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Determinants of anaemia among children aged under-five years in Meghalaya, India

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Abstract: Childhood anaemia poses serious threats to public health and may impair growth, cardiac function and cognitive and physical development. It also causes increased susceptibility to infections. Statistical analysis was performed on the cross-sectional data of 2957 children from 2015-2016 National Family Health Survey (**NFHS-IV**), using binary logistic regression model, to assess the significance of some risk factors of child anemia. Anemia was diagnosed by WHO cut-off points on hemoglobin level. The mean haemoglobin concentration was 114.19 g/dl (95% CI, 113.55-114.83) with the prevalence of child anaemia as 60.4% in Meghalaya. Of the 7 districts in Meghalaya (as per the seven-district classification used in NFHS-4), the highest prevalence was found in West Garo Hills (70.4 per cent), followed by Ri- Bhoi (67.7 per cent) and East Garo Hills (66.4 per cent) and the least prevalence was found in East Khasi Hills (45.6 per cent). The results of binary logistic risk factors showed higher likelihood of anaemia for lower age groups and higher birth orders ($p < 0.05$).

Keywords: *Meghalaya; Children; Anaemia; Risk factors; Logistic Regression.*

1. INTRODUCTION

Anaemia affects 2.36 billion people globally. It is especially prevalent among children and women of child bearing age [1, 2]. Both developing and developed countries account for high prevalence of anaemia which endangers human health, social and economic development [2]. Childhood anaemia poses a major public health threat and results in increased susceptibility to infections, risk of mortality together with serious degrading consequences on cognitive and physical development [4]. Anaemia is considered to be the most common pediatric hematological disease and extensively afflicts both males and females across all age groups in India [5].

National Family Health Survey (NFHS), Govt. of India, estimate an increase in anaemia prevalence from 74 per cent in 1992-93 to 79 per cent in 2005-06 among Indian children aged 6 to 36 months [6, 7]. Anaemia in India is mainly caused due to iron deficiency associated with lack of balanced diet which contains a low content of iron [8, 9]. Iron is required for the production of haemoglobin, a protein present in red blood cells, responsible for carrying oxygen from our lungs to every cell

in our body. In the absence of iron, the body fails to make enough haemoglobin or red blood cells, resulting in iron deficiency anaemia. Although anaemia can result from other causes, the majority are related to iron deficiency. Anaemia can also result from deficiency of other micronutrients like vitamin B12 and folate and from genetic factors (haemolytic anaemias). Low family income, low level of maternal education, lack of access to healthcare services and inadequate sanitary conditions are certain risk factors associated with anaemia[10]. Malaria is caused by Plasmodium falciparum which rupture RBCs and limit their production. Anaemia can also be caused by flukes and hookworm that cause iron drainage from excessive blood loss [11, 12]. Although several anaemia control programmes have been launched in India, the prevalence of anaemia is alarmingly high, especially in the rural areas.

Research has shown that if anaemia is detected at an early age, necessary measures can be taken to ensure that the child grows into a healthy adult. This in turn necessitates indepth study of the factors (socioeconomic and otherwise) associated with child anaemia [13]. Such studies can also ensure the successful implementation of the anaemia control programmes. Many authors have discussed the impact of the socioeconomic status (SES) on the prevalence of anaemia [14, 15]. This study also aims to assess the prevalence of anaemia among the children aged 6-59 months in the state of Meghalaya, India, and also, to explore the significant risk factors associated with anaemia. This paper too emphasizes on the socioeconomic differentials in order to fully understand the status and prevalence of anaemia.

2. MATERIALS AND METHODS

This study derives its data from the database compiled in National Family Health Survey (NFHS-IV) under Ministry of Health and Family Welfare, Govt. of India [16], which was carried out from Jan 20, 2015, to Dec 4, 2016, in all 29 states and seven Union Territories of the country and the results and reports are available in the public domain. The NFHS-IV is a large-scale sample survey conducted to provide essential information on population, family planning, maternal and child health, child survival, HIV and sexually transmitted infections (STIs), reproductive health, and nutrition in India. The relevant information of 2957 children between the ages 6-59 months, whose haemoglobin concentration was measured, were taken for the state of Meghalaya, India to examine the effect of certain socio-economic and demographic factors on child anaemia using statistical modeling. Haemoglobin concentration was measured by finger-prick blood specimens using a portable Hemocue Hb201+ analyzer, and WHO classification criteria were used to categorize a child anaemic.

The binomial logistic regression was used to develop a projecting model on anaemia, and also to examine dependence of anaemia on the risk factors taken into study. Odds ratios were computed using IBM SPSS 22.0 software, with reference category as the first category for all the factors; and Hosmer & Lemeshow test statistic was evaluated to test the goodness of fit of the model. The test statistic is a chi-square statistic with a desirable outcome of non-significance, indicating that the model prediction does not

significantly differ from the observed [17,18]. The response variable was designed as a binary 'anaemia level' (non-anaemic, anaemic) and the predictors as: age of child in years(less than 1, 1-2, 2-3, 3-4, and 4-5), birth order of child (1, 2, 3, and 4 & above), place of residence (urban, rural), religion (Hindu, Muslim, Christian and others), wealth index (poorest, poorer, middle, richer and richest), maternal BMI (under-weight, normal, and over-weight & obese), maternal education (no education, primary, secondary and higher) and iron supplements for mother during pregnancy (no, yes, don't know). Wealth indices indicated economic status of households and was developed using household asset information, and in relation to inequalities in household income, use of health services, and health outcomes. Maternal education was categorized on the basis of years of completion of formal school education; no education referred those who never attended school; primary, secondary and higher education included individuals of 5 years, 10 years and 12 or higher years of completed schooling respectively. Multi-collinearity test was performed to justify the independence of risk factors in the study.

Logistic regression model gives the risk of anaemia for a child for given predictors as:

$$\frac{e^{t(x)}}{1+e^{t(x)}}$$

$t(x)=\beta_0+\beta_1 x_1+\beta_2 x_2+...+\beta r$ is the logit transformation of the logistic regression model.

3. RESULTS

On analysis, it was observed that 60.4 % children were anemic in Meghalaya, India, with mean haemoglobin concentration 114.19 g/L (95% CI, 113.55-114.83) (Table 1). Of the males studied, it was found that 61.9% were anaemic while 59%of the females were found to be anaemic. Thus, the male and female population were equally afflicted with anaemia. On further analysis, it was found that as age increased, proportion of children affected with anaemia decreased with the highest prevalence of anaemia found in children aged less than one year (63.2%). Similar results were observed by Arlappa et al. [19], and Balakrishnan et al. [20] in their respective studies. A much higher prevalence of anaemia was found among rural children (61.8%) as compared to the urban child population (52.1%). The highest prevalence of anaemia was observed among children with birth order 4 and above (65.1%) followed by those with birth order one (56.4%). 60% of the children from Christian households were anaemic compared to children from other religions like Hindus (70.8%) and Muslims (74.1%). 72.3% children belonging to households of poorest wealth index were anaemic; 63 % of poorer, 56.2 % of middle, 55% of richer and 34% children of richest households were found to be anaemic. The prevalence of anaemia showed a decreasing trend from poorest to the richest. 64% of the children born to mothers with no formal education were anaemic, while 48.6% of the children born to mothers who received higher education were anaemic. The prevalence rates thus showed a decreasing trend as level of maternal education increased. Anaemia was predominant among the children of under-nutritious mothers (63.2%). The findings also reflect higher incidence rate

among the children of higher birth order. 53.7% of children born to mothers under the overweight or obese category were anaemic while 60.9% of children born to mothers under the normal category of BMI were anaemic. The analysis also showed that the intake of iron supplements during pregnancy decreased the incidence of anaemia among children.

Table 1: Prevalence rates of child anaemia by population subgroup

Subgroup	N (%)	Haemoglobin concentration (g/L)		Prevalence of anaemia
		Mean	95% CI	%
Gender				
Male	1445(48.9)	113.75	112.84-114.66	61.9
Female	1512(51.1)	114.6	113.7-115.51	59.0
Age of child (Years)				
Less than 1	764(25.8)	114.43	113.16-115.7	63.2
1-2	790(26.7)	113.82	112.58-115.05	62.7
2-3	574(19.4)	114.03	112.55-115.51	58.5
3-4	477(16.1)	113.2	111.63-114.77	60.0
4-5	352(11.9)	116.1	114.22-117.98	53.1
Birth order				
1	746(25.2)	114.61	113.28-115.93	56.4
2	714(24.1)	115.42	114.16-116.68	56.6
3	534(18.1)	113.96	112.48-115.43	62.7
4 & above	963(32.6)	113.94	111.94-114.22	65.1
Place of residence				
Urban	413(14)	118.05	116.26-119.84	52.1
Rural	2544(86)	113.56	112.88-114.25	61.8
Religion				
Hindu	161(5.4)	110.31	107.47-113.15	70.8
Muslim	112(3.8)	109.5	106.56-112.44	74.1
Christian	2437(82.4)	114.37	113.67-115.07	60.0
Others	247(8.4)	117.08	114.61-119.55	51.4
Wealth Index				
Poorest	458(15.5)	108.7	106.99-110.41	72.3
Poorer	1161(39.3)	112.66	111.63-113.68	63.0
Middle	915(30.9)	116.59	115.49-117.69	56.2
Richer	320(10.8)	117.48	115.73-119.23	55.0
Richest	103(3.5)	124.27	120.87-127.67	34.0
Mother's BMI				
Underweight	367(12.4)	112.53	110.65-114.41	63.2
Normal	2283(77.2)	113.92	113.20-114.65	60.9
Overweight & Obese	307(10.4)	118.14	116.22-120.05	53.7
Mother's education				
No education	541(18.3)	111.7	110.1-113.29	64.0
Primary education	824(27.9)	112.92	111.69-114.16	64.7
Secondary education	1407(47.6)	114.96	114.07-115.86	58.1
Higher education	185(6.3)	121.22	118.86-123.57	48.6
ISMP				
No	2009(67.9)	114.06	113.27-114.84	61.3
Yes	909(30.7)	114.38	113.23-115.52	58.6
Don't know	39(1.3)	116.54	111.13-121.95	59.0
All children	**2957(100)**	**114.19**	**113.55-114.83**	**60.4**

BMI, Body mass index; ISMP, Iron Supplement to mother during pregnancy.

Of the seven districts in Meghalaya (as per the seven district classification used in NFHS-4), the highest prevalence was found in West Garo Hills (70.4 per cent), followed by Ri- Bhoi (67.7 per cent) and East Garo Hills (66.4 per cent) and the least prevalence was found in East Khasi Hills (45.6 per cent) (Figure 1).

