

Ecorestoration of Degraded Hills



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B. K. Tiwari
and
Surendra Singh

About the Book ...

The existence of extremely degraded hills and grassland ecosystems in the tropical and sub-tropical humid areas of the world is an unresolved ecological problem. There is a view of ecologists that the present landscape of these wet areas has emerged as a consequence of deforestation and interference of man. The similar type of situation is prevailing in the degraded hills of the North-Eastern Region of the country specially in Meghalaya plateau which receives the highest rainfall of the world. Denudational forces and processes of degradation accelerating in these areas are to be studied carefully for the restoration of ecosystems.

The practical problems of degradation of the tropical wet lands specially of Meghalaya plateau have been discussed and scientific solutions of these problems are suggested. The present volume '**Ecorestoration of Degraded Hills**' is an outcome of two workshops, namely, '**Environmental Problems of Meghalaya Plateau**' and '**Technologies for Ecorestoration of Cherrapunjee Plateau**' organised by the Centre for Eco-Development, North-Eastern Hill University, Shillong. Fourteen papers have been classified into four broad sections, viz., (a) Eco-Restoration : Concepts and Approaches; (b) Problems of Hill Farming; (c) Geoenvironmental Degradation and (d) Forest and Wild life Protection.

The book, '**Ecorestoration of Degraded Hills**' is very much useful for the researchers who are working on the problems of environmental degradation and is expected to open new dimensions of the facts to the environmental scientists and planners of the country.

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Edited By
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Surendra Singh



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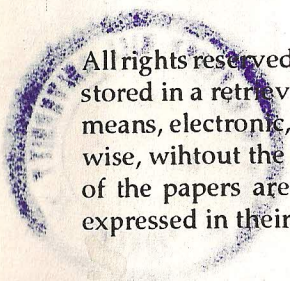
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Preface

Interaction of man with the environment is inseparable as man derives all his requirements from the biotic and abiotic components of the environment around him. The civilization and cultural traits are important parts of human environment. The modern culture, which is largely based on the materialism of the West and follows limitless principles of economic development, does not fit under the ambit of ecological jurisprudence which impose the limits to development and requires to follow some natural laws that regulate the relationships of organism with environment. The habitat dictates these rules of the environmental limits and defines the *niche* of an organism including man in the system. Thus, there seems to be a conflict between nature, controlled environmental systems and uncontrolled human activities which disturb the interrelationships among animate and inanimate components of a particular ecosystem. The key component of ecorestoration is to prepare an integrated strategy for rehabilitation of an ecosystem which is dynamic and where the equilibrium between regeneration and utilization of resource is maintained. The systems which are studied under ecorestoration of an ecosystem where man is the key component involve the decision-making processes, its social acceptance and also its short and long term effects on the activities of man, the resources and functioning of the system.

The question arises how to accelerate decision-making processes to restore the degraded environment? Say for example, the questions of resource utilization, environmental degradation, pollution and the qualitative improvement of life and so on deal with ecorestoration and self-sustained growth of the system. The issues and spot-seen-problems of ecodevelopment and ecorestoration of any system are closely related to three major aspects :

- (a) to search for major issues related to environmental degradation,
- (b) to highlight the problems of local inhabitants related to other abiotic and biotic factors of the environment, and
- (c) to provide solution for optimal growth and attainment of balance between use and replenishment of resources.

There is ample need to stress on these issues and problems of ecodevelopment especially with reference to the environmental conditions prevailing in the hill areas of North-East India where human interaction with nature is intensified and is adversely affecting the rich and well-established intricate balance between man and environment. For studying the issues and problems of eco-development, the Meghalaya plateau of the North-Eastern Hill region of the country is chosen as a case study. The plateau is provided with strong geo-processes and harbours rich biological resources required for supporting a sustainable society. Despite of all favorable environmental conditions, the forests, the aquatic bodies, the wildlife, and the landuse system of the region are greatly disturbed. The Meghalaya plateau is a true representative tropical as well as sub-tropical wet forest lands of the world because it receives the highest rainfall of the world with the moderate temperature. The Cherrapunjee area is the most affected part of the plateau which is now called- 'the Tropical Wet Desert'. Denudational forces and processes of degradation accelerating in these areas are to be studied carefully for the restoration of ecosystems.

