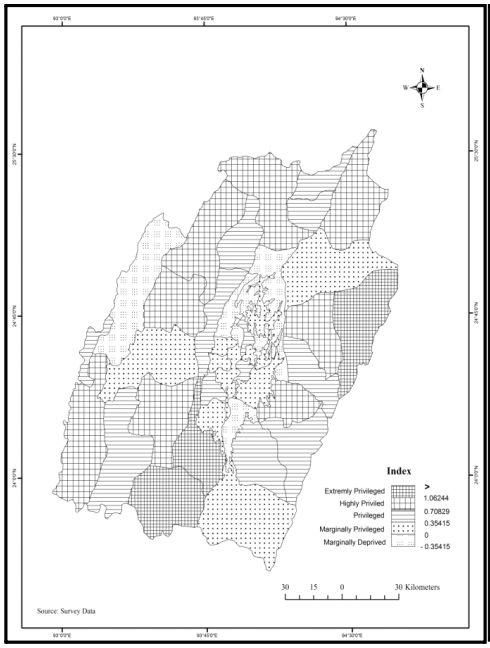

Figure 4. Differentials in Educational Attainment among Schedule Tribe, Manipur, 2012

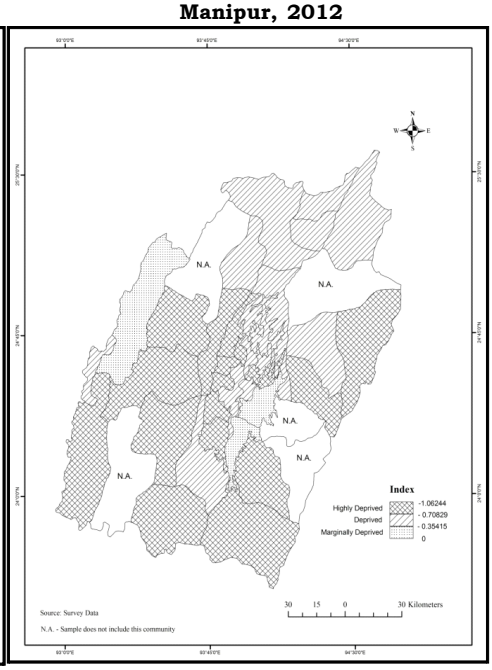

Figure 4. Differentials in Educational Attainment among Muslim, Manipur, 2012

extensive from north to south in the hilly tract on the western and eastern part of the state. The privileged position of caste Hindus is found in several isolated pockets. Two regions of their privileged position are found in extreme north and south-west. A little extensive region of this level flanks the valley on its western side. Three isolated pockets are in the middle and south-eastern hilly tracts, while one on the middle-western part of the state. The level of marginally privileged educational attainment by caste Hindus is observed in isolated form in hilly tract in the north and south of the valley. They are marginally deprived in educational attainment in only two isolated pockets, one in the extreme south and the other in the north-western margin of the state.

Level of marginal deprivation in attainment of education by scheduled castes makes two extensive regions; one from valley extends into adjoining hilly tracts on the eastern side (Figure 3). Another is observed in the south-western part of Manipur. A quite significant region of this level of deprivation is observed in the northern part of the valley. The two main isolated instances are observed in the extreme north and middle-western part. Scheduled castes are extensively deprived over space. An extensive region wherein scheduled castes are deprived extends from extreme south-eastern part of the state towards extreme west and extreme north. High deprivation of scheduled castes forms a very extensive region in the hilly tract of northwestern part of the state. The other region forms north to south in the valley. In addition to these, there are two major isolated instances in the middle-west and south-west.

Differentials in level of educational attainment by scheduled tribes across space in Manipur are shown in Fig. 4.The region of their extreme privilege is prominent in southern part of the state extending between the valley and the southern boundary of the state. An isolated pocket of this level is also observed on the northeastern part of the state. Level of high privilege in educational attainment by scheduled tribes is quite widespread and makes a prominent region in the western and northern part. In north-east and south-west, isolated pockets of this region are found disconnected by regions of privilege or marginal privilege. On the western flank of the valley only two isolated pockets are observed of high privilege. There are three main regions wherein scheduled tribes are found to be privileged in attainment of education. One small region is in the extreme north, one large region is on the western flank of the valley and another in the eastern hills towards south. A large isolated pocket is found in south-west. Other small pockets are scattered all over the

hilly tract. Marginally privileged areas of scheduled tribes are mostly concentrated in the valley except for two large isolated instances in the north-west and south-east. Similarly, scheduled castes have marginally deprived pockets mostly in valley except one isolate instance in middle-west. It is interesting to note that in valley, they could not have attained a position of privilege. It may be due to their low proportion and dominance of caste Hindus therein.

Muslims are marginally deprived in the eastern hills flanked by the valley and in the middle-western part of the state (Figure 5). They are deprived or disadvantaged in large areas. An extensive region of this level of Muslims is in the northern hilly tract. It is an insurgency affected area, may be Muslims out of precaution do not send their children to educational institutions besides low economic status that requires all the members of household to work in order to earn two square meals. Except this large region wherein Muslims are deprived to attain a remarkable educational level, a number of isolated instances are observed, largely concentrated in valley where they are in substantial number and also in two isolated instances, one on the eastern side of the valley and the other in the south of the valley. The most prominent region of highly deprived covers an extensive area starting from south-east, extending towards west and north and a large part of eastern valley. Another region of high Muslim educational deprivation is formed by two sub-divisions on the middle-eastern part of the state.

As a whole, it appears that caste Hindus are highly privileged over space and magnitude in Manipur followed by scheduled tribes. It appears, the advantage of early acceptance of modern education, especially by the scheduled tribes due to the efforts of Missionaries have their imprint on the attainment of education by different ethnic groups. Muslims in the state are not prominent either politically or economically in the state; therefore, like the country as a whole their position with respect to educational attainment is low.

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Land Capability Classification in Chemlui Sub-Watershed, Kolasib District, Mizoram Using GIS and Remote Sensing Techniques

- David B. Lalhruaitluanga
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- Ch.Udaya Bhaskara Rao

Abstract : *Remote sensing provides the basic data to undertake inventory of land, as well as the temporal information required to monitor sustainable land management practices. There is a necessity to develop proper strategies or land capability classification which can frustrate these harmful effects on environment and to improve productivity of land. The study deals with the application of remote sensing and GIS for land capability classification in Chemlui sub-watershed, Kolasib District, Mizoram. In this paper, the current use of remote sensing for sustainable land management is reviewed, and the potential of future (new) satellite systems to contribute to sustainable development is explored. The inbuilt practice of shifting cultivation in this area has rendered extensive destruction of land resources and environmental conditions. For the present study, United State Department of Agriculture (USDA,1973) classification based on parameters has been considered to define land capability classes. Indian Remote Sensing satellite data IRS P6 LISS-III image (2016) has been used for generating various Geographical Information System (GIS) layers with the help of ArcGIS 10.2.2 software. Integration of these with collected ground data resulted in creation of a wide-ranging of land capability for the study area. The study demonstrates that introduced GIS provide advantage to analyze multi-layer of data spatially and classify land based on its capability. The analysis reveals that land capability Classes of IIe, IIIe, IVe, VIe and VIIe are identified. This classification method and information will be very helpful for planning land utilization at sub-watershed level of a region.*

Introduction

Land resources utilization has its impact on the biodiversity and environment of allied region either positively or negatively depending on how it is used in time and space. As land-use planning is defined as a systematic assessment of land capability and water potential, alternatives for land use, and the economic and social conditions required to select and adopt the best land-use options, it is important to identify the available resources at micro level more precisely. The management of resources at watershed or sub-watershed level is convenient and the most effective for their development.

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The basic principle of soil and water conservation is to use the land and according to its capability and treat the land according to its needs. Land capability classification is usually started with the objectives to increase productivity and to improve the sustainability of natural resources. The Remote Sensing technology along with GIS is a perfect device to identify, locating and prepared maps of various types of lands associated with different landform units. Land capability is the ability of land to support a given land use without causing damage. Assessment of land capability considers the specific requirements of the land use, e.g. rooting depth or soil water availability, and the risks of degradation associated with the land use. Land Capability Classification (LCC) is a system of grouping soils primarily on the basis of their capability to produce common cultivated crops and pasture plants without deteriorating over a long period of time. Each soil map unit is assigned a capability class of I through VIII, and classes II through VII are assigned a sub-classes describing limitations or hazards for agricultural purposes (USDA).

The objective of present research work is to identify the land capability classes of Chemlui sub-watershed, Kolasib District, Mizoram. This paper will present a role playing approach of land capability to remote sensing and geographic information systems (RS-GIS) with suitability classification aimed to develop long term management strategies of regional planning by identifying probable areas of future dreadful conditions of land.

The Study Area

The present study area Chemlui sub-watershed is located between 92^{0}40'30"E - 92^{0}48'0"E longitudes and 24^{0}4'0"N - 24^0 24'30"N latitudes covering an area of about 16,563 Ha. (Figure 1). The area falls in parts of survey of India toposheets number 83D/11, 83D/ 12 and 83D/15. The river Serlui is a tributary to the river Tuirial which is flowing towards north in Mizoram. Chemlui is the tributary to the river Serlui. The area experiences humid tropical climate. Linear to arcuate shaped hills separated by narrow and deep structural valleys controlled by faults and fractures are the prominent geomorphic features seen in the area. The maximum elevation of 1100 metres is seen in the southern part of the watershed and the minimum of 60 metres is found at its confluence with river Serlui near Saiphai village. The whole watershed is composed of sedimentary rocks such as sandstones, siltstones and shales.

However, the people practice agriculture and horticulture farming and plantations, shifting cultivation is still the dominant form of agricultural system. The forest type is mainly tropical wet moist

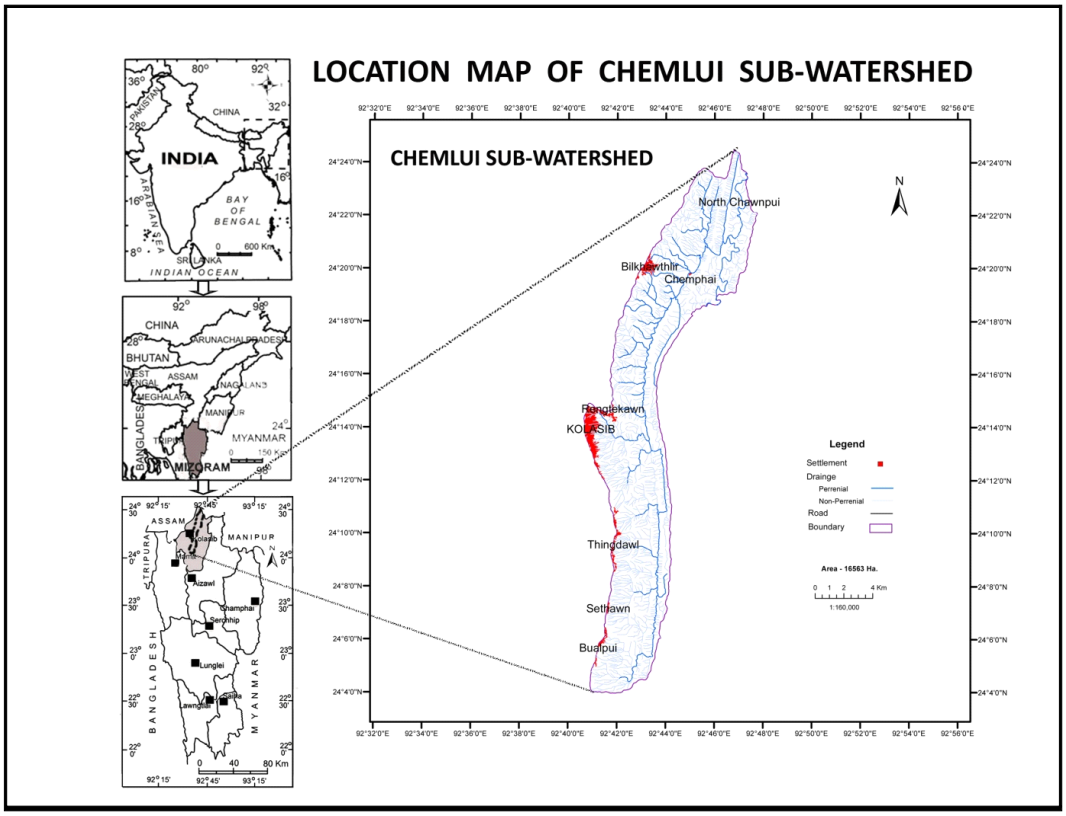

Figure 1. Location Map of Chemlui Sub-watershed

deciduous forests comprising mainly of bamboo.

Methodology

For land capability classification Satellite image of IRS P6 LISS-III sensor 2016 (MIRSAC) has been used. Slope map is obtained from CartoDEM satellite image of 30m spatial resolutions. Based map was prepared from India toposheets number 83D/11, 83D/12 and 83D/15. In this classification, the arable soils are grouped according to their potentialities and limitations for sustained production of the common cultivated crops that do not require specialized site conditioning or site treatment. Non arable soils (soils unsuitable for long time sustained use for cultivated crops) are grouped according to their potentialities and limitations for the production of permanent vegetation and according to their risks of soil damage if mismanaged. It is mainly based on the inherent of soil properties, external land features, and environmental factors that limit the land use.