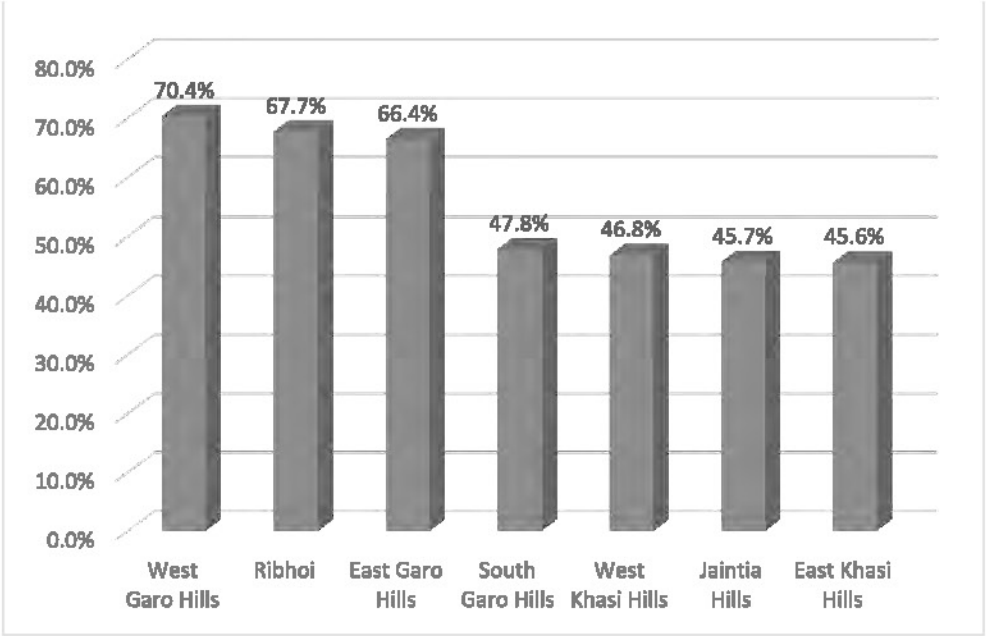

Figure I: District-wise prevalence of child anaemia in Meghalaya

Table 2: Estimates of parameters of binomial logistic regression model

Predictor	p-value	O.R.	95% CI for O.R.
Gender			
Male*		-	-
Female	0.169	0.89	[0.77-1.05]
Age of child (Years)			
Less than 1*		-	-
01-Feb	0.005	0.68	[0.53,0.89]
02-Mar	0.005	0.68	[0.53,0.89]
03-Apr	0.14	0.81	[0.62,1.07]
04-May	0.04	0.75	[0.56,0.99]
Birth order			
1*		-	-
2	0.001	1.412	[1.14, 1.74]
3	0.003	1.38	[1.12, 1.69]
4 & above	0.51	1.08	[0.86, 1.35]

Predictor	p-value	O.R.	95% CI for O.R.
Place of residence			
Urban*		-	-
Rural	0.123	1.21	[0.95, 1.53]
Religion			
Hindu*		-	-
Muslim	<0.001	0.31	[0.196, 0.418]
Christian	<0.001	0.36	[0.216, 0.59]
Others	<0.001	0.65	[0.49,0.85]
Wealth Index			
Poorest*		-	-
Poorer	<0.001	0.24	[0.14, 0.40]
Middle	<0.001	0.361	[0.22, 0.59]
Richer	0.001	0.44	[0.27, 0.72]
Richest	0.002	0.46	[0.28, 0.75]
Mother's BMI			
Underweight*		-	-
Normal	0.23	0.82	[0.59, 1.13]
Overweight & Obese	0.19	0.85	[0.66, 1.08]
Mother's education			
No education*		-	-
Primary education	0.63	1.11	[0.74,1.66]
Secondary education	0.82	0.96	[0.65, 1.4]
Higher education	0.95	1.01	[0.71, 1.44]
ISMP			
No*		-	-
Yes	0.81	0.92	[0.47, 1.79]
Don't know	0.7	0.88	[0.45,1.72]
** Reference category*	***Hosmer and Lemeshow Test value: 4.34 (p-value 0.825)***		

OR, odds ratio; CI, confidence interval; BMI, Body mass index; ISMP, Iron Supplement to mother during pregnancy.

4. DISCUSSION

The results of binary logistic risk factors showed higher likelihood of anaemia for lower age groups and higher birth orders($p<0.05$). A possible explanation is that at lower ages, the requirement of iron is higher than any other group [21]. A diet with a lower iron content may also be considered responsible. Lower chances of anaemia were seen in children aged 1-2 years (O.R. 0.68, 95% CI 0.53-0.89), 2-3 years (O.R. 0.68, 95% CI 0.53-0.89), 4-5 (O.R. 0.75, 95% CI 0.56-0.99) as compared to children of less than one year of age (Table 2). Muslim children were relatively less prone to anaemia as compared to Hindu children (O.R. 0.31, 95% CI 0.196-0.418). Christian children too were less susceptible to anaemia as compared to Hindu children (O.R. 0.36, 95% CI 0.216-

0.59). Wealth index also had significant effect on anaemia. The estimates revealed that a child of poorer category was at lower risk of anaemia than a child of poorest category (O.R. 0.24, 95% CI 0.14-0.40). Children of wealth index classified as middle (O.R. 0.361, 95% CI 0.22-0.59), richer (O.R. 0.44, 95% CI 0.27-0.72), richest (O.R. 0.46, 95% CI 0.28-0.75) were also at comparatively lower risk of anaemia compared to the poorest category. The risks increased as wealth index score decreased. These highlight the plight of the families in the lower socio-economic strata as their financial constraints and lack of awareness prohibit them from taking appropriate care of their children. Research shows that educated mothers may affect healthy decision making and therefore influence the chance of a child meeting nutritional requirements [22]. Some studies have also shown that, in developing countries children of formally educated mothers had a reduced risk of stunting [23, 24]. Hosmer and Lemeshow test value for the model was 4.34 (p-value 0.825), i.e., the model fitted the data at an acceptable level.

5. CONCLUSION

The study showed that the prevalence of anaemia in Meghalaya was very high at 60.4%. 61.9% of the male children aged below five years surveyed were anaemic while 59% of the female children studied were anaemic. The findings revealed significant adverse effect of anaemia on children of higher birth order. Low level of maternal nutrition and maternal education, inadequate antenatal care with insufficient or no iron supplements further aggravated the likelihood of child anaemia. Thus, there is an increased need of optimum implementation of preventive measures to combat child anaemia, with special emphasis to those areas where the prevalence rate is very high.

REFERENCES

[1] Vos, T., Allen, C., Arora, M., Barber, R. M., Bhutta, Z. A., Brown, A., & Coggeshall, M. (2016). Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. *The lancet, 388(10053), 1545-1602.*

[2] Naidu, C. H., Venela, P., Ammika, P., Kattula, S. R., Kokkiligadda, S. V., & Deshmukh, H. (2014). Factors influencing anaemia among adolescent girls from urban slums of Hyderabad-A Cross Sectional Cohort Study. *Indian Journal of Public Health Research & Development, 5 (3), 16-21.*

[3] Latham, M. C. (1997). Human nutrition in the developing world (No. 29). *Food & Agriculture Org..*

[4] Hunt, J. M. (2002). Reversing productivity losses from iron deficiency: the economic case. *The Journal of nutrition, 132(4), 794S-801S.*

[5] Sahu, T., Sahani, N. C., & Patnaik, L. (2007). Childhood anemia-A study in tribal area of Mohana block in Orissa. *Indian Journal of Community Medicine, 32(1), 43.*

[6] IIPS, M. D., & Macro, O. R. C. (2000). National family health survey (NFHS-2), 1998-99: India. International Institute of Population Sciences, Mumbai.

[7] Goswami, S., Acharjee, R., & Dey, S. (2020). Determinants of anaemia among children aged under five years in Assam, India. *International Journal of Contemporary Ped-iatrics, 7(11), 1.*

[8] Thankachan, P., Walczyk, T., Muthayya, S., Kurpad, A. V., & Hurrell, R. F. (2008). Iron absorption in young Indian women: the interaction of iron status with the influence of tea and ascorbic acid. *The American journal of clinical nutrition, 87(4), 881-886.*

[9] Baker, R. D., & Greer, F. R. (2010). Diagnosis and prevention of iron deficiency and iron-deficiency anemia in infants and young children (0–3 years of age). Pediatrics, 126(5), 1040-1050.

[10] Goswmai, S., & Das, K. K. (2015). Socio-economic and demographic determinants of childhood anemia. *Jornal de Pediatria (Versão em Português), 91(5), 471-477.*

[11] Onyemaobi, G. A., & Onimawo, I. A. (2011). Risk factors for iron deficiency anaemia in under-five children in Imo State, Nigeria. *J Appl Sci Res, 7(1), 63-67.*

[12] De Benoist, B., Cogswell, M., Egli, I., & McLean, E. (2008). Worldwide prevalence of anaemia 1993-2005; WHO Global Database of anaemia.

[13] Stoltzfus, R. J., Mullany, L., & Black, R. E. (2004). Iron deficiency anaemia. Comparative quantification of health risks: global and regional burden of disease attributable to selected major risk factors, 1, 163-209.

[14] Dey, S., Goswami, S., & Dey, T. (2013). Identifying predictors of childhood anaemia in North-East India. *Journal of health, population, and nutrition, 31(4), 462.*

[15] Dey, S., & Raheem, E. (2016). Multilevel multinomial logistic regression model for identifying factors associated with anemia in children 6–59 months in northeastern states of India. *Cogent Mathematics & Statistics, 3(1), 1159798.*

[16] IIPS, I. (2017). National Family Health Survey (NFHS-4), 2015–16. *International Institute for Population Sciences (IIPS), Mumbai, India.*

[17] Hosmer Jr, D. W., Lemeshow, S., & Sturdivant, R. X. (2013). *Applied logistic regression (Vol. 398). John Wiley & Sons.*

[18] Agresti, A. (2002). Categorical Data Analysis. Hoboken, NJ: A John Wiley & Sons. Inc. doi: https://doi.org/10.1002/0471249688.

[19] Arlappa, N., Balakrishna, N., Laxmaiah, A., & Brahmam, G. N. V. (2010). Prevalence of anaemia among rural pre-school children of West Bengal, India. *Annals of human biology, 37(2), 231-242.*

[20] Arlappa, N., Balakrishna, N., Laxmaiah, A., & Brahmam, G. N. V. (2012). Prevalence of anaemia among rural pre-school children of

Maharashtra, India. *Indian Journal of Community Health, 24(1), 4-8.*

[21] Gebreegziabiher, G., Etana, B., & Niggusie, D. (2014). Determinants of anemia among children aged 6-59 months living in Kilte Awulaelo Woreda, Northern Ethiopia. Anemia, 2014.

[22] Choi, H. J., Lee, H. J., Jang, H. B., Park, J. Y., Kang, J. H., Park, K. H., & Song, J. (2011). Effects of maternal education on diet, anemia, and iron deficiency in Korean school-aged children. *BMC public health, 11(1), 870.*

[23] Choi, H. J., Lee, H. J., Jang, H. B., Park, J. Y., Kang, J. H., Park, K. H., & Song, J. (2011). Effects of maternal education on diet, anemia, and iron deficiency in Korean school-aged children. *BMC public health, 11(1), 870.*

[24] Chopra, M. (2003). Risk factors for undernutrition of young children in a rural area of South Africa. *Public health nutrition, 6(7), 645-652.*

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A survey of edible fresh fish resources in Iewduh (Bara Bazaar) in Shillong, Meghalaya

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Abstract: Indian fisheries are an important sector of food production, providing nutritional and livelihood security to a vast majority of the population and contributes significantly to the foreign exchange earnings. There is a big demand of fish in north-eastern states of India. Fish market infrastructures include wholesale market, retail market and fish shops. Iewduh, also called Bara Bazaar, is one of the oldest and largest traditional market and trade centre in the northeast. A variety of fish are being sold in Iewduh in Shillong, Meghalaya. Majority of the fishes are sourced from other parts of the country. A total of 30 distinguishable taxa were observed in the market, representing 18 families. There was a predominance of different carp species and a number of catfishes were also available.

Keywords: *Fresh fish resources, fish market, Iewduh, carps, catfishes*

1. INTRODUCTION

Meghalaya, the 'Abode of Clouds' is one of the Seven Sisters states of northeast region of India. It features a total population of 29,66,889, as per the 2011 census. The state is surrounded by Assam to its east, north and west, and by Bangladesh to its south. The capital city of Meghalaya, as well as, the district headquarter of East Khasi Hills District, is Shillong (25.57°N 91.88°E). Iewduh, situated at the heart of Shillong, is one of also called Bara Bazaar, the oldest and largest traditional market and commercial hub in northeast India and is under the direct management of Syiem of Mylliem. It has large sections dedicated to local fruits, vegetables, fish, honey, etc. Betel nuts and leaves form one large section of the market, while fish and other meat form the other. Fishes sold in the market are mostly imported from other states of India though a small portion of fish comes from local fisheries.

Indian fisheries are an important sector of food production, providing nutritional and livelihood security to a vast majority of the population and contributes significantly to the foreign exchange earnings. There is a big demand of fish in north-eastern states like Arunachal Pradesh, Assam, Tripura, Manipur, Meghalaya and Nagaland. These north-eastern states are fulfilling their fish requirement from West Bengal, Odisha, Andhra Pradesh and Bihar. West Bengal

supplies some quantity of fish to Andaman Nicobar Islands, especially to Port Blair [1]. Regulation of fish production and consumption through sale is known as fish marketing [2]. Fish market infrastructures include wholesale market, retail market and fish shops. In wholesale markets, large quantity of fishes is collected from the surrounding places and sold to other wholesalers and retailers. The demand and consumption patterns of fish are determined by geography, availability, feeding habits of the area, tradition and nutritional standards [3]. Demand of fish could also be either for domestic or for export purposes. Marketing and fish distribution could also be completed through various channels which are important characteristics within the process of getting products from source to consumers and known as marketing channels [4]. Marketing of fish and fish products adds to the foreign exchange earning of the country in international markets [5].