The present volume is the product of the deliberations in two workshops, namely, '**Environmental Problems of Meghalaya**' and '**Technologies for Eco-restoration for Cherrapunjee Plateau**' organised by the Centre for Eco-Development, North-Eastern Hill University, Shillong, in which the real issues and problems of environmental degradation were discussed involving the local voluntary organisations, villagers and scientists from various research organisations. We are hopeful that, through this volume, the ground realities of the eco-development problems of the hill areas of the region have been highlighted and their solutions are provided for the protection of the environment in an integrated manner. The studies included in this volume have wide applications in understanding the environmental problems and regional developmental planning particularly with reference to the hill areas of the tropical and sub-tropical lands of the world.

Place : Shillong

B.K. Tiwari

Date : 25th January 1995.

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Jhum Cultivation in Meghalaya

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Socio-Economic Status of Jhumias in Meghalaya

Shifting cultivation is widely practised in the hill areas of the North-east, Southern Orissa and Northern Andhra Pradesh. It is the main stay of local tribals there. It is also prevalent in isolated pockets in Madhya Pradesh, Maharashtra, Bihar, Kerala and Tamil Nadu. It is known generally as *Jhum* in Meghalaya but as *Tekeonglu* in Nagaland, *Adimdik* in Arunachal Pradesh and *Heckusisomoms* in Tripura; *Bagad*, *Dqwar*, *Dipa* and *Dahis* in Madhya Pradesh; *Kumri* or *Kumari* in Western ghats and *Kurai* and *Khalli* in Bihar. During 1960-61 around 618 thousand hectares land was under shifting cultivation in India which increased to 1326 thousand hectare in 1974-75. Meghalaya plateau covers an area of 22540 sq. kms. comprised of different hilly terrains with narrow valleys in between and strips of plain lands adjacent to Bangladesh in the South and West. In the North,

it borders with the great Brahmaputra valley of Assam and, in the East, the detached Mikir Hills.

Physiographically, the Meghalaya plateau is remarkable due to its hilly dissected irregular terrain in the Western faces in contrast to the regular and steep fall of the Southern face. Climate is very fluctuating due to seasonal winds. Soil is prominent by red soil, sandy gravel and shale because of heavy rainfall and other geological underlyings.

The economy of the plateau is almost entirely dependent on agriculture, although 85 per cent of the state land surface has been classified as barren and unsuitable for agriculture. Maximum area (760 sq. kms) is under jhum cultivation in Meghalaya and around 20 per cent of its total population is involved in practising jhum cultivation. Jhum is mostly confined to rural area, however, only 0.1 per cent is practised in urban areas also.

Land Use

Only 37 per cent of the total geographical area is under forest. Around 7 to 8 per cent of total geographical area is under the category of net sown area, of which only 1.3 to 1.4 per cent has been recorded as sown more than once. 14 per cent is under non-agricultural uses (Table-6.1). There are in all 5100 villages in Meghalaya, out of which 418 are in Jaintia Hills District, 1227 in East Khasi Hills, 743 in West Khasi Hills, 677 in East Garo Hills and 1383 in West Garo Hills. 61 per cent of the total villages in East garo Hills and 68 per cent in West Garo Hills are involved in jhum cultivation.

A total of 28352 households in Jaintia Hills, 100313 in East Khasi Hills, 29167 in West Khasi Hills, 26406 in East Garo Hills and 71697 in West Garo Hills are practising jhum cultivation (Table- 6.2). Maximum jhum cultivation occurs in West and East Garo Hills.

Jhum Land and Its Ownership

The land ownership is an important factor determining the land use pattern under shifting cultivation. There are two category of jhum land i.e. owned, and rented. Maximum shifting cultivation lands are generally owned by the village communities. The individual family is assigned a piece of land for cultivation during the season. Thus, he has only right to use it. Maximum 76 to 96 per cent jhumias in different districts of Meghalaya are engaged in owned jhum land and a very little 1.5 to 4.2 in rented and 1.5 to 19.2 per cent in both owned and rented jhum land (Table-6.3). Same way maximum 79.8 to 92.9 per cent population are involved in jhumming on owned land.

