GeoJournal (2018) 83:49–60
https://doi.org/10.1007/s10708-016-9755-6

An analysis of climatic and human induced determinants of agricultural land use changes in Shupiyan area of Jammu and Kashmir state, India

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Published online: 19 October 2016

Abstract The economy of the Jammu and Kashmir state depends mostly on traditional forms of occupation. Unaffected and unaltered by modern day industrial developments and changing times, the indigenous traditional occupations of farming, animal husbandry and horticulture forms the backbone of the state economy. But in the last few decades, Agriculture in the state as well as the study area is receiving a set back and Horticulture is flourishing leaps and bounds. The present study aims to analyze various determinants responsible for this change. Climatic as well as field data was thoroughly analyzed to comprehend the situation. A Mann–Kendall test was done on the climatic data to support the hypotheses. It was observed that initially changing climatic trends proved to be the triggering factor supporting this change, but in due course of time, the determinants took an economic and psychological turn. The perusal of Indian Meteorological Data reveals an increasing trend of annual mean maximum temperature from 16.78 °C in 1985 to 17.58 °C in 1995 and an increase from 5.30 °C to 7.00 °C in the annual mean minimum temperature, and as such acting as a triggering factor for the land use conversion. Further, the mean annual rainfall shows a decrease from 100.75 mm in 1981 to 79.43 mm in 1991. The greater economic returns from horticulture as well as the changing behavioral patterns of people over the time further cemented its growth. The farmers have since persisted with the horticulture activity as it has proven to be an economically a much better lucrative enterprise.

Keywords Psycho-behavioral patterns · Climatic trends · Land use · Horticulture · Jammu & Kashmir

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Introduction

Land use is the intended employment and management strategy placed on the land cover by human agents, or land managers to exploit the land cover and reflects human activities such as industrial zones, residential zones, agricultural fields, grazing, logging, and mining among many others (Chrysoulakis et al. 2004). Land use is a product of interactions between cultural backgrounds, state and physical needs of the society with the natural potential of land (Karwariya and Goyal 2011). Land use change is defined to be any physical, biological or chemical change attributable to management, which may include conversion of grazing to cropping, change in fertilizer use, drainage improvements, installation and use of irrigation, plantations, building farm dams, pollution and land degradation, vegetation removal, changed fire regime, spread of weeds and exotic species, and conversion to non-agricultural uses (Quentin et al. 2006). Land-use/

Land-cover changes may be grouped into two broad categories such as conversion and modification. Conversion refers to the intended shift from one cover or use type to another, while modification involves maintenance of the broad cover or use type in the face of changes in its attributes (Baulies and Szejwach 1998). Land-use change is the proximate cause of land-cover change, the underlying driving forces of which can be traced to a host of economic, technological, institutional, cultural and demographic factors. In fact, humans are increasingly being recognized as a dominant force in global environmental change (Moran 2001; Turner 2001; Lambin et al. 2001) The change is mainly due to human activities and natural processes (Meyer and Turnor 1994). The most obvious forces governing the changes are population growth and concomitant demand for land use products, which seem to differ considerably across and within farming systems (Fresco 1993). Among the straightforward identified human causative factors includes population growth and density, over intensification of land use, farm size, land tenure status and lack of policies on land use (Lakew et al. 2000).

A number of studies in India and abroad reveal that primarily climatic and socio-economic factors determine the land use/land cover change over a period of time. Sometimes, one or two and in some cases, several factors work together to trigger the change. Land use and land cover is changing rapidly due to several driving forces. Socioeconomic aspects can be dealt in two ways, one working out the cost-benefit analysis for various climate change scenarios by using econometric-process models and the other, generating the socio-economic scenario of future which links with the cropping system model for further impact analysis (Antle and Capalbo 2001). Production decision of the farms, such as crop choices, are driven by net returns, which are determined only by input and output prices, farm physical characteristics and socio-economic characteristics of the farm household (Benin et al. 2004). Adaptation to climate change requires that local people first notice that the climate has altered, as this is the trigger for them to identify and implement potentially useful actions to adjust to the change (Maddison 2007). Historical patterns of agricultural land-use change can be used to more firmly establish relationships between land quality and land use. Lands that have recently shifted into or out of cultivated cropland from other, less intensive uses are at the extensive margin of cultivated land, with land use evidently susceptible to economic or other forces. One may compare land attributes (such as yield potential, slope, and location) of transitioning lands and lands that have not shifted to a different land use to infer economic forces as driving land-use change (Lubowski et al. 2006). Increasing population, periodic changes in weather particularly decreasing rainfall trend and in some cases acute drought, increased land fragmentation, introduction of quick income generating crops, shrinkage of land resources are the various factors responsible for land use and biodiversity changes. Also land scarcity in the highlands makes farmers to intensify their land use (increased inputs per hectare) because there is little land available for extension of their farms (Ngailo et al. 2001). World Bank report (1998) analyzed climate change effects on Indian agriculture, through annual net revenues, and found Indian Agriculture sensitive to warming. Temperatures are increasing over J&K with an annual increase in the maximum temperature in the Kashmir region from 0.04 to 0.05 degrees Celsius over the period and a corresponding rise in the minimum temperature in the Jammu region from 0.03 to 0.08 degrees per year (Jaswal and Rao 2010). Longtime rice farmers in the Kashmir Valley are turning to fruits and vegetables to avoid gambling on increasingly unpredictable weather patterns (Global press journal 2014). The land use change studies in the Kahmil catchment of Pohru River (J&K) reveal a remarkable increase in area of orchards because of the greater returns from the same as compared to the returns from crop cultivation. The rain fed agriculture got a boost because of large scale deforestation in the area to provide the land for the same (Ahmed and Rashid 2009).

