SYMMETRIC DETERMINATION OF THE SEVERITY OF PRODUCTIVITY CONSTRAINTS OF FISH FARMERS IN THE TROPICS: A CASE STUDY OF THE NIGER DELTA REGION, NIGERIA

***VALERIE A. Solomon[1] and EMEM B. Inyang[2]**

1Valerie A. Solomon, PhD, Lecturer in the Department of Agricultural Economics and Extension, Bowen University, Iwo, Osun State, Nigeria. E-mail: valasolomon@yahoo.com
*Corresponding author

2Emem B. Inyang, Researcher, Research and Development Unit, Rubino Associates, Eket, Akwa Ibom State, Nigeria. E-mail: embainy@yahoo.com.

Manuscript received: July 28, 2006; Reviewed: March 1, 2007; Accepted for publication: May 14, 2007

ABSTRACT

The study was conducted to fill the gap in the dearth of information on systematic approach to ascertain the severity as well as the magnitude of the constraints responsible for the sub-optimal operation of fish farming in Nigeria. 120 randomly selected fish farmers from a list of 186 fish farmers in the state were interviewed. Participatory appraisal technique and econometric technique were adopted to ascertain the most severe major constraints and also the severity index of each of the sub-constraints that are responsible for the sub-optimal aquaculture operation in the Niger Delta region of Nigeria and the cause of withdrawal from aquaculture by some fish farmers. The sub-constraints severity within the major constraints, across the region gave more insight into the causes of the high rate of withdrawals from aquaculture and the decline in aquaculture productivity in the region. How productive the regional aquaculture would be, even in the nearest future, would depend to a large extent on these major factors: production, marketing and advancement in related technology. Unless pragmatic approach is used to reduce the constraints responsible for the high rate of withdrawal, fish food security in the Niger Delta Region of Nigeria would still be elusive.

Key words: Aquaculture, productivity constraint, Niger-Delta, Nigeria

1. INTRODUCTION/BACKGROUND

Concerted efforts to develop fish-farming (aquaculture) in Nigeria passed through distinct periods (1950 – 1992) and the attempts to reduce the major constraints for rapid aquaculture development, featured prominently in the second phase of the National Development Plan (Ezenwa, 1994) [5]. Extension activities in the 1960's and 70's given by the government demonstration fish farms at Itu and Opobo boosted the awareness process and adoption of the technologies during the early days of aquaculture development in Nigeria (Ajenifuja, 1998) [3]. The then enthusiasm resulted in a significant individual participation in fish-farming within the Niger Delta Region of Nigeria (Inyang, 2001) [8]. Despite campaigns on the potentials of fish farming for mass reduction in protein malnutrition, poverty level and unemployment, diminishing production has become a characteristic feature in the region. The regional aquaculture status report from 2000 to 2005 reveals that the fish farms in the state are either operating at sub-optimal level or abandoned.

Inyang (2001) [8] and COFAD (1999) as cited in FAO (2000) [7] observed that the concept of fish farming is perceived as a foreign technology by the small scale, resource poor farmers, most especially in sub-Saharan Africa and it is seen as a donor driven development. Aquaculture development in this region is characterized by several constraints that are multidimensional and which the largely small-scale fish farmers are unable to solve. There are limited studies on the socio-economic aspect of fish farming in Nigeria (FAO, 1994) [6] but from the available literature, the study of Balarin (1985) [4] did not differ much from Ajana (1996) [1], portraying a decade of difficulties confronting fish farmers. Balarin (1985) [4] categorized constraints to aquaculture development among rural fish farmers into three: technical, social and economic. Under the technical consideration, poor understanding of the biology of the fish, logistics hindering effective training of personnel and extension support activities among others were mentioned. Ajana (1996) [1] listed about ten major constraints to include inadequate site selection, poor designs and construction of fish pond, low level of fish farm management techniques, high cost of pelleted fish feeds, inadequate hatchery facilities and poor record keeping among others Ajana 1996 [1] and 2000 [2] and Simwanza et al 2000 [12] highlighted reasons responsible for unsustainable aquaculture development in Sub-Saharan Africa. Balarin (1985) [4] identified the major and sub-factors that affect aquaculture development in a developing economy but did not present any empirical evaluation of the incidence of these constraints. It is against this back-drop that the study has the following objectives:

- identification of the demographic characteristics of respondents
- determination of the major constraints faced by fish farmers
- determination of the severity index of each sub-constraint
- symmetric determination of the relative severity of major constraints

2. RESEARCH METHODOLOGY

2.1 The study area

The Niger Delta region of Nigeria covers an area of about 70,000km^2 and is inhabited by about 7 million people (NDES, 1997) [9]. The Region is a highly petroliferous basin that situates at the mouth of River Niger bordering the Atlantic Ocean. The traditional occupation of the people of the Niger Delta is artisanal fishing and farming, which is gradually being abandoned due to incessant oil spillage, land and water pollution. The Niger Delta region spreads across 9 states in Nigeria: Rivers, Akwa Ibom, Bayelsa, Edo, Imo, Abia, Delta, Ondo and Cross River. Akwa Ibom State, in the core of the Niger Delta region in Nigeria was purposively selected because it has a relatively longer history of aquaculture development, spanning over four decades (Ajenifuja, 1998) [3] and possesses all the representative features of the Niger Delta. It lies between latitudes 4^{o}31^l and 5^{o}3^l North and longitude 7^{o}35^l and 8^{o}51^l East. The state occupies an estimated total area of 105,000km^2 and has a shoreline of 129km on the Atlantic Ocean to the South, (Ajana 1996 [1] and Uwatt, 2000 [15]).

2.2 Population, sample size, data collection and analysis

The population of the study consisted of all fish farmers in the Niger Delta region of Nigeria, from where adequate sample was selected. The study explored the perception of the aquaculture constraints by farmers and relied on information from in-depth interview with key informants to generate the prevalent aquaculture constraints in the study area. The list of constraints was used to develop a questionnaire that sought a wider perspective of the aquaculture farmers in the region. A sample of 120 fish farmers was selected randomly from a list of 186 fish farmers in the state. The data was analyzed using statistical tools such as means and percentages, as well as a participatory appraisal (soft) approach and an econometric (hard) approach.

Model specification

The relative severity index of the major constraints was

Table1 Distribution of the Responses of Fish Farmers on the Incidences of Constraints.

S/no	Constraints	Level of severity				Pooled Incidence Index
		High	Moderate	Low	None	
a.	Marketing					
I	Lack of local consumption demand	0.158	0.092	0.017	0.733	0.267 [c, 27]
II	Low selling price of the produce	0.158	0.233	0.075	0.533	0.467 [b, 16]
III	High marketing cost of the produce	0.150	0.225	0.175	0.450	0.550 [a, 11]
b	Technological					
I	Locally available methods of fish farming	0.333	0.183	0.125	0.408	0.592 [b, 5]
II	Types of land infrastructure	0.242	0.167	0.025	0.567	0.433 [c, 19]
III	Inadequate introduction of innovations	0.333	0.183	0.125	0.358	0.642 [a, 3]
c	Socio-cultural					
I	Changes in past government and administration	0.167	0.075	0.125	0.633	0.367 [c, 24]
II	Community beliefs on choice of culturable species	0.075	0.142	0.067	0.717	0.283 [d, 25]
III	Activity of thieves (poachers)	0.142	0.208	0.067	0.583	0.417 [b, 20]
IV	Predation of fish by other animals	0.117	0.250	0.183	0.450	0.550 [a, 11]
d	Institutional					
I	Poor level of loan utilization	0.275	0.133	0.125	0.467	0.533 [a, 13]
II	High taxation	0.042	0.092	0.142	0.725	0.275 [c, 26]
III	Lack of motivating government policies	0.008	0.258	0.158	0.475	0.525 [b, 14]
e	Production					
I	Unavailability of adequate land	0.233	0.158	0.183	0.425	0.575 [d, 7]
II	High cost of available land	0.317	0.192	0.075	0.417	0.583 [e, 6]
III	Unavailability of cultural species	0.183	0.192	0.125	0.500	0.500 [g, 15]
IV	Unavailability of space in the streams	0.150	0.133	0.100	0.617	0.383 [h, 22]
V	Unavailability of fish feed on fingerlings	0.508	0.233	0.117	0.142	0.858 [a, 1]
VI	High cost of feeds	0.320	0.200	0.080	0.400	0.600 [c, 4]
VII	Unavailability of equipment for use at different phases of production	0.325	0.133	0.100	0.442	0.558 [c, 10]
VIII	High cost of establishing fish farm	0.358	0.200	0.208	0.233	0.767 [b, 2]
f	Environmental					
I	High depletion of dissolved oxygen in pond	0.067	0.183	0.192	0.588	0.442 [d, 18]
II	The average daily temperature in pond	0.167	0.183	0.033	0.617	0.383 [f, 22]
III	Low water pH in pond	0.075	0.258	0.233	0.433	0.567 [a, 8]
IV	Pond water turbidity	0.117	0.167	0.175	0.542	0.458 [c, 17]
V	Oil pollutions	0.100	0.150	0.142	0.608	0.392 [e, 21]
VI	Atmosphere polluted rains	0.192	0.225	0.083	0.500	0.500 [b, 15]