The domestic fish marketing system in India is neither efficient nor modern, and is mainly carried out by private traders with a large number of intermediaries between producer and consumer, thereby reducing the fisherman's share in consumer rupees, with the physical facilities and infrastructure in all types of fish markets being far from satisfactory [6]. During the process of fish marketing, some of the issues encountered includes high perishability and bulkiness of the species, diversity in size and weight among species, high cost of storage and transportation, no assurance of quality and quantity, variable demand price fluctuation [7]. Fish passes through several intermediaries from the landing centre or fish pond to the consumer [8]. The intermediaries are involved in providing services of head loading, processing, preservation, packing and transporting and these activities result in cost edition at every stage of marketing.

There are several factors which affect the price of the fish. These factors include elasticity of demand, weight and quality of fish, distance of procuring centres to fish markets and structure and location of fish markets. The strategy of fish markets should be analyzed in the light of the present pattern of marketing, setting of objectives, development of fish demand, formulation of new plan and marketing operation and control, etc. The study was, therefore, designated to have a snap-shot of the prevailing fish market in Iewduh (Bara Bazaar) in Shillong, Meghalaya. The identification of various fishes along with the variation of prices has been estimated. Suggestive measures on how to improve the fish market at Iewduh has also been provided.

2. METHODOLOGY

Questionnaires have been prepared for the wholesale fish suppliers and the fish sellers of small stalls in Iewduh during the survey. The site was surveyed once every week, for about 4 months during the entire study. Information on common names, scientific names, family and rate/kg of the fishes were collected and verified with standard literature [9-11]. During the study, photographs of different kinds of fishes have been taken with the help of a digital camera.

3. RESULTS AND DISCUSSION

A variety of fish are being sold in Iewduh (Bara Bazaar) in Shillong, Meghalaya (Figure 1). A total of 30 distinguishable taxa were observed in the market, representing 18 families (Table 1). Cyprinidae, with 11 species, was the most diverse; followed by Bagridae, Clupeidae, Scrombridae, represented by 2 species each and; Ambassidae, Anguillidae, Bramidae, Callorhinchidae, Cichlidae, Clariidae, Erethistidae, Mugilidae, Notopteridae, Osphronemidae, Percidae, Schilbeidae and Siluridae represented by 1 species each.

Table 1: Varieties of fishes in Bara Bazaar (Iewduh)

Sl. no.	Scientific name	Family	Common name	Local name
1	*Abramis brama*	Cyprinidae	Common bream	Bami
2	*Anguilla rostrata*	Anguillidae	American eel	Kha kusia, Kusia
3	*Barilius tileo*	Cyprinidae	Tileo baril	Bolla, Tilei, Tila
4	*Brama brama*	Bramidae	Pomfret	Pomfret
5	*Catla catla*	Cyprinidae	Indian carp	Bhokua, Botcha
6	*Chanda nama*	Ambassidae	Elongated glassy perchlet	Chanda mass, Chanda
7	*Cirrhinus mrigala*	Cyprinidae	Mrigal carp, White carp	Mirki, Mirrgah, Arju
8	*Clarias magur*	Clariidae	Walking catfish	Kha mukur
9	*Clupisoma garua*	Schilbeidae	Gharua	Garua bachcha
10	*Ctenopharyngodon idella*	Cyprinidae	Grass carp	Kha bam phlang
11	*Cyprinus carpio*	Cyprinidae	Common carp	Khasaw
12	*Cyprinus carpio haematopterus*	Cyprinidae	Amur carp	Koi, Kha koi
13	*Edaphodon kawai*	Callorhinchidae	Kawai	Kawai
14	*Gonialosa manimina*	Clupeidae	Gizzard shad	Koroti, Chapila
15	*Hara hara*	Erethistidae	South Asian river catfish	Hara
16	*Hypophthalmichthys molitrix*	Cyprinidae	Silver carp	Kha silver carp
17	*Labeo calbasu*	Cyprinidae	Orangefin labeo	Kha ski
18	*Labeo rohita*	Cyprinidae	Rohu	Kha bah
19	*Mystus seenghala*	Bagridae	Giant river catfish	Bagri, Auri
20	*Notopterus chitala*	Notopteridae	Indian featherback	Shitol, Kandla, Chital
21	*Osphronemus goramy*	Osphronemidae	Giant gourami	Kalung, Kalu
22	*Percina kusha*	Percidae	Bridled darter	Kusha
23	*Rastrelliger kanagurta*	Scombridae	Indian Mackerel	Mackerel
24	*Rhinomugil corsula*	Mugilidae	Mullet	Corsula Mullet
25	*Sperata aor*	Bagridae	Long whiskered catfish	Aor, Shingala
26	*Tenualosa ilisha*	Clupeidae	Hilsa herring	Kha ilis, Ilish
27	*Thunnus orientalis*	Scombridae	Pacific bluefin tuna	Tuna
28	*Tilapia mossambica*	Cichlidae	Mouzambique tilapia	Bloukurper
29	*Tor tor*	Cyprinidae	Mahseer	Kha sher
30	*Wallago attu*	Siluridae	Mully catfish	Boal / Borali

Carp are various species of oily freshwater fish of the family Cyprinidae, and are the main source of proteins for a number of people in Meghalaya. The three Indian major carps, namely catla (*Catla catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*) contribute to the bulk of sale of freshwater fishes in Iewduh. Other carps, including silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*) and common carp (*Cyprinus carpio*) are also readily sold in the market. There are 5 species of catfish sold in Iewduh which includes walking catfish (*Clarias magur*), South Asian river catfish (*Hara hara*), giant river catfish (*Mystus seenghala*), long whiskered catfish (*Sperata aor*) and mully catfish (*Wallago attu*).

Cirrhinus mrigala

Catla catla

Chanda nama

Brama brama

Mystus seenghala *Notopterus chitala*

Figure 1: Varieties of fishes sold at Iewduh, Shillong

Out of the 30 species that are sold in Bara Bazaar (Table 2), 25 species are freshwater species (83%); 2 are marine fishes (7%) and 3 are found both in freshwater and marine habitats (10%) (Figure 2). Most of the fishes are being transported to the market from different regions of the country viz. Andhra Pradesh and Assam. About 15 trucks of fishes arrive per week to the whole sellers who supply the fishes to the stall keepers according to their desired amount. A number of the fishes are sourced solely from a single state in the country; these include 12 species of fish from Assam; 7 species from Andhra Pradesh; and 5 species from Meghalaya. Whereas, some species of fishes are sourced from two states of the country; these include 3 species of fishes sourced from Andhra Pradesh and Assam; and 3 species sourced from Meghalaya and Assam (Figure 3).

Table 2: Habit, source and cost of fishes in Bara Bazaar

Sl. no.	Scientific name	Habitat	Source	Rate/ Kg
1	*Abramis brama*	Freshwater	Assam, Andhra Pradesh	Rs. 280/ Kg
2	*Anguilla rostrata*	Freshwater and Estuaries	Meghalaya	Rs. 200/Kg
3	*Barilius tileo*	Freshwater	Assam	Rs. 160/Kg
4	*Brama brama*	Marine water	Assam	Rs. 160/Kg
5	*Catla catla*	Freshwater	Andhra Pradesh	Rs. 160-200/Kg
6	*Chanda nama*	Freshwater	Assam	Rs. 120/Kg
7	*Cirrhinus mrigala*	Freshwater	Assam	Rs. 160/ Kg
8	*Clarias magur*	Freshwater	Assam	Rs. 200/Kg
9	*Clupisoma garua*	Freshwater	Assam	Rs. 140-200/Kg
10	*Ctenopharyngodon idella*	Freshwater	Meghalaya, Assam	Rs. 120/Kg
11	*Cyprinus carpio*	Freshwater	Meghalaya	Rs. 400/Kg
12	*Cyprinus carpio haematopterus*	Freshwater	Assam	Rs. 400/Kg
13	*Edaphodon kawai*	Freshwater	Andhra Pradesh	Rs. 600/Kg
14	*Gonialosa manimina*	Freshwater	Andhra Pradesh	Rs. 200/Kg
15	*Hara hara*	Freshwater	Meghalaya	Rs. 400/Kg
16	*Hypophthalmichthys molitrix*	Freshwater	Meghalaya, Assam	Rs. 120/ Kg

Sl. no.	Scientific name	Habitat	Source	Rate/ Kg
17	*Labeo calbasu*	Freshwater	Assam	Rs. 140/Kg
18	*Labeo rohita*	Freshwater	Andhra Pradesh, Assam	Rs. 150/Kg
19	*Mystus seenghala*	Freshwater	Assam	Rs. 140/Kg
20	*Notopterus chitala*	Freshwater	Assam	Rs. 300-500/Kg
21	*Osphronemus goramy*	Freshwater	Andhra Pradesh	Rs. 200/Kg
22	*Percina kusha*	Freshwater	Meghalaya	Rs. 500/Kg
23	*Rastrelliger kanagurta*	Freshwater	Meghalaya, Assam	Rs. 160/Kg
24	*Rhinomugil corsula*	Freshwater and Brackish water	Andhra Pradesh	Rs. 200/Kg
25	*Sperata aor*	Freshwater	Assam, Andhra Pradesh	Rs. 280/Kg
26	*Tenualosa ilisha*	Marine water, Freshwater and Brackish water	Assam	Rs. 160/Kg
27	*Thunnus orientalis*	Marine water	Andhra Pradesh	Rs. 500-600/Kg
28	*Tilapia mossambica*	Freshwater	Andhra Pradesh	Rs. 100/Kg
29	*Tor tor*	Freshwater	Meghalaya	Rs. 600/Kg
30	*Wallago attu*	Freshwater	Assam	Rs. 400-500/Kg

In India, the domestic fish marketing system seems to be neither efficient nor modern and is administered by private traders with an outsized number of intermediaries between producer and consumer, leading to a reduction in the fisherman's share [12]. Maximum of the fishes being sold in Iewduh belong to the family Cyprinidae and the rate per Kg of the fishes varies from one species to the other. The rate of the fishes ranges from Rs. 100/Kg to Rs. 600/Kg. The least expensive fish is found to be Tilapia which sells for about Rs. 100/Kg; and the most expensive fish is Kawai and Tuna each costing Rs. 600/Kg. The Indian major carps sell for around Rs. 160-200/Kg in Bara Bazaar. Of the fishes imported from other states, 50% are sold in Iewduh alone and the other 50% are further transported to different parts of the city. The local fish marketing channel is as given below:-

