HILL AGRICULTURE : ISSUES REGARDING IRRIGATION DEVELOPMENT IN NORTH EASTERN HILL REGION

K.K.Satapathy
ICAR Research Complex
Shillong.

INTRODUCTION

The North eastern Region - comprising of Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and Tripura - occupies a total geographical area of 255803 sq.km. with hills covering a substantial part of it. The plains - not exceeding 80,000 sq. km. - are mostly located in the Brahmaputra and Barak valleys of Assam and the Manipur valley. An average of 13.40 per cent of the cultivable area has been utilised so far; while as much as 90 per cent of the cultivable area in Assam and Tripura are utilised, the proportion is very poor in Arunachal Pradesh, Mizoram and Meghalaya which have a forest area of 90 per cent; 62 per cent and 61 per cent, respectively (Anonymous 1988).Permanent cultivation in the plains and shifting cultivation (practised by 4,43,336 families in an area of 386500 ha annually) in hills are the two predominant patterns of prevailing land use in the region.

Irrigation is one of the weakest links in the region, and consequently the extension of new varieties and adoption of new crops is slow. The use of chemical fertilizer for higher productivity is far from satisfactory with Manipur consuming the highest 15.4 kg per hectare and Arunachal only 0.8 kg per hectare during 1981-82 ; Mizoram was yet to use chemical fertilizers, according to a survey (Anonymous 1988). Lack of tradition of irrigated agriculture, heavy rainfall during monsoon along with various agrophysical, factors have contributed to the growth of a largely monocropped subsistence farming system. A switch over to multicropped system - with the adoption of HYV seeds, fertilizers, insecticides and the like - would primarily depend on irrigation and a new approach to development of land and water resources.

UTILISATION OF IRRIGATION POTENTIAL

Brahmaputra river is the principal drainage of the region; not more than 10 per cent of the annual flow of 51.83 million hectare metre is technologically and economically harnessable. Scarcity of storage sites of considerable capacity in the upper reaches, unfavourable dam foundation and seismicity restrict the large scale exploitation of Brahmaputra water. The irrigation potential from major, medium and minor (both surface and ground) irrigation projects in the region as a whole, at the end of the 6th plan, is assessed as 1235 thousand hectare and 2646 thousand hectare respectively. At present 284 thousand hectare under Medium/Major projects and 178.89 thousand hectare under minor projects (Table 1 & 2) are irrigated. To achieve the entire potential by the turn of the century as envisaged, an average of 63.4 thousand hectare under medium/major and 164.5 thousand hectare under minor projects needs to be brought under irrigation annually. Due to hilly nature of the terrain, development of major and medium projects in the most parts of the region are more or less absent. Small size minor irrigation projects are of immediate necessity to do away with the practice of Jhuming in the hills.

The traditional method of irrigation in hiils consists of harnessing the hill streams during monsoon by constructing temporary checkdams on streambcd for diversion and conveyance of water through earthen channels to the cultivated fields. Boulder, timber and earthen dams are built across the stream to raisc the level of water for diversion. There is a tradition of such irrigation works being done by village community as a whole in carrying water from streams over long distances. Most of the irrigated area is under wet paddy cultivation during rainy season. The major scope for augmenting irrigation facilities in the terrain can be envisaged as follows :

(i) Increased utilization of stream - flow through diversion works at feasible locations.

(ii) Exploration of underground water resources and its utilization through wells.

(iii) Harvesting and storage of excess runoff during high rainfall months by constructing a dam or embankment across the water course and its reuse in the lean season.

(iv) Stream flow lift irrigation.

(v) Adoption of scientific on-farm water use and management technology.

STATUS OF GROUND WATER

Systematic geohydrological studies, aimed at the reservoir and aquifer characteristics and assessment of ground water potential, started only recently in the region. In the foothills and valley areas of the region unconsolidated geological formations containing sand, silt and gravel form potential high yielding aquifers which can be conveniently tapped through wells these aquifers get natural recharge from high rainfall and nearby high lands, percolations from hill streams and meandering rivers. The total ground water recharge to the entire Brahmaputra valley is estimated to be 9,418 million cubic metre and water table normally occurs at shallow depth (less than 5 m) in unconfined condition, according to the ground water Board survey. The latest estimate of ground irrigation potential of the region is 840 thousand hectare (Table 3) and its current utilization is insignificant. Most of the states lack drilling rigs and skilled manpower to exploit the underground water source for irrigation.