Source: field survey
Note: the superscript in alphabet and numbers indicates relative positions within the context each group and its totality respectively.

Table 2: Summary of the Soft System Determination of Relative Severity of Major Constraint affecting Aquaculture in a Niger Delta Region, Nigeria.

Constraints	Rank Position							Order of Severity
	1st	2nd	3rd	4th	5th	6th	7th	
Socio-economics	7	5	14	22	24	22	27**	7th
Environmental	13	17	25	27**	17	12	10	4th
Socio-cultural	5	7	15	22	24**	21	26	5th
Institutional	19	15	12	11	23	23**	16	6th
Production	30**	24	13	14	10	16	9	1st
Technological	23	19	27**	15	12	10	14	3rd
Marketing	23	33**	14	9	10	16	18	2nd
Total	120	120	120	120	120	120	120	

** Indicate the relatively most severe major constraints to productive aquaculture

estimated by using four functional forms of multiple regression technique: linear, double log, semi-log and exponential model. The ordinary least square methods was employed in the estimation of the coefficients of the relationship, it is hypothesized that the following functional relationship express in explicit form, explains the relationship between aquaculture output (Dependent variable) and a set of independent variables that reveal the extent of severity of the multivariate relationships. Thus, the model assumes the following relationship:

$Y = A + P_1X_1 + P_2X_2 + .. \ldots\ldots\ldots P_KX_K$

Where A is the intercept

P is the regression coefficient, expressing the extent of the severity of X_1 on Y when X_2 …… X_k are held constant. Subsequent upon the running of analysis, the double logarithmic model was considered the best fit in terms of meeting the statistical and econometric criteria.

3. RESULT AND DISCUSSION

3.1 Objective one: Personal characteristics of the fish farmers

The study agrees with Uchola (2000) [14] that fish farming in this region is male dominated, as most females prefer to engage in the processing and marketing sector. The cross sectional survey reveals that out of a total of 120 fish farmers, only 10 percent were female. The fish farmers were mainly literate with about 56.8 percent of them having over 10years of formal schooling. The mean age of the fish farmers stood at 42.9 years but the age modal class was within the age range of 31-41 years, having 42.5 percent distribution of farmers. Economically, the aquaculturist had diversified livelihood activities, with 30.8 percent involved in general business, 26.2 percent were civil servants while 26.7 percent were involved in other aspects of agriculture apart from fishery. About 82 percent of the farmers had non-fish farming monthly income of US$312.87.

3.2 Objectives Two and Three: Major constraints and severity index of sub-constraints as experienced by the farmers

Based on the outcome of the in-depth interview with key informants, twenty-seven sub-constraints militating against sustainable aquaculture development in the Niger Delta region were identified. Response analyses of the sub-constraints led to the identification of six major mutually exclusive groups of constraints: Production, Environmental, Socio-cultural, Technological and Marketing, as shown on table 1. The figures shown on table 1 are ratio index indicating the degree of severity of the constraints. The severity increases, if the index value approaches 1 and become less or not severe if the value approaches 0. The results across all the sub-constraints portrayed that most of the sub-constraints (15 out of 27) had above 0.50 incidences, having adverse influence on the operation of individual farms (see the column: pooled incidence index). The least severe set of incidence of sub-constraints had about 20 percent (0.2 incidence) influence on the productivity of farms. The numeric superscript shows the relative position of each sub-constraint among others. The ten most prominent sub-constraints were predominantly found to be production oriented with other two relating to technologies needed for efficient production. The lettered superscripts on table 1 depict the severity of each sub-constraint within its mutually exclusive group. The production constraints had about eight sub-constraints of which inadequate supply of fish seed or fingerlings is the most severe and is having a spatial incidence of 0.86. Others shown on table one were high cost of establishing or further expansion

