UNIVERSITY GRANTS COMMISSION
BAHADUR SHAH ZAFAR MARG
NEW DELHI – 110 002

FINAL REPORT OF THE WORK DONE ON THE MAJOR RESEARCH PROJECT

1. Project report No. 1st/2nd/3rd/Final: **Final**

2. UGC Reference No. : **F.No. 41-14/2012 (SR) Dated 10th July 2012**

3. Period of report: **From 01.07.2012 to 30.06.2015**

4. Title of research project: **Iodine nutritional status of school children during post salt iodization period in Churachandpurand Tamenglong districtsof Manipur**

5. (a) Name of the Principal Investigator: **Dr Laishram Hemchandra Singh**

   (b) Deptt. and College where work has been done: **Department of Zoology (P.G. Section), D.M. College of Science, Imphal West, Manipur**

6. Effective date of starting of the project: **01.07.2012**

7. Grant approved and expenditure incurred during the period of the report:

   a. Total amount approved: **Rs. 8, 95, 800/-**
   b. Total amount allocated: **Rs. 8, 71, 542/-**
   c. Total grant released: **Rs. 8, 03, 168/-**
   d. Total expenditure: **Rs. 9, 65, 260/-**
   e. Report of the work done: (**Annexure I**)

SIGNATURE OF THE PRINCIPAL INVESTIGATOR

SIGNATURE OF THE PRINCIPAL

SIGNATURE OF THE CO-INVESTIGATOR

Annexure I

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REPORT OF THE WORK DONE

BRIEF OBJECTIVES OF THE PROJECT

Manipur is in the classical goiter endemic belt of India due to its geographical location in the sub-Himalayan region [WHO/SEARO, 1985]. Endemic goiter and associated iodine deficiency disorders (IDD) were found prevalent among school children of certain population of valley districts of Manipur during post salt iodization period [AK Chandra and L. Hemchandra, 2008]. Therefore, the present research work was undertaken to evaluate the iodine nutritional status of school children in two hill districts of Manipur viz., Churachandpur and Tamenglong districts with the following objectives:

a. To assess the iodine nutritional status of school children during post salt iodization phase.

b. To evaluate whether the existing goiter prevalence if any is for improper iodine intake or for the interference of environmental goitrogenicfactors.

c. To study the impact of the use of iodized salt for the prevention and control ofIDD in the region.

c. To evaluate the bioavailability of iodine in these hilly districts.

WORK DONE AND RESULTS

Clinical Goitre Survey

The most widely accepted marker to evaluate the severity of Iodine Deficiency Disorders in a region is the prevalence of endemic goiter in school children (6-12 yrs.). Therefore, a total of 3233 school children (6 -12 years) of both sexes from randomly selected eight different areas of Churachanpur and Tamenglong districts of Manipur were clinically examined for the enlargement of thyroid (goiter) by palpation method endorsed by WHO/UNICEF/ICCIDD, 1994 [Plate 1-8]. The goiter was classified into three: Grade 0: no goitre; Grade 1: thyroid palpable but not visible, and Grade 2: thyroid visible with neck in normal position according to guidelines of WHO/UNICEF/ICCIDD, 1994.The age of students was confirmed from the school authority and was rounded to the nearest whole number. Sampling of approximately 1% of the population can provide a valid estimate in a large homogenous population in a region[WHO/UNICEF/ICCIDD, 2007].The results showed that the eight studied areas were goitre endemic with total goiter rate of 30.06% and most of the goiter were of grade 1 (27.62%) and the grade 2 was few (2.44%).Area wise goiter prevalence in different age groups are shown in Table 1-9. Table 10 shows the overall goiter prevalence indicating that the studied areas are severely goiter endemic. Table 11 shows the sex specific goiter prevalence in the studied areas. The survey was conducted with the approval of the Institutional Ethical Committee, D.M. College of Science, Imphal.

Measurement of Iodine content in edible salt

According to WHO/UNICEF/ICCIDD, 2001, 90% of the households should get iodized salt at the recommended level of 15 ppm. To explore the effectiveness of salt iodization in the study regions, two hundred and eighty (280) edible salt samples (35 from each area) were collected from the houses of the clinically examined children and analysed the iodine content using iodometric titration method [UNICEF/ICCIDD/PAMM/WHO, 1995], and it was found that all the salt samples tested had iodine. No any salt sample had iodine level below 15 ppm, 88.57% salt samples had iodine level between 15.1-29.9 ppm, and 11.43% salt samples had iodine level equal and above 30 ppm. It indicates that the studied population are consuming sufficient iodine through edible salt and it suggests that Universal Salt Iodization Programme is successfully operating in these two hill districts.