According to the classification made by USDA soils of the study

area have been classified into 5 land capability classes i.e. IIe, IIIe, IVe, VIe and VIIe (Figure 2) using ArcGIS 10.2.2 software. The land capability Classes I to IV are considered as capable of producing cultivated crops with good management and conservation treatment. Classes V to VII are best suited to perennial vegetative species, but may be capable of producing some specialized crops with highly intensive management. Class VIII soils are not suitable for managed vegetative production. Subclass 'e' is made up of soils for which the susceptibility to erosion is the dominant problem or hazard affecting their utilization. Erosion susceptibility and past erosion damage are the major soil factors that affect soils in this subclass.

Result and Discussion

According to the Land capability classification summarized in Table 1, class IIe and IIIe covered 3501.38 hectare (21.14%) of Chemlui sub-watershed can be expressed as the land of suitable for agriculture. The study reveals that 10.32% of the total area falls

Table 1. Land Capability Classification Statistics of Chemlui Sub-watershed

Sl. No	Land Capability Class	Description of Land Capability Classes	Area in Hectare	Area in Percentage
1	IIe	Good arable land on gentle slopes, susceptible to slight Water erosion, very deep soil, suitable for agricultural purpose.	1709.58	10.32
2	IIIe	Good land with moderate sloping to steep, susceptible to severe Water erosion, deep to very deep soil, suitable for horticultural and agricultural purpose.	1791.80	10.82
3	IVe	Highly susceptible to Water erosion, good land on steep to very steep slopes and hill ridge with deep to very deep soil and is suitable for agro-horticultural and sericulture purpose.	9476.66	57.21
4	VIe	Land with severe limitations on very steep slopes, subject to severe erosion and is not suitable for agricultural purpose but suitable for social forestry and0 grazing.	2162.59	13.06
5	VIIe	Land with severe limitations on very steep slopes, subject to severe erosion and is not suitable for agricultural purpose but suitable for social forestry and0 grazing.		
6	Built-up land		429.32	2.59
7	Water bodies		254.31	1.54
Total			**16563**	**100**

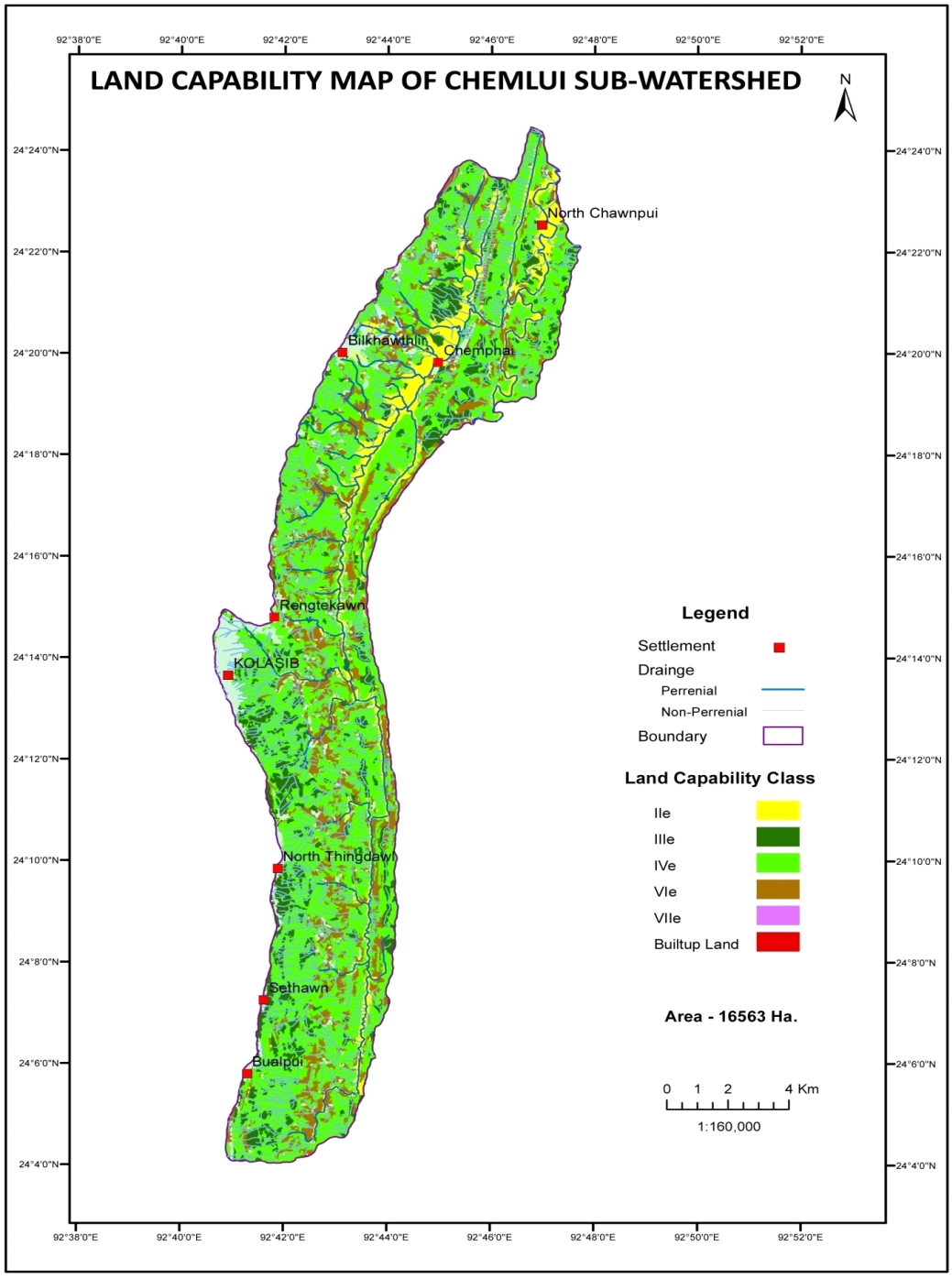

Figure 2. Land Capability Classification of Chemlui Sub-watershed.

in class IIe, there is good arable land on gentle slopes with very deep soil and susceptible to slight Water erosion. Land capability class IVe occupied 9476.66 hectare of land accounted 57.21% of the study area. Soils in this class IVe have high susceptible to Water erosion, good land on steep to very steep slopes and hill ridge with deep to very deep soil and is suitable for agro-horticultural and sericulture purpose. Land capability class VIe covered 2162.59 hectare (13.06%). Land capability class VIe have moderate land with limitations that require special conservation practices on very steep slope with deep to very deep soil which is highly susceptible to water erosion and is suitable for horticultural plantation and forestry. Land capability class VIIe occupied only 738.54 hectare (4.46%) of the study area and found that soils in this class are severe limitations on very steep slopes, subject to severe erosion and is not suitable for agricultural purpose but suitable for social forestry and grazing.

Conclusion

The study reveals that the application of remote sensing and GIS approach provide enormous advantage to analyze those multi-layer of satellite imagery data spatially and classify land based on its capability accordingly. Results of the study exposed the existence of land especially calculating the land capability by classifying into different classes according to their geographical potentiality using advance techniques and tools for future planning of land utilization at sub-watershed. From the land capability classification it is observed that there is good potential for agricultural with horticultural system and plantations in the study area. And also focuses on conservation of the existing forests to maintain ecological balance while taking up improved and alternate farming practices in the sub-watershed as well.

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Identification of Food Security Region for Balanced Development in Mizoram

- Lalrinpuia Vangchhia
- Vanlalṭanpuia

Abstract : *Man needs adequate food to sustain life. The security in food is necessary for attaining life, growth and healthy life. The present study analyses the level of food security status in the eight districts of Mizoram to identify the food security region for attaining balanced development. The level of food security has been determined by considering the three major components like Food Availability, Food Accessibility and Food Stability including nine minor food security indicators. The Z score standardize technique has been used to analyze of the variables. The study area can be divided into two food security regions like food secure and food insecure region. The two districts like Serchhip and Champhai may be treated as a more or less food secure region at state level whereas the other six districts are food insecure region. The study also identified the food security region as well as the unequal development in terms of food security in the state. So, the study has relevance espicially for balanced development.*

Keywords : *Food Security, Food Availability, Food Accessibility, Food Stability, balanced development*

Introduction

The term 'Food Security' was first coined in 1974 by the Food and Agricultural Organization (FAO). The World Bank has defined it as "ensuring food to all people at all times has both physical and economic access to basic food they need" (World Bank, 1990). Mathew (2002) described three main components of food security viz. availability, distribution and access. Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Food security depends on availability of food that is nutritionally adequate and safe, especially food that is produced by the new cutting edge from technology (Singh, 2002).

The Food and Agriculture Organization in the fourth (1977) and fifth (1985) World Food Surveys puts the proportion of the third world population living below a minimum survival level of energy consumption at about 15 per cent, where as World Bank (1986) assesses the number of living on diets in less than optimum energy content at between 14 & 15 per cent. Sukhatme (1977) estimates that in India the numbers of people

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whose energy intake are below the lower limit of adaptation comprise 20 per cent of the population, whereas Dandekar and Rath (1971) estimated about twice that proportion to be unable to purchase a minimum adequate diet.

The Food and Agriculture Organization of the United Nations (2013) estimates around 800 million people worldwide to be food insecure and they are not limited to the developing world. Busch and Lacy (1984), FAO (2003) consider measuring food insecurity at the individual/Household level rather than the national level defers from the more traditional approach of identifying food insecurity as the inadequacy of aggregate supply and accessibility to food (Sen, 1981).

Food security is a matter, which has been receiving attention of every one and has resulted in World food Summit five years ago. Kumar (2011) explained that as far as India is concerned we have achieved the food self-sufficiency and have a large buffer stock of almost 60 million tons of food grains. However, at the same time we have about 26 per cent of the population Below Poverty Line. In terms of absolute numbers, this means that almost 260 million persons are below the poverty line in the country. A large proportion of this population lives in rural areas. It is estimated that almost 193 million persons out of the 260 million persons below the poverty line live in rural areas.

Mizoram stood at a very low level in food by taking the food security components as an indicator. The per capita production per annum, per capita per day availability of rice, livestock availability per head, percentage irrigated land etc. is extremely low in the state. At the same time, there is inequality in terms of Public Distribution System (i.e., number of fair price shop) in rural and urban areas. The road density and conditions are also imbalance among the district in general and rural and urban in particular. Thus, the study of disparity in the state is necessary for planning an equal and sustainable development.

Objectives

The main objectives of the study are:

i) To find out the food security level in Mizoram
ii) To identify food secure and insecure districts in Mizoram
iii) To suggest a model for food security in Mizoram

The Study Area

Mizoram is located on the tip of the Northeastern boundary of India lies between 21°56'N -24°31'N latitudes and 92°16'E - 93°26'E longitudes. According to 2011 census, the state has 10, 97,206 Population, among the total population, 91.58 per cent are literate; the number of female per 1000 male is 976. The food production per head per annum in

the year 2013-2014 is only 69.68 (Agriculture Abstract, Mizoram, 2014). As a result of the study the state can be divided into two parts i.e., more or less food secure region and insecure region. The two eastern north districts may be treated as food secure region while the other 6 district are falling under insecure region.

Data and Methods

The present study is mainly based on secondary data which is published by the state government. The data about food production per head per annum, irrigated area in % and yield per hectare are collected from Agriculture Abstract of Mizoram (2013-2014). Statistical Handbook of Mizoram (2014) has been used to find out per capita per day availability of rice, number of livestock per head and number of fair price shop per village or local council. Percentage of main workers and literacy rate were collected from Census of India publication 2011.

The present study attempts to

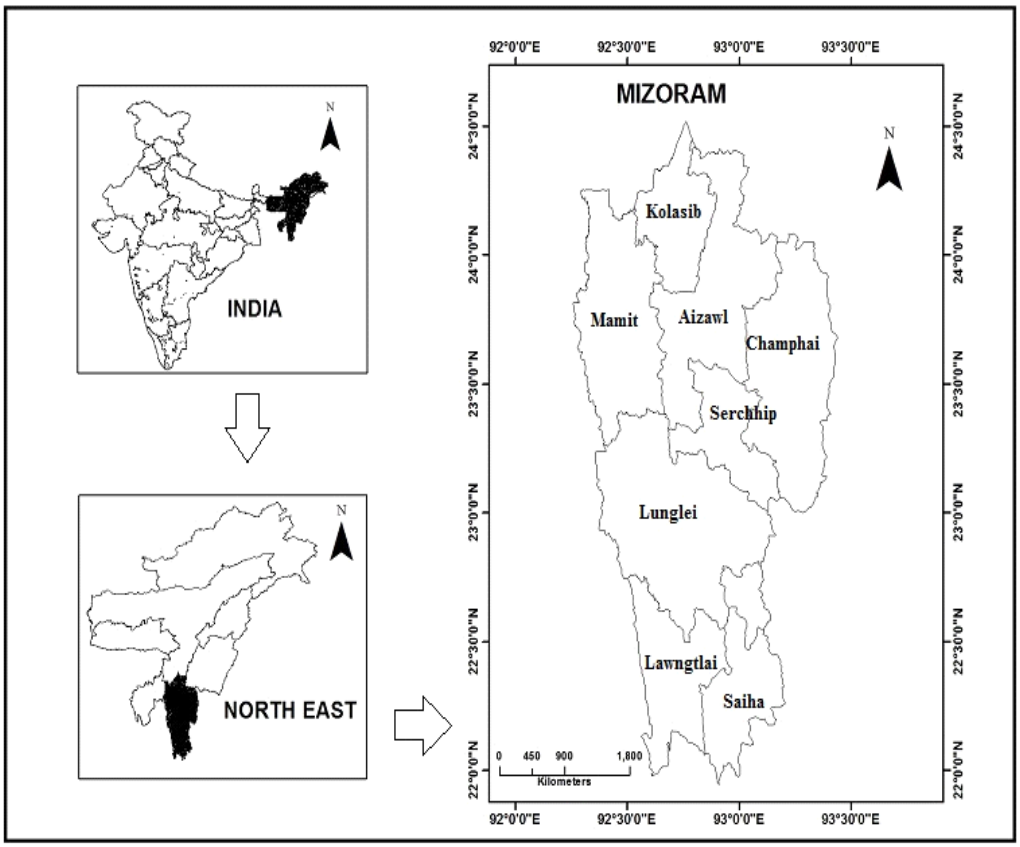

Fig 1: Map of the Study Area

find out the levels of food security to identify the food secure and insecure region in Mizoram by considering the major three components like food Availability, food accessibility and food stability including the 9 food security indicators (i.e., each components have three indicators). To analyze of these variables Standard Deviation and Z score stand-ardization techniques have been applied. Arc GIS 9.0 has been employed to in cartographic works.

