Agricultural Economics Research Review
Vol. 22 January-June 2009 pp 145-154

Land-use Dynamics in Jammu and Kashmir§

M.H. Wani*, S.H. Baba and Shahid Yousuf
Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Shalimar Campus, Srinagar – 191 121, Jammu & Kashmir

Abstract

The dynamics of shift among different land-use classes has been studied in the state of Jammu and Kashmir. A significant decline has been observed in the total reported area, which necessitates a proper land-use survey through remote sensing. A declining trend has also been observed in the area under forests. The unfavourable increasing trends in the area put to non-agricultural uses and barren and unculturable land are likely to have serious implications on ecological balance. Inter-sectoral land budgeting analysis has revealed that shifts in area are occurring from desirable ecological towards undesirable ecological sector. The estimates of regression analysis have revealed that the net irrigated area, literacy and area not available for cultivation have significantly improved the cropping intensity in the state agriculture, whereas agricultural density and area under rice are significant determinants of current fallow lands. The study has emphasized on the evolution of suitable institutional mechanism for scientific management, conservation and development of land resources in the state.

Introduction

Indian agriculture is a prelude to economic development and a pre-requisite for poverty alleviation and overall economic development (Ravallion and Dutta, 1996; Singh and Baleka, 1999; Anonymous, 2007). In view of this, Indian agriculture is now poised for technical transformation for ensuring food security, export earnings, and decentralized development to reduce rural poverty, owing to the severe population pressure on the natural resource base of land, water, bio-diversity and other resources to meet its growing food and development demands.

Agriculture is a land-based activity and as such land and water have been the basic elements of life-support system and an important resource for the economic life of a majority of people in the world. The way people handle and use land resource is decisive for their social and economic well-being as well as for the sustained quality of land resources. India, with only 2.3 per cent of world's total land area supports 18 per cent of human and 15 per cent of livestock population in the world. According to the National Remote Sensing Agency's (NRSA) report, there are 75.5 million hectares of wastelands in the country of which around 58 million hectares are treatable and can be brought into productive levels through appropriate measures. However, the per capita arable land in the country is only 0.15 ha, which is expected to come down to nearly 0.08 ha by 2025 (Kanda, 2007).

It is a paradoxical situation that on the one hand more production is required from the scarce soil resources for meeting the demand of ever-expanding population, while on the other, cultivable areas are being shifted towards non-agricultural uses. India has experienced a considerable shift under different land-use classes during post-independence period.

* Author for correspondence;
E-mail: dr.masoodulhaq@rediffmail.com

§ The paper is a part of research work conducted under University financed project on "Agricultural Development in the State of Jammu & Kashmir" during the period 2003-05

Land-use is a highly dynamic process. It implies that policy discussions and development planning have to be based on a sound understanding of these dynamics. Therefore, it is imperative to make a comprehensive study of the pattern and magnitude of land-use shifts for sustainability and productivity of agriculture in an area.

There are a wide variations in the distribution and utilization of land resources across different states of the country, based on topographic, geographical, political and other factors. Jammu and Kashmir, one of the north-western hill states, has a total reported area of 2416 thousand hectares, of which only 31 per cent is available for cultivation and the rest is either under demarcated forests or other land-use classes. Moreover, due to urbanization and infrastructural development, there is all the possibility of a shift among land-use classes in the state. While some land-use shifts have occurred in the desirable direction, some others might have been in the undesirable direction. In this back drop, the present study was undertaken to investigate the dynamics of land-use pattern in Jammu & Kashmir (J&K) with the following objectives: (i) To analyze the trends and dynamics of shift among different land-use classes in J& K, and (ii) To study the extent of productive and unproductive land-use pattern and their determinants in J&K. The objectives have been accomplished to test the hypothesis that although there has been a shift among land-use classes, no shift has occurred in the undesirable direction.

Data and Methodology

The study is based on secondary data obtained from various issues of *Digest of Statistics* and other publications of the Directorate of Economics and Statistics, Government of Jammu and Kashmir, for the period 1966-67 to 2004-05.

The compound growth rates in different land-use classes were estimated by employing Equation (1):

$$Y = ab^t \qquad \ldots(1)$$

where,

Y = Area under a land-use class ('000 ha),

a = Constant,

b = Regression coefficient, and

t = Time in years.