Fishermen → Auctioneer → Local Whole seller → Retailer → Consumer

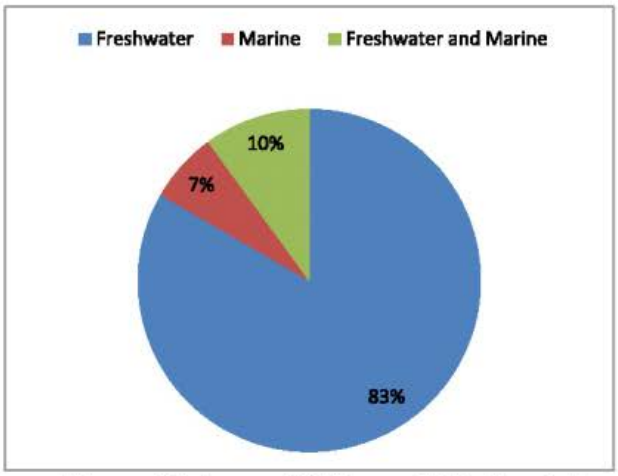

Figure 2: Types of fishes sold in Iewduh

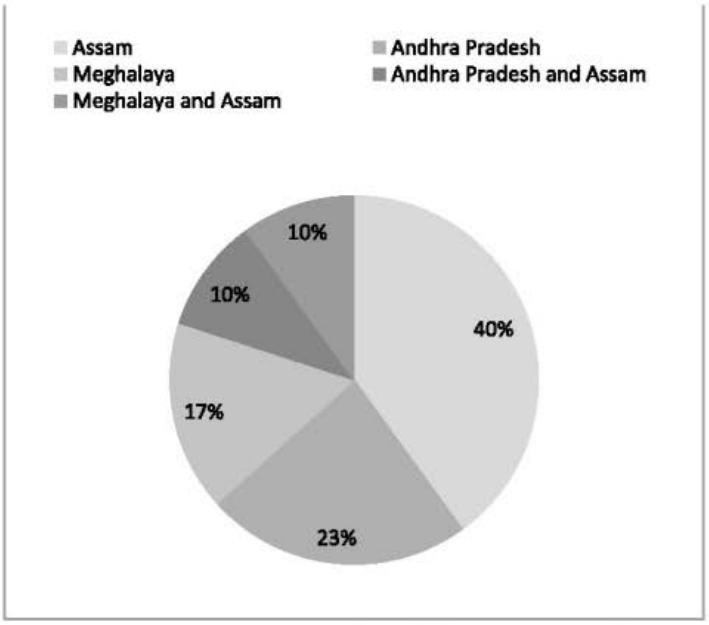

Figure 3: Places from where fishes are sourced

The fish are sourced from the auctioneers in bulk by the wholesalers and are brought into the state by trucks at *Khlieh iew* (the topmost part of the market where the parking lots are situated). From here, the fishes are then sold to retailers or other traders. There are six whole sale suppliers in Bara bazaar area of Shillong, Meghalaya. Each whole sale supplier employs around 5-6 people for the smooth operation of their business. The whole sellers are working on commission basis which is 6% from the total sale per truck. They gain lots of profit but they face loss at regular intervals as it is a perishable item which is likely to spoil if kept for long. The retailers sell the fish directly to consumers. An efficient fish marketing system could substantially reduce malnutrition by supplying fish at reasonable prices to lower income people [13]. There are around 60-70 stalls selling fishes in the main Iewduh market. Since fish is a perishable commodity, preservation of fish is a must. A large amount of ice is required to keep the fishes fresh. The amount of ice required also depends on the stock of fishes available. It has been found that with the passage of time and increase in population, the consumption of fish has also steadily increased.

Meghalaya is rich in fish diversity with about 165 species reported so far [14-15]. *Neolissochilus hexagonolepis* and *Tor* spp. are the important sport fishes inhabiting the fat flowing rivers and streams of the state. Table 3 shows the current status of the fishes available in Bara Bazaar.

Table 3: IUCN Red List Status of fishes in Bara Bazaar

Sl. no.	Scientific name	IUCN Red List Status
1	*Abramis brama*	Least Concern
2	*Anguilla rostrata*	Endangered
3	*Barilius tileo*	Least Concern
4	*Brama brama*	Data Deficient
5	*Catla catla* Least Concern	
6	*Chanda nama*	Least Concern
7	*Cirrhinus mrigala*	Vulnerable
8	*Clarias magur*	Least Concern
9	*Clupisoma garua*	Least Concern
10	*Ctenopharyngodon idella*	Not Evaluated
11	*Cyprinus carpio*	Vulnerable
12	*Cyprinus carpio haematopterus*	Not Evaluated
13	*Edaphodon kawai*	-
14	*Gonialosa manimina*	Least Concern
15	*Hara hara* Least Concern	
16	*Hypophthalmichthys molitrix*	Near Threatened
17	*Labeo calbasu*	Least Concern
18	*Labeo rohita*	Least Concern
19	*Mystus seenghala*	Not Evaluated
20	*Notopterus chitala*	Near Threatened
21	*Osphronemus goramy*	Least Concern
22	*Percina kusha*	Endangered
23	*Rastrelliger kanagurta*	Data Deficient
24	*Rhinomugil corsula*	Least Concern
25	*Sperata aor* Least Concern	
26	*Tenualosa ilisha*	Least Concern
27	*Thunnus orientalis*	Vulnerable
28	*Tilapia mossambica*	Not Evaluated
29	*Tor tor*	Near Threatened
30	*Wallago attu*	Near Threatened

Of the 30 species of fishes available in Bara Bazaar, a number of them are in the IUCN Red List of threatened species (Table 3). 14 species are under the category of Least Concern; 4 species are under the category of Near Threatened; 3 species are listed as Vulnerable; and 2 species are Endangered. However, there are 2 species which are Data Deficient; 4 species are Not Evaluated as yet, and 1 species with no information on the list. Conservation aquaculture is nowadays gaining recognition in the rehabilitation programmes of endangered and threatened

species of fish. Population of fish species that have declined can be targeted for conservation and restoration. The Indian Fisheries Act of 1897 (modified in 1956) maybe a landmark approach in the conservation of fishes. Besides provision to and monitor gears, mesh size and observance of fishing or closed seasons, the Act also prohibits the use of explosives or poisons to indiscriminately kill fish in any water.

4. CONCLUSION

Increasing population has increased the demand of fishes, leading to widespread overfishing thereby declining the fish population. Though there are a number of organizations and policies related to population of fish marketing in the country, there is a need to formulate a uniform market policy for fishes so that it becomes easier in operations and regulations. It will not only handle country's fish production but will deliver it also to the consuming population, ensuring at the same time remunerative prices to the fishes.

The market for fish at Iewduh is noisy and overcrowded with buyers and fish vendors. Infrastructure facilities are seen to be seriously lacking with no proper storage facilities, lack of water supply, absence of drains and sewer systems, and no proper collection of wastes. The fish market is so congested and the pathway between the fish shops is very narrow that people can hardly find a place to stand and buy their fish. The pathway is slippery and perpetually covered with water from the melting ice used for packing the fish mixed with raw sewage water, thereby making it a serious health hazards for the people using the market.

A few steps have been suggested for improvement of the fish market.

- The hygienic conditions of fish market should be improved and basic infrastructural facilities like proper drains and clean water should be ensured.
- Proper storage area for fishes, including cold storage should be provided.
- Pathways should be widened and repaired.
- Selling places should be raised and not allowed to encroach towards/on the pathways.
- Shops should have proper tin shades.
- Adequate removal and disposal of garbage should be ensured.

Local government, city municipalities, market management committees and the Syiem of Mylliem, should work together to maintain and improve the overall scenario of Iewduh, including the improvement of infrastructures like the footpath and its cleanliness. This will go a long way in ensuring the marketing of quality products to consumers and securing a better livelihood for sellers.

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REFERENCES

[1] [1] Singh, R., Pandey, P. K., Salim, S. & Krishnan, M. (2014). Evolving fisheries business in India with GIS. *India Geospatial Digest* 4(8).

[2] Shammi, Q. J., & Bhatnagar, S. (2002). Applied Fisheries. Jodhpur: Agrobios.

[3] Biswas, K. P. (2006). Economics in Commercial Fisheries. Delhi: Daya Publishing House.

[4] Olubunmi, A., & Bankole, A. F. (2012). Determinants of income from fish marketing in Ibarapa area of Oyo state, Nigeria. *Science Journal of Agricultural Research and Management* 12(1), 1-6.

[5] Kumar, A. (2004). Export performance of Indian fisheries strength and challenges ahead. *Economic and Political Weekly* 39, 4264-4270.

[6] FAO. (2001). Production, accessibility, marketing and consumption patterns of freshwater aquaculture products in Asia: A cross-country comparison. Rome: FAO Fisheries Circular No. 973.

[7] Ravindranath, K. (2008). Domestic marketing of fish and fishery products in India – Opportunities and challenges. In: National Workshop on Development of Strategies for Domestic Marketing of Fish and Fishery Products, held at College of Fisheries Science, Nellore, 7-8 February, pp. 43-48.

[8] Bishnoi, T. K. (2005). Marketing of Marine Fisheries. New Delhi: Sonali Publication.

[9] Jayaram, K. C. (1994). The freshwater fishes of India, Pakistan, Bangladesh, Burma and Sri Lanka. A Handbook. Calcutta: Zoological Survey of India.

[10] Jhingran, V.G. (1997). Fish and Fisheries of India. New Delhi: Hindustan Publishing Corporation.

[11] Ravi, V. (2014). Practical Manual on Keys to Marine Fish Identification. Delhi: Narendra Publishing House.

[12] Kumar, B. G, Datta, K. K., Joshi, P. K., Katiha, P. K., Suresh, R., Ravisankar, T., Ravindranath, K. & Menon, M. (2008). Domestic fish marketing in India – changing structure, conduct, performance and policies. *Agricultural Economics Research Review* 21, 345-354.

[13] Rao, P. S. (1983). Fishery Economics and Management in India. Mumbai: Pioneer Publishers and Distributors.

[14] Sen, N. (2000). Occurrence, distribution and status of diversified fish fauna of North East India. In: Fish Biodiversity of North East India, (ed. by A. G. Ponniah & U. K. Sarkar), pp: 31-48. Lucknow: National Bureau of Fish Genetic Resources (NBFGR), National Agricultural Technology Project (NATP) Publication.

[15] Sen, N. (2003). Fish Fauna of North East India with special reference to endemic and threatened species. *Record of Zoological Survey of India* 102, 81-99.

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Pharmacognostic studies of *Flemingia vestita*

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Abstract: *Flemingia vestita* (Family: Fabaceae), is a leguminous root crop commonly found in the northeastern region of India. The tubers are anthelmintic and eaten unpeeled by the natives against gastrointestinal worm infection. The present study deals with the pharmacognostic studies on the rhizome of crude drug *of F. vestita.* Our preliminary phytochemical studies of the powdered rhizome revealed the presence of alkaloid, carbohydrate, protein, amino acids, phenol, tannic acid flavonoid, phytosterols, saponins, fat, oil, gum and mucilage. The physico-chemical, morphological, histological parameter may be proposed as parameters to establish the authencity of *F. vestita.*

Keywords: *Flemingia vestita, pharmacognostic, phytochemicals, thin layer chromatography*

1. INTRODUCTION

It is an undeniable fact that in today's world, herbal medicine plays a vital role in health care of large sections of the population, particularly in developing countries, where they often bridge the gap between the availability and demand for modern medicines [1]. The use of traditional medicine in getting rid of worm infections is wide spread across the world. In many parts of India, especially those inhabited by tribal populations, there persists a rich folklore regarding the vermicidal and vermifugal properties of many plants [2,3]. In Meghalaya (Northeast India) various medicinal plants are used by the natives as curatives against worm infections. *F. vestita* as cure against gastrointestinal worm has long been used in local traditional medicine in Meghalaya, North East India [4,5] . *Flemingia vestita* Benth and Hooker (Family: Fabaceae), locally known as Sohphlang in Meghalaya, Khasi Hills is a leguminous root crop commonly found in the northeastern region of India [6]. Native people of Meghalaya in Northeastern India have brought *F. vestita* under cultivation. Its small somewhat juicy tuber (3-6cm long) can be found in local market in the Khasi and Jaintia Hills of Meghalaya where it is grown for its edible, tuberous roots, which are nearly elliptical and about an inch long [4]. The tuberous root have anthelmintic properties and hence eaten unpeeled by the natives as a popular cure against

worm infections [5]. Tandon *et al.* (1997)[7] observed that *in vitro* treatment of the adult trematodes, viz., *Fasciolopsis buski* and *Artyfechinostomum sufrartyfex,* with the crude extract of the root tuber peel of *F. vestita* induces paralysis and pronounced integument damage and disruption. Also Das *et al.* (2007)[8] reported a vermifugal /vermicidal effect in the fowl tapeworm *Raillietina echinobothrida* by treating the alcoholic crude root-peel extract of *F. vestita* and its major isoflavone, genistein.

Pharmacognostical study is the preliminary step in the standardization of crude drugs. The detailed pharmacognostical evaluation gives valuable information regarding the morphology, microscopical and physical characteristics of the crude drugs. Pharmacognostic studies have been done on many important drugs; however no work has been done on *F. vestita* despite its medicinal value. Therefore the morphological, microscopic, physi-cochemical and chromatographic studies on *F. vestita* (Fabaceae) would serve as a standard reference for identification, authentication and distinguishing the plants from its adulterants.

2. MATERIALS AND METHODS:

2.1 Plant material and its extract:

Flemingia vestita (Fabaceae) tuber were purchased from the local markets of Shillong, Meghalaya India in the month of September 2013. The tuber of the plant was dried under shade and made to a fine powder using mortar and pestle. The powdered drug (approx. 20 gm.) was then packed in the soxhlet apparatus and was extracted successively with petroleum ether (40-60ºC) (Merck, India), chloroform (Merck, India), methanol (Merck, India) and distilled water for six hours. The extract was filtered using Whatman filter paper No.1 and the filtrates were evaporated under reduced pressure and dried using a rotatory evaporator at 55 ºC. Crude extracts were stored in refrigerator at 4°C for further use in phytochemical analysis.