Result and Discussion

Food Availability

Food availability is one of the most important component in food security, since rice is the main food in the state. Food availability is measured by studying the three indicators like rice production per head per annum, per capita per day availability of rice and number of livestock per head (as live stock is the other important source of food that provides meat and milk).

Food production per head per annum:

Since rice as the staple food, production of rice per head in a year is taken as an important component for food security. It refers to the domestic production of rice per head per annum. In 2014, the average rice production per head per annum is 69.68 kilogram per hectare of land. Among the 8 district, Champhai has scored the highest (125.49 g/head) while Aizawl has produced only 13.16 which is 112.33 lower than Champhai district. Champhai district is followed by Kolasib (121.02), Serchhip (106.72), Lawngtlai (75.80), Mamit (47.00), Lunglei (38.13) and Saiha (30.10).

Per capita per day availability of rice:

The study shows that the per capita per day availability of rice in Mizoram (i.e.193.59 gram) is less than the national average (i.e., 462 grams). The district Champhai has got the highest (348.67 grams) while Aizawl has the lowest position in this indicator (36.67 grams). Among the district, the north and eastern part of the state have a high levels (except district Aizawl as an exceptional case) while the south and western part of the state have a low per capita per day availability of Rice. The study shows that there is no district which is higher than the national average in availability of rice in the study area.

Number of Livestock per head:

Livestock is taken as one of the important indicators of food security because the important food such as meat and all dairy products like milk, butter, ghee etc. are derived and hence the number of livestock per head is taken as an indicator of food security levels measurement. In this case, Champhai district has attained the highest position (2.55) followed by Saiha (2.38), Serchhip (1.74), Mamit

(1.63), Kolasib (1.56), Lunglei (1.40), lawngtlai (1.11) and Aizawl (1.02).

Levels of Food Availability

To evaluate the level of food availability, the composite score of the three indicators such as food production per head per annum, per capita availability of food and number of livestock per head for the study area were taken into account. The result shows that the district champhai has the highest score in food availability i.e., 4.5 followed by Kolasib (2.14), Serchhip (1.82), Saiha (-0.51), Mamit (-0.11), Lawngtlai(-0.74), Lunglei (-0.93) and Aizawl (-3.76).

Food Accessibility

The accessibility of foods is another important component which determines the food security in an area (Swaminathan, 2010). Majority of malnourished population cannot produce or afford to buy enough food. They have inadequate access to natural resources, jobs, income or social scores (Chaturvedi, 1997). Road density, number of fair price shop per village and percentage of main workers are the main indicators to examine the food accessibility.

Road Density plays an important role for the food accessibility. The good condition and high density of road provide a good accessibility and further result in to food security. In the study area, the road density is very low i.e., 2.68 kilometers per square kilometer. District Mamit has the highest density of road among the eight district 3.9 km per Sq km while the

Table 1. Food Availability, Mizoram, 2014

District	*Food production per head per annum (kg)	**Per capita per day availability of Rice (Gram)	**No. of livestock per head	Composite Score
Aizawl	13.16	36.67	1.02	-3.76
Champhai	125.49	348.67	2.55	4.15
Kolasib	121.02	336.00	1.56	2.14
Lawngtlai	75.80	210.67	1.11	-0.74
Lunglei	38.13	106.00	1.40	-1.93
Mamit	47.00	130.67	1.63	-1.11
Saiha	30.10	83.67	2.38	-0.51
Serchhip	106.72	296.33	1.74	1.82
Mean	69.68	193.59	1.67	
S.D	43.80	121.61	0.55	

Source : **Agriculture Abstract, Mizoram, 2013-2014*
***Statistical Handbook, Mizoram, 2014*

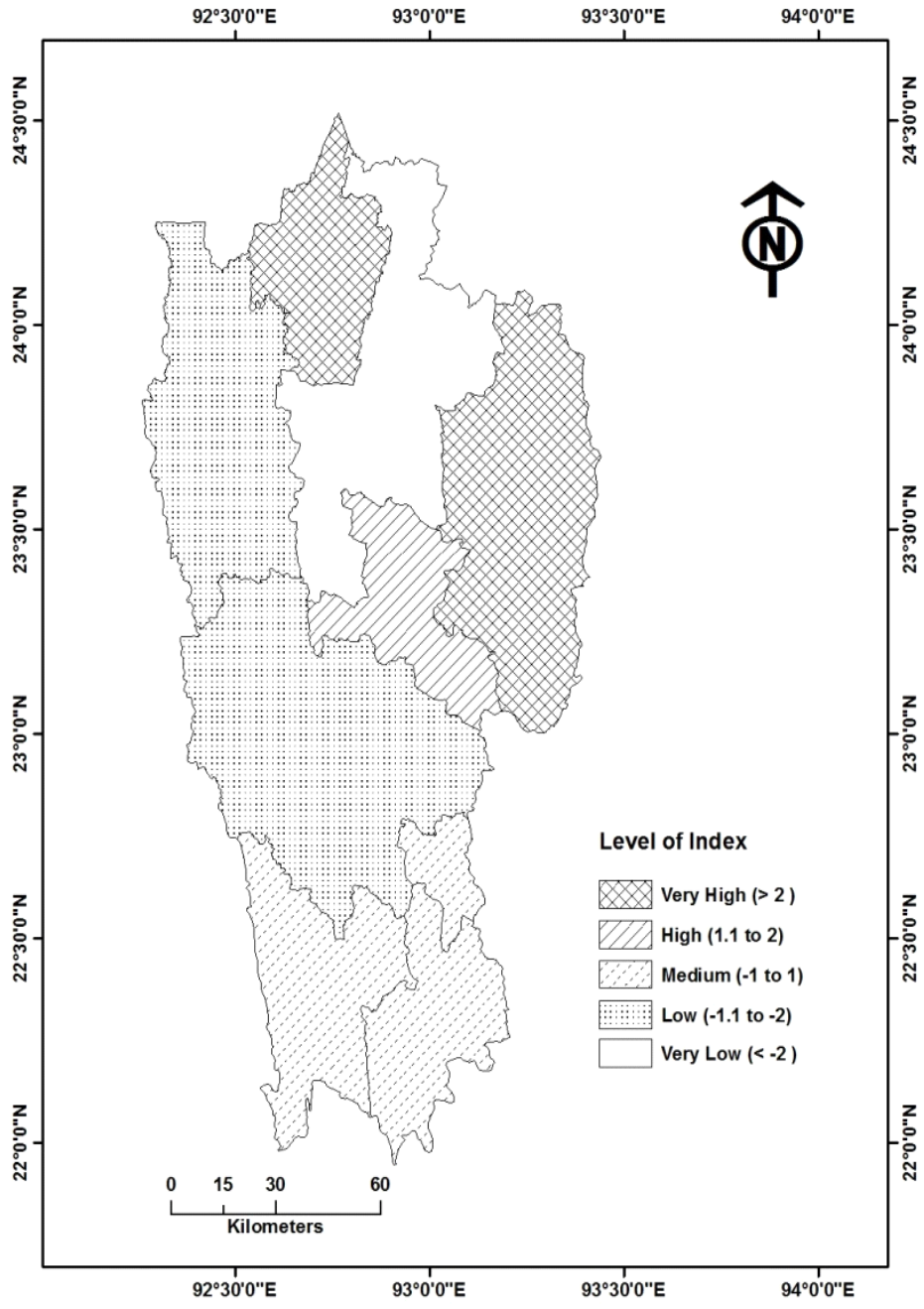

Figure 2. Level of Food Availability, Mizoram, 2014

lowest road density district of Kolasib has 1.8 only. The district Mamit is followed by Lunglei (3.5), Lawngtlai (2.8), Serchhip (2.6), Champhai (2.4), Aizawl (2.3), Saiha (2.1) and Kolasib (1.8). The study shows that south and western part are quite good and have a better accessibility than north and north eastern part of the state.

Number of Fair Price Shop per village or Local Council is one of the most important components of food accessibility as to store and distribute food, availability, nearness and regularity of fair price shop are very essential for supporting the poor people. Hence the availability of fair price shop is taken as an important indicator for food accessibility. In the study area, 1.7 fair price shop are available in every Village Council or Local Council in an average. Aizawl district has attained the highest position which has more than 3 numbers of fair price shop per village or Local council. On the other hand district Lawngtlai has a very low availability (i.e. 0.64) which is almost three times lower than Aizawl district and it indicates there is some village or local council do not have fair price shop in the district. The district Aizawl is far highly developed in case of fair price shop availability which is followed by Serchhip (2.30), Champhai (1.78), Kolasib (1.53), Lunglei (1.57), Saiha (1.39), Mamit (1.15) and Lawngtlai (0.65). The result finds that the Public Distribution System (PDS) in the state is suffering from an urban biasness. The most urban have a high number of Fair Price Shop and vice versa.

Percentage of Main Workers to the total population is another important component which represents total employment scenario of the area. In the study area 37.50 percent are main

Table 2. Food Accessibility, Mizoram, 2014

District	*Road density	**No. of fair price shop per village	***Percentage of main workers	Composite Score
Aizawl	2.3	3.26	37.82	1.3
Champhai	2.4	1.78	42.24	0.46
Kolasib	1.8	1.53	35.37	-1.8
Lawngtlai	2.8	0.64	32.3	-1.99
Lunglei	3.5	1.57	38.42	1.14
Mamit	3.9	1.15	41.9	1.72
Saiha	2.1	1.39	25.97	-3.04
Serchhip	2.6	2.30	45.95	1.99
Mean	**2.68**	**1.70**	**37.50**	
S.D	**0.71**	**0.79**	**6.31**	

*Source: *Internet, **Statistical Handbook (2014), ***Census (2011)*

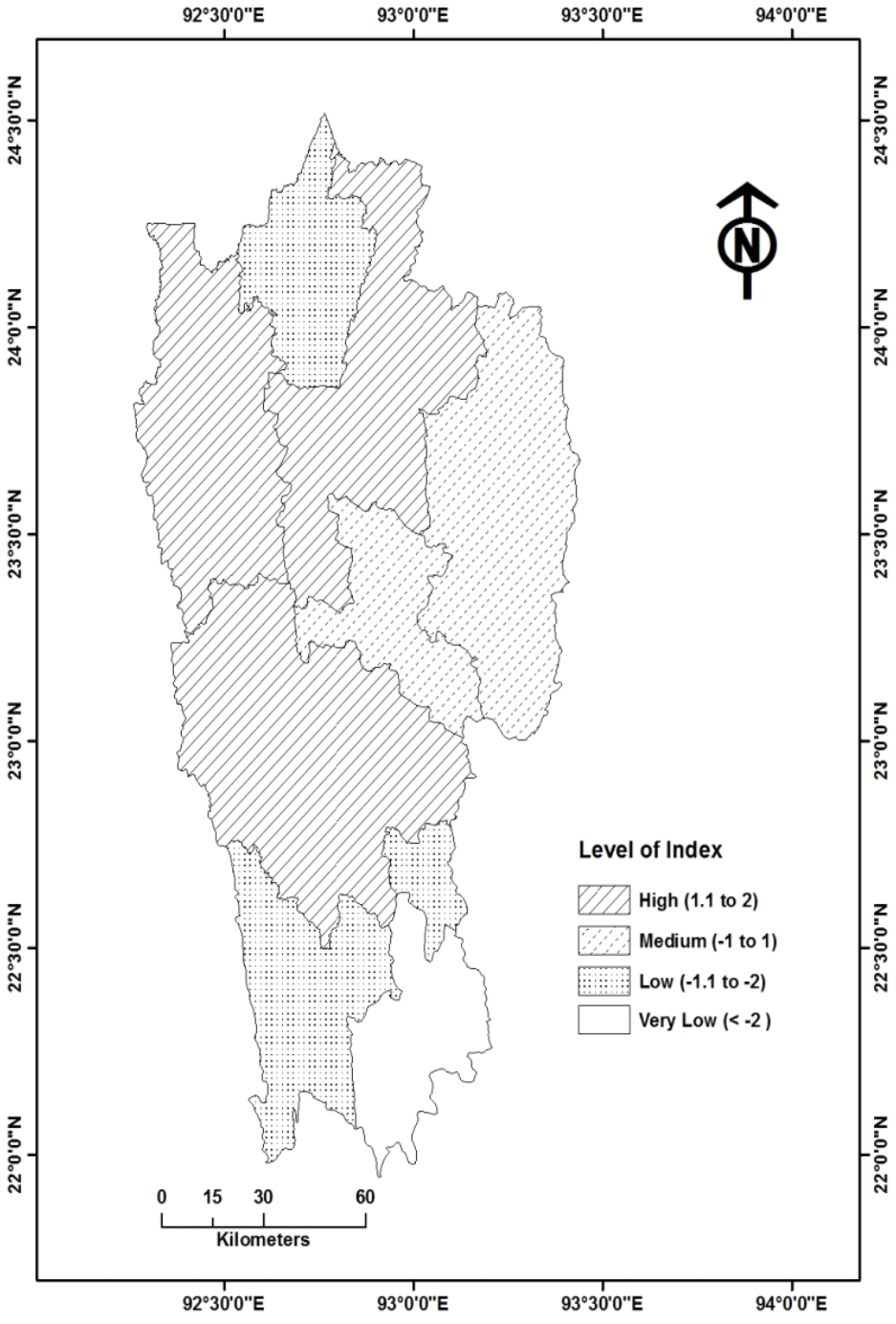

Figure 3. Levels of Food Accessibility, Mizoram, 2014

workers. The district Serchhip has the highest position in that case where 45.95 per cent of the total populations are under main worker followed by Champhai (42.24), Mamit (41.9), Lunglei (38.42), Aizawl (37.82), Kolasib (35.37), lawngtlai (32.3) and Saiha (25.95). It can be shown that the southern parts of the study area has less number of worker as compared to northern part of the state.