Table 3: Summary of the Hard System Determination of Relative Severity of Major Constraints affecting Aquaculture in a Niger Delta Region, Nigeria

Exogenous Variable	Double Model***	Linear Model	Semi Log Model	Exponential Model	Order of Severity
Production	-0.925 [a]	-3507.64 [a]	-1245.20 [a]	-2.907 [a]	1st
(S.E)	0.190	742.181	254.578	0.539	
Marketing	-0.51 [a]	-1259.47 [b]	-477.047 [b]	-0.910 [b]	2nd
(S.E)	0.143	529.930	191.725	0.383	
Technological	0.363 [b]	1428.012 [c]	567.051 [b]	1.016 [b]	3rd
(S.E)	0.142	649.386	190.475	0.472	
Socio-cultural	0.095[d]	73.218 [d]	153.980 [d]	1.072 [c]	4th
(S.E)	0.123	780.514	165.011	0.567	
Institutional	-0.025 [d]	28.552 [d]	172.056 [d]	-0.765 [d]	5th
(S.E)	0.145	699.355	193.581	0.508	
Environmental	0.012 [d]	51.587 [d]	14.724 [d]	-0.375 [d]	6th
(S.E)	0.160	787.865	214.886	0.572	
Constant	5.832 [a]	3035.29 [a]	846.992 [a]	8.102 [a]	
(S.E)	0.320	357.847	428.817	0.261	
F	6.461 [a]	10.654 [a]	8.105 [a]	10.437 [a]	
R^2	0.255	0.361	0.301	0.357	

*** Indicates the best fit model and it is the lead equation.

a = significant at 0.01%, b = significant at 0.05% and c = significant at 0.10% and d = not statistically significant

of fish farms (0.77 incidence), high cost of feeds (0.60 incidence), high cost of available land space (0.59 incidence) and insufficient availability of land space (0.58 incidence).

Among the environmental constraints, low water pH in ponds was the most severe sub-constraints, with a prevalence of a pH value of about 0.57 across the region. This could be attributed to the high rate of air, water and land pollution in the region due to the high concentration of petrochemical activities, gas flaring and other industrial and human activities, that release carbon compounds into the atmosphere. The farmers also complained of the effect of acidic rainfall (0.55 incidence index) while high turbidity had incidence index of 0.46, as shown on table 1. Among the socio-cultural constraints; predation of fish by other animals, had the highest incidence (0.55), activities of poachers had 0.42 incidence. These constraints call for serious concern, as their incidences are high and can significantly reduce the profitability of any firm. Instability in government programmes had 0.36 adverse incidence on the sustainability of the farms. Undoubtedly, the establishment of the recommended productive unit requires substantial capital expenditure and yet inadequate access to loans and credit among the farmers was admitted as the most severe constraints. It had an incidence level of 0.54, depicting that more than half of the farm units are having difficulties in securing loans for investment in the sector. Government policies and its extent of implementations were adversely felt by farmers, its incidence index of 0.55, was felt within the region as indicated on table 1. The technological constraints depicted that the level of introduction of innovation into the region was not adequate. This constraint had an incidence index of 0.64, implying that there is 0.36 index of innovation satisfaction i.e. 36 percent of the farmers were comfortable with the available technological status quo. Locally available methods were admitted by the farmers to retard the productivity of aquaculture operations, having incidence of 0.60 across the region. The relatively less talked about marketing constraints revealed increasing cost of marketing of the product as the most severe sub-constraint with an incidence index of 0.55 across the region while low selling price of the produce had 0.46 incidence as the next severe sub-constraints. Aquaculture development in the Niger Delta region of Nigeria needs serious attention, except the adverse incidence of these sub-constraints are reduced to an index of 0.35 or less, accomplishing the expected fish food sufficiency would still be a mirage. Table one gives a detailed break-down of the incidence index of all the constraints discussed.