Population Involved in Jhum Cultivation by Category of Jhum Land

Average size of jhum land per house hold ranges from 0.4 to 1.3 hectare and the area per jhum plot is 0.3 to 1.1 hectare. However, the land size under permanent cultivation is grater compared to that of jhum land. Of the total population, 9.5 per cent in Jaintia Hills, 6.9 per cent in East Khasi hills, 11.9 per cent in West Khasi Hills, 34.1 per cent in East Garo Hills and 38.3 per cent in West Garo Hills are engaged in jhum cultivation (Table - 6.4). In Laskein and Khliehriat C.D. Blocks in Jaintia Hills, Bhoi area and Nongpoh Blocks in East Khasi Hills, Songsak, Samanda and Dambo Rongjeng in East Garo Hills, and Rongrara, Dambuk, Chokpot, Dalu and Rongram in West Garo Hills, maximum people are involved in jhum cultivation. Maximum jhumming in these areas is practised in owned land, however, in Mawsynram Block of East Khasi Hills, jhumming occurs only in rented or owned land.

Table - 6.1: Landuse Pattern in Meghalaya.

Categories	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79
Geographical Area (in 0000ha)	224.89	224.89	224.89	224.89	224.89	224.89
1. Forest	36.59	36.59	36.60	36.59	36.17	36.13
2. Not Available for Cultivation	13.75	13.75	13.75	13.75	13.92	13.99
3. Other Cultivated Land Excluding Fallow Land	27.29	27.29	27.28	27.28	27.66	27.55
4. Fallow Land	14.66	14.65	14.64	14.64	14.33	13.87
5. Net Area Sown	7.72	7.72	7.73	7.65	7.93	8.57
6. Area Sown More than Once (%)	1.29	1.29	1.29	1.31	1.36	1.36
7. Total Cropped area(%)	9.00	9.02	9.03	9.05	9.29	9.93

Source : Statistics of Jhum Cultivation in Meghalaya, The Directorate of Economics & Statistics and Evaluation, Meghalaya, 1988.

Table - 6.2 : Number of Households Involved in Jhum Cultivation.

Sl. No.	District C.D. Block	Total No. of House Holds	% of Total H.H. involved in Jhum	Percent Owned	Jhumia Rented	Household Owned & Rented
(a)	Jaintia Hills	28352	11.47	89.45	4.15	6.40
1.	Thadlaskein	8407	4.80	73.20	3.47	23.33
2.	Laskain	8349	13.57	89.05	6.71	4.24
3.	Khliehriat	7768	16.55	99.77	-	0.23
4.	Amlarem	3828	11.21	74.83	10.49	14.68
(b)	E. Khasi Hills	100313	7.01	76.84	4.01	19.15
1.	Nongpoh	7973	47.77	70.36	0.64	29.00
2.	Bhoi-Area	11912	26.05	90.11	2.13	7.76
3.	Mawryng kneng	4988	2.63	100.00	-	-
4.	Mylliem	44537	1.98	71.77	7.82	20.41
5.	Mawphlang	5358	3.06	82.92	8.54	8.54
6.	Pynursla	7262	8.59	65.54	10.42	24.04
7.	Shella	7688	6.50	34.80	2.60	62.60
8.	Mawsynram	6819	0.23	-	43.75	56.25
9.	Mawkynrew	3776	5.08	65.11	20.31	14.58
(c)	W.Khasi Hills	29167	12.44	77.13	1.49	21.38
1.	Mairang	7923	2.21	30.28	0.05	2.73
2.	Mawkyrwat	8634	5.72	93.32	6.07	0.61
3.	Nongstoin	7598	14.96	69.66	1.05	29.29
4.	Mawshynrut	5012	34.42	86.55	0.46	12.99
(d)	E. Garo Hills	26406	33.84	96.25	2.27	1.48
1.	Dambo	8253	22.99	89.46	4.95	5.59
	Ronggeng					
2.	Songsak	5160	67.67	99.66	0.08	0.26
3.	Resu Belpara (east)	8968	17.18	92.21	6.88	0.91
4.	Samanda	4025	49.81	99.85	-	0.15
(e)	W.Garo Hills	71697	40.28	93.00	3.84	3.16
1.	Resu Belpara (west)	3496	28.63	99.00	0.40	0.06
2.	Dadengiri	9765	40.19	97.40	0.13	2.47
3.	Selsella	10776	24.32	96.98	1.22	1.80
4.	Rongram	12522	47.71	97.99	0.45	0.66
5.	Betasing	8229	29.63	83.47	6.23	10.30
6.	Zikzak	7961	37.47	95.54	0.54	3.92
7.	Dalu	7042	50.87	97.57	0.35	0.88
8.	Chokpot	5760	46.94	80.51	18.05	1.44
9.	Dambuk Aga	3857	59.06	75.29	15.36	9.35
10.	Rongara	2309	61.84	96.50	0.63	2.67
	Meghalaya.	255935	20.21	90.03	3.44	6.53

Source : As in Table - 6.1.