2.2 Macroscopic and microscopic studies

The macroscopical characters (size, shape colour, odour, texture, fracture) of rhizomes were studied following standard methods [9,10]. Microscopic studies of rhizomes and powder was identified by clearing with Herr fluids and mounted in glycerine medium. *F. vestita* tubers fixed in FAA was used for microtomy by the usual dehydration method using tertiary butyl alcohol series followed by impregnation with paraffin wax [11]. The paraffin blocks were trimmed and sectioned at a thickness of 7-10µm using Leitz rotatory microtome. The sections were stained by following the staining procedures: Safranin fast green [11]. Slides were observed and photomigrograph were taken under Olympus microscope (BX43).

2.3 Determination of physico chemical parameters

Physicochemical values such as the percentage of total ash, acid insoluble ash, acid soluble ash, extractive values like

petroleum ether soluble extractives, alcohol-soluble extractives and water-soluble extractives were calculated according to the methods described in the Ayurvedic Pharmacopoeia of India Vol 1.

2.4 Preliminary phytochemical screening:

Preliminary Phytochemical screening of various extracts were carried out by standard methods [12]. Fluorescence analysis was conducted using methods of Kokoski (1958) and Chase and Prat (1949) [13].

2.5 Thin layer chromatography:

The thin layer chromatography (TLC) was performed on glass plate coated with silica gel G, preactivated at 110°C for 30 min. The test extract was dissolved by using appropriate solvent in a concentration of 1 mg/mL and subjected for spotting by using three solvent systems as mobile phase: Petroleum ether: Ethyl acetate (8:2), Hexane: Ethyl acetate (8:2), Toluene: Ethyl acetate (9:1). Spots have been detected by using both non-destructive and destructive visualisation techniques. The spots were equally sized, dried, and developed and finally the Rf values were calculated.

3. RESULTS AND DISCUSSION

3.1 Macroscopic and Microscopic studies:

The tuberous root is externally brownish, cylindrical and tapering with transverse fissures and lateral portion with several roots and root scars (Figure I).

The transverse section of the root showed narrow cork consisting of 2-4 layers of cork cells followed by phelloderm made up of several layer of thin walled parenchymatous cells. Secondary phloem consists of sieve tubes, companion cells, phloem parenchyma and fibres being traversed by uni biseriate medullary rays (Figure IIA).

The xylem is solid core consisting of vessels, tracheids, fibres parenchyma and uni biseriate medullary rays, as the cell being thick walled and lignified (Figure II B)

The powdered microscopy reveals the presence of lignified bordered pitted xylem vessel, fibres and starch grains (Figure III A, B, C, D).

Figure I: External morphology of tuberous root of *F. vestita*

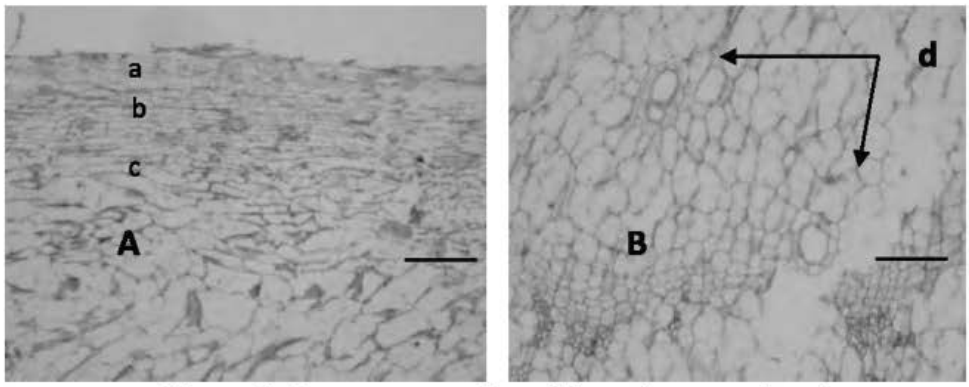


Figure II. Transverse section of *F. vestita* roots showing -
A. a) cork cell b) phelloderm c) pericyclic fibre . Bar =20 µm
B. d) vascular bundles with xylem, phloem and medullary rays. Bar =20

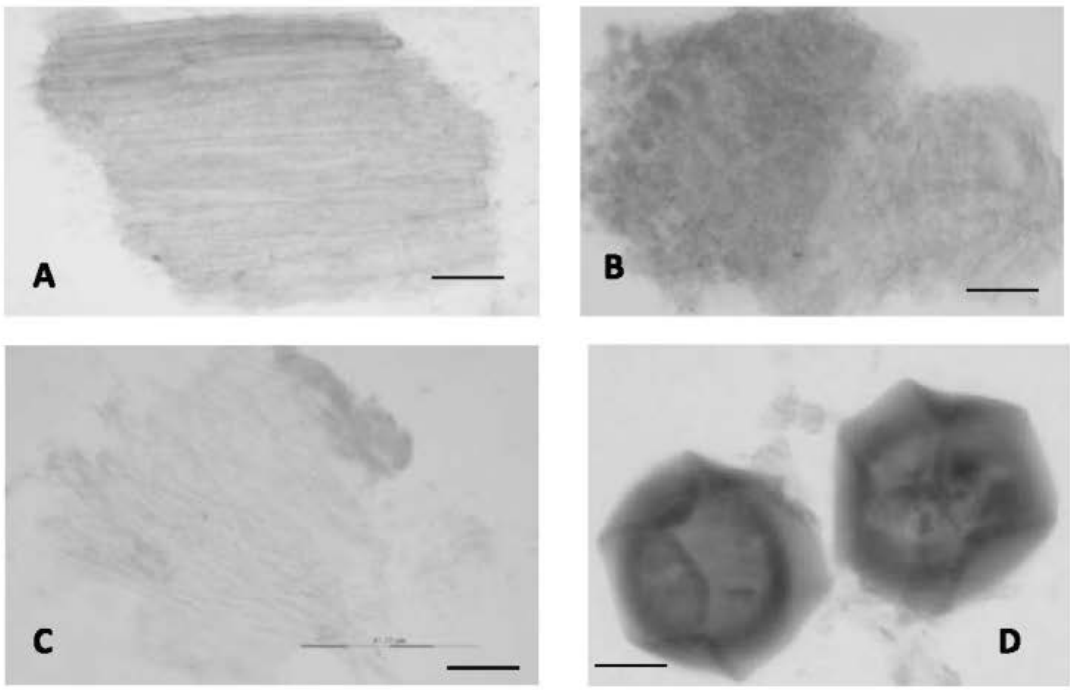


Figure III . Powder characterestics of *F. vestita* roots showing-
A. Xylem vessels. Bar=20 µm B. Fibre. Bar=20 µm
C. Parenchymatous cells. Bar =47.77 µm D. Starch grains. Bar = 20 µm

3.2. Powder analysis

The powder is light brown and possesses a pleasant odour. The fluorescence analysis of the stem of *F. vestita* powder was observed in day/visible light and UV light and the data obtained are tabulated in Table I. The different crude extracts were also examined under day light and UV light to find out the presence of fluorescence compound within them Table II.

Table I: Fluorescence characteristics of different extracts of rhizome of *F. vestita*

Sl.No	Extracts	Day Light	UV Light (265 nm)
1	Petroleum ether	Light yellow	Dull white
2	Chloroform	Dark brown	yellowish
3	Methanol	Light brown	Creamy white
4	Water	Brown	Fluorescence light green

Table II. Fluorescence analysis of powdered rhizomes of *F. vestita*

Sl. No	Powdered drugs	Visible/Day light	UV Light (265 nm)
1	Powder as such	Light brown	Light brown
2	Powder + 50 % H_2SO_4	Brown	Light green
3	Powder + 50 % HNO_3	Brown	Dark green
4	Powder + 5 % KOH	Brown	Green
5	Powder + Methanol	Light brown	Light brown
6	Powder + 1 N Methanolic NaOH	Brown	Light brown
7	Powder + Ethanol	Brown	Light brown
8	Powder + 1 N Ethanolic NaOH	Brown	Light brown

3.3 Physico- chemical studies

Moisture content, ash value and extractive value was determined and results are presented Table III. The percentage of total ash, acid insoluble ash and water soluble ash was 4.13, 2.73 and 2.03 respectively. The percentage of moisture content 11.88, total ash 4.13, acid insoluble ash 2.73, water soluble 2.03, alcohol soluble extractive 3.80 and water soluble extractive 3.33. Extractive values like alcohol soluble and water soluble extractive value were 3.80 and 4.52 % and moisture content was 11.88 %.

3.4 Preliminary Phytochemical Analysis

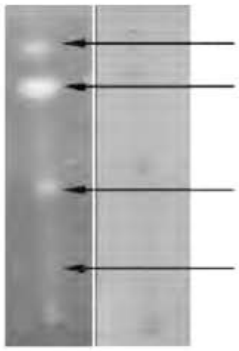
Qualitative phytochemical analysis of all extracts namely petroleum ether, chloroform, methanol and aqueous extracts is summarized in Table IV. Phytochemical screening of petroleum ether extracts revealed the presence of alkaloids, carbohydrate, flavonoids, and phytosterols, carbohydrate, phenol and tannic acid, flavonoid and phytosterol were found in the chloroform extracts; alkaloids, carbohydrate, phenolic and tannic acid, flavonoids were found in methanolic extracts. In aqueous extract alkaloids, carbohydrate and flavonoid were present.

Table III: Ash values, moisture content and extractive values of *F. vestita*

Sl. No	Constants Values (%)	
1	Total ash	4.13
2	Acid insoluble ash	2.73
3	Water soluble ash	2.03
4	Alcohol soluble extractive	3.8
5	Water soluble extractive	3.33
6	Moisture content	11.88

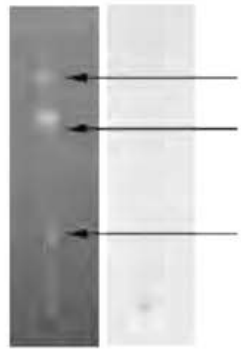
Table IV: Preliminary phytochemical screening of rhizome extracts of *F. vestita*

Phytoconstituents	Petroleum ether extract	Chloroform extract	Methanolic extract	Aqueous extract
Alkaloids	+	–	+	+
Carbohydrate	+	+	+	+
Protein & amino acids	–	–	–	–
Phenol and Tannic acid	–	+	+	–
Flavonoid	+	+	+	+
Phytosterols	+	+	–	–
Saponins	–	–	–	–
Fat and oils	–	–	–	–
Gums and mucilage	–	–	–	–



UV 265 nm After spray

PETROLEUM ETHER EXTRACT USING PETROLEUM ETHER: ETHYL ACETATE (8:2)
NOTE: 4 SPOTS



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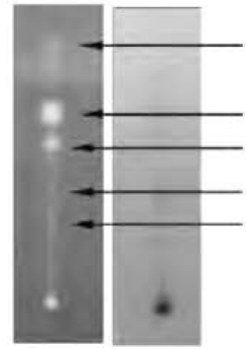
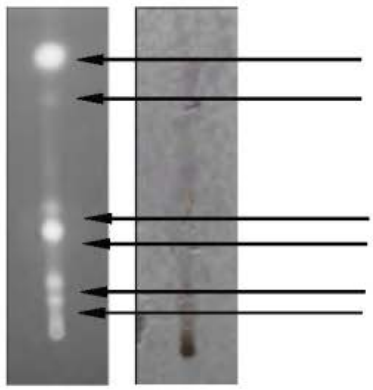
PETROLEUM ETHER EXTRACT USING HEXANE: ETHYL ACETATE (8:2)
NOTE: 3 SPOTS



UV 265 nm After spray

PETROLEUM ETHER EXTRACT USING TOULENE: ETHYL ACETATE (9:1)
NOTE: 6 SPOTS



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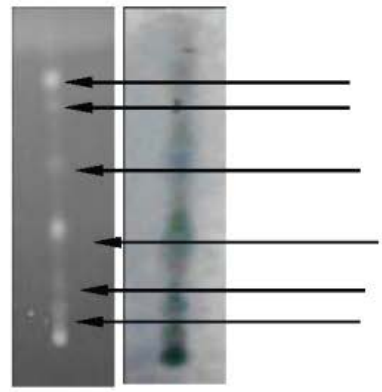
CHLOROFORM EXTRACTS USING TOLUENE : ETHYL ACETATE (9:1)
NOTE: 6 SPOTS



UV 265 nm After spray

METHANOL EXTRACTS USING TOLUENE : ETHYL ACETATE (9:1)
NOTE: 6 SPOTS

Figure V: TLC profiling of various extracts

3.5 Thin layer chromatography (TLC)

Thin layer chromatography of different extracts using different solvent systems of different ratios of mobile phase showed presence of various compounds (Figure V and Table IV). Using petroleum extracts, four spots of R_f 0.46, 0.67,0.71, and 0.91 were located in the solvent system petroleum ether: ethyl acetate (8:2), three spots of R_f 0.32, 0.55 and 0.86 were located in hexane : ethyl acetate (8:2) and five spots of R_f 0.37, 0.47, 0.53, 0.65 and 0.87 were located in toulene: ethyl acetate (9:1). TLC of chloroform extracts with solvent system toulene: ethyl acetate (9:1) showed six spots of R_f 0.16, 0.20, 0.28, 0.32, 0.54 and 0.60. Similarly with methanol extracts using same solvent system toulene: ethyl acetate (9:1) also showed six spots of R_f 0.17, 0.24, 0.38, 0.55, 0.67 and 0.75.