Study area

Kashmir is the northwestern region of the Indian subcontinent. It is bordered by China in the east, rest of India to the south, Pakistan to the west and Afghanistan to the North. Geographically it lies between the co-ordinates 33.43 °N to 74.49 °E latitude & longitude and covers an area of 15948^2 km (6158 sq. miles) at an elevation of 1850 m above sea level. The valley of Kashmir is well known for its horticultural produce both in India and abroad. The valley offers good scope for cultivation of horticultural crops, covering a variety of temperate fruits like apple, pear, peach, plum, apricot, almond, and cherry. Horticulture is gaining momentum in the state as its contribution to Gross State Domestic Product (GSDP) remains around 7–8 % (Department of Horticulture 2011) over the past few years. The area under fruit cultivation in the state was around 3000 ha. in 1950–1951, which has exponentially increased to 45,000 ha. in 1988–1989 (Khan A.R. 2013) and 341,372 ha. in 2011–2012 (Digest of Economics and Statistics 2011–2012).The production of horticultural produce of the state was about 8.3 lac metric tonnes in 2000 which increased to about 21.57 lac metric tonnes in 2011 (Digest of Statistics 2011–2012) and generated a revenue of about 4100 crore for the same year (Department of Horticulture).

Shopian is a historical town, and has gained importance since Mughal advent. The District is situated in the foot Hills of Pir panjal range and most of its area is Hilly Terrain. The District is having an area of 30,741.6 hectares and an altitude of 2146 mts a.s.l. The district is known as Apple Bowl of the state as it is famous for Horticulture Sector. The district possesses tremendous scope for expansion of fruit industry under different schemes which can boost the economy not only of this district but the whole state (Fig. 1).

Conceptual framework

The landuse/land cover changes that are happening at the global level have a pronounced effect on the ecology and economy of a place. These changes are being driven by a one point agenda of social and economic development, putting, proper resources utilization at the backburner resulting in over use and exploitation of resources. Changing climatic trends as well as economic parameters have been instrumental in triggering these changes both at the global and national level and particularly in the developing and under developed part of the world because of faulty planning or lack of it therof, resulting in quite serious ramifications to the environment.

The valley of Kashmir having a fragile mountainious environment has been subjected to unplanned and unprecedented landuse/land cover changes in the last three decades giving rise to a host of problems. This study has been mainly conceived with an approach to give a broad framework for determining various factors/determinants which have played an unparalleled role in assisting the humongous changes in the agricultural land use and its conversion to horticulture thereof in the area of the study. Role of the changing climatic trends was found to be a triggering factor to

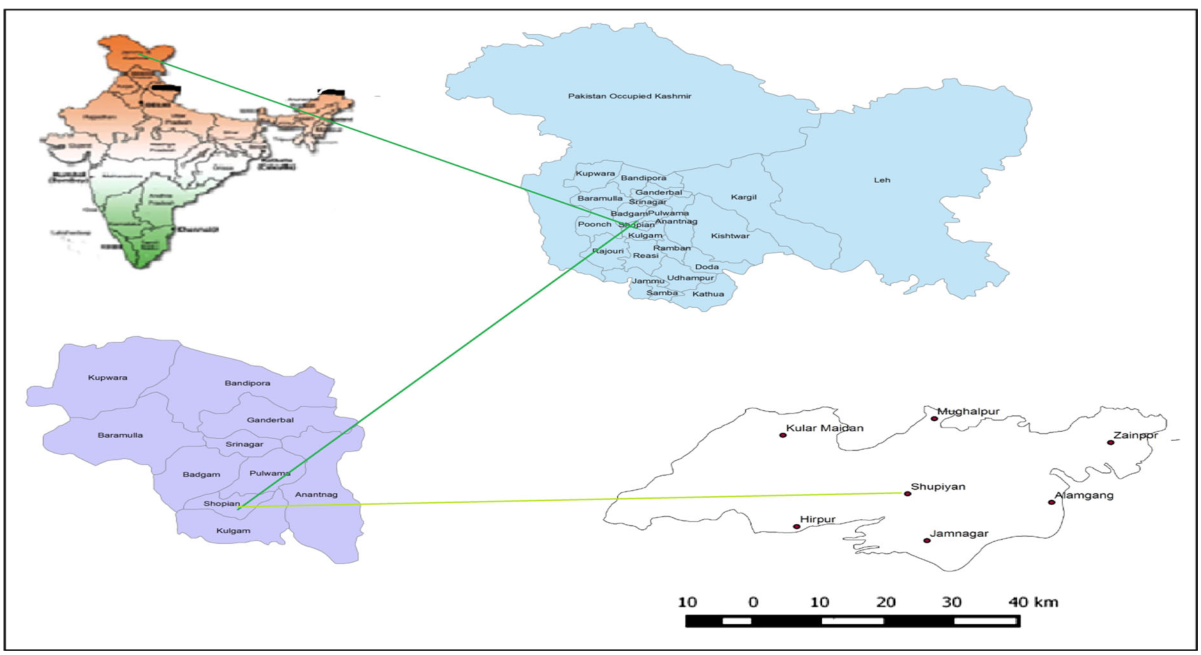


Fig. 1 Study area

support this change and at the same time economic returns from the horticulture helped in sustaining this type of land use conversion. The general psyche and behavior of the respondents surveyed was also favoring this particular type of land use change. This understanding would be useful to comprehend the driving forces responsible for the agricultural land use changes in the study area. Undoubtedly this change will have widespread ramifications which have already been put in motion in the form of decreasing food security in the area, with a free reign to the land managers to exploit the land according to their interests in absence of a proper land use policy.