The dynamics of land-use shifts in each state was examined with the help of a simple identity of linearly additive land-use changes (Sharma and Pandey, 1992; Pandey and Tiwari, 1987). The first accounting identity linearly summed up the area under all land-use classes which was equal to the total reporting area, given by Equation (2):

$$R = F_r + P + M + N + U + W + F_e + F_o + C \qquad \ldots(2)$$

where,

R = Total reporting area,

F_r = Area under forests,

P = Area under permanent pastures,

M = Area under miscellaneous tree crops,

N = Area under non-agricultural uses,

U = Usar and barren lands,

W = Culturable wastelands,

F_e = Current fallows,

F_o = Fallow lands other than current fallows; and

C = Net area cultivated.

Also, $$\Delta R = \Delta F_r + \Delta P + \Delta M + \Delta N + \Delta U + \Delta W + \Delta F_c + \Delta F_o + \Delta C \qquad \ldots(3)$$

Then, the total land endowment was grouped into three broad sectors, viz. (i) ecological sector (E) comprising F_r, P, M and U, (ii) agricultural sector (A) comprising W, C, F_c and F_o, and (iii) non-agricultural (NA) sector. The ecological sector was further divided into two sub-sectors, viz. (i) the desirable ecology (E_1) comprising F_r, P and M, and (ii) undesirable ecology (E_2) comprising U. Then, the net changes within each sector were grouped as per equation (4)- (6) :

$$\Delta E = \Delta E_1 + \Delta E_2 = (\Delta F_r + \Delta P + \Delta M) + (\Delta U) \qquad \ldots(4)$$

$$\Delta A = \Delta F_c + F_o + \Delta W + \Delta C \qquad \ldots(5)$$

$$\Delta R = \Delta E_1 + E_2 + \Delta A + \Delta N \qquad \ldots(6)$$

Thus, the annual rates of change in different classes were worked out and budgeted as per

Equations (4), (5) and (6). This budgeting facilitated the analysis of direction of land-use shifts and their dynamics.

To quantify the determinants of productive and unproductive land utilization in J&K, regression models of the following structural forms were fitted:

(a) Productive Utilization

Steadily growing population and shrinking net sown area demand urgent evolution and adoption of technologies that augment land productivity. Such technologies can be classified under two analytical heads: those which raise the yield of any particular crop per unit of land, and those which increase the total output per unit of land from all crops grown over a rotational period through increase in cropping intensity. Yield increases are of course associated with additional capital use; all this may also increase the total labour input per unit of area. But then, it is usually noted that labour-use per unit of capital or per unit of output would decline significantly under such circumstances. Thus, this yield raising technique is better suited to capital-abundant and labour-scarce economies. The latter kind of technological changes which improve cropping intensity are desirable not only for fuller utilization of land resources but also for reducing seasonal unemployment in the labour-abundant and capital-scarce rural economy and for achieving higher stability in food supply (Rao, 1976; Dev, 1989). Therefore, cropping intensity was specified as endogenous variable in productive land-use model as per Equation (7):

$$CI = f\,(IA, HOLD, ANAC, LIT, U) \quad \ldots(7)$$

where,

CI = Cropping intensity (%),

IA = Net area irrigated (ha),

HOLD = Average size of holding (ha),

ANAC = Area not available for cultivation (ha),

LIT = Literacy rate (%), and

U = Error-term.

(b) Untapped/Unproductive Utilization

The under-utilized agricultural land can be categorized on the basis of length of period for which land remains unused as: current fallows (less than a year), fallows other than current fallows or long-term fallows (1-5 years) and cultivable or culturable wastelands (> 5 years). Among these categories, culturable wasteland is mostly constituted by degraded land and the reasons for not cultivating such lands include poor soil fertility, salinity, alkalinity, waterlogging, etc. (Sharma *et al*., 1990). The reasons for keeping land as long-term fallows may be poverty, inadequate supply of water, silting of canals and unremunerative nature of farming. This category also includes degraded land. The category of current fallows does not constitute degraded land; on the contrary, it represents some potential for increasing net sown area, and is important from the point of view of management of agricultural land. In view of this, it is desirable to consider the current fallows as untapped or unproductive use of agricultural land. Accordingly, a current fallow was specified as endogenous variable in the function (8):

$$CF = f\,(RAIN, AR, YLD, AD, U) \quad \ldots(8)$$

where,

CF = Current fallow (ha),

RAIN = Annual rainfall (mm),

YLD = Average yield level of food grains (Mt/ha),

AR = Area under paddy cultivation (ha),

AD = Agricultural density (Rural population / Cultivated area), and

U = Error-term.