Table- 6.3: Classification of Jhum Land in 1981.

State/District	Type of Jhum Land	Jhumia No.	%	Persons engaged	Per cent to total
Meghalaya	Owned	46565	93.7	231557	90.12
	Rented	1787	3.6	8370	3.26
	Owned & Rented	3374	6.8	17020	6.62
Jaintia Hills	Owned	2908	89.5	13544	90.89
	Rented	135	4.2	634	4.25
	Owned & Rented	208	6.4	724	4.86
East Khasi hills	Owned	5401	76.8	28356	79.79
	Rented	282	4.0	1313	3.69
	Owned & Rented	1346	19.2	5871	16.52
West Khasi Hills	Owned	2799	77.1	15287	79.59
	Rented	54	1.5	363	1.89
	Owned & Rented	776	21.4	3557	18.52
East Garo Hills	Owned	8600	93.0	42699	91.80
	Rented	203	2.3	1110	2.39
	Owned & Rented	132	1.5	2703	5.81
West Garo Hills	Owned	26857	93.0	131671	92.86
	Rented	1108	3.8	5950	4.20
	Owned & Rented	912	3.2	4165	2.94

Source : As in Table- 6.1.

Table -6.4 : Population Involved in Jhum Cultivation by Category of Jhum Land.

District/ C.D. Block	Population	People engaged in jhum cultivation (% to total population)	Percentage of population engaged in jhum cultivation		
			Owned	Rented	Owned & Rented
Jaintia Hills	156402	9.53	90.89	4.25	4.86
1. Thadlaskein	44709	2.79	74.06	3.28	22.66
2. Laskein	46853	12.57	87.79	7.66	4.55
3. Khliehriat	43075	15.06	99.92	-	0.08
4. Amlarem	21765	5.86	75.70	11.13	13.17
East Khasi Hills	511414	6.94	79.79	3.69	16.52
1. Nongpoh	39555	18.19	-	-	-
2. Bhoi-Area	60378	25.88	92.37	1.61	6.02
3. Mawryngkneng	27132	2.30	100.00	-	-
4. Myllem	229792	2.45	78.63	5.37	16.00
5. Mawphlang	29455	3.29	83.87	8.99	7.64
6. Pynursla	34001	7.96	63.33	12.59	24.08
7. Shella Bholaganj	36549	4.49	36.50	3.60	59.90
8. Mawsynram	34137	0.28	-	38.30	61.70
9. Mawkynew	20415	5.11	68.93	17.55	13.52
West Khasi Hills	161576	11.89	79.59	1.89	18.52
1. Mairang	45023	2.75	21.05	1.77	77.18
2. Mawkyrwat	46206	5.93	91.50	7.77	0.73
3. Nongstoin	42185	14.83	74.61	1.41	23.98
4. Mawshynrut	28162	31.85	87.52	0.04	12.04
East Garo Hills	136550	34.06	91.80	2.39	5.81
1. Dambo Ronggeng	44329	27.42	74.03	4.63	21.34
2. Songsak	24387	67.65	99.69	0.12	0.21
3. Resu Belpara	48215	15.65	92.22	7.01	0.77
4. Samanda	19619	52.58	99.81	-	0.16
West Garo Hills	369877	38.33	92.56	4.20	2.93
1. Resu Belpara (w)	18496	26.59	98.86	0.41	0.73
2. Dadenggiri	49351	36.14	97.43	0.12	2.45
3. Selsella	56430	21.13	97.94	1.22	1.67
4. Rongram	65937	44.54	97.86	0.59	0.55
5. Betasing	41811	28.84	84.60	5.87	9.53
6. Zikzak	40935	36.20	96.02	0.62	3.36
7. Dalu	35103	48.98	97.56	0.84	1.60
8. Chokpot	29597	45.85	79.91	18.58	1.51
9. Dambuk Aga	20682	62.13	75.99	16.06	7.95
10. Rongara	12075	63.18	96.74	0.81	2.45
Meghalaya	255935	20.21	90.03	3.44	6.53

Source : As in Table- 6.1.

