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Strategies for Integrated Rural Development

SOME ALTERNATIVE STRATEGIES FOR OPTIMAL USE OF LAND AND OTHER RESOURCES IN THE HILL REGION OF UTTAR PRADESH*

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The hill region of Uttar Pradesh is one of the five agro-climatic regions in which the State of Uttar Pradesh has been divided. The region comprises eight districts and extends over an area of about 51,100 sq. km. which is 17.4 per cent of the total area of the State. According to the 1971 Census, the population of the region was 38.22 lakhs which was only 4.3 per cent of the State's total population. Agriculture which is the main occupation of the majority of people living in the region still continues to be, by and large, primitive and backward. It is characterized by predominance of marginal and small farms and low resource productivity. According to the Agricultural Census 1970, about 68 per cent of the total number of 5.97 lakh operational holdings in the region were less than one hectare in size and about 94 per cent less than three hectares. The average size of holdings was 1.07 hectare which is slightly smaller than the State average. Modernization of agriculture is difficult on account of adverse topographical features, poor soils, lack of irrigation facilities, small and scattered land holdings, lack of institutional credit and marketing facilities, inadequate transport and communication facilities, etc. It is largely because of these adverse physical and socio-economic factors that all the eight districts in the region have been declared economically backward.

Part of the reason for the backwardness of the region is the lack of a comprehensive strategy for integrated development and utilization of its natural and human resources. What exists in the region at present in the name of development programmes is an unco-ordinated assortment of selected activities falling under the jurisdiction of separate government departments and agencies. This paper is intended as a modest attempt to outline a strategy for integrated use of land and other resources in the region drawing upon the work done under the Rural Area Planning Research and Action Project (RAPRAP).

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EXISTING AND OPTIMUM RESOURCE USE PATTERN

Existing Resource Use Pattern

Since land is the most important natural resource contributing to agricultural production in the region, and since land use pattern largely determines the pattern of use of other resources, we shall take land use pattern as a proxy for resource use pattern. To begin with, we shall examine the existing land use pattern and crop pattern in the region and then we shall identify and evaluate a few alternative optimum resource use plans with special reference to Naurar watershed where RAPRAP was launched.

A soil and land use survey of the Naurar watershed was conducted by the Institute of Photo-Interpretation (I.P.I.), Dehradun for RAPRAP. On the basis of this survey, the present land use pattern in the watershed was determined. It is given in Table I. The table shows that out of a total of 6,030 hectares of land in the watershed, 916 hectares (or 15.19 per cent) were under forests, 1,609 hectares (or 26.69 per cent) under waste land and the rest 3,505 hectares (or 58.12 per cent) under cultivation of crops.

TABLE I--PRESENT LAND USE PATTERN IN NAURAR WATERSHED*

Land use	Area (ha.)		Per cent of total area	
1. Forest: Chirpine and oak	254	916	4.22	15.19
2. Forest: Chirpine	662		10.97	
3. Waste land: Xerophytic bushes	1,609		26.69	
4. Cultivated: rainfed	3,159	3505	52.39	58.12
5. Cultivated: irrigated	176		2.92	
6. Cultivated: partly irrigated	170		2.81	
Total	6,030		100.00	

* *Source:* A. N. Singh and D. K. Yadav: Soil and Land Use Survey of Naurar Catchment in Almora District, U. P., Institute of Photo-Interpretation, Dehradun, 1975.

A land capability classification was developed for the watershed on the basis of information on soil characteristics, slope of land, erosion hazards, climate and present land use. It is presented in Table II. The table indicates that only about 33 per cent of the total land (classes III and IV lands) could be put to regular cultivation when very intensive soil and water conservation measures are adopted. Rest of the land (classes VI, VII and VIII lands) is unfit for regular cultivation. It is suitable for permanent vegetation like orchards, pastures and forests.

TABLE II—LAND CAPABILITY CLASSES IN NAURAR WATERSHED*

Class/Sub-class	Area (ha.)		Per cent of total area	
IIIs**	59	1978	0.98	32.80
IIIce**	33		0.54	
IIIes	287		4.76	
IVec	1,599		26.52	
VIs	667		11.07	67.20
VIec	1,527		25.32	
VIIes	249		4.12	
VIIIes	1,609		26.69	
Total	6,030		100.00	

* *Source:* Singh and Yadav: *op. cit.*
** s= soil and root zone limitation, c = climatic limitation, and e = erosion limitation.