Measurement of Iodine concentration in drinking water

To monitor the soil iodine concentration of a region, the iodine content in drinking water of the region can be assessed. According to Zeltser*et al*1992, three types of iodine deficient zones can be established: severe deficient zone (iodine < 4µg/l water), moderate deficient zone (4 – 10µg/l) and relative deficient zone (11 – 20µg/l). On the basis of these criteria, the iodine content in drinking water indicates the bioavailability of iodine. Forty (40) drinking water samples (5 from each area) collected from the houses of the students were analysed for the iodine content by the method of Karmarkar*et al* (1986). The present study showed that the region is moderately iodine deficient zone as the mean iodine content was 9.83 ± 3.87 µg/l.

Measurement of Iodine concentration in urine

As per recommendation of WHO/UNICEF/ICCIDD (1994), measurement of iodine in urine samples should be done in school-aged children (6 – 12 years) for the assessment of iodine nutritional status of a region. A median urinary iodine concentration of 100µg/l and when not more than 20% of the samples are below 50µg/l in an area indicates no iodine deficiency [WHO/UNICEF/ICCIDD, 1994)]. In the present investigation, three hundred and twenty (320) spot casual urine samples (40 from each area) were collected from the clinically examined children irrespective of thyroid size and measured the iodine concentration by arsenite method following dry ashing [Karmarkar*et al*, 1986]. The median urinary iodine level was 125 µg/l indicating that there is no biochemical iodine deficiency in the studied population. The urinary iodine levels less than 100µg/l were seen in 26.88% of the samples tested, and the iodine levels less than 50µg/l were found only in 5% of the samples tested [Table: 12].

Measurement of Thiocyanate concentration in urine

The urinary thiocyanate truly reflects the consumption pattern of cyanogenic foods. Certain plants such as those of the family Brassicaceae are the sources of cyanogenic glycosides and glucosinolates. Bamboo shoots and cassava also contain high amount of cyanogenic glycosides. These cyanogenic compounds are the precursors of thiocyanate [Van Etten CH, 1969]. Thiocyanate inhibits the iodide uptake by the thyroid and also blocks the organic binding of iodine by competing with iodide. It also increases iodine efflux. The urinary thiocyanate concentration in non-goitrous population of India is 0.504 ± 0.197 mg/dl [AK Chandra and L. Hemchandra, 2006]. Marwaha*et al* (2003) reported that thoiocyanate might play an important role in the development of goiter among poor children in India during the

post salt iodisation phase.Thethiocyanate concentration was also measured from the urine samples collected for iodine by the method of Aldridge and modified by Michajlovskij and Langer, 1958. Themean urinary thiocyanateconcentrationof the present study was0.837± 0.084mg/dl [Table 12] indicating that the studied population must have consumed sufficient amount of cyanogenicplant foods such as cauliflower, cabbage, mustards, bamboo shoots, etc., which contain anti-thyroid substances likethiocyanate and isothiocyanate.

Table 1: Goiter prevalence in different age groups of school children of Salem Veng, Churachanpur district

Age (Years)	Total number of children examined	Number of children with goiter		
		Grade – 1	Grade – 2	Total (1+2)
6	72	20 (27.78)	0 (0.00)	20 (27.78)
7	67	12 (17.91)	4 (5.97)	16 (23.88)
8	64	15 (23.44)	0 (0.00)	15 (23.44)
9	75	14 (18.67)	1 (1.33)	15 (20.00)
10	86	20 (23.26)	2 (2.33)	22 (25.58)
11	77	11 (14.29)	0 (0.00)	11 (14.29)
12	68	15 (22.06)	1 (1.47)	16 (23.53)
Total	**509**	**107 (21.02)**	**8 (1.57)**	**115(22.59)**

(Parentheses indicate percentage)

Table 2: Goiter prevalence in different age groups of school children of Torbung, Churachanpur district