People Involved in Jhum in Rural and Urban Areas

The maximum share of jhum land (99.9 per cent) is located in the rural areas in which 10.4 to 42.8 per cent of the total population is engaged. The jhum land is negligible in the urban areas because non-agricultural activities dominate in these areas (Table-6.5).

Table-6.5: Households Involved in Jhum Cultivation in 1981.

State/District	Total Rural Urban	No. of House holds practicing jhum cultivation	No. o. Persons engaged in jhum cultivation	Percentage engaged in jhum cultivation HH persons
Meghalaya	Total	51720	256947	19.24
	Rural	51666 (99.9%)	256654	23.45
	Urban	54 (0.1%)	293	0.12
Jaintia Hills	Total	7029	35540	6.95
	Rural	7029 (100.00%)	35540	10.75
	Urban	-	-	-
East Khasi Hills	Total	3251	14902	9.53
	Rural	3251 (100.00%)	14902	10.39
	Urban	-	-	-
West Khasi Hills	Total	3629	19207	11.89
	Rural	3629 (100.00%)	19207	12.18
	Urban	-	-	-
East Garo Hills	Total	28877	141786	38.33
	Rural	28823 (99.8%)	141493	42.82
	Urban	54 (0.21)	293	0.74
West Garo Hills	Total	8935	46512	34.06
	Rural	8935 (100.00%)	46512	35.17
	Urban	-	-	-

Source : As in Table - 6.1

Area Under Crops

Rice, oil seeds and cash crops are the main crops under jhum cultivation in Meghalaya. Maximum areas, 38 to 71 per cent in the different districts is utilized for cultivation of rice, only 8 to 16 per cent for other food grains, 0.3 to 8.0 per cent area under in oil seeds and 14 to 40 per cent for cash crops. Rice, Maize and Millets are the major crops in Jaintia and East Khasi Hills and West Khasi Hills. In addition, wheat and small millets are also grown in East and West Garo Hills. Among cash crops, Potato is grown maximally 25 to 73 per cent in Jaintia, East Khasi and West Khasi Hills, however, only 1.1 to 2.00 per cent in East and West Garo Hills. Tapioca, Jute, Mesta, Cotton and Banana are the major cash crops in East and West Garo Hills. Sesamum Rape and Mustard are the major oil seeds in different districts of Meghalaya. Generally, mixed cropping and crop rotation are practised.

Mixed Cropping : In the Kharif season, the practice of raising a variety of crops as a mixture is common in jhum land. The combination of mixed cropping are :

Paddy-Pumpkin-Maize-Cotton-Yam-Cucumber-Watermelon and other vegetables in *kharif season*. In the *Rabi* season, Beans, Cabbage and Mustard are grown in the same plot of land.

Crop Rotation : Crop rotation is the important aspect of cropping pattern. The system of crop rotation is still traditional. In late March or early April, the jhumias cultivate mostly vegetables and Maize, such as Pumpkin,

Cucumber, Brinjal and Chilies for the cultivation of cash crops like Sesamum, Tobacco and Ginger, the farmers select a fertile plot of land, these plots are not mixed with other vegetables and crops.

Average Crop Production

Maximum 1137.17 kg. per household paddy, 1009.3 kg per household ginger and 1546.3 kg household fruits is

produced in jhum cultivation. Production in permanent cultivation is much higher than in jhum cultivation (Table-6.6). Crop production is too lower compared to settled agriculture in other part of country.

Table-6.6 : Average Quantity of Crops Produces under Jhum and Permanent Cultivation

(Figs. in kg. per household)

Crop	Jhum Cultivation	Permanent Cultivation
Paddy	1137.17	2320.85
Maize	171.71	339.55
Other Cereals	236.10	284.32
Mustard	83.33	341.32
Other Oil Seeds	75.77	-
Potatoes	887.83	1588.41
Other Vegetables	182.96	135.00
Other Fruits	1546.25	-
Ginger	1009.70	1314.29
Chilli	170.26	1170.59
Turmeric	228.72	-
Mesta	400.93	-
Jute	75.00	268.67
Cotton	157.59	-
Tapioca	544.42	-
Sweet Potato	518.75	373.75
Arum & Other Roots	474.44	-
Any Other Crops	45.71	1237.50
Other Pulses	-	202.86
Tobacco	-	41.57
Total	2089.94	2685.68

N.B. : Since an average 1.00 ha land is under possession of each household, the production will be 1137.17 Kg./ha.