A comparison of data presented in Tables I and II brings out an important fact that even though only 33 per cent of the total land in the watershed is fit for cultivation, yet under present socio-economic conditions actual cultivation is being done on about 58 per cent of the land. Even a large proportion (50-60 per cent) of class IV land which does not have well maintained terraces should be brought under permanent vegetation. It would, therefore, be advisable that for sustained economic returns only about 20 per cent of the total land in the watershed should be put under regular cultivation of crops like cereals and vegetables and the rest about 80 per cent be put under permanent vegetation, community pastures, orchards and forests.

To find out the existing crop pattern and input use rates, a base line survey of a sample of 100 farmers was conducted in the watershed. The survey revealed that paddy and *ragi* were the two major foodgrain crops grown in *kharif* and wheat in *rabi*. Among the cash crops, chillies in *kharif* and potatoes in *rabi* were important but their cultivation was confined to small irrigated lands only. Mixed cropping was a common practice in the watershed. Paddy was usually bordered with *jhungra* (a kind of small millet) and *ragi* with legumes like *bhat* (black soybeans) and *urd* (black gram). Use of purchased inputs like improved/high-yielding seeds, chemical fertilizers and plant protection chemicals was almost negligible. The average expenditure on fertilizers

was only Rs. 22 per hectare. This means that the amount of capital (in the form of non-conventional inputs) combined with land and labour was much less than the optimum (Rs. 350 per hectare in the case of paddy IR-24).

To explore the possibilities of increasing farm income and employment by optimum resource combination, a few alternative optimum plans were developed for the cultivated land held individually by farmers in the watershed by the linear programming technique. For this purpose, a synthetic or representative farm situation was developed on the basis of information obtained from a sample of 100 farmers. The size of the synthetic farm was 0.86 hectare. Besides, a suitable plan was also developed for the land held collectively by the local community in a sub-watershed, namely, Danpo. This land mostly consisted of class VI, VII and VIII lands.

Alternative Optimum Plans for Land held by Farmers Individually

The following six alternative plans were prepared for the synthetic farm:

Alternative 1 (A_1) : Optimum crop plan with existing technology;

Alternative 2 (A_2) : Optimum crop plan with improved technology and limited credit;

Alternative 3 (A_3) : Optimum crop plan with improved technology and unlimited credit;

Alternative 4 (A_4) : Optimum crop-cum-livestock plan with improved technology and limited credit;

Alternative 5 (A_5) : Optimum crop-cum-livestock plan with improved technology and unlimited credit; and

Alternative 6 (A_6) : Optimum crop-cum-livestock-cum-poultry plan with improved technology and unlimited credit.

The alternative optimum plans along with the existing crop pattern are presented in Table III. The important features of alternative plans based on improved technology (A_2-A_6) were (1) introduction of high-yielding varieties of wheat and paddy, (2) introduction of new cash crops like soybeans, capsicum, tomatoes and French beans, (3) reduction in acreage devoted to local paddy + *jhungra*, (4) complete elimination of local wheat, and (5) introduction of improved milch cow (A_4, A_5 and A_6) and poultry (A_6).

TABLE III—ALTERNATIVE OPTIMUM PLANS FOR A SYNTHETIC FARM IN NAURAR WATERSHED

	Crop/Livestock/Poultry	Existing crop pattern	Alternative plans* (per cent of total cropped area)					
			A_1	A_2	A_3	A_4	A_5	A_6
1.	Local paddy + *jhungra* ..	19.41	22.17	11.65	11.65	11.65	Crop pattern same as under A_3.	
2.	High-yielding paddy ..	0	0	11.94	8.37	0		
3.	*Ragi* + *bhat/urd*	19.83	22.12	18.64	18.64	35.50		
4.	Capsicum	0	0	0.21	0.58	0		
5.	Chillies	1.29	3.49	1.16	1.16	1.16		
6.	Tomatoes	0	0	0.58	0.58	0.50		
7.	French beans	0	0	1.16	1.16	1.16		
8.	Soybeans	0	0	4.66	4.66	0		
9.	Summer potatoes	0	0	0	2.33	0		
10.	*Rabi* potatoes	0.15	5.82	0	5.24	0		
11.	Local wheat + barley/*lahi*	21.55	22.16	0	0	0		
12.	High-yielding wheat ..	0	0	19.50	22.92	7.20		
13.	Peas	0	0	3.49	0.58	3.49		
14.	Oats	0.14	0	0	1.16	0		
15.	Maize	2.11	0	0	0	0		
16.	*Rabi* fallow	35.52	24.24	18.64	20.97	18.64		
17.	Land left unused (slack activity)	0	0	8.37	0	20.70		
18.	Local buffalo (No.)	1	0	0	0	1	1	1
19.	Improved cow (No.)	0	0	0	0	1	1	1
20.	Poultry units (1 unit = 50 layers)	0	0	0	0	0	0	2