Age (Years)	Total number of children examined	Number of children with goiter		
		Grade – 1	Grade – 2	Total (1+2)
6	48	10 (20.83)	1 (2.08)	11 (22.92)
7	51	10 (19.61)	1 (1.96)	11 (21.57)
8	44	16 (36.36)	1 (2.27)	17 (38.64)
9	49	18 (36.73)	2 (4.08)	20 (40.82)
10	40	13 (32.50)	1 (2.50)	14 (35.00)
11	39	12 (30.77)	2 (5.13)	14 (35.90)
12	39	17 (43.59)	2 (5.13)	19 (48.72)
Total	**310**	**96 (30.97)**	**10 (3.23)**	**106 (34.19)**

(Parentheses indicate percentage)

Table 3: Goiter prevalence in different age groups of school children of New Lamka, Churachanpur district

Age (Years)	Total number of children examined	Number of children with goiter		
		Grade – 1	Grade – 2	Total (1+2)
6	38	15 (39.47)	-	15 (39.47)
7	36	20 (55.56)	1 (2.78)	21 (58.33)
8	43	14 (32.56)	-	14 (32.56)
9	53	15 (28.30)	-	15 (28.30)
10	53	21 (39.62)	1 (1.89)	22 (41.51)
11	48	17 (35.42)	2 (4.17)	19 (39.58)
12	56	19 (33.93)	1 (1.79)	20 (35.71)
Total	**327**	**121 (37.00)**	**5 (1.53)**	**126 (38.53)**

(Parentheses indicate percentage)

Table 4: Goiter prevalence in different age groups of school children of Loktak project, Churachanpur district

Age (Years)	Total number of children examined	Number of children with goiter		
		Grade - 1	Grade - 2	Total (1+2)
6	36	6 (16.67)	2 (5.56)	8 (22.22)
7	45	12 (26.67)	1 (2.22)	13 (28.89)
8	38	7(18.42)	0 (0.00)	7 (18.42)
9	30	6 (20.00)	1 (3.33)	7 (23.33)
10	37	5 (13.51)	0 (0.00)	5 (13.51)
11	42	9 (21.43)	0 (0.00)	9 (21.43)
12	42	6 (14.29)	0 (0.00)	6 (14.29)
Total	**270**	**51 (18.89)**	**4 (1.48)**	**55 (20.37)**

(Parentheses indicate percentage**)**

Table 5: Goiter prevalence in different age groups of school children of Tamenglong H.Q., Tamenglong district

Age (Years)	Total number of children examined	Number of children with goiter		
		Grade– 1	Grade - 2	Total (1+2)
6	76	20 (26.32)	0(0.00)	20(26.31)
7	95	23(24.21)	4(4.21)	27(28.42)
8	119	39(32.77)	5(4.20)	44(36.97)
9	104	29(27.88)	0(0.00)	29(27.88)
10	131	42(32.06)	3(2.29)	45(34.35)
11	129	33(25.58)	4(3.10)	37(28.68)
12	125	28(22.4)	2(1.6)	30(24.00)
Total	**779**	**214 (27.47)**	**18(2.31)**	**232(29.78)**

(Parentheses indicate percentage**)**

Table 6: Goiter prevalence in different age groups of school children of Noney, Tamenglong district

Age (Years)	Total number of children examined	Number of children with goiter		
		Grade - 1	Grade - 2	Total (1+2)
6	56	19(33.93)	0(0.00)	19(33.93)
7	42	8(19.05)	0(0.00)	8(19.05)
8	50	12(24.00)	1(2.00)	13(26.00)
9	71	23(32.39)	1(1.41)	24(33.80)
10	74	27(36.49)	3(4.05)	30(40.54)
11	51	16(31.37)	4(7.84)	20(39.22)
12	48	13(27.08)	2(4.17)	15(31.25)
Total	**392**	**118(30.10)**	**11(2.81)**	**129(32.91)**

(Parentheses indicate percentage**)**

Table 7: Goiter prevalence in different age groups of school children of Tamei H.Q., Tamenglong district

Age (Years)	Total number of children examined	Number of children with goiter		
		Grade - 1	Grade - 2	Total (1+2)
6	42	11(26.19)	2(4.76)	13(30.95)
7	48	12(25.00)	3(6.25)	15(31.25)
8	46	10(21.74)	2(4.35)	12(26.09)
9	47	16(34.04)	2(4.26)	18(38.30)
10	42	09(21.43)	1(2.38)	10(23.81)
11	49	12(24.49)	2(4.08)	14(28.57)
12	53	14(26.42)	3(5.66)	17(32.08)
Total	**327**	**84(25.69)**	**15(4.59)**	**99(30.28)**