Food Stability

Food stability refers to the stability in production, price, marketing, distribution system, access to safe drinking water and environmental hygiene. Food stability for the present study has been examined by considering the three indicators like percentage of irrigated land, yield per hectare and literacy rate.

Irrigated area of land in Mizoram is only 1.07 per cent of the total land area. Irrigation is the basic requirement for the continuation of agricultural production in India since India's agriculture is mainly depends upon the rainfall. In the study area, the district Kolasib has the largest irrigated land, 2.77 per cent of the total land area have irrigation system. Beside Kolasib there are only the other two district having irrigated land across 1 per cent of the total land such as Serrchhip (1.79), Champhai (1.24),. The other 5 districts have below 1 per cent irrigated land of the total land area such as Aizawl (0.75), Mamit (0.54), Lawngtlai (0.54), lunglei (0.48) and Saiha (0.44).

Yield per Hectare or the agricultural productivity a one of the effective factor determining the

Table 3. Food Stability, Mizoram, 2014

District	*Irrigated area In %	*Yield per hectare (kg)	**Literacy rate (%)	Composite Score
Aizawl	0.75	1407.59	98.5	-0.16
Champhai	1.24	1580.21	93.51	1.24
Kolasib	2.77	1672.15	94.54	3.87
Lawngtlai	0.54	1439.66	66.41	-3.26
Lunglei	0.48	1420.07	89.4	-1.25
Mamit	0.54	1293.5	85.96	-2.46
Saiha	0.44	1464.32	88.41	-1.07
Serchhip	1.79	1668.27	98.76	3.07
Mean	1.07	1493.22	91.58	
S.D	0.83	134.43	10.39	

Source: **Agriculture Abstract, Mizoram, 2013-2014),*
***Census of India, 2011*

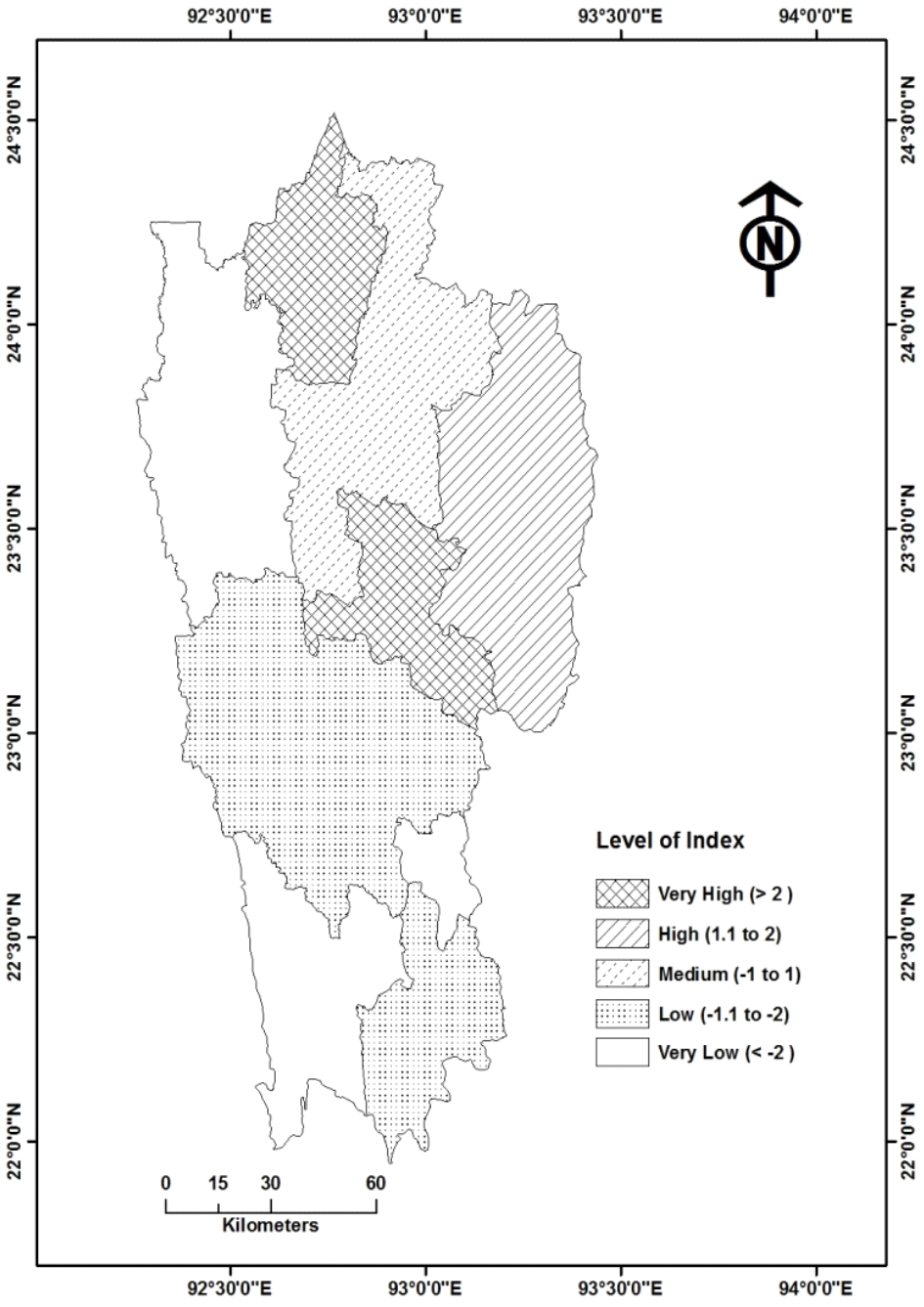

Figure 4. Levels of Food Stability, Mizoram, 2014

stability of foods. It refers to production of rice in kilogram per hectare of land. The high productivity region might attain the food stability and security whereas the low productivity region is on the other side could not attained stability and security of food. The average yield per hectare in the study area is 1493.22 kilogram per 1 hectare of land. Among the 8 districts, Kolasib has attained the highest agricultural productivity i.e. 1672.15 kg/hectare which is followed by Serchhip (1668), Champhai (1580.21), Saiha (1464.32), Lawngtlai (1439.66), Lunglei (1420.07), Aizawl (1407.59) and Mamit (1293.5).

Literacy rate is the important factor for management of food and food stock. The food stability of a family is largely depends on the educational level and knowledge. Thus literacy rate is taken as one of the indicators affecting the stability of food in the study area. The average literacy rate in the study area is 91.58 (census 2011), it is higher than the national average (74.04 percent). Serchhip District has the highest literacy rate which is 98.76 per cent whereas Lawngtlai District has attained 66.41 per cent only. The other district has also a good status in educational levels such as Aizawl (98.5), Kolasib (94.51), Champhai (93.51), Lunglei (89.4), Saiha (88.41) and Mamit (85.96).

Food Security Region in Mizoram

To identify the food security region of the state, Z score of the every 9 indicators have been calculated in each district. Further all the concerned indicators have been added at district level and average is obtained to find out the Z score of food security level. The standard deviation techniques has been applied to divide the study region in to five levels of food security such as very high, high, medium, low and very low.

Table 4. Index of Food security in Mizoram, 2014

District	Food Availability	Food Accessibility	Food Stability	Composite Score
Aizawl	-3.76	1.3	-0.16	-2.62
Champhai	4.15	0.46	1.24	5.85
Kolasib	2.14	-1.8	3.87	4.21
lawngtlai	-0.74	-1.99	-3.26	-5.99
Lunglei	-1.93	1.14	-1.25	-2.04
mamit	-1.11	1.72	-2.46	-1.85
Saiha	-0.51	-3.04	-1.07	-4.62
Serchhip	1.82	1.99	3.07	6.88

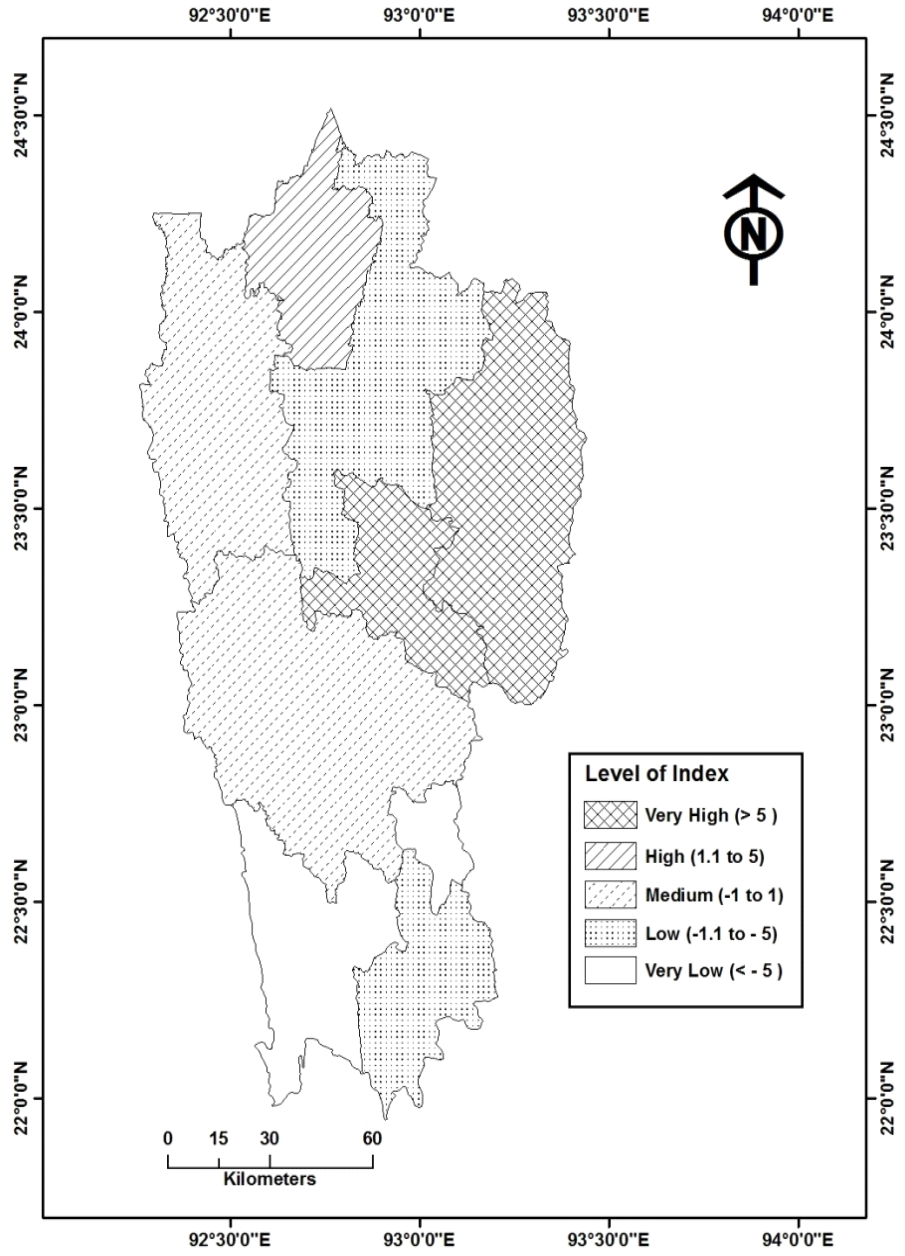

Figure 5. Food Security Region in Mizoram, 2014

The district Serchhip and Champhai are categorized as a food secure region. The two districts have score 6.88 and 5.85 in the Z score value. On the other hand the other districts were identified as a food insecure region. The results also indicated that there is unequal development in Mizoram due to major factors like food availability, food accessibility and food stability deference among the district.

Conclusion and Suggestion

As a result of the study, Mizoram can be divided into two regions i.e., food secure and food insecure region. The only 2 districts such as Serchhip and Champhai may be treated as a food secure region in the state whereas the other 6 district are food insecure region. There is an unequal development between higher score secure region and lower score insecure region. For instance: Disparity between Serchhip and Lawngtlai is 12.7 in composite score is severely high. The imbalance between the score of Secure and insecure region is 34.02. The study also find out that the highest literacy district has highest food security levels and vice versa. However, the whole state does not attain food security as per recommended energy requirement (i.e., 669.82 Kcal per capita/day) on the basis of per capita availability of rice (i.e., 193.59 g).

Mizoram in general and the southern and western part in particular should be uplifted in case of: Education, Public Distribution System must cross at least 1 at Z score, irrigational facilities, agricultural production and productivity including Livestock (it must be increase at least by 10 per cent) to attain stability of foods. At the same time it is important to diversify agriculture, improving infrastructure, providing market linkage and food processing and storage etc. Road connection should be developed by at least 30 per cent for accessibility of foods in every district. The waste land also must be developed permanent scientific cultivation. In doing so, the severity and deficiency of food can be minimized and only after that the balanced development at district level in foods and others factors could be attained in the state.