The models specified above were estimated in log linear form using ordinary least square (OLS) procedure.

Results and Discussion

Trends in Different Land-use Classes

To find the trends in different land-use classes in J&K, both compound growth rates and percentage changes in each class were estimated (Table 1). The percentage changes have revealed a marginal decline (0.083%) in the total reported area which necessitates proper land-use surveys through remote sensing. The area under forest has decreased at an annual

Table 1. Trends in different land-use classes in Jammu & Kashmir

Land use class	Area ('000 ha)		Compound growth rate (%)	Change, %
	1966-67	2004-05		
Total reported area	2418	2416	-0.002* (0.0007)	-0.083
Area under forests	671	658	-0.035* (0.009)	-1.937
Area not available for cultivation				
Land put to non-agricultural uses	276	293	-0.079 (0.095)	6.159
Barren and uncultivatable land	271	289	0.540* (0.096)	6.642
Total	547	582	0.205* (0.030)	6.398
Other uncultivated land excluding fallows				
Permanent pastures & other grazing lands	125	125	-0.059* (0.023)	0.000
Land under miscellaneous tree crops not included in area sown	121	72	-1.553* (0.114)	-40.496
Culturable wasteland	146	141	-0.232* (0.040)	-3.425
Total	392	338	-0.498* (0.030)	-13.775
Fallow land				
Fallow land other than current fallow	15	13	-2.279* (0.530)	-13.330
Current fallows	118	73	0.0154 (0.147)	-38.1356
Total	133	86	-0.314* (0.102)	-35.338
Net area sown	675	752	0.191* (0.014)	11.407

Note: Figures within the parentheses indicate standard errors
*Denotes significance at 5 per cent or better level

compound growth rate of about 0.035 per cent, from 671 thousand hectares (1966-67) to 658 thousand hectares (2004-05). This decline could be attributed to deforestation and a wide gap between rates of afforestation and deforestation. These trends are likely to cause severe ecological imbalances, including adverse agro-climatic changes and acute shortages in meeting the rising demand of fuel, fodder and timber in the state.

The area put to non-agricultural uses has shown a substantial increase, from 276 thousand hectares in 1966-67 to 339 thousand hectares in 1977-78, but a slight favourable decline has been observed thereafter in its reaching 293 thousand hectares in 2004-05 (*Digest of Statistics*, various issues). The increasing demand of over 6 per cent land per annum during the period 1966-67 to 2004-05, for infrastructural development and urbanization has resulted in the increase of area under non-agricultural uses. This trend may have serious implications in the long-run.

The barren and unculturable land has also exihibited an increasing trend of 6.6 per cent per annum. Soil-water conservation and other reclamation measures need to be seriously implemented to bring this class of degraded land under plough.

The area under permanent pastures and other grazing lands has remained stagnant at 125 thousand hectares over the years which is a cause of concern to planners due to increasing demand for grasses and fodder for livestock. In the area under miscellaneous tree crops, the compound growth rates (1.55) have revealed a significant declining trend. This decline might be due to a shift of this land towards non-agricultural uses. The land under permanent pastures and miscellaneous tree crops significantly contribute to the village economy and ecology and is quite vulnerable to demand for non-agricultural uses. Hence, the declining trends in both these land-use classes need to be checked.