Table IV: Rf values of solutes separated from the various extracts of *F. vestita*

Sl.No	Solvent system	Nos of spot	Rf value
Petroleum ether extracts	Petroleum ether: ethyl acetate (8:2)	4	i) 0.46 ii) 0.67 iii) 0.71 iv) 0.91
	Hexane : Ethyl acetate (8:2)	3	i) 0.32 ii) 0.55 iii) 0.86
	Toluene : Ethyl acetate (9:1)	5	i) 0.37 ii) 0.47 iii) 0.53 iv) 0.65 v) 0.87
Chloroform extract	Toluene : ethyl acetate (9:1)	6	i) 0.16 ii) 0.20 iii) 0.28 iv) 0.32 v) 0.54 vi) 0.60
Methanol extract	Toluene : Ethyl acetate (9:1)	6	i) 0.17 ii) 0.24 iii) 0.38 iv) 0.55 v) 0.67 vi) 0.75

4. CONCLUSION

Despite a long tradition use of the species, the genus has not been explored properly. In the concluding part, the future scope of *F. vestita* has been emphasized with a view to establish pharmacognostical study which includes macroscopy, microscopy, physico-chemical constants and fluorescence analysis and TLC profiling. This will help for correct authentication and proper identification

of this plant for future investigation. This study will also serve as a reference tool to practitioners in the fields of ethnophar-macology and natural products chemistry.

ACKNOWLEDGEMENTS

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REFERENCE

[1] Akerele, O. (1990). Medicinal plants in Traditional medicine. In: Farnsworth NR, Wagner, H, editors. Economic and Medicinal Plant Research.(Vol 4). Plants and Traditional Medicine. London: Academic Press.

[2] Bhakuni, D. S., Goel, A. K., Jain, S., Mehrotra, B. N. (1988). Screening of Indian plants for biological activity: Part XIII. *Indian J Exp Biol*, 26:883-904.

[3] Shilaskar, D. V., & Parashar, G. C. (1989). Evaluation of indigenous anthelmintics. In vitro screening of some indigenous plants for their anthelmintic acitivity against *Ascaridia galli. Indian J Indigen Med*, 6:49-53.

[4] Rao, R. R. (1981).Ethnobotany of Meghalaya: medicinal plants used by Khasi and Garo tribes. *Economic Bot*, 35:4-9.

[5] Neogi B., Prasad MNV., Rao R R. (1989). Ethnobotany of some weeds of Khasi and Garo Hills, Meghalaya, Northeastern India. *Economic Bot*, 3:471-479.

[6] Jain, S. K., P. K. Hajra, & Sanpru. R. (1977). A survey of edible plants in bazaars of Meghalaya. *Bulletin of Meghalaya Science Society*, 2: 29–31.

[7] Tandon, V., Pal, P., Roy, B., Rao, H. S. P & Reddy, K. S. (1997). In vitro anthelmintic activity root-tuber peel extract of *Flemingia vestita*, an indigenous plant in Shillong, *India. Parasitol Res*, 83:492-498.

[8] Das B., Tandon V., & Saha N (2007): Genistein from Flemingia vestita (Fabaceae) enhances NO and its mediator (cGMP) production in a cestode parasite, Raillietina echinobothrida. *Parasitology*,134. 1457-1463.

[9] Trease, GE & Evans, WC (2002). Pharmacognosy (15th Ed) Saunders Publishers, London.

[10] Wallis, T E. (1967). A textbook of pharmacognosy (5th Edition) TA Churchill, London.

[11] Johansen, DA. (1940). Plant Microtechnique. *Mc Graw Hill Book Company Newyork & London.*

[12] Harbone, JJ. (1984). Phytochemical methods: A guide to modern techniques of plant analysis Edn 2, Chamapal and Hall, New York.

[13] Chase C R,. & Pratt R. (1949). Fluorescence of powdered vegetable drugs with particular reference to the development of a system of identification. *J AM Pharm Asso*, 38: 324-330.

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Integrated Aquaculture: Road ahead for sustainable rural development in Meghalaya

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Abstract: The unitary concept of producing crop is gradually changing to integrated system, with a view to integrate different farming components *viz.* fishery, live stock, horticulture to produce fish, eggs, meat and vegetables from the same farm. The major benefit of integrated system is utilization of resources effectively and recycling of waste within the farm and thus, ultimately maintaining ecological balance. The state Meghalaya, located in the North Eastern India, is characterized by hills and plateaus interspersed with valley lands in the foot hills. People of Meghalaya are predominantly dependent on agriculture and allied sector. Fish, a very valuable source of protein, comprises an important part of the diet of local tribal people. As local wild fish supplly from natural water bodies diminishing gradually and relatively limited aquaculture, fish production in the state is insufficient to satisfy the present demand of fish. The present fish production in the state is less against the demand estimated 30 thousand tons per annum. The difference between demand and production of fish is providing a market opportunity for fish producers in the state. The present study categorized integrated aquaculture as an important and promising enterprise for rural farming sectors of Meghalaya to maximize their farm income, providing nutritional security and ingeneral to achieve sustainable development in the rural economy.

Key words: *Integrated aquaculture, sustainable development, hilly area, rural economy*

1. INTRODUCTION

Meghalaya, a hilly state, is one of the eight states of North-Eastern Region of India. The state is located between 25°02′ north to 26°06′ north latitude and 89°48′ east to 92°52′ east longitudes. Meghalaya is one of the four tribal majority states of North Eastern Region, others being Arunachal Pradesh, Mizoram and Nagaland. The Khasis, Jaintias and Garos form the major ethnic groups of of the state. People of Meghalaya are predominantly dependent on agriculture. Agriculture and allied sector is vital for the livelihood and nutritional security of the rural population of the state. According to Planning Department of Meghalaya, more

than 70% of the population depend on agriculture and allied sectors *viz* horticulture, animal husbandry and fisheries as their source of livelihood [9]. More than 80% of the total population of Meghalaya is residing in rural area and approximately 85% population is tribal community [6]. Local rural community practices agriculture both in the form of settle and shifting cultivation commonly known as jhum cultivation. Shifting cultivation is considered as primitive way of agriculture. Shifting cultivation is involving cutting, clearing and burning of weeds cover or even forest, growing of different crops, on the cleared land with simple technology under rain fed conditions and shifting to new sites when soil gets exhausted [1]. The total number of families depending upon jhum in the state is 7900 and it comprises about 13.87% rural population. In the jhum cultivation, the main crops are potato, sweet potato, millet, hill paddy. Shifting cultivation basically practiced by Garos but Khasi have four main types of land uses *viz* the forest land for jhum cultivation, wet paddy land, high grass land and homestead land which is situated close to their courtyard [2]. Meghalaya has a significant livestock population and playing an important role to boost up socio economic condition of rural area. Poultry, Pig and cattle population in the state has been increasing steadily since 1972 (14)

Aquaculture plays important roles in providing food and income in many developing countries, either as a stand-alone activity or in association with crop agriculture and livestock rearing [3]. Cultured food fish supplied currently are accounted for nearly 50% of that consumed globally [7]. Fish occupies an important place in the diet of indigenous population of the state from the time immemorial. Inland Fisheries resources of the state can be divided into two sub sectors viz capture fisheries (river, streams, wetlands) and culture fisheries commonly known as aquaculture (Ponds, tanks and reservoir). Fish production has shown increasing trend since aquaculture mission launched in the year 2012. (13) (Fig: 1). Meghalaya is one of the states in the country where majority of the population is non vegetarian. In the year 2011 the total consumption in the State is estimated at 19 thousand tons. The gap between demand and supply will be about 14.5 thousand tons [4]. Considering the WHO recommendation per capita consumption 11 kg/ year, the requirement of fish in the state has increased from 23 thousand tons in 2001 to 30.97 thousand tons in the year 2011 with deficit which is 13% more than 2001. Total consumption pattern of fish including both locally produced and imported is 15500 t/year and per capita consumption is 7.08 kg/annum which is still less as per WHO recommendation [10]. The domestic production of fish is not sufficient to meet the demand and there is a significant import every year from the states mainly Andhra Pradesh, Assam and West Bengal to bridge the gap between demand and supply.

Fish culture is now come to be a capital intensive and profitable enterprise. Large investments are required for

scientific fish culture for renovation and repairing ponds, eradication of weeds, purchase of fish seed, fertilizers, supplementary feed, health care and harvesting of fish. Integrated aquaculture is the concurrent or sequential linkage between two or more farm activities, of which at least one is aquaculture. Integrated aquaculture strategies are regarded as an efficient utilization of available resources, waste recycling and energy saving, and for maintaining ecological balance. Integrated aquaculture involves the direct use of crop/livestock wastes, as well as the recycling of crop or manure-based nutrients which function as fertilizers to stimulate natural food. A perusal of literature reveals that integrated aquaculture i.e. integration of fisheries with poultry, duck, piggery and horticultural crops would be much more beneficial to boost the economy of farming community of north east India. Farmers can integrate their livestock components with aquaculture which enables them to efficiently utilize wastes as manure in the fish pond. The farmer would be able to cut down additional expenditure incurred on buying feed and fertilizers [12]. Fish production in pig-fish and duck-fish system is 2.3 to 3.6 times more than without integration system [8]. On the other hand rice cum fish culture increases rice more than 10% and additional more than 500 kg/ha fish can be produced annually [11]. Ayyappan et al,1998 [5] stated that about 3-4 cows, 30-40 pigs,500-600 poultry birds,200-300 ducks, 300-500 rabbits and 40-50 goats would provide sufficient manure to fertilize a one hectare water area when integrated with aquaculture.

The present study aimed to assess the possibility of expansion of integrated aquaculture in rural area to maximise income, nutritional security, and also addressing the sustainable development in the rural sector of the state.