(Parentheses indicate percentage**)**

Table 8: Goiter prevalence in different age groups of school children of Langmei village, Tamei,Tamenglong district

Age (Years)	Total number of children examined	Number of children with goiter		
		Grade - 1	Grade - 2	Total (1+2)
6	42	13(30.95)	0(00.00)	13(30.95)
7	40	10(25.00)	2(5.00)	12(30.00)
8	46	17(36.96)	1(2.17)	18(39.13)
9	39	11(28.21)	1(2.56)	12(30.77)
10	47	15(31.91)	1(2.13)	16(34.04)
11	52	17(32.69)	2(3.85)	19(36.54)
12	53	19(35.85)	1(1.89)	20(37.74)
Total	**319**	**102(31.97)**	**8(2.51)**	**110(34.48)**

(Parentheses indicate percentage**)**

Table 9: Goiter prevalence (in percentage) in different studied areas of Churachanpurand Tamenglongdistricts of Manipur

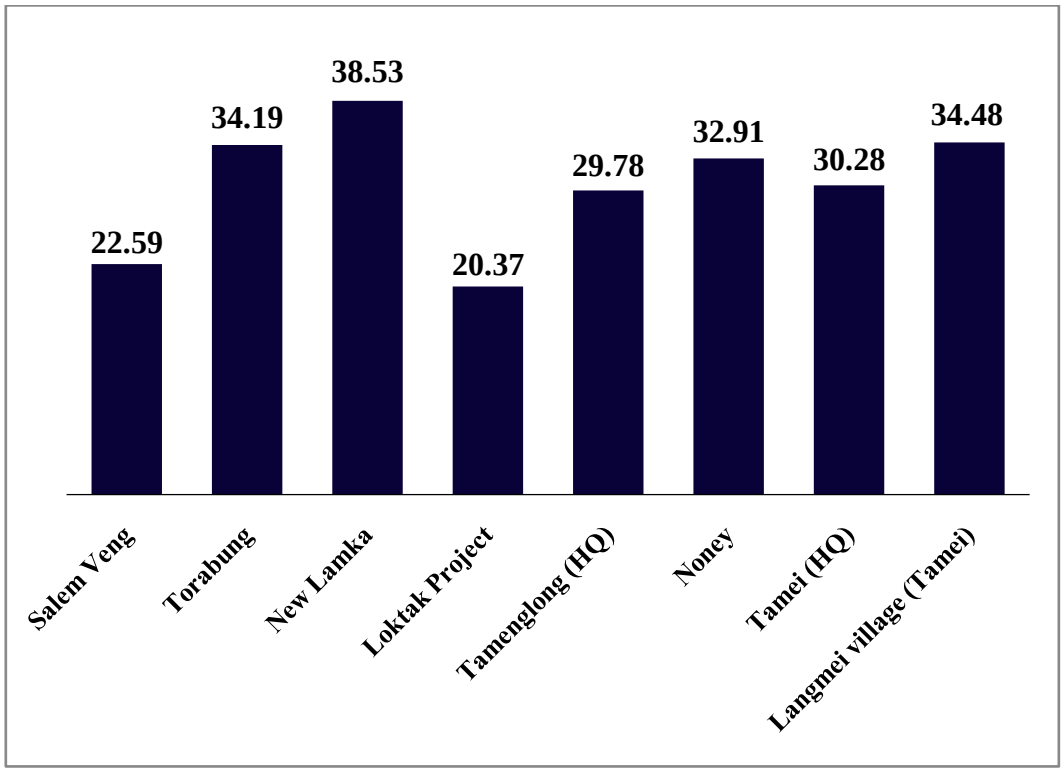

Table 10: Goiter prevalence in different studied areas of Churachanpurand Tamenglongdistricts of Manipur