Methodology

Records of monthly precipitation (mm) and temperature of Meteorological station, Qazigund available from 1980 to 2014 have been obtained from the Indian Meteorological Department (IMD) Srinagar. The same have been used to compute the annual variability in precipitation and temperature for Shupiyan. The average annual precipitation and temperature data was plotted against time, and trends were examined by fitting the Time series analysis to the data. Linear trends were also drawn to show the fate of precipitation and temperature over the last 34 years of the study period. Besides statistical techniques like Regression etc. were used for further analysis of the IMD data. A Mann–Kendall (non-parametric) was run on time series data for the time period 1980–2014. The Mann–Kendall test is a non-parametric test for identifying trends in time series data. The test was suggested by Mann (1945) and has been extensively used with environmental time series (Hipel and Mcleod 2005).

In addition, a structured questionnaire was prepared to collect baseline information from the primary respondents. Extensive field surveys were conducted, and the sample size was selected using stratified random technique. Out of the total 228 hamlets and villages 22 villages were surveyed which comprises 10 % of the total villages. Group and individual interviews were held with Agriculturists, social workers, business people etc. and their responses recorded. For each village, farmers of different wealth categories i.e. rich, average and poor in resources endowment were interviewed. A sample size of 10 % was obtained using random stratified technique and as a result more than 500 respondents were interviewed and information pertaining to farm productivity, mechanization, farm inputs, auxiliary benefits and land use changes including the adjustment strategies were collected. The socio-psychological behaviors including lifestyle and attitude changes have also been assessed. A comprehensive database with respect to land use change in time and space was generated (Figs. 2, 3, 4, 5).

Results and discussions

Land use changes are influenced by multiple and complex factors. Adverse climatic conditions, changes in population, land pressure and changes in socio-economic conditions are among factors that favor or discourage certain changes. In the case of the study area lifetime farmers may be more obliged to shift their land from crop production to horticulture enterprise because changing climatic trends initially prove to be the triggering factor to do so, and at the same time the future expectations from horticulture are economically more satisfying and beneficial than the previous cropping regimes, thus favoring the shift. The flowchart given below hypothesizes some of the major determinants responsible for the land use change in the study area where the major shift has been from agriculture to horticulture (Fig. 6).

Climatic determinants

A time series analysis was drawn for the study period 1980–2014 by fitting annual precipitation data. A trend line was drawn to ascertain the slope in precipitation and temperature. Long-term rainfall data shows a high degree of variability within years, coupled with very poor distribution throughout the year.There is a significant decrease in the annual precipitation from 1980s onwards accompanied by an increasing trend in mean annual temperature. The decade of 1980s shows a continuous considerable decrease in the annual precipitation ranging from 1144 mm in 1980, 1067 in 1985 and 1100 mm in 1990.The average mean maximum temperature follows an increasing trend with a temperature of about 18.6 °C in 1980, 19.6 °C in 1984 and about 20.5 °C in 1990. The average mean minimum temperature also

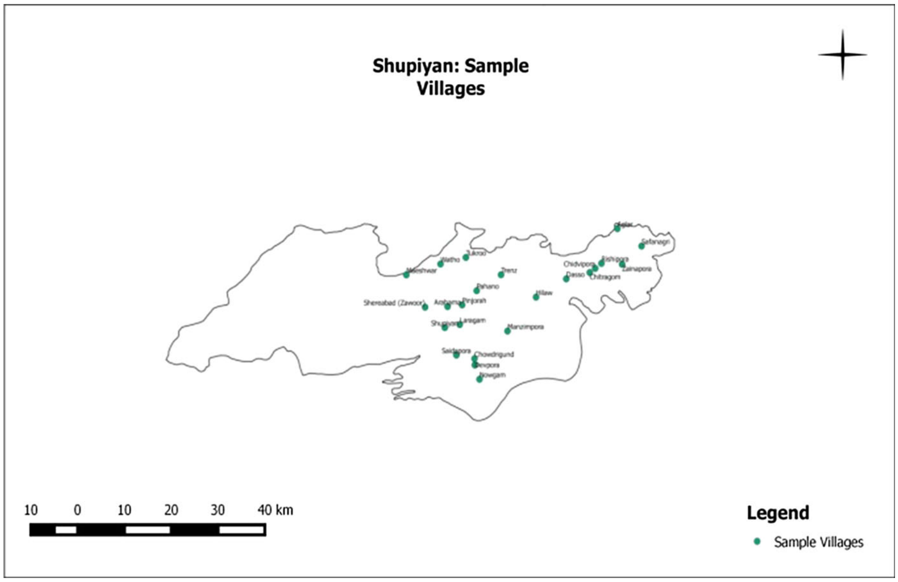


Fig. 2 Sample villages

Fig. 3 Digital elevation map

follows a similar trend with average annual mean minimum temperature about 6.3 °C in 1980, 6.8 °C in 1984 and about 7.1 °C in 1990. The decreasing and high rainfall variability between seasons is partly responsible for the changes in agricultural land use. These conditions often result in occurrences of crop failures (Fig. 7, 8, 9).

The hydrological cycle of an area is affected by climate change and human activities (Xia et al. 2011). Climate change, particularly the changing trends in rainfall and temperature largely determines the future runoff of a basin (Wang et al. 2009). Changing trends in climatic variables were also responsible for affecting the discharge capacity of the main river which caters to the study area (Rembiara river). The perusal of discharge data reveals that the discharge shows an upward trend from 1974 with the annual discharge standing at 215,563 cusecs in 1975, and about 361,782 cusecs in 1980, but after this the annual discharge shows a decreasing trend with annual discharge standing at about 134,367 cusecs in 1981 and 195,664 cusecs in 1992. The data was extrapolated 20 years forward which highlighted the consistent decrease in the annual discharge, signifying the role of changing climatic parameters on the discharge of the said river (Fig. 10).