The fallow land and culturable wasteland have shown a decline of over 35 per cent and 3 per cent, respectively from 1966-67 to 2004-05, with an annual growth rate of -0.314 per cent and -0.232 per cent, respectively. The decline in these land-use

Table 2. Budgeting of inter-sectoral land-use shifts

Land-use sectors	Annual rate of change ('000 ha)		
	1966-67 to1984-85	1985-86 to 2004-05	1966-67 to 2004-05
Ecological sector ($\Delta E = \Delta E_1 + \Delta E_2$)	-71.67	29.00	-42.67
Desirable ecological sector (ΔE_1)	-59.33	-1.00	-60.33
Undesirable ecological sector (ΔE_2)	-12.33	30.00	17.67
Agricultural sector (ΔA)	34.00	-10.00	24.00
Non-agricultural sector (ΔN)	32.00	-19.00	13.00
Net sectoral changes*	-5.66	0.00	-5.66
Total reported area (ΔR)	-3.33	1.00	-2.33

Note: *The net sectoral change is equal to algebraic sum of $\Delta N + \Delta E_1 + \Delta E_2 + \Delta A$

classes is in consonance with the increase in the area under cultivation and barran & unculturable land. The net sown area has shown an increase of about 11 per cent with an increase of about 77 thousand hectares during the period 1966-67 to 2004-05.

Inter-Sectoral Budgeting Analysis

The inter-sectoral budgeting analysis was carried out to find the pattern and extent of dynamics in land-use shifts in the state (Table 2). It has been observed that land-use shift has been occurring from the desirable ecology towards undesirable ecology, agricultural and non-agricultural sectors. There was a positive shift of land towards the agricultural sector during the period-I (1966-67 to 1984-85) which tilted unfavourably towards undesirable ecology during the period-II (1985-86 to 2004-05). The shift of land from the agricultural sector to undesirable ecology may have serious implications towards agricultural growth and requires an immediate check. Inter-sectoral budgeting estimates for non-agricultural sector have indicated a significant increase during period-I, which later showed a decline and shifted towards undesirable ecology. The unfavourable trend of desirable ecological sector and the vicious land-use dynamics lead to the degeneration of this important natural resource, which needs priority management.

Productive Land Utilization

The net area sown and irrigated area in a year were taken as the productive land-use in this study. It has been observed that the area available for cultivation had increased from 675 thousand hectares to 752 thousand hectares during 1966-67 to 2004-05. The net area sown as per cent of total reported area in the state has also shown an increase, from about 28 per cent to 31 per cent during this period (Table 3). However, per capita availability of net area sown has significantly declined over the years, indicating a huge pressure of increasing population on land and other resources of the state. The net irrigated area had increased from 280 thousand hectares to 311 thousand hectares, but the irrigated area as per cent of net area sown has remained more or less stagnant over this period.

The district-wise distribution of cultivated area in the state has been presented in Table 4. The reported area has been found to be highest in the district of Udhampur, followed by Doda and Jammu districts. The land under cultivation in these districts has been found highest in the district Budgam (> 66%), followed by Kupwara (65%), and Anantnag (64%). Almost 100 per cent of the net area sown in the Kargil district had irrigation facilities, followed by Leh and Srinagar districts. As per the figures in Table 4, the role of irrigation in improving cropping intensity has appeared inconsistent across different districts. Although irrigation is a critical input and is considered an important determinant of agricultural intensification, the agro-climatic constraints were found to hamper multiple croppings in the temperate and cold-arid regions of the state. Moreover, the quality and seasonality of irrigation systems are important against the proportion of area under irrigation (Narian and Roy, 1980; Dhawan,

Table 3. Productive utilization of land in Jammu & Kashmir

(area in ’000 ha)

Year	Total reported area (TRA)	Net area sown (NAS)	Net area sownas per cent of TRA	Per capita NAS	Irrigated area	Irrigated area as per cent of NAS
1966-67	2418	675	27.91	0.165	280	41.48
1974-75	2415	688	24.49	0.137	295	42.88
1980-81	2414	715	29.62	0.122	304	42.52
1985-86	2415	732	30.31	0.109	309	42.30
1990-95	2416	731	30.26	0.096	298	40.78
1995-96	2416	734	30.38	0.084	307	41.77
2000-01	2416	748	30.96	0.075	311	41.56
2004-05	2416	752	31.12	0.072	311	41.34

Source: *Digest of Statistics* (various issues), Government of J&K, Srinagar.