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Rainwater Harvesting Practices in Durtlang

- K.C. Lalmalsawmzauva

Abstract : *The present study examined rainwater harvesting potential and practices in Durtlang. The Study reveals that Durtlang has high potential of rainwater harvesting with annual rainfall of more than 250 cm. Among the different types of rainwater harvesting roof water harvesting is focused for present study. It is found that a remarkably high number of 94 per cent household practised rainwater harvesting and almost half of the households are reported of using rainwater as their main source of living. However, 87 per cent household reported that rainwater harvesting is not sufficient for family consumption and merely 15 per cent reported that rain water is sufficient for family requirements. Major problems are inadequate storage facility, no space to construct water tank in their premises and a good number of them are having financial problems to make storage facility. It is suggested that if the existing system is improved, almost all the families can get sufficient water requirement from rain water alone*

Introduction

Increasing demand of water to meet the requirement of rapid growth of population and associated developmental activities seek additional sources of water all over the world. Scarcity of fresh water on the earth surface like-river, lake, spring and underground water are accelerated by global warming and industrialization. Among other water sources, rainwater harvesting becomes one of the most potential to cope with water scarcity in different parts of the world including Mizoram. Since Mizoram is located in the hilly rugged topography with steep slope, rainfalls easily flow away as soon as it reaches the earth surface. Therefore, it is necessary to harvest rainwater before it reaches to the ground and for this, rainwater harvesting from the roof is extremely important. In addition, the sedimentary soils of Mizoram are too loose to hold water back to form underground water table aggravating water problems in the state even though the state lies in a heavy monsoon region. Though the state of Mizoram is endowed with high rainfall of over 250 cm averages annually, it seems that more than half of the population are not getting sufficient water requirement. This is mainly due to lack of rainfall management in the state. If rainwater harvesting is practised properly in Mizoram, more than half of the requirement of the state can be met from rainfall alone (Lalmalsawmzauva, 2015).

Rainwater harvesting is practised since long time back in human history. Its popularity resurgent recently due to the realization of the potential of the rain water and due to the increasing

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demand of water to meet speedy growth of population and associated developmental activities. Rainwater is pure and soft. It has nearly neutral pH and is free from disinfection, by-products, salts, minerals, and other natural and man-made contaminants. Though, the practice of rooftop water harvesting is an age-old one, systematic collection and storage of water to meet the domestic water requirements is thought of recently.

Definition

The total amount of water that is received in the form of rainfall over an area is called the rainwater catchment of that area. Out of this, the amount that can be effectively utilized is called the water harvesting potential. Rainwater harvesting potential of a site is generally influenced by eco-climatic conditions and the catchment characteristics of an area. Rainwater harvesting is a technology used for collecting and storing rainwater from rooftops, land surface or rock catchments using simple techniques such as jars, pots as well as more complex techniques like as underground check dams.

The common means of catchment areas includes rooftop catchments, land surface catchments and clearing or altering vegetation cover. Commonly used collection devices include storage tanks and rain water containers of any kind. Another important component for rainwater harvesting is the conveyance systems, which requires transferring the rainwater collected on the rooftops to the storage tanks. This is usually accomplished by making connections to one or more down-pipes connected to the rooftop gutters and finally end to the storage tank.

Background of the Study Area

The present study focuses on the practices of rainwater harvesting in Durtlang ward No. 3 (according to Census of India, 2011). Durtlang has been selected on the basis of the fact that even though it is Aizawl city Ward No. 3, government does not provide proper piped-water connection till the survey time i.e 2013 while almost all other Aizawl municipal wards are providing piped-water supply. It is assumed that the locality are meeting their water requirement from other sources in which rainwater harvesting is expected to play an important role. It is also known that the locality used to buy water from water-carrying truck supply or tank lorry by private supplier.

Since its existence, Durtlang has been seen as an important location with good amount of rainfall and the name Durtlang itself literally means- 'Dark cloud Mountain'. It consist of two words, 'Dur' mean 'Dark" due to clouds and

'Tlang' means 'Mountain or Hill. So, it receives huge amount of rainfall every year. It is also believed that Durtlang might be the place where modern rainwater harvesting was first practised in Mizoram by the Welsh Christian missionary, most probably around 1930s or 1940s. Welsh Mission hospital was started in 1928 and gradually the present hospital campus has been developed including staff quarters where rain water harvesting has been in practice till date. Therefore, it is interesting to study about the current practice of rainwater harvesting, considering the long history of rainwater harvesting practice in the locality.

Objective

There are three broad objectives

1. To examine rainwater harvesting practices in Durtlang ward no-3
2. To study major sources of water and
3. To study water consumption/ uses in Durtlang ward no-3

Data and Methods

Primary sources-For the present study primary data has been collected by using questionnaires. Household survey was done during a period between January and February, 2013. There were 812 households in Durtlang ward No. 3 (2011 census) and out of which 106 houses were surveyed randomly which represent the sample size of more than 13 %.

Questions like type of roofs used, average roof size (catchment area), whether the family practise any kind of rainwater harvesting or not, main sources of water of the household and daily water consumption were asked to understand the general water utilization of the family. Enquiry was also made regarding their major problems in the practice of rainwater harvesting.

Secondary sources includes

- Statistical Abstract 2014 published by Directorate of Agriculture (Crop Husbandry) Mizoram, Aizawl
- Meteorological Data of Mizoram-2014 published by Directorate of Economic& Statistics, Mizoram, Aizawl
- Census of India-2011, Director of Census Operations, Mizoram
- Literatures- books, articles, journal and e-journal etc.

Literature Review

Different books, journals, e-journals and articles are consulted to understand about rain water harvesting practices in various parts of the world. Literature reviews covers studies on Europe, Asia, Africa and India including Northeast states. Rainwater harvesting has been internationally widely accepted, however, the emphasis has not been on the utilisation of rainwater but on its practices.

In Korea, Australia and Taiwan, programmes to promote rainwater utilization have been launched in schools in order to familiarise future generations with this topic (Klaus, 2010).

On Jeju-Island, south of Korea and on Miyake, a volcano island in the Pacific about 200 km south of Tokyo, rainwater is harvested from trees. For this purpose, many strings with interwoven ends hang down from trees. Water trickles over this meshwork into a gutter which is directed into a cistern or a jar (Schutze, 2005)

Japan is one of the developed countries in Asia who fostered from the very beginning an intensive international exchange in the field of rainwater utilization. The activities of the administration of Sumida-City are internationally well known and recognised since the first rainwater utilisation conference in Japan in 1994. In the past few years, the number of urban buildings in Tokyo utilising rainwater has increased considerably from 3 plants in 1970 to about 1000 in 2003. The city advises and supports residents and firms in the planning and installation of rainwater plants. Newly constructed public facilities must collect and use rainwater. Other Japanese cities are following their steps (Konig, 2001).

Since October 1, 2005 all new buildings in Autralia have to be constructed according to the BASIX-Standard. This implies that rainwater utilisation plants are becoming a must. Rainwater has been used since long as a drinking water resource in Southern Australia. Likewise, it is common to use rainwater in the "hot water systems" (building services systems for hot water processing) for the personal hygiene. Long-term, scientific investigations on the impact of rainwater used as drinking water are available in Australia since 2001. The risk for intestinal diseases has been rated as very low (Heyworth, 2001).

On Haiti, where only a small part of the population have access to the public drinking water supply, the whole water requirement is traditionally covered by rainwater cisterns. Freshwater reserves are not available on the island. In the capital Port-au-Prince where most of the population live, water from tank lorries can be also bought to fill the cistern. However, the costs for this water exceed the contingency of the family budget. Also in Bermuda, Antigua and Anguilla it is self-evident to use rainwater from cisterns for drinking purposes.

On Barbados, there exists an obligation in new buildings to set up appropriate cisterns dependent on the area of the building. The costs can be set off against tax liability (Konig,2001). Special engagement in rainwater management is known

from the US States of Maine, California, Oregon and Washington. Rainwater utilisation for irrigation is popular in Texas. The American Rainwater Catchment Systems Association ARCSA is based there as well as a commercial filling station for rainwater for use as drinking water. The bottle labels have been humorously designated with "fresh squeezed cloud juice". The source of origin is the Dripping Springs.

Germany is as before the leading country in Europe playing a significant role in the development of service and rainwater utilisation. Developments in the field are also found in Austria, Switzerland, Belgium and Denmark (Hiessl, 2005).

Traditionally, rainwater has been practiced in India before the colonial rule. The Centre for Science and Environment (CSE), an independent organisation, which supports and promotes rainwater utilisation in India through several measures, offers courses continuously in the different regions of India (Agarwal,2001).

Roof top rainwater harvesting was taken in North-Eastern Region under Central Sector Scheme during IX Plan in Assam, Arunachal Pradesh, Meghalaya, Mizoram and Nagaland and under Fresh Water Year 2003 in Assam. During IX plan period Central Sector Scheme provides roof water harvesting structures to different states of Northeast, such as 42 in Nagaland, 35 in Mizoram, 13 in Assam, 6 in Meghalaya and 5 in Arunachal Pradesh. All the 35 rain water harvesting structures are confined to Aizawl district during this plan period.

Water utility in Mizoram and Durtlang in particular confined to domestic uses whereas in many developed and industrialized countries, water uses are comparatively higher in sectors like industry and agricultures purposes. In 1900 industry used an estimated 6% of the world's water. It now uses four times that share. Over the same period, municipalities' share of water tripled to 9 per cent. However, while industrial and municipal demand for water grew spectacularly in the 20th century, agriculture still takes the lion's share. In developing countries agriculture still accounts for more than 80% of water consumption (HDR, 2006)

Discussion

General background of the study area - There were 812 households in Durtlang ward No. 3 (2011 census) and out of which 106 houses were surveyed randomly which represent the sample size of more than 13 per cent. The average family size of Durtlang ward no. 3 was 5.6. Family size has been divided into three categories, such as large (7+ members), medium (4-6 members) and small or nucleus (below 3 members). Medium size of

the family comprised the greatest number of 60(56.6%), followed by large family size, sharing 29 (27.4%) and small family shared only 17 (17%). It appears that the average household size of Durtlang is much higher than the average of Mizoram and India of 4.8 each (NFHS-3). This will directly affect the average daily water consumption of the household. According to 2014 rainfall data published by Department of Agriculture, Government of Mizoram, Aizawl district received a total 3701.7 mm rainfall from six centers of rain gauges located in Aizawl, Sialsuk, Neihbawi, Darlawn, Khawruhlian and Sairang. Even though there is no rainfall collection centre (gauge station) in Durtlang, the two nearest collection centers of Aizawl and Neihbawi recorded the annual rainfall of 1913.7mm and 2976 mm respectively. And according to the latest 2015 data recorded by Department of Geography, Mizoram University, it is found that Aizawl received 2548 mm rainfall in 2015. Based on these three rain gauge stations data, it can be assumed that Durtlang received more than 2500 mm annually.

Roof Types - Types of roof can extensively affect potential of rainwater harvesting. Common types of roof in Mizoram are concrete/RCC, CGI, tin, tarpaulin and thatch. However, only concrete/RCC and CGI roof are available in the study field. Out of 812 households 106 houses are surveyed and only owners of the houses were interviewed. Study reveals that 78.3% have Corrugated Metal Sheets/Iron (CGI) roof whereas the remaining 21.7% are having concrete roof. Both of which are ideal for rainwater harvesting. This significantly shows the high potential of rainwater harvesting in the study area.

Table 1. Durtlang: Type of Building/House Roof

Type	No.	%
CGI	83	78.3
Concrete	23	21.7
Total	106	100
CGI= Corrugated metal sheets/Iron		

Source: Field Survey-2013

Research tries to find out the average size of roof in Durtlang, which finally end up without any concrete result because of too many diversities of roof size. Almost every roof size or catchment area is different from one another. Apart from type of roof, size of catchment areas is so important to know potential of rainwater harvesting. It is therefore, assumed that the average size of roof/catchment area in Durtlang is 5mx10m approximately with high potential of rain water harvesting.

Daily Water Consumption

The standard norms of daily water consumption vary from country to country mostly

depending on climatic conditions. Usually warm tropical region require more water than cold temperate regions. However, due to developments and improving standard of living water requirement increases even in the temperate regions. In India the minimum requirement of water is 135 litres per head per day (Bureau of Indian Standards, 2010). According to UN Human Development Report-2006 the average water use per person per day was 575 litre in United States, followed by Australia(493 litres), Italy (386litres) and Japan (374 litres).

Table 2. Durtlang: Daily water consumption of the family in litres

Water consumption	No. of Family	%
100-200 litre	62	58.5
300-500	35	33.0
600-1000	5	4.7
1000-1500	3	2.8
2000 +	1	0.94
Total	**106**	**100**

Source: Field Survey-2013

Daily per capita water consumption of household has been asked to understand water uses in the study area. Table-2 shows that majority of the family (58.5 %) consumed between 100-200 litre of water daily while a good number of the family (33%) consumed 300-500 litre of water per day and merely 7% are consuming more than 600 litre of water per day.

As mentioned earlier the average household size in Durtlang is 5.6 and if we divided 200 litre by 5.6 family members the average daily water consumption per person per day is just 35 litre and if we divided 600 litre by 5.6 family members, daily water consumption is 107 litre per person per day, which is still below all India standard of 135 lpcpd. Therefore, it can be concluded that Durtlang does not have sufficient water to satisfy their daily requirement.