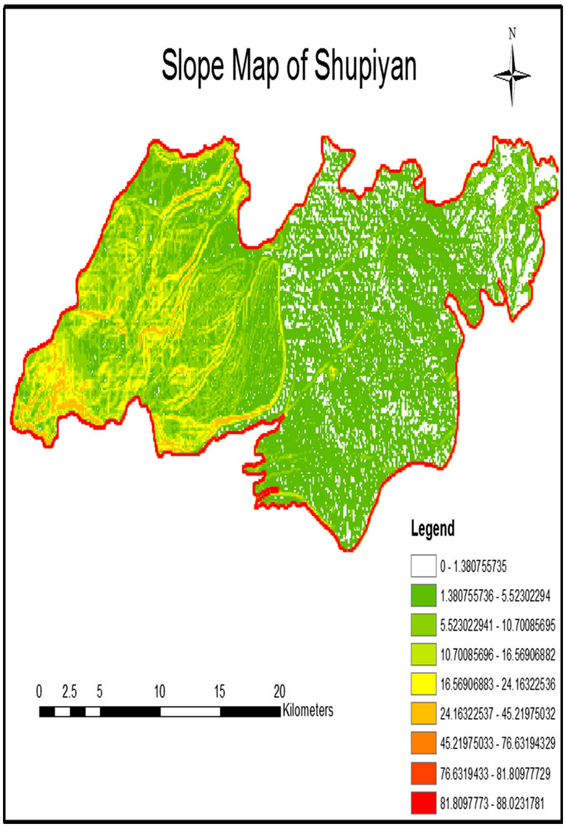


Fig. 4 Slope map of study area

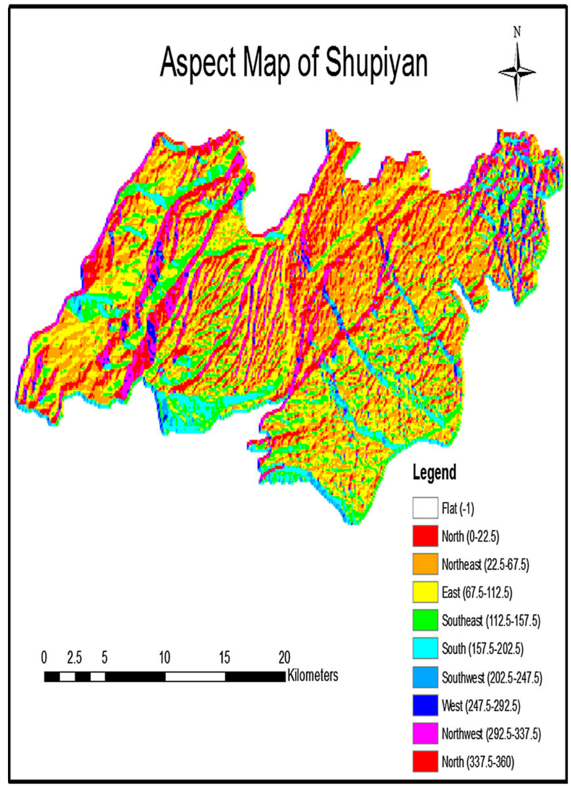


Fig. 5 Aspect map of study area

The above mentioned data reveals that these climatic variations were to a large extent instrumental in compelling the farmers to shift to horticulture and other dry farming activities wherein the water requirements were less. This paved the way for horticultural practices in those parts which were previously dominated by pure cropping practices.

Mann–Kendall test

The Mann–Kendall S Statistic is computed as follows:

$$\mathrm{MKT} = [(4\Sigma_{\mathrm{ni}}/\mathrm{N}\ (\mathrm{N}-1)] - 1$$

with

$$\mathrm{Var}\ (\mathrm{MKT}) = [(4\mathrm{N}+10)/\,(9\mathrm{N}\ (\mathrm{N}-1)]$$

where n_i is the no. of values larger than the ith value in the series subsequent to its position in the series of N values.

The resultant Mann–Kendall test statistic (S) indicates how strong the trend in precipitation and temperature data is and whether it is increasing or decreasing (Table 1).

A very high positive value of Z-score is an indicator of an increasing trend, and very low negative value indicates a decreasing trend. However it is necessary to compute the probability associated with Z-score and the sample size, n to statistically quantify the significance of the trend.

For annual mean maximum temperature, the test shows a Z-statistic value of (1.633) indicating a significant(S) trend at 90 % level of significance. The significant trend of Mann–Kendall test is indicative of increasing mean maximum temperature, as indicated by time series.

For annual mean minimum temperature, the test shows a very low value of Z-statistic (0.128) indicating an statistically insignificant (NS) trend in Mann–Kendall test with an almost constant mean minimum temperature across the time series with minor fluctuations.