Table 4. District-wise productive land utilization in J&K: 2004-05

(area in ’000 ha)

District	Total reported area (TRA)	Net area sown (NAS)	NAS as per cent of TRA	Average size of holding (ha)	Irrigated area (IA)	IA as per cent of NAS	Cropping intensity (%)
Anantnag	119.80	76.44	63.81	0.44	45.24	59.18	128
Pulwama	97.61	57.00	58.40	0.62	35.77	62.75	147
Srinagar	51.01	21.40	41.96	0.26	16.26	75.98	127
Budgam	77.83	51.82	66.58	0.56	29.17	56.29	109
Baramulla	143.75	81.38	56.61	0.51	38.02	46.72	115
Kupwara	66.59	43.12	64.75	0.44	19.75	45.80	105
Leh	45.17	10.18	22.54	0.70	08.48	83.30	103
Kargil	19.46	09.05	46.51	0.71	09.04	99.89	110
Jammu	320.12	119.03	37.18	0.84	62.93	52.87	179
Udhampur	431.01	69.67	16.16	1.13	05.76	8.27	161
Doda	411.02	69.27	16.85	0.65	07.29	10.52	120
Kathua	264.73	63.79	24.10	1.04	22.17	34.75	196
Rajouri	253.34	52.97	20.91	1.07	07.42	14.01	185
Poonch	114.38	27.30	23.87	0.89	03.60	13.19	167
Total	2415.80	752.42	31.15	0.66	310.90	41.32	146

Source: Digest of Statistics, Government of J&K, Srinagar (2004-05)

1985; Dev, 1989). The average size of holdings has been found to be lower in the state than the national average. Across districts, Udhampur has the highest average size of holdings (1.13 ha), while Srinagar has the lowest holding-size (0.26 ha), which is in consonance with the population density in these districts.

Intensification-based classification of districts has been presented in Table 5. The class I included the districts having cropping intensity above 175 per cent, class II included districts having cropping intensities from 125 to 175 per cent, and class III up to 125 per cent. Out of the fourteen districts, only three districts were found under class I, five were under class II

Table 5. Intensification-based land-use classes in different districts of J&K

Region	Class		
	I (above 175%)	II (125 – 175%)	III (up to 125%)
Kashmir	-	Anantnag	Budgam
	-	Pulwama	Baramulla
	-	Srinagar	Kupwara
Ladakh	-	-	Leh
	-	-	Kargil
Jammu	Jammu	Udhampur	Doda
	Kathua	Poonch	-
	Rajouri	-	-

and six under class III. Due to variations in the geographical, climatic and other factors, a wide variation amongst the provinces regarding land-use cannot be ruled out.

The Ladakh province experiences a very harsh climate for about 3/4th part of a year and the farmers have access to their agricultural land only for a few months in a year. Kashmir province too witnesses a harsh climate during winters and receives less rainfall, whereas most of the districts in the Jammu province receive more and evenly distributed rainfall and have a comparatively favourable climate for most part of the year.

Untapped Land/Unproductive Utilization

The productivity can be improved by tapping uncultivated land, including wasteland and fallow land. The magnitude of untapped agricultural land in the state has remained stagnant for the past few decades, though some inter-sectoral fluctuations have been observed (Table 6).

The two broad classes of untapped land, viz. area not available for cultivation, and fallow land have depicted opposite trends over the years. Area not available for cultivation has increased from 417 thousand hectares in 1966-67 to 430 thousand hectares in 2004-05, whereas the fallow land including current fallows has decreased during this period from 93 thousand hectares to 86 thousand hectares. Thus, the overall level of untapped land has been found to be maintained around 500 thousand hectares. The agricultural production can be more or less doubled if this untapped land could be brought under cultivation. In this direction, land-use planners and government have a major role to play. Farmers should be provided training to use land on scientific lines. Incentives in the form of cheap credit, development subsidies, etc. may improve financial status of the poor farmers, enabling them to invest on land improvement, and purchase of technologies and critical inputs. In this way, they could shift unproductive land to productive use and

Table 6. Untapped agricultural land in Jammu and Kashmir: 1966-67 to 2004-05

(area in ’000 ha)