Sources of Water:

In Aizawl district one of the major sources of drinking water is tap water from treated source, which mean water supply provided by government to household using piped lines. Government water supply covered 57.7 % household in Aizawl district. Merely 14.9% rural household are covered by government piped water supply while 69 % in the case of urban

Table 3. Durtlang: Main sources of drinking water

Source	No. of Family	%
Rain	50	47.2
Buy truck water-Private	30	33.0
PHE/Govt. truck water	5	4.7
Public well/Spring	21	19.8
Total	**106**	**100**

Source: Field Survey-2013

household (Household Census-2011). The remaining water sources includes -tap water from untreated sources, well, hand pump, spring, lake, river etc. However, in the study area, major sources of water are rainwater, water-carry truck water from private vendor and from government agency as well as from spring/well found in the locality.

Table 3 shows major sources of water in the study area. It is clearly found that as many as 50 (47.2%) families are depending on rainwater, which means at least this much of the families practises rainwater harvesting. A good number of 30 (33%) families are regularly buying water from private supplier through truck water. Merely 5 families (4.7%) are depending on government agency like PHE water supply through water carrying-truck. During the survey government starts distributing and supplying water in Durtlang locality by using water-carrying truck but that was not regular. There are around three springs/wells in the locality where 21 (19.8%) families depend on it. Therefore, it can be concluded that rainwater became the most common source of water in Durtlang, followed by water supply by private vendor and public spring.

Availability of Water Tank

Having sufficient water storage facility gives us contentment and vice-versa. As far as water is concerned it appears from the general observation that the main problem of Mizoram in general and Durtlang in particular is lack of adequate water storage facility. Even if they have storage facility it is not enough to store family requirements. It is interesting to reveals that as many as 101 (95.3%) families in Durtlang are reported of having water tank to store water and just 5 (4.7%) families are not having any water tank.

Table 4 shows that even though almost every family are having water tank, the capacity of water tank is usually limited and not sufficient for the family. Only 31 (30.7%) families are having water tank with a capacity of less than 1000 litre while 21(20.8%) families are having water storage capacity of between 2000-5000 litre. Those families who are having water storage capacity of 5000-10000 litre are 20 (19.8%) and slightly decreased the number of families who are having more water storage capacity of 10000-50000 litre and

Table 4. Durtlang - Size of water reservoir

Water reservoir in litre	No. of Family	%
1000	31	30.7
2000-5000	21	20.8
5000-10000	20	19.8
10000-50000	18	17.8
50000+	11	10.9

Source: Field Survey-2013

above 50000 litre to 18(17.8%) families and 11 (10.9%) families respectively.

Practice of Rainwater Harvesting

In support of the previous discussion, rain water harvesting become very common in Durtlang ward no. 3. Out of 106 families surveyed, 100 of them reported to practise rainwater harvesting, which is more than 94% and a negligible 5% are not practicing rainwater harvesting. Most of the families utilized house roof for rainwater harvesting. Apart from house roof, merely 6.6% are utilizing other construction/structures like toilet, pig shed etc. for the same purpose.

Table 5. Durtlang : If you store rainwater, is it sufficient for your family

	No. of Family	%
Sufficient	7	6.6
Not sufficient	93	87.7
Total	**100**	

Source: Field Survey-2013

Even though majority of the families reported to practice rainwater harvesting and many of them are depending on it, table 5 discloses that merely a handful of 7 families or 6.6 % reported that rainwater is sufficient to meet their daily family requirement. A remarkably great number of more than 87 % families are saying rainwater storage facility is not sufficient to meet their family consumption. It is ironical to highlight here that many families are depending on rainwater harvesting while only 6.6 % reported that rain water harvesting is sufficient. This is due to the long monsoon seasons experienced by Durtlang as the locality receives practically around 7-8 months of rainfall during which a good number of family simply depending on regular rainfall. However, many people reported that it is not sufficient mainly because they do not have enough water tanks to store rain water for the lean seasons.

Table 6. Durtlang: How long your water tank(s) can sustain your family's requirement

	No. of Family	%
1-3 weeks	25	25.3
2-3 m	33	33.3
4-5m	26	26.3
6-7m	8	8.1
Almost a year	5	5.05
More than a year	2	2.0
Total	**99**	**99**

Source: Field Survey-2013

Table 6 shows that most of the families could not stock rainwater after monsoon is over. Generally, monsoon last for a period of 7-8 months in Durtlang and most of the family can store only these periods and the remaining five months are problematic for them. Only around 7 % have large water storage facility sufficient enough to fulfill family

requirement.

Problems on Rainwater Harvesting

There can be a variety of problems on rain water harvesting. It might be roofs, gutters and downspouts or even storage tank.

Table 7. Durtlang : If not sufficient, why?

	No. of Family	%
No proper water tank	55	55.6
Water tank too small	37	37.4
Others	7	7.1

Source: Field Survey-2013

Table 7 depicts that the main problem of rainwater harvesting in the study area is lack of sufficient storage facility. As many as 55.6% families are not having proper water tank while 37.4% families reported that their water tank was too small for storage and only few of them reported 'Others' causes. During field survey it was found that many of the families are practicing rainwater harvesting for name sake. If the existing water tanks are improved and enlarged, half of their problems can be solved easily.

When enquired 'If their water tank is too small, why don't they construct a bigger one' - the answers became multiple. As shown in table 8 as many as 55.6% reported the caused being 'financial constraints', 10.1% mentioned 'space' problem to construct or extend water tank and 12.1% confessed of 'ignorance' as the main caused and 18.2% blamed both 'space and financial constrain' as the main problems. It is observed that more awareness is required for practicing 'proper' rain water harvesting. Not only storage facility but also gutters and downspouts needs to be improved.

Table 8. Durtlang : If water tank is too small, why don't you construct a bigger one

	No. of Family	%
No space	10	10.1
Financial constrain	55	55.6
Both	18	18.2
Ignorance	12	12.1
Others	4	4.0

Source: Field Survey-2013

Expenditure for Water

Since there is no piped-water connection, as many as 81.8 % families are buying water from private vendor and only 18.2 % are

Table 9. Durtlang: What is the average annual expenditure for buying water

Expenditure	No. of Family	%
Rs 1000-5000	48	59.3
6000-10000	21	25.9
20000-50000	8	9.9
50000-100000	1	1.2
100000 and above	3	3.7

Source: Field Survey-2013

not buying water. Research was carried out to find out the annual expenditure of household on water.

Table 9 exposes that almost 60 % of the families in Durtlang locality spent between Rs 1000-5000/- per annum and around 25 % families spent between Rs 6000-10000/- for buying water. Around 10 % of the families spent Rs 20000-50000/- per annum while only 1.2 % spent for buying water and only 3.7 % spent more than Rs 100000/-per annum for the same. It is also interesting to exposes that no family had reported of purchasing water during rainy seasons showing the prevalence of rain water harvesting practice in Durtlang.

Findings and Conclusion

The present study is the first attempt of its kind in Mizoram as far as empirical research on rainwater harvesting practice is concerned. Consequently, the methods of study and analyses seem literally inadequate. Even though it is an examination of just one ward with a sample size of 13%, it gives us broad ideas on the prevalence of rainwater harvesting practice in Durtlang.

The major findings of the research are-

1. Durtlang has high potential of rainwater harvesting with annual rainfall of more than 250 cm.
2. There are practically two types of catchment areas or roof types, such as- CGI roof and Concrete roof, which is the most ideal types of rain water harvesting.
3. Daily per capita water consumption in the study area is extremely low, almost 60% reported that their daily water consumption per head is 35 litre and around 5% are using 107 liter per day, which is far lesser than Indian standard of 135 liter per person per day.
4. As expected a remarkably high number of 94% household practised rainwater harvesting and almost half of the households are reported of using rainwater as their main source of living. However, 87% household reported that rainwater harvesting is not sufficient for family consumption and merely 15 % reported that rain water is sufficient for family requirements.
5. The main problem of rainwater harvesting in the study area is inadequate storage facility as water tank are generally too small in almost all cases. Many of the families also reported that there is no space to construct water tank in their premises and a good number of them are having financial problems to make storage facility. Ground investigation found out that apart from the above problems, ignorance also responsible for their problem of water scarcity and for not harvesting rainwater.
6. Study, finally suggested that if the existing system is improved, almost all the families can get

sufficient water requirement from rain water alone. Structures of rainwater harvesting components like gutter, downspouts and water tank really need improvements.

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Development of Mizoram: A District Level Analysis

- Lalrinmawia

Abstract : *Mizoram, in spite of being a small state, has certain key features that make it distinct from other states of the country and highlights its potential for development. However, development has taken place in the state but some of the districts have been left behind. Most of the districts have subsistence farming as their main economic activity. They are land-locked with lack of transportational network and large distances between the markets and resources. Because of these constraints, traditional agriculture cannot be the lead sector for development. This can be achieved by working towards common goal through infrastructure development, tourism promotion, agriculture diversification, and agro-based industry.*

Introduction

In recent years development has emerged as a major area of economic analysis both in terms of theoretical and empirical research. The term development may be regarded as a process whereby an economy's real national income increases over a long period of time. The nature of development in the early 1990's differing from that seen early in the 1950's or from that in the 19th century. Development means growth with change and increase in welfare. Development is something more than economy growth. Development includes in its ambit economic growth. But growth may be attained without development (Clower *et al.*, 1966). In other words, growth may be affected by inducing selected and sectoral investments in scarce resources and its resultant growing disparities on personal as well as regional levels. Developmental efforts, on the contrary, strive to offer increasing option to the people through which accessibility and exploitability of resources is assured 'unto the last'. Development therefore may be defined as a process that creates conditions leading to reduction if not elimination, of inter personal disparities. It may, however, be affected only if inter regional disparities are minimized (Dutta,1970).

Thus economic development implies economic growth along with change- a change for the betterment. This change can come through structural transformation- which is an ingredient of economic development. As the economy grows, changes take place regarding shares of different sectors in employment and GDP, structure of trade, structure of demand, energy consumption and distribution of income etc. According to Todaro (1993), development must be conceived as a multi-dimensional

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process involving major changes in the social structures, popular attitudes, and national institution, as well as acceleration of economic growth, reduction in inequality, and the eradication of absolute poverty. Development is in essence, must represent the entire gamut of change by which an entire social system, tuned to diverse basic needs and desire of individuals and social groups within that system, moves away from a condition of life widely perceived as unsatisfactory and towards a situation or conditions of life regarded as materially and spiritually better. Thus development means structural transformation of an economy that penetrates widely and deeply. It affects social structural and cultural facets of a society. It is taken to a much wider range of variables. It includes especially the whole range of social, economic and political processes expected to lead to a perceptible and cumulative rise in the standard of living and equality of opportunity. Generally, however the word is believed to denote to a set of complex changes induced by human endeavour to seek 'peoples' welfare and about expansion of their capabilities and functioning. Development is both a physical reality and a state of mind in which society has, through some combination of social, economic and institutional processes, secured the means for obtaining a better life. Whatever the specific components of this better life, development thus, involves, attempt to i). increase the availability and distribution of basic life sustaining goods. ii). Raise levels of caring and education to increase both material welfare and self-esteem, and iii). Expand the range of social and economic choice to both individual and nations, freeing them from servitude and dependence. Such efforts necessarily bring about structural and behavioural changes. Development, therefore, may be defined as value positive process aiming at enhancing the level of the living conditions of mankind in spatio- temporal dimension. It means not only change but also a change for betterment. It is supposed to address to sustainable intra-generational as well as intergenerational equity enabling the people to make best use of their capabilities.

It is, therefore, considered essential to make analysis of developmental processes vis-à-vis spatio temporal organization of the physical environment, the economy and the people and their participation to obtain developmental goals on regional, national and international levels.

Objectives

1. To identify relatively backward and developed District of the state with the help of a number of socio-economic indicators and also to measure the level of

regional disparities in the state
2. To identify reasons those contributed to such regional disparities and thus, provide some policy instruments in reducing regional disparities in the state.

Methodology

Sixteen indicators of development was chosen that reflect four dimension of development, Industry and power, Health, Transport and communication and, Agriculture. The study has been designed to prepare composite indices at the district level that maximises the squared sum of correlation using principal component analysis. This is done in two stages: first compositing the variables group-wise (the four groups of indicators) and then to prepare the final index by taking principal components (of the four groups) as the factor loadings on the variables to arrive at the final development indices for eight districts. Before using principal component analysis, all the data were normalised by using formula as:

$$NV_{ij} = 1\left[\left(BestX_i - ObservedX_{ij}\right)/\left(BestX_i - WorstX_i\right)\right]$$

The analysis has been carried out in the following manner:

1. Group wise correlation matrices have been worked out
2. Group wise Eigen values were calculated, which were used as factor loading (weights) on the respective variables
3. Multiply each value in different column by respective weights presented on the top of the column and obtains the sum of each multiplication which is then divided by total weights presented above in the column to obtain index.

The following formula is used to determine the index -

$$I = \frac{\sum_{i=1}^{n} X_i \left[\sum_{j=1}^{n} |L_{ij}| E_j\right]}{\sum_{i=1}^{n} X_i \left[\sum_{j=1}^{n} |L_{ij}| E_j\right]}$$

Where I is the Index, X_i is the i^{th} indicator; L_{ij} is the factor grading value of the i^{th} variable on the j^{th} factor; E^j is the eigen value of the j^{th} factor.

Industry and Power Sector

Mizoram is perhaps one of the few states of India that has conspicuous absence of any industries. There are various reason for it-lack of geological surveys and known economic minerals. In a developing economy mineral exploitation and power resources is a starting point of industrial development. However, the state has rich tradition in household and cottage industries.