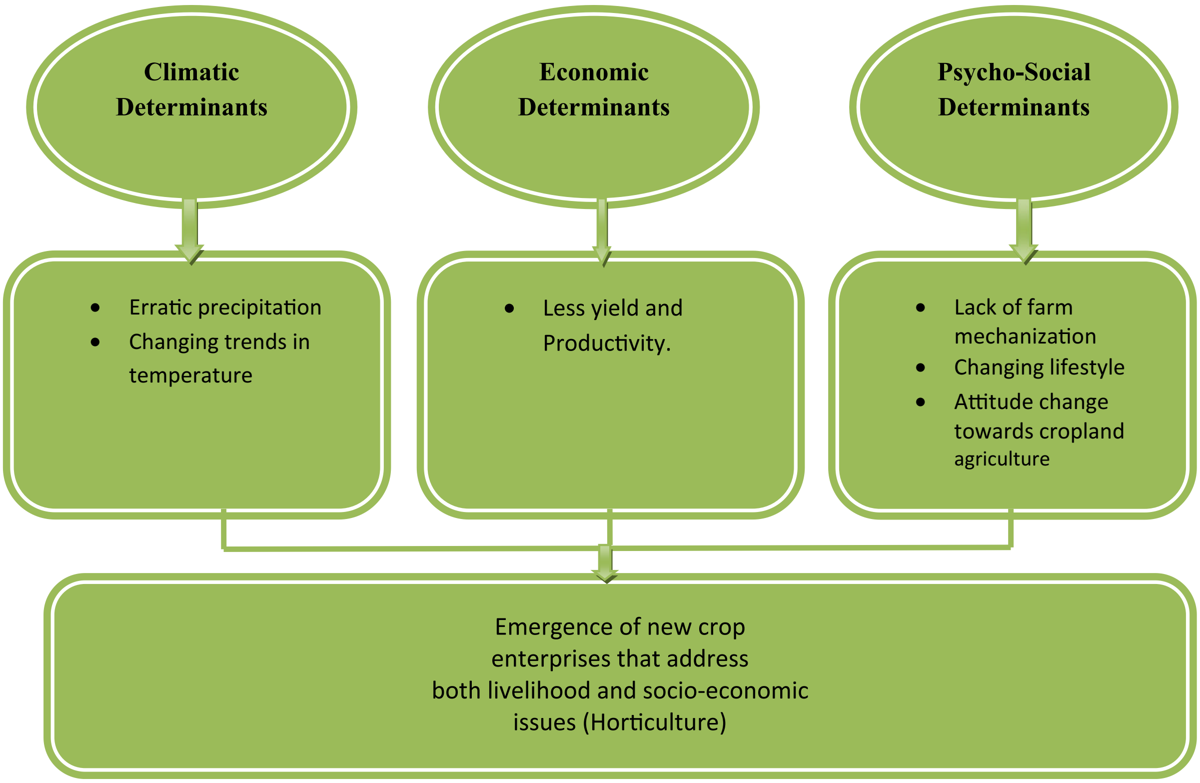


Fig. 6 Hypothetical summary of agricultural land use changes in Shupiyan district: major causes

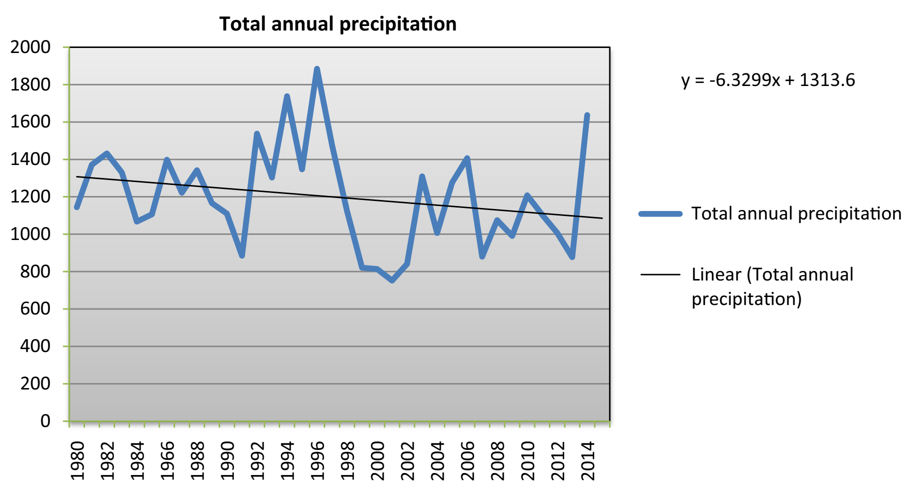


Fig. 7 Total annual precipitation

For average annual precipitation, the test shows a negative value of Z-statistic (−1.567) indicating an insignificant (NS) trend. The non-significant trend of Mann–Kendall test is indicative of decreasing precipitation across the time series.

Economic determinants

Farmers tend to keep highly productive cropland in cultivation regardless of changing economic conditions. But economic conditions, such as changing