Study areas	Rural/ Urban	Total number of children examined	Number of children with goiter			Severity as public health problem
			Grade -1	Grade -2	Total	
Salem	Rural	509	107(21.02)	8(1.57)	115(22.59)	Moderate
Torbung	Rural	310	96 (30.97)	10 (3.23)	106 (34.19)	Severe
New Lamka	Rural	327	121 (37.00)	5 (1.53)	126 (38.53)	Severe
Loktak project	Rural	270	51 (18.89)	4 (1.48)	55 (20.37)	Moderate
Tamenglong (HQ)	Rural	779	214 (27.47)	18(2.31)	232(29.78)	Moderate
Noney	Rural	392	118(30.10)	11(2.81)	129(32.91)	Severe
Tamei (HQ)	Rural	327	84(25.69)	15(4.59)	99(30.28)	Severe
Langmei village	Rural	319	102(31.97)	8(2.51)	110(34.48)	Severe
Total		**3233**	**893(27.62)**	**79(2.44)**	**972(30.06)**	**Severe**

(Parentheses indicate percentage)

Table 11:Prevalence of goiter in boys, girls, and overall studied population of Churachanpur andTamenglong districts

Age (Yrs)	Boys				Girls				Total			
	Number of children examined	Grade of goiter		Total (1+2)	Number of children examined	Grade of goiter		Total (1+2)	Number of children examined	Grade of goiter		Total (1+2)
		1	2			1	2			1	2	
6	238	66 (27.73)	3 (1.26)	69 (28.99)	172	48 (27.91)	2 (1.16)	50 (29.07)	410	114 (27.80)	5 (1.22)	119 (29.02)
7	233	55 (23.61)	6 (2.58)	61 (26.19)	191	52 (27.23)	10 (5.24)	62 (32.47)	424	107 (25.24)	16 (3.77)	123 (29.01)
8	254	72 (28.35)	6 (2.36)	78 (30.71)	196	58 (29.59)	4 (2.04)	62 (31.63)	450	130 (28.89)	10 (2.22)	140 (31.11)
9	261	72 (27.59)	2 (0.76)	74 (28.35)	207	60 (28.99)	6 (2.90)	66 (31.89)	468	132 (28.21)	8 (1.71)	140 (29.92)
10	287	81 (28.22)	8 2.79	89 (31.01)	223	71 (31.84)	4 (1.79)	75 (33.63)	510	152 (29.80)	12 (2.35)	164 (32.15)
11	275	68 (24.73)	7 (2.55)	75 (27.28)	212	59 (27.83)	9 (4.25)	68 (32.08)	487	127 (26.08)	16 (3.29)	143 (29.37)
12	279	75 (26.88)	9 (3.23)	84 (30.11)	205	56 (27.32)	3 (1.46)	59 (28.78)	484	131 (27.07)	12 (2.48)	143 (29.55)
Total	**1827**	**489 (26.77)**	**41 (2.24)**	**530 (29.01)**	**1406**	**404 (28.73)**	**38 (2.70)**	**442 (31.43)**	**3233**	**893 (27.62)**	**79 (2.44)**	**972 (30.06)**

(Parentheses indicate percentage)

Table 12: Urinary iodine, urinary thiocyanate, and iodine content in edible salt and drinking water samples from Churachanpur and Tamenglong districts

Study areas	Urinary iodine level (µg/l)			Urinary SCN level mg/dl (Mean ± SD)	Iodine in edible salt			Iodine content in drinking water (µg/l)
	Median	% Urine samples <100 µg/l	% Urine samples <50 µg/l		% Salt samples with iodine < 15 ppm	% Salt samples with iodine 15.1-29.9 ppm	% Salt samples with iodine ≥30 ppm	
Salem Veng	175	7.5	7.5	0.917 ± 0.112	-	94.29	5.71	20.20 ± 6.22
Torbung	195.75	5	0	0.945 ± 0.077	-	71.43	28.57	8.28 ± 4.18
New Lamka	135	25	5	0.896 ± 0.058	-	85.71	14.29	4.48 ± 3.84
Loktak Project	105	30	0	0.955 ± 0.037	-	94.29	5.71	10.98 ± 2.25
Tamenglong (HQ)	100	47.5	7.5	0.744 ± 0.078	-	97.14	2.86	7.12 ± 2.44
Noney	135	22.5	0	0.756 ± 0.070	-	88.57	11.43	9.20 ± 4.11
Tamei (HQ)	115	35	7.5	0.770 ± 0.075	-	85.71	14.29	10.04 ± 3.22
Langmei village	110	42.5	12.5	0.711 ± 0.067	-	91.43	8.57	8.32 ± 3.28
	125	**26.875**	**5**	**0.837 ± 0.084**	**-**	**88.57**	**11.43**	**9.83 ± 3.87**