Source : As in Table-6.1.

Causes of Low Production

The energy inputs in jhum comprises two parts: (1) energy inputs by man (2) natural energy inputs through biological process and by harvesting solar energy. The energy inputs by man may comprise two part, viz., labour input and energy input by use of chemical fertilizer or machines which largely depends on fossil energy. In case of jhum, labour input is largely for felling of trees, burning the debris, dressing the fields, sowing, protection and harvesting in which protection forms a major component. Jhum cultivators either do not use improved seeds and chemical fertilizer or very little compared to that of the cultivators in permanent lands (Table - 6.7). Table-6.8 summarises the use of seeds, green manure and fertilizer in jhum and permanent cultivation. Improved seeds green manure, cow dung and chemical fertilizers are used more in permanent cultivation.

Minimal use of improved seeds and fertilizers are either due to lack of knowledge, non-availability of technological inputs, people being hesitant about their benefit (Table - 6.7).

How to Improve Economies of Jhumias

The most preferred solution to the problem of shifting cultivation is to change the economic base of the community by providing them some agricultural land. Under this scheme plain land can be easily brought under cultivation, perhaps with some investments. In some places, it is possible to locate extensive plain areas. In case of slope land, terraced fields need to be prepared. On sites of new settlements away from their existing habitations, it is necessary to establish new colonies.

A typical colonisation scheme comprises allotment of agricultural land, provision of financial assistance for the development of lands, purchase of bullocks and implements, supply of seeds for one or two seasons, subsistence allowance for a period of six to twelve months, and sometimes

Table-6.7 : Households Not Using Improved Seed and Fertilizer and Its Causes.

Persons	Per cent Household			
	Improved Seeds		Chemical Fertilizer	
	Jhum	Permanent	Jhum	Permanent
% Households not using improved seeds & fertilizer	100.00	95.33	94.83	82.87
(A) Causes				
1. No Knowledge	13.93	13.61	15.40	8.98
2. Not Interested	26.97	25.59	33.41	32.99
3. Not Certain About	13.72	13.43	13.74	13.15
(B) Benefit				
4. Short Supply	0.67	2.36	-	2.30
5. Not Available	36.40	32.67	27.25	32.15
6. Lack of Funds	5.84	11.07	6.16	8.55
7. Others	2.47	1.27	4.03	1.88
Total	100.00	100.00	100.00	100.00

Source : As in Table- 6.1.

Table-6.8 : Percent Households Using Improved Seeds, Green Manure, Cowdung and Chemical Fertilizers in Jhum and Permanent Cultivation.

Extent of Use	Jhum Cultivation				Permanent Cultivation			
	Impr. Seed	Green Manure	Cow Dung	Chemical Ferti.	Impr. Seed	Green Manur	Cow Dung	Chem. Fert
Entire Area	-	2.25	5.62	5.17	0.69	6.57	15.74	3.46
Half or More	-	0.90	-	-	1.04	9.00	3.64	7.27
Less than Half	-	-	-	2.94	0.87	9.69	6.40	-
Not Used	100.00	96.85	94.38	94.83	95.33	83.56	70.93	82.87
Total	100	100	100	100	100	100	100	100

Source : As in Table-6.1.

Table-6.9 : Household Types Practising Jhum, Permanent and Both Jhum and Permanent Cultivation
(fig. in percent)

Household Group	Jhum	Permanent	Jhum & Permanent
1. Scheduled Caste	-	85.71	-
2. Khasi & Jaintia	8.88	53.05	31.47
3. Garo	44.24	21.41	15.53
4. Hajong	-	84.62	-
5. Rabha	-	100.00	-
6. Mikir	-	33.33	53.33
7. Kachari	-	100.00	-
8. Biate	80.00	-	20.00
9. Vaipheh	100.00	-	-
10. All Sch. tribes	27.58	37.00	22.93
11. Others	-	61.11	-
Total	25.31	39.17	21.04

N.B.- The remaining are non-cultivating households.