Fig. 8 Annual mean minimum temperature

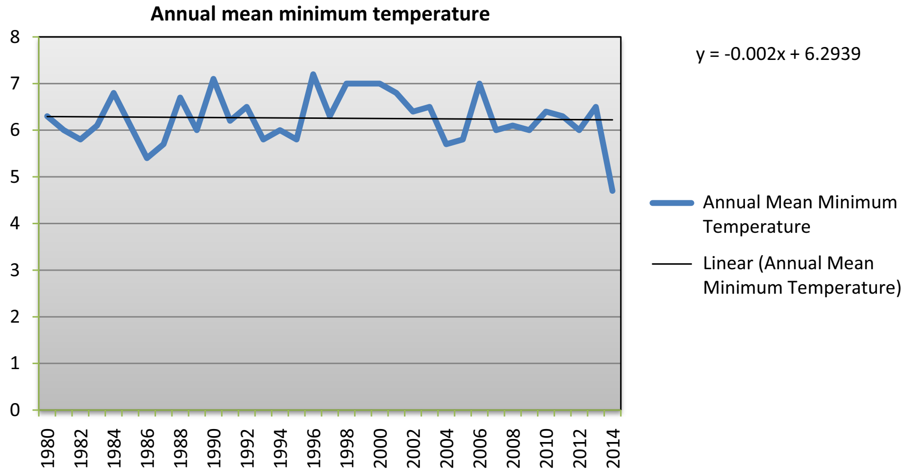


Fig. 9 Annual mean maximum temperature

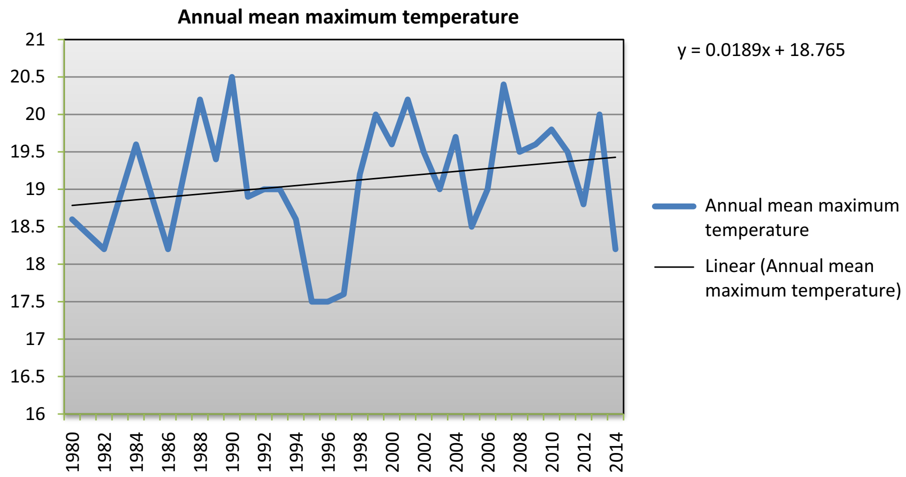
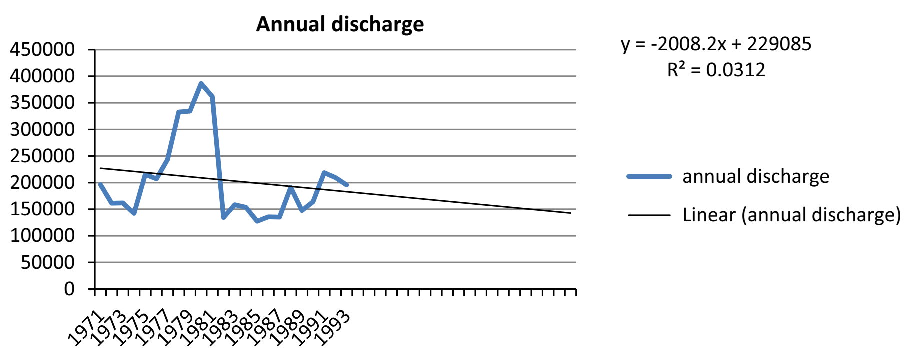


Fig. 10 Annual discharge



commodity prices or production costs, encourage farmers to expand production to less productive land or to shift less productive croplands to other uses. Agricultural and conservation policies also affect land use (Lubowski et al. 2006).

Besides, the climatic ones, economic determinants have a major role in motivating the agriculturists to look for greener pastures outside the regular cropping exercise. The economic growth leads to overall development of the individual as well as the society.

Table 1 Mann–Kendall test

Technique	Climatic attribute	Mean	Median	SD	Z-score	a = 0.10	a = 0.05	a = 0.01	Result
Mann–Kendall test	Mean maximum temperature	19.10	19	0.79	1.633	1.645	1.96	2.576	S (0.1)
	Mean minimum temperature	6.25	6.2	1.96	0.128	1.645	1.96	2.576	NS
	Annual precipitation	1199.6	1166	271.7	1.567				NS (0.1)

The improvement in economic conditions leads to improvement in purchasing power which in turn influences and determines the future occupation of the said population. During the last few decades, diversification of agriculture in State towards high value commodities, i.e. fruits, vegetables and livestock products is taking place at a faster pace and is reflected by the high share of High Value Commodities (HVCs) vis-a-vis agricultural production in number of districts (Department of Finance and Planning). Sustained economic and income growth, are fuelling rapid growth in demand for high value commodities in the State. In Shupiyan, High Value Horticulture has a comparative advantage in production and labor absorption over staple food items and thus is reckoned as an important activity for orchard holders.

In the study area, Farmers have opted to shift the land from agriculture to Horticulture in response to increasing economic benefits in the form of profits and output from the latter as compared to the former. 85 % people have opted for Horticulture inspite of higher inputs in the same as compared to output because the profits are manifold large than the latter. The Average input per Acre in the case of agriculture is Rs. 26,400 as compared to Horticulture with an Average input of Rs. 156,000 for the same quantity of land, but at the same time the output/Acre for agriculture is only 36,000/annum and about 9lacs/annum for horticulture. In addition, there has been an introduction of Bulgarian and other modern root stocks imported from France, Italy, and U.S.A., which include M9 and M26 in the recent years. These are developed on high density orchards, which yield fruit from the third year itself and have got the capacity to produce three times more than, conventional orchards per unit area. However, these require high establishment costs, trained and skilled manpower, assured irrigation which everybody cannot afford. Obviously, Farmers will choose to stay with orchards cultivation and expand them wherever possible (Fig. 11; Table 2).

Psycho-social indicators

The human population also affects land use patterns through behavior. Motivations, personal histories, attitudes, and individual perceptions of land managers influence land-use change decisions, sometimes profoundly. The intended and unintended land-use change decisions all depend on the knowledge, information, and management skills available to land managers, and these in turn are often linked to economic conditions (Figs. 12, 13).