At both the stages principal component analysis has been used to obtain factor loadings (weights) on the variables, and then the indicators have been composited into indices. The correlation matrix of Industry and power sector is given in Table 1.

Table 1. Industry and Power Sector

	No. of SSI units per 100 sq.km to total geographical area	No. of SSI unit per 10000 population	Percentage of employees to total population	Percentage of village electrified
No. of SSI units per 100 sq.km to total geographical area	1.000	.845	.814	-.172
No. of SSI unit per 10000 population	.845	1.000	.889	-.361
Percentage of employees to total population	.814	.889	1.000	-.151
Percentage of village electrified	-.172	-.361	-.151	1.000

It may be noted that except percentage of village electrified all the correlation coefficients are positive. The principal component (Eigen Value) is quite satisfactory, i.e. 2.787 thus explaining 69.68 % of variation in the data matrix. The composite index derived after the normalised factor loadings have been multiplied with the indicators. The composite index of Industry and power is given in Table 2.

The composite index shows that Aizawl district performed far better than other district. It is followed by Lunglei and Champhai district. The worst performance is found in Mamit and Kolasib district located in the northern part of the state.

The second group of indicators deals with the Health sector: Hospital CHC PHC per 10000 population, Sub-center per 10000 population, Hospital beds per 10000 population and Doctors and nurses per 10000 population. The inter-correlation of the indicators is summarised in Table 3.

Table 2. Industry and Power Sector

Weights	**2.558**	**2.706**	**2.597**	**1.014**	**8.876**	Rank
District	No. of SSI Units per 100 sq.km of total Geographical area	No. of SSI Units per 10000 population	Percentage of Employees to Total Population	Percentage of village Electrified	INDEX	
Mamit	0.000	0.042	0.052	0.75	0.113	7
Kolasib	0.012	0	0	0.833	0.098	8
Aizawl	1	1	1	0.75	0.971	1
Champhai	0.150	0.459	0.578	1	0.467	3
Serchhip	0.012	0.026	0.052	1	0.141	6
Lunglei	0.195	0.705	0.473	0.75	0.495	2
Lawngtlai	0.355	0.689	0.368	0	0.420	4
Saiha	0.083	0.383	0.578	0.388	0.354	5

It may be noted that the correlation coefficient of the two variables are positive and two variables are negative. The highest eigen value is 2.119 and explain 52.97 % in the data matrix. The composite index obtained and their ranks are summarises in Table 4.

The composite index shows that the highest value is found in Saiha district followed by Aizawl and Champhai districts. The lowest value is found in Lawngtlai district that is located in a close proximity with Saiha district.

The third group of indicators broadly deals with transport and communication. The variables are Road length per 100 sq.km to total geographical area, No. of post office per 100 sq.km to total geographical area, No. of post office per 10000 population, No. of land line telephone and mobile connection per 10000 population. The inter-correlation is summarised in Table 5.

The correlation matrix shows that there are other negative elements in the variables. The highest Eigen value is 2.518

Table 3. Health Sector Correlation Matrix

		Hospital, CHC, PHC per 10000 population	Sub-center per 10000 population	Hospital bed per 10000 population	Doctors and Nurses per 10000 population
Correlation	Hospital,CHC,PHC per 10000 population	1.000	.624	-.250	-.086
	Sub center per 10000 population	.624	1.000	.246	.391
	Hospital bed per 10000 population	-.250	.246	1.000	.937
	Doctors and Nurses per 10000 population	-.086	.391	.937	1.000

Table 4. Health Sector

WEIGHTS	0.983047	2.110066	1.9849	2.253903	7.331916	Rank
District	Hospital, CHC.PHC per 10000 population	Sub-Centres per 10000 population	Hospital beds per 10000 population	Doctors and Nurses per 10000 population	INDEX	
Mamit	0.571	0.713	0	0.142	0.325	7
Kolasib	0.428	0.684	0.134	0.461	0.432	6
Aizawl	0	0.453	1	1	0.708	2
Champhai	1	0.964	0.316	0.444	0.633	3
Serchhip	0.642	0.86	0.355	0.572	0.605	4
Lunglei	0.125	0.96	0.475	0.493	0.573	5
Lawngtlai	0.089	0	0.022	0	0.018	8
Saiha	0.607	1	0.724	0.747	0.794	1

explaining 60.91% in the data matrix. The composite index thus obtained along with their ranks is summarised in Table 6.

The composite index shows that the highest value is found in Aizawl district. The worse performance is found in the southern part of the state in Lawngtlai district, Saiha and Mamit ocated in the northern part of the state.

Table 5. Transport and Communication Correlation Matrix

		Road length per 100 sq.km to total geographi-cal area	No.of post office per 100 sq.km to total geographi-cal area	No.of post office per 10000 population	No. of landline telephone and mobile connection per 10000 population
Correlation	Road length per 100 sq.km to total geographical area	1.000	.651	-.408	.697
	No.of post office per 100 sq.km to total geographical area	.651	1.000	.023	.875
	No.of post office per 10000 population	-.408	.023	1.000	-.016
	No.of land line telephone and mobile connection per 10000 population	.697	.875	-.016	1.000

Table 6. Transport and Communication

Weight	1.404	2.459	1.121	2.418	7.404	
District	Road length per 100 sq.kms of total Geographical Area	No. of Post Offices per 100sq.kms of total Geographical Area	No. of Post Offices per 10,000 population	No. of landline telephone and mobile connection per 10,000 population	INDEX	Rank
Mamit	0.171	0.127	0.759	0.111	0.226	7
Kolasib	0.944	0.263	0.278	0.639	0.517	4
Aizawl	1	1	0.370	1	0.904	1
Champhai	0.499	0.423	0.878	0.464	0.520	3
Serchhip	0.590	0.362	0.645	0.615	0.531	2
Lunglei	0	0.308	0.913	0.574	0.428	5
Lawngtlai	0.241	0	0	0	0.0458	8
Saiha	0.363	0.238	1	0.2207	0.371	6

The fourth group deal with agriculture sectors. The variables are: Total agricultural production, Intensity of cropping, Net irrigated area and Live stock. The correlation matrix has been summarised in Table 7.

The correlation matrix has other negative elements, therefore, the highest eigen value though is high 2.469, explaining 61.56 % of explained variations generated the weight which has also negative elements. The composite index of agriculture indicators and their ranks are given in Table 8.

The composite index reveals that the highest value is found in Champhai district followed by Kolasib district. The lowest value is found in Saiha district located in the south eastern corner of the state and Mamit district in the north western part of the state.

The correlation matrix shows that all the sectors are positive. A very low correlation is found in agriculture sector. Eigen value in

Table 7. Agriculture Sector Correlation Matrix

		Total agricultural production	Intensity of cropping	Net irrigated area	Livestock conversion into units
Correlation	Total agricultural production	1.000	.131	.953	.677
	Intensity of cropping	.131	1.000	.243	-.209
	Net irrigated area	.953	.243	1.000	.536
	Livestock conversion into units	.677	-.209	.536	1.000

Table 8. Agriculture Sector

Weight	2.531	1.276	2.583	1.533	7.924	
District	Total Agricultural Production	Intensity of cropping	Net irrigated area	Conversion of Livestock into Unit	INDEX	Rank
Mamit	0.295	0.174	0.274	0	0.211	7
Kolasib	0.662	1	0.901	0.302	0.725	2
Aizawl	0.486	0.095	0.511	0.987	0.528	3
Champhai	1	0.063	1	1	0.849	1
Serchhip	0.362	0	0.570	0.022	0.305	5
Lunglei	0.412	0.507	0.380	0.287	0.393	4
Lawngtlai	0.162	0.460	0.199	0.111	0.212	6
Saiha	0	0.095	0	0.218	0.057	8

the final correlation is quite high which is 2.291 explaining 57.26 in the data matrix. The final composite index has been given in Table 10.

Final composite or overall development score refers to aggregate development of districts in respect of industry and power, health, transport and communication, and agriculture. Aizawl district scores the highest value with 0.79 on index. It ranks 1st on the overall development composite index. Development of small scale industry, health facilities due to available transportation network has enabled the district to score high value in the final index. Champhai district located in the eastern part of the state score the second highest in the overall development index. The district scores 0.60 on the overall composite index. Despite its location in the eastern part of the state, the district has large area of land on cultivable slope. With sufficient amount of moisture supply and permanent cultivation in the vicinity of Khawzawl and Champhai has enabled the district to have rich natural resources. Its location in the eastern part bordering Myanmar, on the other hand, has facilitated the district to have good infrastructure than other districts. Lunglei district due to its unfavourable physical factor have hampered the development of

Table 9. Correlation matrix for final index

		Industry and Power Sector	Health Sector	Transport and communication Sector	Agriculture Sector
Correlation	Industry and Power Sector	1.000	.313	.552	.175
	Health Sector	.313	1.000	.728	.160
	Transport and communication Sector	.552	.728	1.000	.521
	Agriculture Sector	.175	.160	.521	1.000

Table 10. Final Index

District	Industry and power	Health	Transport and communication	Agriculture	Final Index	Rank
Mamit	0.113	0.325	0.226	0.211	0.223	7
Kolasib	0.098	0.432	0.517	0.725	0.440	4
Aizawl	0.971	0.708	0.904	0.528	0.796	1
Champhai	0.467	0.633	0.520	0.849	0.601	2
Serchhip	0.141	0.605	0.531	0.305	0.419	5
Lunglei	0.495	0.573	0.428	0.393	0.474	3
Lawngtlai	0.420	0.018	0.045	0.212	0.155	8
Saiha	0.354	0.794	0.371	0.057	0.417	6

agricultural resources. Its location on the crossroad between Aizawl and the southern part of the state on the other hand, has facilitated the district to have good transportational network, health facilities and industry.

Kolasib district ranked 4th in the final composite index. Kolasib district by virtue of its location near the Assam plain has favourable physical conditions. Large area of land under cultivable slope, adequate moisture supply through rainfall and availability of irrigational facilities in the district has favoured development of agricultural resources. Besides this, another patch of flat valley such as Chemphai and Buhchangphai along the river Teirei and Serlui, Phaisen and Chhimluang to the west of Bilkhawthlir, Hortoki and Bairabi along the river Tlawng mostly have been brought under permanent cultivation with increase in irrigation facilities.

Two districts namely Lawngtlai and Saiha located in the southern part of the state score very low in the final composite index. These districts are characterized by ridges and wide valleys with hot and humid climate throughout the year. It is dissected by rivers such as Chhimtuipui River, Kawrpui River and Tuichawng River. Inspite of their topography with lack of transportational network, its peripheral location and harsh environment on the other hand, has hindered the development of industry and agriculture in these districts.

Conclusion

The present analysis however, stresses one point that in Mizoram physical environment still plays a dominant role in its socio- economic development. Even the other resources in their regional context depend to large extent on the physical environment. This dependency on one aspect of resource appears to dominate whole of the state as long as the economy depends only on agriculture. Though the areas well within the sphere of towns so far have failed to provide any sound alternative economic base other than services which, in most cases, have outgrown their requirement. Moreover, they cannot be considered a reproductive economy whereas in a state like Mizoram having certain sociological problems some productive economic activities are needed to be expanded. As a matter of fact, the state requires some supplementary economy besides agriculture. Of course, steps have been initiated in this direction and the bamboo industries at Sairang and Bairabi, Mizoram Industrial Food Corporation at Chhingchhip are efforts in this direction. Though they are expected to bring substantial change but they are just not enough for the entire state. As such the state has little option. Development

of agriculture should be given top priority. Though agriculture may not initiate industrial development, but its progress will strengthen the rate of agro based industries in the state. The lack of power generation capacity is the acute problem in the state. The major rivers in the state must be surveyed in order to developed and generate hydel power. Availability of assured power is expected to diversify economic activities in the state. Poor communication and transport facilities also hinder exploitation of natural resources in the state. Attempts should be made to make the state and its different parts more accessible. The increased accessibility with developed transport network will also encourage development of other sectors in the state.

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Need for Settled Farming and Sustainable Agriculture in the North-Eastern Region of India

- C. Lalmuankima

Abstract : *The North-eastern region of India is a predominantly agricultural region. As tribal people make up the overwhelming majority of the population of the states of NE India, except for Assam, shifting agriculture (shifting cultivation) and forest resources play a major role in their economic life. The system of cultivation in this region is known as 'Jhuming' or 'Shifting cultivation'. Large area of land is destroyed every year for Jhum purposes and the region is under severe threat of soil erosion. The present study makes an attempt to reveal the need for settled farming and sustainable agriculture in the North-Eastern region of India by exploring the status of sustainable agriculture in N.E.R. and its consequences and highlighting the problems faced in the way of maintaining sustainable agriculture in N.E.R., and the various strategies to achieve sustainable agriculture in N.E.R. of India. It is revealed in the present study that 54.4% of the total geographical area of NE India is under forest cover and 14.5% of the total area is under cultivation. It is also revealed in the study that the total area of the N.E.R., used for practicing shifting cultivation or Jhuming is 277462.5 million hectares which causes a soil loss of 121.0 million tonnes annually. The study sorts out the problems confronting the people in the way of adopting settled farming and maintaining sustainable agriculture in the N.E.R., and lays down some strategies and alternatives for settled farming and sustainable agriculture in the region.*

Introduction

The North-Eastern Region of India consists of eight hill states, viz., Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. Of these, Assam is the least hilly since much of it lies in the plains of the Brahmaputra river system. Most of North-East India, however, consists of hills or mountains deeply dissected by rivers and streams due to uplifting of the land. Because of this terrain, travelling in this region of India is difficult and slow. This region is bounded by China, Bhutan, Bangladesh and Myanmar. Tribal people make up the overwhelming majority of the population of these states, except for Assam, shifting agriculture (shifting cultivation) and forest resources play a major role in their economic life. Rising populations and desire for an improved standard of living in this region (where the incidence of poverty is high) have resulted in lack of sustainability of traditional practices in agriculture and forest use. Consequently, there is a need to search for alternative methods of agriculture and forest use and to evaluate their sustainability from an economic,

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social and biophysical point of view. This paper makes an attempt to reveal the need for sustainable agriculture in the North-Eastern Region (N.E.R.) of India by exploring the status of sustainable agriculture in N.E.R. and its consequences and highlighting the problems faced in the way of maintaining sustainable agriculture in N.E.R., and the various strategies to achieve sustainable agriculture in N.E.R. of India with the following objectives:-

1. To highlight the components of sustainable agriculture.
2. To highlight a rough idea about the status of sustainable agriculture in the North-Eastern Region of India and its consequences.
3. To highlight the problems faced in the way of maintaining sustainable agriculture in the North-Eastern Region of India.
4. To know various strategies and alternatives to achieve sustainable agriculture in the North-Eastern Region of India.