3.3 Objective Four: Symmetric determination of the relative severity of the major constraints

3.3. I Soft system (participatory appraisal) approach

Warren (1990) [17] and Olawoye (2001) [10] maintained

Table 4: Comparatives Analysis of the Symmetric Determination Approach

Order of Severity	Soft System Approach	Hard System Approach
1	Production	Production
2	Marketing	Marketing
3	Technological	Technological
4	Environmental	Socio-cultural
5	Socio-cultural	Institutional
6	Institutional	Environmental
7	Socio-economic	

that indigenous knowledge of rural dwellers hold a lot of information and has been increasingly recognized as being a fundamental inputs for sustainable development. As proposed by Van der ban (1997) [16], this study examined the perception of farmers of the established constraints. They were asked to rank the major constraints in a relative decreasing order of adverse incidence, affecting the degree of productivity of aquaculture in the region. Seven major constraints were presented to the farmers and they were asked to assign the seven major constraints to the relatively ranked positions (1 to 7). A value of 1 was considered as being most severe and a value of 7 as being the least severe. The mode of the frequency distribution in each position was considered to be the most severe in each position. Table 2 shows production constraints were the most severe and closely followed by marketing and technological constraints respectively. In the second column (2^{nd} ranked position) marketing constraint was clearly picked out while production and technological constraints were respectively ranked next to the marketing. Closer observation reveals the three major constraints: production, marketing and technological were keenly ranked in the first two positions. The third constraints, technological, was the most prominent constraints in the third column. Surprisingly within the third column, environmental and socio-cultural groups competed respectively next to the technological. In column 5, two variables had the same rating, but socio-cultural constraint was picked at the 5^{th} position since socioeconomic constraint ranked highest at the 7^{th} position. The results of the ranking positions of seven major constraints are shown in the last column of table 2. The participatory appraisal (qualitative) technique used for the identification process revealed production constraints and presents others in order of less severity. This implies that production constraints contributed most to the dwindling aquaculture productivity in the region, followed by marketing constraints. Others in the corresponding decreasing severity were technological, environmental, socio-cultural, institutional and lastly socioeconomic constraints.

3.3.2 Hard system (econometric) approach

A twenty-seven item, two points factual scale was developed to assessed the spatial distribution of the sub-constraints over the region. A composite ratio index value was derived for each of the mutually exclusive major constraint groups, which served as exogenous variables to the aquaculture output of each farming unit. Four functional models of multiple regression analysis were used to determine the severity of the major constraints affecting aquaculture but the double logarithmic model was the best fit. The test result on table 4 shows that production, marketing and institutional constraints have negative relationships with the quantity of fish output. Thus, the high incidences of these constraints in the region have adverse effect on the productivity of the farming units. The three most severe determinants mentioned above were the only significant major constraints at 0.05 level of probability. The relative order of the severity of the exogenous variables (constraints) is shown on table 3. The pattern of relative severity indicated by the standardized beta coefficient appears to follow underlying dimensions that simulate the reality of reasons for unresponsive aquaculture development efforts in the region.

3.4 Comparative analysis of the outcome of the symmetric determination approach

Table 4 gives a comparative analysis of the symmetric determination approach. Both the soft system and hard system techniques reveal concurrently, a consistent order of severity of major constraints affecting fish farming in the Niger-Delta region of Nigeria. These are production, marketing and technological constraints in their decreasing order respectively. However, in the relative position 4, 5 and 6, there was asymmetry determination by the two approaches. The econometric approach identified decreasing order of severity in the following sequence: socio-cultural, institutional and environmental, while the participatory appraisal technique perceived

environmental constraints incidence index most critical, followed by socio-cultural and institutional constraints. The consideration of Environmental constraints to be more critical in the participatory appraisal technique could be informed by the high level of environmental degradation due to the activities of multinational oil companies involved in gas flaring and by intermittent oil spillage in the socially turbulent Niger Delta region of Nigeria. Another reason advanced by respondents for ranking environmental constraints as more critical than socio-cultural constraints is that environmental mishap or hazard is unpredictable and can render the entire investment unproductive unlike socio-cultural, even institutional and socioeconomic constraints. The econometric approach reveals more latent information than the participatory appraisal as it is based on the underlying pattern of interrelationship existing among the variables under consideration. The model reveals that, the direction of aquaculture operation is inversely influenced by production, marketing and institutional constraints (see table 3 under the double log model). The environmental constraint appears less influential, reflecting intense pressure from the indigenous people in the region on the petroleum exploring companies to ensure environmentally friendly activities.

Though, the econometric approach statistically confirmed the significance of the three most severe and consistent constraints, others such as socio-cultural, institutional and environmental constraints still require serious attention. They could be potent enough to reduce the growth and productivity of aquaculture in the region.