Farmer's responses were noted to study the common behavioral aspects. Out of the total no. of farmers surveyed, different responses were observed from people of different educational categories. About 90 % of the highly educated group and 70 % of the secondary educated ones were inclined towards Horticulture, and about 58 % people who had obtained basic education were inclined towards horticulture.

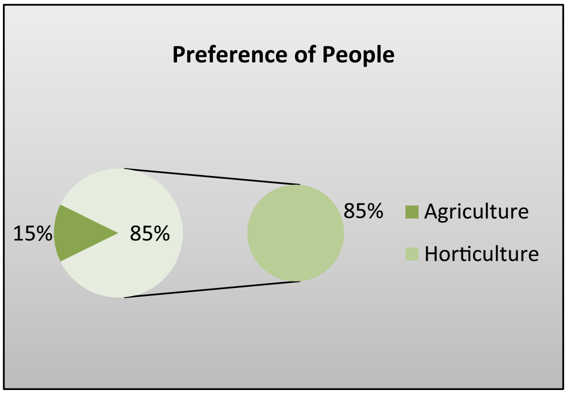


Fig. 11 Preference of people. *Source*: Primary Survey (2015)

Table 2 Input/output in agriculture vs horticulture. *Source*: Primary Survey (2015)

Agriculture	Input (in rupees/acre)	Output(in rupees/acre)	Horticulture	Input(in rupees/acre)	Output(in rupees/acre)
Plough	3200	36,000	Fertilizer	20,000	8–10 Lacs
Seeds	800		Insecticides	64,000	
Nursery	1600		Plucking	28,000	
Planting	4800		Packaging	36,000	
Deweeding	2400		Paper	4000	
Harvesting	5600		Pruning	24,000	
Thrashing	4800		Tilling	8000	
Carriage	3200				
Total	26,400	36,000		156,000	9 Lacs

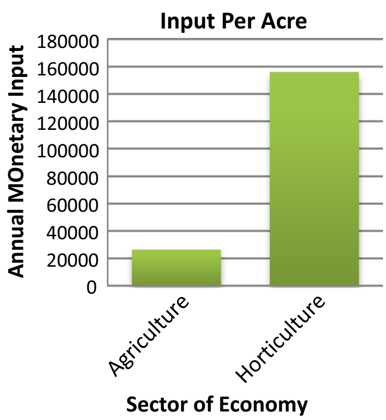


Fig. 12 Input per acre. *Source*: Primary Survey (2015)

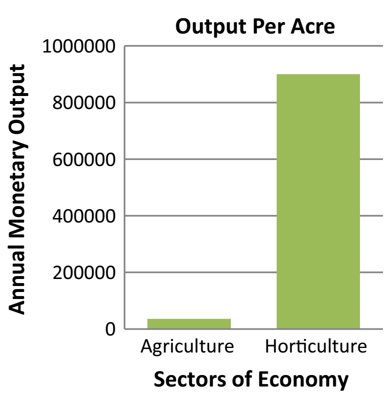


Fig. 13 Output per acre. *Source*: Primary Survey (2015)

This shows the bias of attitude towards different land uses across people of different educational levels. The bias was also very prevalent among the people of different income categories, with about 82 and 61 % of the high and middle income groups respectively preferring horticulture over agriculture and comparatively about 73 % of the low income groups giving preference to agriculture. The bias can be ascertained to the factor that high and middle income groups are economically well off and can easily manage the huge inputs for horticulture enterprise in the form of mechanization, pesticides, insecticides, fertilizers etc. but the people belonging to the economically undermined category can only manage low inputs for agriculture, which are meager as compared to that of horticulture (Tables 3, 4).

A very high degree of difference was found in the perception level of mechanization and ease of operations among people between agriculture and horticulture. About 72 % people found that Horticulture from its inception till date is progressively mechanized at every stage whereas about 28 % people found that agriculture is still at its initial stage of mechanization. Further, the rapid development of horticulture owing to various factors during recent years has pushed people to go for more and more mechanization while declining interest of people in pursuing cropland agriculture has acted as barrier in the advancement of mechanization for the same. Ease of operations is a very important factor in providing people a choice to opt for a particular land use which suits them better. In this case 76 % people found horticulture to be less laborious and more at ease to operate than the cropland agriculture which is comparatively more laborious.

Conclusion

Land use changes are usually natural but human factors sometimes accelerate these changes beyond

Table 3 Respondents perception on agriculture vs horticulture. *Source*: Primary Survey (2015)

Indicator	Different levels	Perception of respondents preference towards a particular land use and their reasons			
		Agriculture		Horticulture	
		% age	Reason	% age	Reason
Education	Basic	58	Lack of awareness in advances in the agricultural diversification,	42	Level of awareness increases, Psychological setup making it easy to adapt with changing lifestyle
	Secondary	30	Economically stable, Food security,	72	
	Higher	10		92	
Income levels	Lower	73	Following Family traditional methods of Agriculture	21	Credit facilities availed by a small segment
	Middle	39	To avail food security,	61	
	Higher	12		82	High awareness levels, readiness to take risks.

Table 4 Respondents perception on agriculture vs horticulture. *Source*: Primary Survey (2015)

Indicator Mechanization	Agriculture (%)	Horticulture (%)	Respondents reasons
Initial stages of mechanization	28		Psychological inclination towards horticulture has led to tremendous advancement in applying latest techniques, methods and equipments.
Progressively mechanized		72	
Ease of operations	24	76	As the mechanization increases Horticulture has become comparatively less laborious and less time consuming

the permissible natural limits. In the case of the present study, undoubtedly the natural forces have proven to be the triggering forces for initiating the conversion of agricultural land into horticulture but the economic and Pyscho-social factors have also played a pivotal role in the further consolidation of this change. The change is in favor of horticulture, which is gaining momentum and is fast emerging as the major land use pushing cropland agriculture to the second place. Though this change may have proved to be fruitful and economically beneficial for the population living in the study area, but in the long run this change has far reaching consequences. The most important impact of this change is the decreasing self sufficiency in the food grains particularly rice which is the staple food of the Kashmir Valley. In the recent years, rice in large quantities is being imported from the other states and food dependency is increasing day by day. This situation of food insecurity has large scale ramifications and effective management strategies are needed to address the problem at this crucial juncture.