Year	Total reported area	Area not available for cultivation				Fallow land				Total	
		Barren & unculti-vated land	Cultur-able waste land	Total		Fallow land other than current fallows	Current fallow land	Total		Area	% of TRA
				Area	% of TRA			Area	% of TRA		
1966-67	2418	271	146	417	17.24	15	118	133	5.50	550	22.75
1974-75	2415	244	155	399	16.52	8	105	113	4.68	512	21.20
1980-81	2414	231	147	378	15.66	8	94	102	4.22	480	19.88
1985-86	2415	259	164	423	17.51	7	86	93	3.85	516	21.37
1990-91	2416	295	137	432	17.88	6	97	108	4.47	541	22.35
1995-96	2416	291	141	432	17.88	7	96	103	4.26	535	22.14
2000-01	2416	291	140	431	17.84	8	82	90	3.72	521	21.56
2004-05	2416	289	141	430	17.80	13	73	86	3.56	516	21.36

Source: Digest of Statistics (various issues), Government of J&K, Srinagar transform agriculture towards commercialization. Soil and water conservation and other reclamation measures could help bring the untapped land under plough for productive uses.

Determinants of Productive and Unproductive Land Utilization

The exponential function was fitted to quantify the determinants of productive (cropping intensity) and unproductive (current fallow) land-use. The estimates of exponential function (Table 7) for productive land-use have revealed that the net irrigated area, literacy level and area not available for cultivation are the positive significant determinants of the variation in cropping intensity. The irrigation is a critical input for multiple cropping; hence, there is a need to expand irrigation capacities of the state, particularly where they are much needed. The existing irrigation capital stock should also be made functional to improve its efficiency. The regression coefficient of the average holding size (0.15) has revealed its positive contribution to the improvement of cropping intensity, although the relation has not been found statistically significant. Small size of holdings hinders mechanization and capital formation, which are important determinants of productivity and intensity in the long-run. The literacy level was also found to be an important positive determinant of cropping intensity. Educated farmers can put agriculture on scientific lines and remain aware about the possible benefits of multiple cropping. The positive coefficient of the area not available for cultivation indicated that further increase in this area may significantly improve cropping intensity. The increasing demand of land for urbanization and infrastructural development due to increasing population may increase pressure on area left for cultivation and improve cropping intensity *per se*. The adjusted regression coefficient has turned out to be statistically significant, indicating the function to be a best fit (Table 7).

The estimated adjusted R^2 of current fallow equation was found to be 0.62, which indicated that the variables specified in the model could explain more that 60 per cent of the variations in the endogenous variables (Table 7). The regression coefficient of agricultural density (0.13) signified that the increase in rural population in relation with cultivated area had significantly contributed to the increase of area under current fallow. The current fallows are left as such for few years and are ultimately used for construction and other non-agricultural uses. In view of this, there is a dire need to implement and revitalize land laws being included in the 9th schedule of Indian Constitution.

The area under rice was found to be significant and positive determinant of area under current fallows. The crop season of rice usually coincides with the crops to be taken up during the *rabi* season and compel the farmers to leave their land as fallow. Although, SKUAST-K has developed a few short-

Table 7. Estimates of exponential function of cropping intensity and current fallows

Cropping intensity		Current fallows	
Explanatory variable	Coefficients	Explanatory variable	Coefficients
Net irrigated area	0.39*	Agricultural density	0.13**
	(0.03)		(0.08)
Average holding size	0.15	Yield	0.003
	(0.09)		(0.20)
Area not available for cultivation	0.79*	Area under rice	1.2**
	(0.34)		(0.59)
Literacy rate	0.18*	Rainfall	-0.09
	(0.08)		(0.12)
Adjusted R^2	0.9041	Adjusted R^2	0.6259

Notes: * and **denote significance at 1 per cent and 5 per cent levels, respectively.
Figures within the parentheses indicate standard errors

duration genotypes of rice, but these varieties are still confined to a few pockets of the state. The research efforts coupled with proper extension services should be emphasized in this area. Moreover, the existing farming system should be diversified towards short-duration vegetable crops. The multiple cropping of vegetable crops may help generate higher revenue and uplift the rural community.