Definitions and concepts of sustainable agriculture

"In simplest terms, sustainable agriculture is the production of food, fiber, or other plant or animal products using farming techniques that protect the environment, public health, human communities, and animal welfare. This form of agriculture enables us to produce healthful food without compromising future generations' ability to do the same." *(http://www.sustainabletable.org/246/sustainable-agriculture-the-basics)*

"Sustainable agriculture is the efficient production of safe, high quality agricultural products, in a way that protects and improves the natural environment, the social and economic conditions of farmers, their employees and local communities, and safeguards the health and welfare of all farmed species" *(http://www.saiplatform.org/sustainable-agriculture/definition)*

U.S. House of Representative's conference report on the Food, Agriculture and Trade Act of 1990 (p. 1055) "Sustainable agriculture is an integrated system of plant and animal production practices having a site-specific application that will, over the long term:

1. satisfy human food and fiber needs;
2. enhance environmental quality and the natural resource base upon which agricultural economy depends;
3. make the most efficient use of non-renewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls;
4. sustain the economic viability of farm operations; and
5. enhance the quality of life for farmers and society as a whole."

Sustainable agriculture can be defined in many ways as narrated above, but ultimately it seeks to sustain farmers, resources and communities by promoting farming practices and methods that are profitable, environmentally sound and good for communities. Sustainable agriculture fits into and complements modern agriculture. It rewards the true values of producers and their products. It draws and learns from organic farming. It works on farms and ranches large and small, harnessing new technologies and renewing the best practices of the past.

In short, Sustainable Agriculture is:

* Economically viable : If it is not profitable, it is not sustainable.
* Socially Supportive : The quality of life of farmers, farm families and farm communities is important.
* Ecologically Sound : We must preserve the resource base that sustains us all.

Components of sustainable agriculture

Using the above-listed definitions and descriptions of agricultural sustainability, six components, viz., productivity, stability, efficiency, durability, compatibility and equity, are set out for consideration in order to make a comprehensive assessment of any agrological system.

Status of Shifting agriculture in the NE Region of India and its consequences

The North-Eastern states have total geographical area of 2,55,090 sq. km., out of which 1,36,785 sq. km. or 54.4% is under forest cover. About 37,220 sq. km. area or 14.5% of the total area is under cultivation in the region. The region can broadly be divided into three physiographic zones as follows:-

1. hills and mountains of folded topography;
2. peninsular plateau; and
3. plain.

The following table shows the land utilization in the north-eastern region of India during the year 2005-06. From the table, it is learnt that Arunachal Pradesh has the largest area of land under forest, i.e., 92.92% of her total geographical area while Assam has the smallest area of land under forest, i.e., only 24.62% of her total geographical area in the north-eastern region of India.

Similarly regarding land not available for cultivation, Sikkim, having 34.34% of her total geographical area, contributes the largest area while Arunachal Pradesh, having 0.58 % of her total geographical area, contributes the smallest area in the region. Again, in the case of net sown area, we have found that the net sown area in Assam, being 35.34% of her total

geographical area, is the largest while the net sown area in Mizoram, being 4.29% of her total geographical area, is the smallest net sown area in the region.

Shifting cultivation, the predominantly form of agricultural prevalence in the region, is practiced in about 3869 sq. km. of area annually. As shifting cultivation plays a dominant role in the economic life of the people of N.E.R., the region is under severe threat of soil erosion. Appropriate estimated soil loss from shifting cultivation in N.E.R. is shown below: (Area in Million Hectares/Tonnes)

Apart from shifting cultivation, minor and major land slips and landslides, agriculture on the slopes are another major contribution to the process of soil erosion and land degradation. On the other hand so far as food security is concerned, it is a matter of suspicion whether food security can be maintained along with sustainable agriculture. Regarding this, if we look at food production in the North-Eastern Region of India, we found that in

Table 1. Land Utilization of Northeastern Region during 2005-06 (All figures are in percentage)

Sl. No.	States	Land Under Forest	Land available for cultivation	Net sown area
1	Assam	24.62	32.28	35.34
2	Manipur	86.82	1.38	11.44
3	Meghalaya	42.29	10.21	9.50
4	Mizoram	82.25	6.92	4.29
5	Nagaland	54.55	4.77	19.53
6	Sikkim	43.82	34.34	26.69
7	Tripura	57.77	12.27	29.16
8	Arunachal Pradesh	92.92	0.58	15.38

(Source: CMIE Report, January 2009)

Table 2. Soil Loss from Shifting Cultivation in the Northeastern Region of India.

Sl. No.	States	Jhum Area	Total Soil Loss
1	Arunachal Pradesh	35000.0	15.2
2	Assam	22819.0	9.9
3	Manipur	37113.4	16.3
4	Meghalaya	49074.1	21.3
5	Mizoram	35660.4	15.5
6	Nagaland	81153.8	35.5
7	Tripura	16641.8	7.3
	Total	**277462.5**	**121.0**

Source: Mishra, 1999

2000-2001 total food grains production in the N.E.R. was 5,875 million tonnes, about 3 percent of all India level. The share of the region's population in India is higher at about 4 percent than its 3 percent share of food grain production; the N.E.R. has a regional level deficit in food production and is dependent upon food grain from outside in India and abroad.

Therefore, if we are concerned with sustainable agriculture, then it is evident that sustainable agriculture is to some extent achieved by the north-east states as compared to some other states of India. Because the agricultural pattern in the North-Eastern Region of India is mechanised partially. But on the other side, natural calamities, shifting cultivation, faulty type of cultivation are also giving threat to sustainable agriculture in N.E.R. Hence it is a comprehensive matter to say how much sustainable agriculture exists in the region. Thus, the feasibility of prevalence of environmental degradation as well as ensuring food security, without compromising the natural resources will require efficient and proper management strategies.

The following problems are faced in the way of maintaining sustainable agriculture in the North-Eastern Region of India :-

1. ***Shifting cultivation :*** Due to predominance of shifting cultivation in the North-Eastern Region of India, it is under severe threat of soil erosion which gives a threat to sustainable agriculture.
2. ***Traditional land use system:*** The traditional land use system practised by the small and marginal farmers degrades the soil quality to a large extent, which also gives a threat to sustainable agriculture.
3. ***Rapid increase in population growth :*** With the rapid increase in population and to meet the growing demand for food, more and more fertilizer and pesticides are applied in agriculture fields. This gives a threat to sustainable agriculture.
4. ***Frequent Flood :*** Flood that occurs frequently, especially in Assam increase salutation of the soil through water logging which is another responsible factor for soil degradation.
5. ***Lack of awareness among the farmers :*** Because of narrow outlook and unconsciousness of the farmers, they are not aware about the severe evil effects of environmental degradation.

Strategies and alternatives for sustainable agriculture in the NE Region of India

Maintenance of sustainability in agriculture is a great challenge not only for N.E.R., but also for the country as a whole. If serious efforts are made to adopt effective and

adequate strategies and some remunerative alternatives, the goal can be achieved to a large extent. A variety of philosophies, strategies and practices have contributed to this goal. Few of them can be enumerated as under:-

1. ***Inputs management strategy:*** Many inputs and practices used by conventional farmers are threatening to sustainable agriculture. Inputs should be used in such a manner that it does not need high level material inputs. To be more sustainable over the long term, labour must be acknowledged and supported by Government policies, recognized as important constituents of Land Grant University and carefully considered when assessing the impact of new technologies and practices.
2. ***Soil management strategy:*** For improving soil fertility, the following practices can be applied in agriculture fields:-
   i) Use of farm composting, mulches and green manure.
   ii) Use of intercropping, strip cropping and crop rotation.
   iii) Application of physical method such as contours bunds to minimize erosion especially on sloping lands.
3. ***Water management strategy:*** An extensive water storage and transfer system should be established which helps crop production to expand to every arid region. In drought-prone areas, limited surface water supplies should be prompted over draft of ground water.
4. ***Energy management strategy:*** Modern agriculture heavily depends on non-renewable energy sources, especially petroleum. The continued use of these energy sources cannot be sustained indefinitely, yet to abruptly abound on our reliance on them would be economically catastrophic. However, a sudden cut off in energy would be equally disruptive. In sustainable agriculture system, there is reduced reliance on non-renewable energy sources and a substitution of renewable sources on labour to the extent, i.e., economically feasible.

Since agriculture-related activities are highly desired and cannot be checked overnight, therefore, along with the above strategies we may adopt some remunerative alternatives as soon as possible with the help and support of Government agencies. Cottage and Small-scale industries, animal based farming system, agriculture and allied activities are some other alternatives that should be practised in order to improve social economic status of farming community by preserving the national treasure of soil and nutrients. Few workable suggestions are made in this regards as follows:-

(a) Poultry and livestock farming: Poultry farming and livestock farming are two primary ventures that have vast potential in the region, Tripura, Assam and plain regions of Manipur and Meghalaya can be converted to the poultry production area in the region. Duck can also be promoted for egg and meat purposes. There is an immense scope for livestock development in Mizoram, Meghalaya, Nagaland and other tribal-dominated areas.

(b) Dairy farming: Though dairy farming is practised in the North-Eastern Region of India, it is on a minor scale especially by the migrated labourers from the neighbouring states. Sheep and goats are also seen but due to high humidity probably they are not able to withstand the climate pressures. The region due to high rainfall offers great potentials for fodder product around the year for dairy cattle.

(***c) Tea plantation and tea industry:*** N.E.R. is the world largest tea growing region having 16% share and is the largest producer and exporter of tea in India (share 55%). Tea plants, being perennial in nature, can withstand high intensity rainfall and provide the cover to the exposed land surface in torn helping to check the soil erosion to a large extent. Tea growing is being expanded to non-traditional areas of N.E. region such as Mizoram, etc. Tea growing areas need a boost in the region for resource sustainability and profitability.

(d) Cash crops and plantation crops: The tropical, sub-tropical and temperate climate of the north-eastern region of India is conducive for growing cash crops and plantation crops like ginger, squash, banana, pineapple and many other cash crops.

(e) Horticultural crops: The tropical, sub-tropical and temperate climate in plain areas, plateau and high hills of the N.E.R. offers excellent conditions for development of tropical and temperate horticultural crops production. The region's congenial climate is also suitable for large-scale production of Oil Palm, etc.

(***f) Cultivation of medicinal and aromatic plants:*** There is a huge biospecies having medicinal plants and aromatic properties in the North-Eastern Himalayan region. Opportunities can be explored to start the cultivation of such plants species, which are perennial in nature and do not require disturbing of the land beneath due to weeding.

(g) Cottage and small-scale industries: As one of the chronic problems, faced in

agriculture, is excessive pressure of population on land, it is imperative to develop cottage and small-scale industries in the rural areas for immediate relief and amicable solution of the problem.

Suggestions

(i) All states in the North-Eastern Region of India are predominantly agricultural states. The main occupation of rural people in these eight states - agriculture, engages about 70 % of the population. The system of cultivation in this region is an age-gold primitive method known as 'Jhuming' or 'Shifting cultivation'. Large area of land is destroyed every year for jhum purposes. Since majority of the people are related to shifting cultivation in this region as stated above and whereas it cannot be eliminated completely, therefore, policies should be made to improve the shifting cultivation so that adverse effect can be minimized.

(ii) Credit Institution should be more effective so that people can go for various alternatives. The development of transport and communication facilities at a faster rate is also urgently required in this region.

(iii) Building up mass awareness among the people and proper motivation to the concerned through dialogues, meeting, seminar, workshop, conference and publicity in electronic media for whole-hearted participation is the need of the hour.

(iv) Research for optimum utilization of resources, production of value-added products of value-added produces, improve technology for various agriculture activities, impro-visation of various indigenous methodology of production are also very much essential.

(v) Efforts should be made to generate more and more energy - both conventional and non-conventional in this region by exploiting her vast power potential.

(vi) More training programmes for skill development should be launched targeting the rural youths of NE.R. Industrial training institutes should be established in each and every sub-division.

(vii) Marketing facilities should be developed so as to enable the farmers and cultivators of this region to sell their products at remunerative prices.

(viii) Last, but not the least, rapid increase in population including infiltration from Bangladesh, Myanmar and other neighbouring countries must be checked both for food security and economic use of existing resources so that resources can be reserved for future generation as far as possible.

Conclusion

It is important to point out that marching towards sustainable agriculture and achieving sustainable development in agriculture in the north-eastern region of India is the responsibility of all participants in the system including farmers, labourers, policy makers, researchers, retailers and consumers. Each group has its own part to play, its own unique contribution to make to strengthen the sustainable agriculture community.

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