2. METHODOLOGY

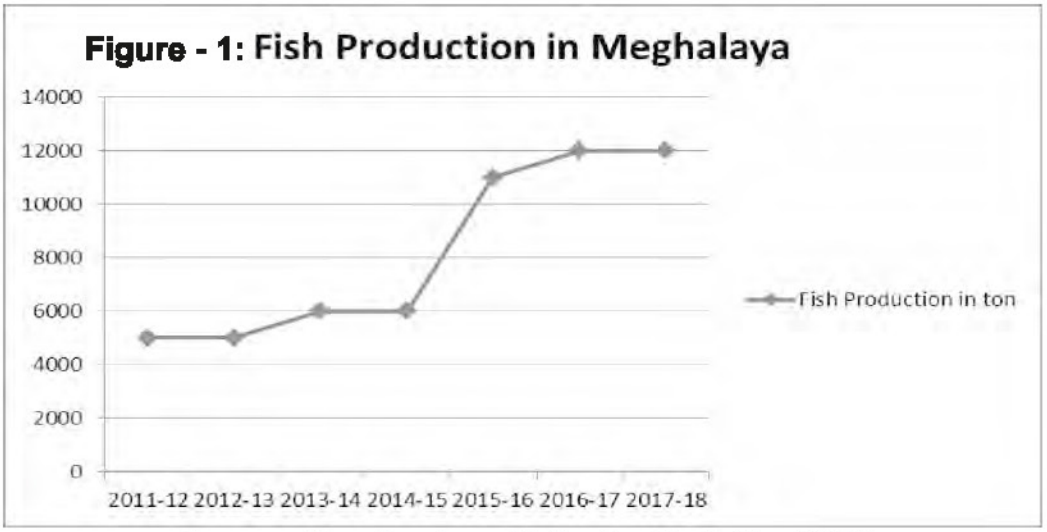
A questionnaire survey of randomly selected farmers from six blocks were selected for the survey, *viz.* Mairang , Mawthadraishan block of West Khasi hills districts, Umsning and Umling block of Ri-Bhoi district, Shella- Bholagang block of East Khasi hills and Resubelpara block of North Garo hills district. Survey was undertaken to find out the farming components and scope for integrated aquaculture practices.

Data with regard to various farming systems of fish farmers were analysed to assess scope of integrated aquaculture in the study area.

3. RESULTS

Earthen ponds are most dominant aquaculture facility in the state. Aquaculture, consisting of carp production in ponds is mainly done in the low-lying areas and in agricultural land. A large percentage (95%) of farmers has very small fish farm of less than one hectare in size. About four percent of farmers have small fish farm of 1-2 hectare in size. Only one percent farmer has medium fish farm of 2.1- 5 hectare in size (Table 1). Farming systems namely agriculture, horticulture, live stock and aquaculture were identified in the study

area. with variation in land holding size and socio-economic position of the specific family (Table 2 and 3). Under agriculture farming system rice is the most widely grown field crop in the entire state followed by the maize. Major horticultural crops identified under fruit viz citrus fruit, banana, pine apple., vegetables like radish, cabbage, cauliflower, squash, capsicum and pumpkin and spices like turmeric, ginger and chilly. Under the livestock farming farmer rears pig, poultry, duck, goat, cattle and in limited scale rabbit. Aquaculture is mainly practiced in valley and in natural depressed areas. Indian major carps namely Khabaw (*Catla catla*), Kha bah (*Labeo rohita*), Kha mirka (*Cirrhinus mrigala*), Khaski (*Labeo gonius*), and exotic carps species such as Khadkhar (*Cyprinus carpio*),(*Ctenopharyngodon idella*) and (*Hypophthalmichthys molitrix*) are main fish species cultured in the study area.



Source: Handbook on Fisheries Statistics 2018

Table 1: Categorization fish farm in study area

Class size	Fish Farm size	Percentage of farmer
Very small	<1 ha	95
Small	1-2 ha	4
Medium	2.1-5 ha	1
Moderately large	5.1 – 10 ha	Nil
Large	10.1 – 20 ha	Nil
Very large	>20 ha	Nil

Table 2: Farming system in the study area

Area (Block)	Farming system	Principal crop
Mairang	Agri +AH +Horti + Aquaculture	Paddy, vegetables, pig, poultry, cattle and fish
Mawthadraishan	Agri +AH +Horti + Aquaculture	Paddy, pig, poultry, vegetables, fish
Umsning	Agri +AH +Horti + Aquaculture	Paddy, pig, cattle, poultry, duck, vegetables, fish
Umling	Agri +AH +Horti + aquaculture	Paddy, cattle, pig, poultry, duck vegetables, fish
Shella- Bholaganj	Agri +AH +Horti + Aquaculture	Paddy, cattle, pig, poultry, duck vegetables, fish
Resubelpara	Agri +AH +Horti + Aquaculture	Paddy, pig, cattle, poultry, duck vegetables, fish

Agri: Agriculture; AH: Animal Husbandry; Horti: Horticulture

Table 3: Livestock population in Meghalaya in lakh (1972-2007 Census report)

Year	Cattle	Buffaloes	Sheep	Goats	Pigs	poultry
1972	4.67	0.47	0.18	0.96	1.26	9.75
1977	4.77	0.39	0.20	1.18	1.51	10.73
1982	5.49	0.28	0.25	1.86	2.06	14.08
1988	5.86	0.27	0.15	1.94	2.84	15.41
1992	6.37	0.33	0.23	1.95	2.94	18.26
1997	7.55	0.17	0.17	2.80	3.50	21.51
2007	8.87	0.23	0.21	3.65	5.42	30.93
2012	8.96	0.22	0.20	4.73	5.43	34.00

Source: Annual Report 2012-13, Ministry of Agriculture, GOI.

Table 4: Background information of the respondents

Farming system	Frequency	Percentage
Agriculture	120	100
Horticulture	120	100
Live stock	96	80
Aquaculture	60	50

4. DISCUSSION

Aquaculture is a new entrant in the state compared to allied sectors like agriculture, animal husbandry and horticulture. It was observed that 50 percent farmers were practicing aquaculture in the study areas (Table 4). Many fish farmers have started aquaculture enterprise commercially but

very little number of farmers approximately ten percent practicing integrated aquaculture. The concept of integrated aquaculture in Meghalaya is not gearing up in spite of having potentialities (8). It was observed that those farmers have adopted integrated aquaculture with live stock; they are not doing the practice scientifically. There is a considerable potential to develop integrated aquaculture in Meghalaya with the available farming systems. In almost all the households, a livestock and horticultural crops are common activities and integration of fishery with livestock or horticulture would be a viable proposition (5). Farmer can choose any one of the live stock components to integrate with the pond and live stock wastage would be utilized as fertilizer in the pond water to enhance biological productivity. Horticultural crops like vegetables and fruit crop like banana; lemon etc can be grown on the dyke of the fish farm. Removal of mud from the pond bed at annual basis is essential to reduce organic load of fish pond, otherwise it may upset water quality of the pond water. This mud is a good fertilizer can be used for horticultural crops. Pond water can be utilized for horticultural crops during drought period. There is a huge scope for enhancing rice-cum fish culture statewide but rice-fish technology is not popular in Meghalaya. In rice-cum-fish system comprises of a rice field, embankments, and side trenches. Rice can be grown in the middle and Side trenches uses for rearing fish. Farmers can produce both rice and fish simultaneously by adopting this technique.

The constraint for non adoption or partial adoption of integrated aquaculture in Meghalaya is basically due to inaccessibility to technology. The technology constraint, that needs to be addressed in order to popularize integrated farming at farmer level. There is a need for percolation of knowledge and skill of integrated aquaculture with other farming systems to farmers. Training is one of the most important critical inputs in this regard. Organizing need based training and demonstration programmes on integrated aquaculture system at field level for farmers is utmost important. It was observed that though technologies are available at research station but the extension machinery in the state is not very successful hitherto to disseminate integrated farming technologies to farmer level. In the recent time, Meghalaya state government has identified fisheries as key sector and launched "Meghalaya State Aquaculture Mission" for a period of five years to make Meghalaya self-sufficient in fish production (6). The mission aims at construction of one lakh individual ponds to enhance fish production. The concerned department and other extension agencies can play an important role to infuse the integrated aquaculture technology to fish farmers. This technology would reduce pressure on natural resource exploitation; help in maintaining ecological balance; support organic farming as well as to guarantee household food and nutritional security for the rural people and as a whole will ensure sustainable development in the rural sector of the state.

REFERENCES

[1] [1]Agarwal. A. K.(1988).North Eastern Economy: problems and prospects, Mittal publications, Delhi.

[2] Anonymous (2005). Vision 2025, ICAR Research Complex for N EH Region, Umiam, Meghalaya.

[3] Anonymous (2011). Aquaculture, fisheries, poverty and food security, working paper 2011-65. The World Fish Center, Malaysia.

[4] Anonymous (2012). Meghalaya State Aquaculture Mission" Fish Farmers Development Agency, Meghalaya

[5] Ayyapan, S., Kumar, K and Jena, J. K.1998. Integrated fish farming-Practices and potentials. *Fishing Chimes,* 18(1).15-19

[6] Census (2011). Provisional population totals. Office of the Register general and census commissioner, India.

[7] De Silva, S. S., Soto. D. (2009). Climate change and aquaculture: potential impacts, adaptation and mitigation. In K. Cochrane, C. De Young, D. Soto & T. Bahri, eds. Climate change implications for fisheries and aquaculture: overview of current scientific knowledge, pp. 156–212. FAO Fisheries and Aquaculture Technical Paper No. 530. Rome, FAO.

[8] Kumaresan. A, Pathak. K. A, Bujarbaruah. K. M and Vinod. K, (2009). Analysis of integrated animal fish production system under sub-tropical hill agro ecosystem in India: Growth performance of animals, total biomass production and monetary benefit, Tropical Animal Health and production, *Springer Netherlands* 41(3): 385-391.

[9] Meghalaya Agriculture Profile. (2006). Department of Agriculture, Meghalaya.

[10] Nath, R (2010) Current status and strategies for sustainable development of fisheries sector in Meghalaya. In Mahanta. P and Sarma. D (Eds) Coldwater Fisheries Management. DCFR, ICAR. Bhimtal.

[11] Rai, A K., Clausen, J and Smith, S F. (2008). Potential development interventions for fisheries and aquaculture in Nepal, Asia Pacific Fishery Commission, FAO, Bangkok. 6-18.

[12] Vinod. K., Margaret. A. M. R and Mandal. B. K. (2000). Integrated Fish Farming to enhance food production in hills. *Indian J Hill Farmg.* 13(1&2).8-12.

[13] Handbook of Fisheries statistics (2018) Department of Fisheries Ministry of Fisheries, Animal Husbandry & Dairying Govt. of India, New Delhi

[14] Annual Report (2017-18) Department of Animal Husbandry, Dairying and Fisheries Ministry of Agriculture

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Indigenous Traditional Knowledge in West Jaintia Hills District, Meghalaya

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Abstract: Indigenous Traditional Knowledge (ITK) is local application methods practiced in different sectors especially in fisheries by local population from time immemorial with some changes from time to time. Many of the ITKs are based on scientific values but they are not well documented. The present study aimed to evaluate the Indigenous Traditional Knowledge practiced in West Jaintia Hills District of Meghalaya. The ITKs identified are divided in three different groups. They are ITK in value added product, ITKs used as fish baits and fish poison and ITKs used as gear for catching fishes from natural water bodies.

Keywords: *ITK, Jaintia Hills District, Fish poison, Gear, Value added product.*

1. INTRODUCTION

Over time, Indigenous peoples around the world have preserved distinctive understandings, rooted in cultural experience, that guide relations among human, non-human, and other-than human beings in specific ecosystems. These understandings and relations constitute a system broadly identified as Indigenous traditional knowledge, also called traditional knowledge.

Traditional knowledge is the knowledge which is passed from one generation to another generation of a particular community and indigenous to the location. Traditional Indigenous knowledge also can be defined as a network of knowledges, beliefs, and traditions intended to preserve, communicate, and contextualize Indigenous relationships with culture and landscape [1]. The mechanism and linkages by which such information is transferred within the community or between communities is a source of research. Normally, this information is passed on from the elderly population to the younger generation by practical use and they are not documented. Therefore, at times, due lack of communication between two generations, some of the traditional practices get lost. Traditional knowledge can be defined as a cumulative body of knowledge and beliefs which are handed down through generations by cultural transmission Such knowledge may

include the relationship of living beings with one another and with their environment.

Indigenous knowledge is the knowledge that the population of a particular community has, practiced over time and continues to do so with some minor changes [2]. Traditional knowledge is an attribute of a society with historical continuity in resources, and such practices, by and large continue to be in use. It is also a mode of thought or behavior followed by a people continuously from generation to generation it may be a custom or usage [3]. Such knowledge is an important source of practice and traditional technique to maintain the method practiced traditionally by the people of the state. Such knowledge is the fertile ground from which springs traditional custom. The government too, should help people in their effort to keep their traditions alive since tradition is a rich source of information on which research can be based.

The proper investigation and documentation of ITKs in fisheries sector in every locality and community is important. The knowledge of traditional practices is important to understand the scientific use of some of the local materials and methods for sustainable development of the fisheries sector and at the same time to improve scientific and technical knowledge of fisheries including their interaction with the ecosystem for sustainable conservation management of fishes and their development.