Source : As in Table-6.1.

establishment of a colony with residential houses, schools, drinking water and other social amenities. Agricultural development programmes inevitably tend to concentrate their efforts on the factors that seem most crucial to crop production such as popularization of high yielding varieties of key grain crops, the proliferation of irrigation systems and the introduction of fertilizer and other inputs. Jhum cultivators in Meghalaya are not using improved seed either due to lack of knowledge, non-availability of improved variety seeds or they are not sure about the benefits. Even in settled agriculture, only 5 per cent cultivators are using chemical fertilizers. Because of the size of land holdings and the constraints of yield, shifting cultivation tends to inhibit the productivity of the land and can not absorb other resources which contribute to productivity. Researches are, therefore, needed to determine the carrying capacity of land to give a crude estimate of the number of people that a given type of land can support with a given technology. Stress should be laid on proper resource management including horticulture and animal husbandry in conjunction with shifting cultivation.

In addition to introduction of high yielding food crops, trees satisfying some of the farmers structural, animal feed, fuelwood and other requirements need to be planted.

Change in Ownership Pattern

Community ownership of resources with some local variations of detail has been generally the basis of jhum economy. The contact with other systems where private ownership is prevalent has induced some changes among the shifting cultivators as well. In many areas, as a result of growing pressure of population, shifting cultivators are adopting to settled cultivation to varying extent. In Meghalaya, the cultivators are moving towards permanent cultivation, however, Vaipheh, Biata are still sticking with jhum cultivation. Schedule Castes, namely, Hajong, Rabha and Kachari have maximally adopted permanent cultivation. However, Khasi,

Jaintia, Garo, Mikir, Biate and all schedule tribes are doing both jhum as well as permanent cultivation (Table- 6.9). In most cases, the individual has only limited ownership right over his fields; he can not transfer the land. Even a developed permanent field reverts to the community if the individual discontinues cultivation or leaves the village.

Programmes for Improving Shifting Cultivation

In most areas of the North-Eastern India, a greater span of time for fallow are required before crops can be successfully cultivated again. Moreover, the fallow period of jhum varies according to soil types and ecological zones. There are areas where fallow periods have been reduced to less than two years under such conditions, farmers face problems of soil degradation, loss of fertility, reduced yields, rampant weed growth and infestation by pests. As a result, there is an urgent need to improve or develop new efficient systems for sustained yields which are scientifically sound, economically viable, and culturally acceptable.

Such a system should have following basic ingredients :

1. Systems should improve on the capacity of shifting cultivation to accommodate population growth.
2. Systems should be suitable for farmers especially marginal and small scale farmers.
3. Systems should be environmentally sound, and at the same time supply farmers with their requirements of food and cash.

Researches

Researches and problem specific studies should be conducted in order to collect information and to understand the functioning of the system. This is also required for mid-term correction and will help for further improvement of the working and acceptability of the system. The following

aspects must be emphasized in detail :

1. The farmers environment, including agroclimatology, soil, vegetation, and pests.
2. Existing farming and productive systems.
3. Commodities produced, including trees, crops and livestock.
4. Resources and its management practices.
5. Input/output ratio for energy and materials.
6. Roads, transportation facilities, marketing and pricing systems.
7. Identification of social and physical Constraints.

Training and Extension

The collaborative programmes need to familiarize farmers with the results of its researchs and to help them develop the new skills they require. Some of them can be accomplished by the involvement of farmers in the experimental projects described above. Research extension usually involves interaction between farmers and extension workers, which provides the feedback to researchers. The process is strengthened when extension workers share the same experiences as the farmers.

Publications

Publications can also give farmers, extension workers, and policy makers greater familiarity with alternatives to and improvements in shifting cultivation. The news media can also be used in campaignings which make people aware of common practices that cause soil erosion and environmental deterioration.

FAO Role in Improving Shifting Cultivation

FAO (Food and Agriculture Organisation of United

Nations) has played a unique role in the past, and is in a position to make particularly important contribution. FAO is currently providing assistance for improving shifting cultivation in following ways :

1. It has contact with many regional and inter-national institutions involved in agricultural research and development.
 2. It promotes exchanges of experiences and practices among countries through technical co-operation among developing countries (TCDC).
 3. It informs policy makers, through the FAO statutory bodies and other fora to introduce the action needed for improvements and alternatives to shifting cultivation.
 4. It develops projects at the national level to demonstrate improvements in shifting cultivation.
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