SUMMARY OF THE FINDINGS OF THE STUDY

Clinical Goitre Survey

Endemic goiter and associated iodine deficiency disorders (IDD) were found prevalent among school children of certain population of valley districts of Manipur during post salt iodization period. Therefore, the present research work was undertaken to evaluate the iodine nutritional status of school children in two hill districts of Manipur viz., Churachandpur and Tamenglong. A total of 3233 school children (6 -12 years) of both sexes from randomly selected eight different areas of Churachanpur and Tamenglong district of Manipur were clinically examined for the enlargement of thyroid (goiter) by palpation method endorsed by WHO/UNICEF/ICCIDD, 1994. According to WHO/UNICEF/ICCIDD, 1994, the goiter was classified into three: Grade 0: no goitre; Grade 1: thyroid palpable but not visible and Grade 2: thyroid visible with neck in normal position. The results showed that the eight studied areas were goitre endemic with total goitre rate of 30.06% and most of the goitre were of grade 1 (27.62%) and the grade 2 was few (2.44%).

Measurement of Iodine content in edible salt

Two hundred and eighty (280) edible salt samples (35 from each area) collected from the houses of the clinically examined children were analysed for iodine content using iodometric titration method (UNICEF/ICCIDD/PAMM/WHO, 1995) and it was found that all the salt samples tested had iodine. No any salt sample had iodine level below 15 ppm, 88.57% salt samples had iodine level between 15.1-29.9 ppm, and 11.43% salt samples had iodine level equal and above 30 ppm. It indicates that the studied population are consuming sufficient iodine through edible salt and it suggests that Universal Salt Iodization Programme is successfully operating in these two hill districts.

Measurement of Iodine concentration in drinking water

Forty (40) drinking water samples (5 from each area) collected from the houses of the students were analysed for iodine content by the method of Karmarkar*et al* (1986). The mean iodine content was 9.83 ± 3.87 µg/l indicating that the region is moderately iodine deficient zone as the iodine content in drinking water indicates the bioavailability of iodine.

Measurement of iodine in urine

Three hundred and twenty (320) spot casual urine samples (40 in each area) were collected from the clinically examined children irrespective of thyroid size and iodine concentration was also measured by arsenite method following dry ashing (Karmarkar*et al*, 1986). The median urinary iodine level was 125 µg/l indicating that there is no biochemical iodine deficiency in the studied population. The urinary iodine levels less than 100 µg/l were seen in 26.88% of the samples tested, and the iodine levels less than 50 µg/l were found only in 5% of the samples tested.

Measurement of Thiocyanate concentration in urine

The thiocyanate concentration was also measured from the same urine samples collected for iodine by the method of Aldridge and modified by Michajlovskij and Langer, 1958. Themean urinary thiocyanateconcentration was0.837± 0.084mg/dl suggesting that the studied population must have consumed sufficient amount of cyanogenicplant foods such as cauliflower, cabbage, mustards, bamboo shoots, etc., which contain anti-thyroid substances likethiocyanate and isothiocyanate.

PAPER PUBLICATION FROM THE PROJECT

Name of the Journal:	*International Journal of Medical and Health Sciences* Jan 2015, Vol-4; Issue-1
Title of the Paper:	Prevalence of Endemic Goiter in School Children during Post Salt Iodization Period in Churachanpur District, Manipur, India
Name of authors:	Laishram Hemchandra Singh, IshwarHaobam, L. Arke, Amar K Chandra
Impact Factor of the Paper:	3.51

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A. THE WORK WAS DONE ACCORDING TO ORIGINAL PLAN OF WORK SUBMITTED TO UGC AND TOWARDS ACHIEVING THE OBJECTIVES

B. DUE TO THE SHORTAGE OF ALLOCATED FUND, THERE WERE LOTS OF PROBLEMS IN PROCURING OF EQUIPMENT AND GLASSWARE, AND EXPENDITURE OF TRAVEL AND FIELD WORK. TRAVEL AND FIELD WORK IN HILLY REGIONS, PARTICULARLY IN MANIPUR ARE VERY EXPENSIVE AND RISKY

C. ACKNOWLEDGEMENT

I am very much thankful to University Grants Commission, New Delhi for providing a financial support which enabled me to carry out such a public health related research work.

Dr L. Hemchandra Singh
Principal Investigator