2. METHODOLOGY

Survey was conducted for a period of three months from August to November. The data and information was collected from fishers and experienced persons through personal interview and by using structured interview schedule. Different areas of the West Jaintia Hills district were visited frequently to get information about the traditional techniques practiced by the local people. The description provided by the local resource person was documented and photographical evidences were collected.

3. RESULTS

3.1 ITKs in value added product:

3.1.2 Bamboo smoked Fish (Dakha *dapatli*):

Fresh fishes like Khabah (Rohu-*Labeo rohita*) are bought from local markets to the processing unit for preparation (Plate. 1). The fish is first washed, the gills removed and the head cleaned thoroughly. Fresh bamboos are cut in to specific sizes and are sharpened on both ends so that the fish can be easily pierced through. The bamboo pieces are inserted through the mouth up to the stomach then the internal organs of the fish including the guts are taken out through a cut on the side of the body of fish. The fish head is secured by bamboo slits in order to prevent breakage of the fish. Then, the fish is put over fire for smoking. A period of 24 hours is required to smoke the fish perfectly and ready it for sale.

The traditional method adopted by

Plate 1: Showing fish smoking processess

Fig. Preparation of Bamboo smoked fish (Dakha *dapatli*)
Sources of information: Mon Lamurong, West Jaintia Hills District
Practiced: Individual

3.1.3 Tungtap *(Chutney)*:

Tungtap is a dry fish paste or chutney made from the dry fish (*Puntius* sp.) which is preserved by the local people of Meghalaya (Plate 2, Fig. A). The villagers collect the dry fish particularly Puntius species from the market. Thereafter, the fishes are washed thoroughly in salt water and allowed to stand overnight. Then, the fishes are mixed with salt and fat of fish and put inside an earthen pot (*Khiew Khyndew*) and covered securely (Plate 2, Fig. B). The fish is then first layered by thrash fishes which are later thrown. Then the pot is sealed and kept aside for 3 months. The preparation is either sold in the market or consumed at home.

Plate.2: Preparation of Tunglap (*Puntius sps*)

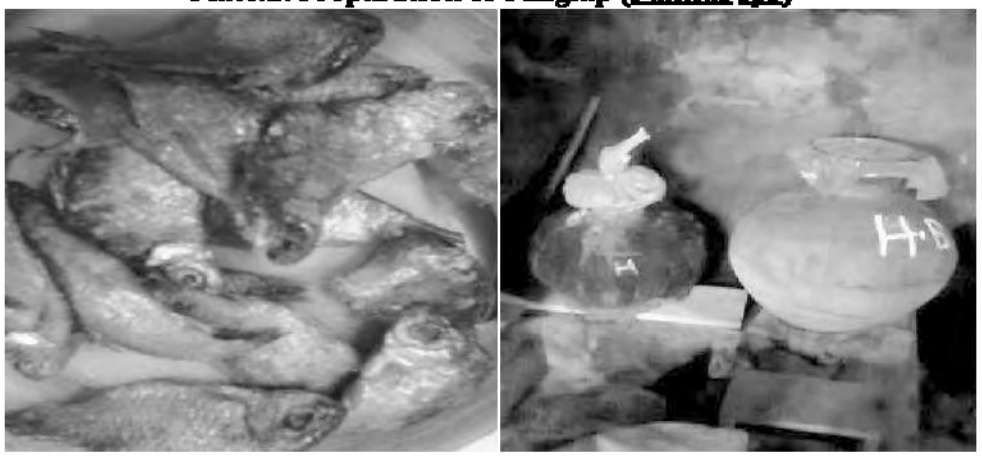

Fig . A: Dry fish (*Puntius sps*)

Fig. B: The preparation preserved in earthen pot

Sources of information: Keshia Khyriem , Chutwakhu, West Jaintia Hills,
Practiced: Individual

3.2. ITKs for fish baits. Fishing baits are special substances or live materials which are used to attract and catch fish. Each bait has a special method of preparation.

3.2.1 Shru (*Collocasia esculenta*): Shru is a local name of *Collocasia esculenta in* Jaintia Hills (Plate 3, Fig. A). Shru is cooked and then used as fish bait for angling. Chru cannot be preserved hence fresh preparation is essential

3.2.2 Sohlang (*Viburnum foetidum* wall): *Viburnum foetidum* is known as Sohlang in the local language of Jaintia Hills (Plate 3, Fig. B). The fruit known as Sohlang is used as a bait. The fish gets attracted to the aroma of the fruit and in its effort to eat the fruit, it is caught in the hook.. Different fishes are caught by this method, however Rohu (*Labeo rohita*), Khaski (*Labeo gonius*) etc. are main target species.

3.2.3 Salahdieng (*Mahinot esculenta*): Salahdieng is a local name of *Mahinot esculenta* in Jaintia Hills (Plate 3, Fig. C). This can be used as fish bait for hook and line fishing. The Rhizome of the plant is boiled and thereafter are put on the hook for fishing. The raw Rhizome of the plant can be preserved for use throughout the year.

Plate 3: Plant materials used as fish baits

Fig. A: Shru (*Collocasia esculenta*)
Sources of Information: Bluemoon Nongrum, Amlari West Jaintia Hills,
Practiced: Community

Fig. B: Sohlang (*Viburnum foetidum* wall)
Sources of information: Molwas Pakma, Moodymmai West Jaintia Hills,
Practiced: Community

Fig. C: Salahdieng (*Mahinot esculenta*)
Sources of information: Bluemoon Nongrum, Amlari West Jaintia Hills,
Practiced: Community

3. 3 ITKs used for fish sedatives:

3.3.1 **Kharu (*Milletia Pachycarpa*)** – *Milletia Pachycarpa* is known as Kharu in local language of Jaintia Hills district (Plate 4, Fig. A). Firstly the roots of this plant are collected, washed and ground till the milky fluid is extracted. The milky fluid is then thrown into the water body intended for fishing. The juice of the roots of Kharu act as fish poison and the fishes that are present in the water body are killed and caught. The roots of the plant can be preserved for a year to be used in fishing. Though, the ITK is of destructive nature but it is still in use in many parts of the district.

3.3.2 Salia – It is the local name of a tree in Jaintia Hills (Plate 4, Fig. B). The bark of the tree is taken out and ground. Then the ground bark is thrown into the river since the juice acts as poison. The fishes initially get stupefied and eventually they die. The bark of the tree can be preserved and can be used for the whole season.

3.3.3 Jaiur (*Zanthoxylum alatum*) – Jaiur is a local name of *Zanthoxylum alatum* in the Jaintia language (Plate 4, Fig.C). This time, the fruit of the tree acts as a fish poison. The fruit is ground into fine powder and thrown into the river. The poisonous extract of the powder acts on fish and kill them. The dead fishes are then collected with a scoop net.

Plate 4: Showing Pant materials used as fish sedative or poison

Fig. A: Kharu (*Milletia Pachycarpa*)
Source of Information: Synran Nongrum, East Jaintia Hills District
Practiced: Community

Fig. B: Salia
Source of Information: Synran Nongrum, East Jaintia Hills District
Practiced: Community

Fig. C: Jaiur *(Zanthoxylum alatum)*
Source of Information: Synran Nongrum, East Jaintia Hills District
Practiced: Community

3.4 ITKs in Fishing Gears:

Fishing gears are commonly classified into two main categories, passive and active, based on the operation mode of the fishing gear. With passive gear, the capture of the fish generally depends on movement of the target species and the gears remain in static position while the active gears capture the fish on an aimed chase of the target species. A parallel on land would be similar between the trapping off and hunting for animals. Passive gears are, in general, the most ancient types of fishing gear. These gears are most sAuitable for small scale fishing and therefore often used in artisanal fishing, some passive fishing gears are often referred to as "Stationery" fishing gear and such gears are anchored to the seabed. However, some moving gears such as nets may also be classified as passive gear as fish capture by these gears also depend on movement of the target species towards gears.

3.4.1 Pyrsieh Khwe (Fishing Rod):

Pyrsieh Khwe is the local name of fishing rod and line in Jaintia Hills District. Fishing rod is made from bamboo (Plate 5, Fig. A). At the tip of the bamboo a karkot (thread) is tied and at the end of the karkot the fishing hook is tied. Baits such as worms, insects, fruits etc. are used.

Plate 5: Indigenous fishing gears

Fig. A: Pyrsieh Khwe (Fishing Rod)
Source of Information: Molwas Pakma, Moodymmai, West Jaintia Hills District
Practiced: Community

Fig. B: Sasi
Source of Information: Molwas Pakma, Moodymmai, West Jaintia Hills District
Practiced: Community

Fig. C: Jar
Source of Information: Molwas Pakma, Moodymmai, West Jaintia Hills District
Practiced: Community

3.4.2 Sasi:

It is a local name of the scoop net used in the Jaintia Hills District (Plate 5, Fig. B). Sasi is made up of bamboo, cane or even wire mesh and is one of the fishing gears that is used to catch small fish only in the stream, river etc. and is mostly practiced in Jaintia Hills. The gear is operated just by dipping it into the water where the fish are gathered in a school and then caught.

3.4.3 Jar:

Jar is the local name of fishing nets used in Jaintia Hills District (Plate 5, Fig. C). The Jar is made up of different materials including wire mesh, cotton or silk thread depending on use and intended fish to be caught. This gear is usually operated in river, stream and in fields etc. It is thrown in the middle or side of the river, stream etc. Bait such as wheat flour, rice etc. are used.

5. DISCUSSION

The protection of Traditional Knowledge is one of the major issues that have to be addressed [4]. Indigenous people and local communities have an important role in the management of biodiversity. The value of indigenous knowledge (IK) is recognized by scientists, managers, and policy-makers, and is an evolving subject of national and international law [5]

ITK is also recognized as a form of rational and reliable knowledge developed through generations of intimate contact by native people with their lands that has equal status with scientific knowledge

The ITKs used in the Jaintia hills district of Meghalaya are unique and the purpose of use is very simple. The present report is to give an insight into the ITKs used in fisheries sector of the state and it is not intended to provide a detail or scientific analysis of selectivity, rather to give sufficient information for discussion which may be of interest for many fishery managers. For water managed and the state wide regulations with corm or other baits to attract fish would be considered illegal practice, providing that anglers do not get carried away and liberally coat the bottom of the stream with bait. If this were the case, then it would be considered littering. Indigenous Traditional Knowledge is relevant for policy and program developers and researchers across non-government spheres within heath of related sector. It is access to nutritious and affordable food is a key determinant of achieving health equality and closing the gap in life expectancy between indigenous and non-indigenous.

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REFERENCES

[1] Margaret Bruchac (2014): Indigenous Knowledge and Traditional Knowledge. https:// repository.upenn.edu/ anthro_papers /171

[2] Kumar Dilip, Sharma A, Sharma R, Sukla S P & Babu S (2010). Inedenous technical knowledge in fisheries of North East India, CIFE, Mumbai pp 122.

[3] Kalita k, Bhagawati S & Kasyap D (2012): Application of traditional knowledge in fisheries – A hand book (Translated from original in Assamese) Fisheries college, AAU, Roha. 94.

[4] Mathur A (2003): Who owns traditional knowledge,; Indian Council For Research On International Economic Relations, Paper no. 96.

[5] Francesco Mauro and Preston D. Hardison (2000): Traditional knowledge of indigenous and local communities: international debate and policy Initiatives, *Ecological Applications:* Vol. 10, No. 5, 1263–1269.

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[4] Espenson, J. H. (1995). Chemical kinetics and reaction mechanisms (Vol. 102). New York: McGraw-Hill. **For Book**

[5] Cappuccino, J. G., & Sherman, N. (1996). Microbiology: a laboratory manual. **For Book**

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[7] Anonymous. Parallels between tissue repair and embryo morphogenesis: a conceptual framework. Global Health. 2006;16:4. Accessed 29 March 2012. **For Web-resource** Available: http: // www.globalizationandhealth.com/ content/1/1/14.

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Beale, Calvin L. 1975. *The Revival of Population Growth in Nonmetropolitan America*. U.S. Department

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Web page:

National Library of Medicine. Environmental Health and Toxicology: Specialized Information

Services.

http://sis.nlm.nih.gov/enviro.html (accessed Aug 23, 2004).

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Internet Site:

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