The major problem of ground water development is in the hard rock areas, which occupies a large part of the region. The hard rock formations are heterogeneous in nature storing considerable amount of water in cracks, fractures and fissures, the study of these hydrological parameters is very complicated. This warrants detailed microlevel geohydrological studies in the hard rock areas of the region. Particular mention need to be made of the role which small storages - ideally one in every minicatchment - can play in increasing ground water recharges in hard rock areas.

SCOPE OF WATER HARVESTING STRUCTURES

Rolling topography of hills and gorges in the tract facilitates the construction of water harvesting structures - mai-'y comprising of earthen embankments and spillways - with high storage and earth work ratio. These structures are normally located on the stream courses in the lower reaches of hill catchments blocking the path of surface and subsurface flow resulting accumulation of water in the pond for its subsequent utilization or disposal through appropriate spillway conveyance systems.

The most important considerations for the suitability of sites are adequate storage capacity with least amount of earthfill, availability of suitable fill soil near the site, adequate scope for disposal of surplus water, relatively impermeable strata under the dams. In a case study at the ICAR farm, Barapani (Meghalaya), a similar storage structure having a catchment area of 11.1 hectare - with a well planned watershed based land use system - received 1.2 hectare metre water in the year 1984 with 2195 mm rainfall; contribution of storage from direct rain, runoff (surface flow) and baseflow (sub-surface flow) was 22.4, 2.3 and 75.3 per cent respectively (Singh, 1985). Construction of these structures involves chiefly, manual labour input and use of locally available materials - earth, stones, grasses and the like. However, the soil in the entire region, barring a few places,has extremely low water holding capacity and seepage loses are very high. Such ponds, therefore, sometimes require lining against seepage losses, or otherwise, storage becomes seasonal. Essentially community owned as these enterprises are, suitable organisational setup needs to be developed for the effective execution and management of the water harvesting projects with the active participation of beneficiary farmers.

PERSPECTIVE OF STREAM FLOW LIFT IRRIGATION

Water lift system is essential in the vast tracts which can not otherwise be served by diversion works. The lift irrigation potential in the region, however, remains largely unexplored, though it is a distinct possibility in Brahmaputra valley. Recently, ICAR initiated an operational research project on lift irrigation and water management to demonstrate and evaluate pumping systems for lifting water from rivers, tanks and improved systems of water management in the foothills of Nagaland. The results (Satapathy, 1987) indicated that large areas of plane and gently sloping lands of the region can be brought under irrigation by installing high discharge lowhead pumpsets at the appropriate locations after ascertaining the flow characteristics of the stream at the selected site.

Large scale adoption of conservation farming practices supported by bench terraces and allied structures in the hills has also brought into being favourable conditions for lifting irrigation water in the terraces located at comapratively higher elevations. However, the planning and designing of lift irrigation systems matching the topography in the hilly terrain would be greatly different from that in the planes and would involve high head pumping and other appropriate structures. Also, conveyance and distribution of water in high hills would entail intricate network of underground pipe line system for conducting water through undulating topography, comprising of steep terrains and gorges as well as fragmented and isolated locations. Further, terracing of the banks along the small rivers and irrigation by lift pumps energised by a microhydel scheme in the nearby river reach itself could form an innovative development. The NEC has funded pilot projects for such microhydel-cum-irrigation projects in the state of Mizoram.

ECONOMIC ISSUES

The quantum of fixed cost per unit of water can be minimised by operating the irrigation system for maximum possible hours per year. Scientific crop planning, utilizing maximum irrigation potential is, thus, the prime neccessity for achieving the best possible economic efficiency. Anticipatory research on optimum crop and water use pattern suited to local soil and climatic factors needs to be initiated even much before an irrigation project is due for completion.

The current practice is to choose irrigation projects which have a benefit cost ratio of 1.5 or more. Yet similar projects are sanctioned quite liberally with much lower benefit cost ratio in drought affected and tribal areas like North Eastern Region where there are often pressing social and human reasons to correct regional imbalances. However, such projects would involve proper planning and design of suitable irrigation systems in hilly terrain, analysis of both cost and annual benefit derived following the introduction of the irrigation project, to ascertain whether beneficiary farmers would have sufficient incentive to take to irrigated farming.

REFERENCES

1 Anonymous. 1985 Basic statistics of North Eastern Region, 1985. North Eastern Council Secretariate (Shillong).

2. Anonymous. 1988 Varying patterns in NE land utilisation. The Times of India (12-1-88), New Delhi.

3. Dasgupta, K.R. 1983 Need for Agricultural Resource planning in the North Eastern Region with a view to Boosting Agricultural production, Social research Vol. 3 Nos 3-4 pp. 13-22.