Acknowledgements The authors would like to acknowledge District Administration Shopian (J & K) for facilitating the Field Surveys. We are also thankful to Indian Meteorological Department, Srinagar for providing us with the necessary climatic data. The Department of Geography & Regional Development, University of Kashmir is also acknowledged for providing us with Infrastructural facilities.

References

Ahmed, P., & Rashid, S. M. (2009). *Dynamics of land use/land cover change in Kahmil catchment of Pohru River using remote sensing and GIS* (pp. 236–244). Laxmi Nagar Delhi: Jamia Geographical studies Manak publications Pvt. Ltd.

Antle, J. M., & Capalbo, S. M. (2001). Econometric-processes models for integrated assessment of agriculture production systems. *American Journal of Agricultural Economics, 83*(2), 389–401.

Baulies, X., & Szejwach, G. (1998). LUCC data requirements workshop survey of needs, gaps and priorities on data for land-use/land-cover change research organized by IGBP/IHDP-LUCC AND IGBP-DIS, Barcelona, Spain, 11–14 November 1997 LUCC Report Series no. 3.

Benin, S., Smale, M., Pender, J., Gebremedhn, B., & Ehui, S. (2004). The economic determinants of cereal crop diversity on farms in the Ethopian Highlands. *Agricultural Economics, 31*(197), 208.

Chrysoulakis, N. et al. (2004). Combining satellite and socio economic data for land-use models estimation. In R. Goossens (Ed.) *Proceedings of 3rd Workshop of EARSel interest group on remote sensing in developing countries.*

Department of Horticulture. (2011). Directorate of Horticulture, J&K Govt.

Digest of Economics and Statistics. (2011–2012). Published by Directorate of Economics and Statistics Government of Jammu and Kashmir.

Fresco, L. O. (1993). Imaginable futures. A contribution to thinking about land use planning. In *Presentation to the international conference the future of the land*, Wageningen.

Hipel and Mcleod. (2005). *Time series modelling of water resources and environmental systems*. Amsterdam: Elsevier Science Pub Co.

Jaswal, A. K., & Rao, G. S. P. (2010). Recent trends in meteorological parameters over Jammu & Kashmir. *Mausam, 61*(3), 369–382.

Karwariya, S., & Goyal, S. (2011). Land use and land cover mapping using digital classification technique in Tikamgarh district, Madhya Pradesh, India using remote sensing. *International Journal of Geomatics and Geosciences, 2*(2), 519–529.

Lakew, D., Menale, K., Benin, S., & Pender, J. (2000). *Land degradation and strategies for sustainable development in the Ethiopian Highlands: Amhara Region*. Socio-Economics and Policy research working paper 32, 122.

Lambin, E. F., Turner, B. L. II, Geist, H. J., Agbola, S. B., Angelsen, A., Bruce, J. W., et al. (2001). The causes of land-use and land-cover change: Moving beyond the myths. *Global Environmental Change: Human and Policy Dimensions*, *11*(4), 5–13.

Lubowski, R. N. et al. (2006). *Environmental effects of agricultural land-use change*. The role of economics and policy, economic research report USDA.

Maddison, D. (2007). *The perception of and adaptation to climate change in Africa*, World Bank eLibrary.

Mann, H. B. (1945). Nonparametric tests against trend. *Econometrica*, *13*, 245–259.

Meyer, W. B., & Turnor, B. C. (1994). *Change in land use and land cover: A global perspective*. Cambridge: Cambridge University Press.

Moran, E. F. (2001). Progress in the last ten years in the study of land use/cover change and the outlook for the next decade. In A. Diekmann, T. Dietz, C. C. Jaeger & E. A. Rosa (Eds.), *Human dimensions of global change*. Cambridge: MIT Press.

Ngailo, J. A., Kiwambo, B. J., Baijukya, F., Kaihura, F. B. S., & Ndondi, P. M. (2001). *Land use changes in response to peri-urban pressures in Arumeru district, Arusha Region Tanzania*. PLEC Project Tanzania Sub-cluster.

Quentin, F. B., Jim, C., Julia, C., Carole, H., & Andrew, S. (2006). *Drivers of land use change, final report: matching opportunities to motivations*. ESAI project 05116, Department of Sustainability and Environment and primary industries, Royal Melbourne Institute of Technology, Australia.

Turner, B. L. (2001). Land-use and land-cover change: Advances in 1.5 decades of sustained international research. *GAIA-Ecological Perspectives in Science, Humanities, and Economics*, *10*(4), 269–272.

Wang, G. et al. (2009). Quantification of effects of climate variations and human activities on runoff by a monthly water balance model: A case study of Chaobai River basin in northern China. *Water Resource Research, 45*(7).

World Bank report. (1998). http://elibrary.worldbank.org/doi/abs/10.1596/0-8213-4192-8.

Xia, J., et al. (2011). Opportunity and challenge of the climate change impact on the water resources of China. *Advances Earth Science, 26*(1), 1–22.

Webliography

Unpredictable rainfall forces Kashmir rice farmers into Horticulture, Global Press Journal (2014) www.globalpressjournal.com.