* A_1 = optimum crop plan with existing technology; A_2 = optimum crop plan with improved technology and limited credit; A_3 = optimum crop plan with improved technology and unlimited credit; A_4 = optimum crop-cum-livestock plan with improved technology and limited credit; A_5 = optimum crop-cum-livestock plan with improved technology and unlimited credit; and A_6 = optimum crop-cum-livestock-cum-poultry plan with improved technology and unlimited credit.

An economic evaluation of the alternative plans vis-a-vis the existing situation is presented in Table IV. The existing situation yielded Rs. 1,813 as returns over variable costs which increased by about 32 per cent under A_1 when resources were merely recombined according to profitability of crops. The highest increase in returns over variable costs (347 per cent) was possible under A_6 when improved crop technology was introduced along with milch animals and poultry and credit constraint was relaxed fully. In terms of returns over variable costs, A_6 was followed by A_5 (Rs. 5,353), A_3 (Rs. 4,124), A_4 (Rs. 3,972), and A_2 (Rs. 3,634).

TABLE IV—RETURNS OVER VARIABLE COST, MARGINAL VALUE PRODUCTS OF SCARCE RESOURCES, EMPLOYMENT POTENTIAL AND CREDIT REQUIREMENTS UNDER VARIOUS ALERNATIVE FARM PLANS IN NAURAR WATERSHED

Evaluation criterion	Existing situation (1973-74)	Alternative farm plans					
		A_1	A_2	A_3	A_4	A_5	A_6
1. Returns over variable costs (ROVC) (Rs.) ..	1,813	2,385	3,634	4,124	3,972	5,353	8,103
2. Percentage increase in ROVC of the existing situation ..	—	31.54	100.40	127.47	118.53	195.25	346.93
3. Marginal value products of scarce resources							
Kharif irrigated land (Rs./ha.)	—	1,415	3,804	3,890	1,779	3,890	3,890
Kharif rainfed land (Rs./ha.)	—	2,045	1,996	1,925	1,779	1,925	1,925
Rabi irrigated land (Rs./ha.)	—	1,351	2,966	8,199	2,966	8,199	8,199
Rabi rainfed land (Rs./ha.)	—	1,544	0	955	0	955	955
Human labour during October-November (Rs./day) ..	0	0	0	5.60	0	5.60	5.60
Kharif cash (Rs.)	0	0	1.56	0	4.76	0	0
Rabi cash (Rs.)	0	0	2.70	0	2.70	0	0
4. Employment potential (man-days used per annum)	230 (19.18)*	308 (25.74)	515 (43.04)	562 (46.96)	312 (26.09)	632 (52.81)	665 (55.57)
5. Credit requirement (Rs./ha.)	0	0	233	868	233	1,287	4,830

* Figures in parentheses indicate percentage of total man-days available per annum.

The marginal value product (MVP) of *kharif* irrigated land was the highest under A_3, A_5 and A_6, being Rs. 3,890 per hectare under each of these alternatives and that of *kharif* rainfed land was the highest under A_1, being Rs. 2,045 per hectare. Similarly, the MVP of *rabi* irrigated land was the highest under A_3, A_5 and A_6 and that of *rabi* rainfed land was the highest under A_1 and zero each under A_2 and A_4. The MVP of labour was zero in all periods except during the October-November period when it was Rs. 5.60 per day each under A_3, A_5 and A_6. Zero MVP of labour throughout the year except during October-November shows that labour was not a limiting factor in increasing farm income. The MVP of cash in both *kharif* and *rabi* seasons was zero in all the alternatives except under A_2 and A_4 when cash was limited. It is interesting to note that under the existing technology, no additional cash could be profitably used even when land was reallocated according to profitability of crops under A_1.

So far as employment potential is concerned, A_6 had the highest potential (665 man-days per annum). It was followed by A_5, A_3, A_2, A_4 and A_1. Even under A_6, only about 56 per cent of the total labour days available

could be used leaving about 46 per cent unused. However, employment could be substantially increased from 230 man-days per annum under the existing crop pattern to 665 man-days in A_6.