4. Datta, R. 1987 Prespective planning for conservation, utilisation and development of water resources in the North Eastern Region. Souvenier to commemorate water resources day on 10th April, 1987. pp. 42-47, Organising committee for celebration of water resource day, Shillong.

5. Michael, A.M.; Sarma, P.B.S; Ashok Raj, P.C.;Choudhury, R.K. 1978 Resources Inventory of Garo hills (Meghalaya) pp. 176-187. Indian Council of Agricultural Research, New Delhi.

6. Prasad, K.K. 1979 Report on the analysis of hydrogeological and hydrochemical data of network of observation wells in the North Eastern Region (August 1969 - Dec. 1978). Central ground water Board, Govt. of India, New Delhi.

7. Prasad, R.N. 1987 Feasibility of individual contribution for development of water resources in hills. Souvenir to commemorate water resource day on 10th April, 1987 pp. 24-25 organising committee for celebration of water resource day, shillong.

8. Rangachar, N.S.1987 Water resources development in the North Eastern Region. Souvenir to commemorate water resources day on 10th April, 1987 pp. 32-34. Organising committee for celebration of water resources in the North Eastern Region, Shillong.

9. Sharma. N. 1982 A broad appraisal of the exploitable water resources and the projected water needs of the Brahmaputra basin. India's North East : A multiface view ; pp. 169-177 Prakash Publishing house, Tinisukia (Assam).

10. Satapathy, K.K. 1987 Economic evaluation of an operational research project on lift irrigation and water management in the foothills of Nagaland. Agricultural Engineering Today. Vol. II No. 6 pp. 27-30.

11. Singh, A. 1985 Planning for water harvesting in watershed management project. Proceeding of training courses on water harvesting structures and propagation of its technology in the NEH Region, ICAR Research complex for NEH Region.\,(Shillong).

12. Swaminathan, M.S. 1982 Irrigation and our Agricultural future. Science and integrated rural development pp. 64-99. Concept Publishing Company, New Delhi.

Table 1 Cultivated and irrigated area (1981-82)

Sl. No.	Particulars	Arunachal Pradesh	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Tripura	Total
1.	Net cultivated area 1981-82 ('000 ha)	112	2696	140	193	65	153	246	3605
2.	Net irrigated by different sources, (1981-82 ('000 ha)								
	(i) Canal	-	362	-	-	-	-	-	362
	(ii) Tanks	-	-	-	-	-	-	-	-
	(iii) Wells	-	-	-	-	-	-	-	-
	(iv) Other sources	24	210	65	50	8	62	29	448
	(v) Total	24	572	65	50	8	62	29	810
3.	Percentage of net irrigated area to net cultivated area 81-82	21.4	21.2	46.4	25.9	12.3	20.5	11.8	22.5
4.	Irrigated area under selected crops 1981-82 ('000 ha)	24	532	75	51	8	62	18	770
	(i) Rice	24	532	75	51	8	62	18	770
	(ii) Wheat	-	-	-	-	-	3	2	5
	(iii) Pulses	-	6	-	-	-	-	-	6
	(iv) Other food crops	-	1	-	-	-	3	9	13
	(v) Non food crops	-	33	-	-	-	-	-	33

Source : Basic statistics of North East Region (1985)

Table 2 Surface water potential in the NEH Region
(At the end of the sixth plan)

State	Surface water potential (Mmm³)	Irrigation potential ('000 ha)		Irrigation Utilization ('000 ha)	
		Major/medium projects	Minor irrigation projects	Major/medium projects	Minor irrigation projects
Assam	5,58,776	970	1000	142	7.00
Arunachal pradesh	3,66,000	N.E.	166	NIL	35.00
Mizoram	31,291	N.E.	75	NIL	8.18
Manipur	19,794	135	100	41	29.30
Meghalaya	67,216	20	85	NIL	29.80
Nagaland	14,090	10	80	NIL	61.80
Tripura	7,616	100	100	1	37.11

N.E. : Not Estimated
Source: Basic statistics of North East Region (1985)

Table 3 Ground water potential in North Eastern Region

State	Ground water potential (Mmm³)	Surplus exploitable resources (Mmm³)	Additional Tubewell feasible	Minor irrigation potential (.000 ha*)
Arunachal pradesh	1,125	1,125	3,750	100
Assam	13,959	13,069	62,900	700
Manipur	44	44	220	5
Meghalaya	357	347	1,770	15
Mizoram	N.A.	N.A.	N.A.	.5
Nagaland	48	48	240	N.E.
Tripura	574	574	1,870	15

N.A. Not available, N.E. Not estimated * Relates to the end of the sixth plan

Source:- (i) Basic statistics of North Eastern Region
(ii) Dasgupta (3)