4. RECOMMENDATION/CONCLUSION

This study concludes that relative efficiency in aquaculture development programmes in the Niger-Delta could be achieved if the constraints affecting the sector could be reduced to an incidence index of less than 0.30. Presently, sub-constraints associated with production, marketing and technological advancement require urgent attention. Donor organizations and the government should assist in areas such as improving market distribution pattern and information signals on domestic and international demands. Efficient research institutes are unavoidably expedient to supply and generate the needed technology as well as desirable and compatible innovations. The institutes and the innovations must also have an extension unit for efficient dissemination of information to fish farmers and other stakeholders in the aquaculture business. The institutional sector must ensure that functional investment policies become a priority to encourage and boost private sector involvement in aquaculture.

The existence of these numerous constraints implies that fish food security and indeed adequate protein intake in the Niger Delta region of Nigeria would still be a mirage unless pragmatic steps are taken by all stakeholders to reduce the constraints, stem the spate of withdrawal from aquaculture and increase productivity.

REFERENCES

[1] Ajana, A. M., Survey of Coastal and Brackish-Water Shell Fish Fishery of Akwa Ibom State. A Refills Report for National Aquaculture Research Project; Nigerian Institute for Oceanography and Marine Research, Lagos, June, (1996) Pp 6-10.

[2] Ajana, A. M., Overview of Highlight and Problems of Fisheries Extension. National Agriculture. January/February, (2000). 14, 1. Pp 1-3.

[3] Ajenifuja, Y. F Post Independence Historical Perspectives in Fisheries Development in Nigeria. (1998). P.72.,

[4] Balarin, J. O., Technical and Socio-Economic Factors Inhibiting Development. In Proceedings of the Commonwealth Consultative Workshop on Village Level Aquaculture Development in Africa. (1985). Pp. 28 –35.

[5] Ezenwa, B, Aquaculture Development and Research in Nigeria: In Aquaculture Development and Research in Sub-Saharan Africa, National Reviews. CIFA Technical paper, 223 supl. FAO, Rome. (1994). Pp 45-79.

[6] FAO, Aquaculture Development and Research in Sub-Saharan Africa. FAO. Tech. Paper. (1994). Pp45-62.

[7] FAO, Farm Management and Production Economics Service Inland Water Resources and Aquaculture Service. FAO, Rome, (2000), 27pp.

[8] Inyang. E. B., Factors Affecting Aquaculture Production in Akwa Ibom State. Unpublished M.Sc project Report to the Department Agricultural Extension and Rural Development, University of Ibadan, Ibadan. (2001). 80pp.

[9] NDES, Niger Delta Environmental Survey Phase One Report, (1997), 1: 114.

[10] Olawoye, J. E., Contemporary Research Interests and Problem Areas in Agricultural Extension and Rural Development, The Ibadan Extension Monograph Series, (2001), 2, 47p

[11] Satia, B. P., National Reviews for Aquaculture Development in Africa. FAO Fish; (1990). Circular 770, 29:1991pp.

[12] Simwanza, B. and C. Maguswi, Report on Integrated Immigration and Aquaculture (IITA) in Zambia. Paper Presented at the IITA workshop, Accra, Ghana, 20–21, September 1999. (2000).

[13] Tobor, J. G., The Fishing Industry in Nigeria Studies and Potential for Self Sufficiency in Fish Production. NIOMR Tech Paper No. 54. (1990).

[14] Uchola, E.B., An Economic Analysis of Fish Farming in the Western Extension Zone of Lagos State. Unpublished M.Sc Research Report, Dept of Wildlife and Fisheries Management, University of Ibadan, Ibadan, (2000).

[15] Uwatt, U. B., Impact of New Technology on Agricultural Production; A Case of Small Farmers in Akwa Ibom State of Nigeria (in) International Journal of Social Science Vol. No 1, June. (2000), Pp. 75 – 76.

[16] Van der Ban, A. W., Successful Agricultural Extension Agencies are Learning Organization. In R, K. Samantha and S. K. Arora (eds). Management of Agricultural Extension in Global Perspectives B. R. Publishing Corporation, New Delhi, (1997). pp 47-77.

[17] Warren, D. M., Indigenous Knowledge and Development. Background Paper for Seminar Series on Sociology and National Resource Management held on 3 Dec. at Agriculture Dept., The World bank, Washington. DC. (1990) P2