Credit requirement was the highest under A_6, being Rs. 4,830 per hectare which seems to be much higher than the amount which can possibly be made available to a typical farmer in the region through the existing institutional sources. But the credit requirements under other alternatives appear to be manageable. It is interesting to note that no credit is required under A_1 because under the existing conditions practically no cash inputs are used.

On the whole, A_6 could be considered the most profitable alternative with total returns over variable costs of Rs. 8,103 which is about 347 per cent higher than that of the existing situation. This alternative devotes a higher proportion of total cropped area to cash crops than the existing crop pattern (15.71 per cent vs. 1.44 per cent). But it requires a very large amount of credit (Rs. 4,830/ha.) which seems to be too high to be manageable. A_5 would be the next best choice with total returns over variable costs of Rs. 5,353 and with a much lower credit requirement (Rs. 1,287/ha.). If credit is limited, A_2 appears to be the most profitable alternative with total returns over variable costs of Rs. 3,634 which is about 100 per cent more than that of the existing situation and with a credit requirement of only Rs. 233 per hectare.

Optimum Plan for Land held by Village Community

Most of the lands belonging to the village community are in a very bad shape mainly because of over-grazing. A separate plan was prepared for the community land allocating land to pastures and fruit orchards as recommended by the soil scientist on the basis of land capability survey of the watershed. In terms of per hectare returns over variable costs, the orchard enterprise was estimated to be more profitable than the pastures (Rs. 2,750 vs. Rs. 250), but the latter was included in the plan for two reasons. First, pastures support the livestock enterprise which is complementary to the crop enterprise and therefore some pastures would seem, *a priori*, to be necessary for the community. Secondly, the land which is hardly suitable for orchards can be put under pasture grasses. The area under pastures was determined on the basis of fodder requirements of the village community. After determining the pasture acreage, the remaining land was allocated to orchards and other uses. Thus, about 44 per cent of the community land was allocated to pastures, about 38 per cent to orchards and the rest about 18 per cent to other uses. The total returns over variable costs from community orchards and pastures were estimated to be Rs. 78,332 per annum.

In terms of per hectare and per family, the returns over variable costs were estimated to be Rs. 2,350 and Rs. 1,059 respectively. This represents a substantial amount which can be realized by proper planning and management of the community lands in the watershed. Besides, orchards and pastures would also check soil erosion to a great extent. The actual benefits

to the people from these lands at present are only a very small fraction of the potential gains.

IMPLEMENTATION OF THE OPTIMUM PLANS

The results of the linear programming exercise showed the potential of increasng farm income and employment under ideal conditons in a typical watershed in the region. The normative results represent upper limits of income that might be reached. The increase in income from the existing situation to various alternative plans represent the extreme case of a one year conversion from a traditional agriculture to a scientific one. In reality, the recommended plans would be implemented in stages over a period of time which may range from 3 to 5 years or even more depending upon the approach and efficiency of the implementing agency. The optimum plans presented here may need to be modified to suit the managerial ability and resource restrictions of the individual farms.

Since much of the land use planning we have attempted here involves the activities of other people (farmers and groups of farmers) and resources over which the university and the State Government do not have direct control, effective planning would call for directional measures that can guide, limit or control the activities of others. The more direct types of measures for implementing land use plans by individuals, private groups and various levels of government include education and training, technical assistance, cost sharing (subsidies), incentive payments, provision of facilities and services such as irrigation, land levelling, terracing, credit and marketing. Besides, some regulatory measures such as land use regulations may also be adopted. Some of the State Governments have already amended their soil conservation acts prohibiting use of land for purposes other than those specified for the area and compelling the adoption of recommended soil and water conservation measures in specified areas. Similar land use regulations may be prescribed for the hill region of Uttar Pradesh also.

CONCLUSIONS

The present land use pattern in the region is not based on land capability considerations and as a result the land resource base of the region has been deteriorating over time. There is urgent need for an appropriate land use policy to discourage unwise and wasteful use of land and other related resources and to promote proper land use planning and management. The results of the analysis attempted in this paper indicate substantial potential in the region for increasing farm income and employment by proper land use planning and management on a watershed basis. Farm income and employment can be increased manifold if improved agricultural technology is adopted along with optimal combination of crop, livestock and poultry enterprises. For this to happen, a well-thought out and properly phased implementation programme is needed.