Conclusions and Policy Implications

The study has revealed a major shift of land from the desirable to undesirable land-use classes. There has been an increase in the net area sown in Jammu and Kashmir on account of various land reclamation measures adopted till early-1980s, but later this land-use class has shown an unfavourable decline towards 2004-05. Cropping intensity has been lower in the Kashmir than Jammu province due to unfavorable climatic conditions prevalent in the valley. No significant association has been found between irrigated area and cropping intensity, indicating lack of location-specific technological advancements and their respective channelization. It is required more so due to altitudinal variations that demand short-duration varieties for increasing cropping intensity. The state largely comprises small and marginal farmers (about 94 %), and the per capita availability of cultivated land in the state is only 0.072 ha, which is a major constraint in agricultural development in the state. Therefore, a high priority needs to be accorded for exploring the potentialities of crop diversification in different agro-climatic zones of the state with a view to maximizing the returns per unit of land to the farmer. The unproductive utilized land in the state, though has decreased over the years, is still over 500 thousand hectares, which need to be brought under cultivation through effective measures.

The study has suggested that the following policy options could be considered for the management of land resources of the state:

The declining trend in the reported area of the state needs to be checked by land surveys through remote sensing under GIS. Since irrigation is an important determinant of agricultural growth, low gestation irrigation projects should be funded to expand irrigation capacities. Moreover, the existing irrigation structures should be made functional to improve efficiency of the existing capital stock. Desirable land-use pattern could be achieved through sectoral approach/plan linkages and there is a need to apply modern science and technology to enhance productivity on a sustainable basis. Further fragmentation of holdings should be strictly prohibited. There should be a suitable institutional mechanism for scientific management, conservation and development of land resources. There is an immense requirement of preserving agricultural land. The land reform measures should be strictly implemented and the construction of residential buildings and other establishments on agricultural land should be banned. Reform policies should be supported by strict laws and regulations. Diversification of agriculture should be encouraged in the state because it not only enhances income and protects from risks, it also enhances soil properties and prevents degradation of land.

Acknowledgement

The authors are highly grateful to the anonymous referee for his valuable suggestions

References

Anonymous (2007) *Indian Economy*, Pratiyogita Darpan, New Delhi.

Dev, S. M. (1989) Towards an explanation of spatial and temporal variations in cropping intensity in India. *Indian Journal of Agricultural Economics*, **44**(1): 27-44.

Dhawan, B. D. (1985) Questionable conceptions and simplistic views about irrigated agriculture of India. *Indian Journal of Agricultural Economics* **40**(1): 1-13.

Kanda, M. (2007) *Land Resource Management in India*, Department of Land Resources, Government of India, New Delhi.

Narian, D. and Roy, S. (1980) *Impact of Irrigation and Labour Availability on Multiple Cropping: A Case Study of India*. Research Report No. 20. International Food Policy Research Institute, Washington, DC, USA.

Panday, V.K. and Tewari, S.K. (1987) Some ecological implications of land-use dynamics in U.P. *Indian Journal of Agricultural Economics,* **42**(3): 338-394.

Rao, C. H. H. (1976) Factor endowments, technology and farm employment: Comparison of East Uttar Pradesh with West Uttar Pradesh. *Economic and Political weekly*, **11**(39): A117-123.

Ravallion, M. and Dutta, G. (1996) India's checkered history in fight against poverty. *Economic and Political Weakly,* **31**(35, 36 &37): 2479-2485.

Sharma, S. C., Srivastawa, G. P. and Sharma, M. L. (1990) Distribution and changing pattern of culturable wastelands in the tarai tracts of eastern Uttar Pradesh, In: *Utilisation of Wastelands for Sustainable Development in India: Proceedings of the National Seminar on Utilization of Wastelands for Sustainable Development in India*, Eds.: S. C. Sharma, R. B. Chaturvedi and O. P. Mishra. Concept Publishing Company, New Delhi. pp. 155-172.

Sharma, U.K. and Panday, V.K. (1992) Dynamics of land-use in different states of India. *Agricultural Economics Research Review*, **5**: 24-33.

Singh, P. and Baleka, J.B. (1999) Factors affecting fertilizer consumption in the western Maharashtra. *Agricultural Situations in India,* **56**(6): 361-368.