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Interannual Variation in Area and Productivity of Crops as Influenced by Rainfall, Soil and Land Holding in Changeri Micro-watershed of Udaipur District of Rajasthan

Aditya Kumar Singh[1], R.S. Singh[1], S.K. Singh[2] and R.L. Shyampura[1]

[1] *National Bureau of Soil Survey & Land Use Planning (ICAR), Regional Centre, Udaipur 313002, India*

[2] *Central Arid Zone Research Institute, Jodhpur 342 003, India*

Abstract: Reasons for yield gap on the farms owned by medium to large farmers and marginal to small farmers have been investigated based on the socio-economic survey of 130 farm families and soil characteristics. Reasons for inter-annual variation in land use pattern from 2002 to 2004 were also studied simultaneously. Better soil conditions such as depth, texture, water holding capacity, slope and good management were the causes for 30 to 50% higher yield on the farms owned by medium to large farmers as compared to the farms belonging to marginal to small farmers. Food habits and dietary needs control the area for maize, whereas per capita return and lower water requirement influenced the area under groundnut, mustard and cumin. Sub-optimal rainfall sometimes led to increased area under sorghum at the cost of other kharif crops. Water available for irrigation, which is declining on account of depleting ground water resources, decided the area of wheat crop.

Key words: Land holdings, constraints of production, soils, prices of crops, selection of crops.

The increasing demand for intensification of existing cultivation, especially in the areas with less favorable conditions, implies that a new equilibrium need to be achieved between human factors, socio-economic conditions and environmental factors. Depending upon soils and site characteristics, Ricquier *et al.* (1970), Storie (1954), Sanchez and Cochrane (1980); and Sys *et al.* (1991) have devised schemes of land use planning for achieving such equilibrium. These scientific land use plans are far from the total adoption. The yield gap between the farms owned by resource rich farmers and resource poor farmers has widened between the yields at research farm and farmers field. Peoples' needs, their socio-economic status and aspirations are not taken into consideration while developing land use plan and technologies for them.

An attempt has been made to understand the peoples' aspirations and their demand in a watershed at Changeri representing major landforms and soils of Udaipur district.

Materials and Methods

Udaipur district covers 14.62 lakh ha (4.27% of the Rajasthan) areas, with 34.3% area under hills and uncultivable land while 27.7% is under forest and 6.3% is under pasture land. The culturable waste and fallow cover another 8.9 and 6.8% area, respectively. Agriculture is being practiced

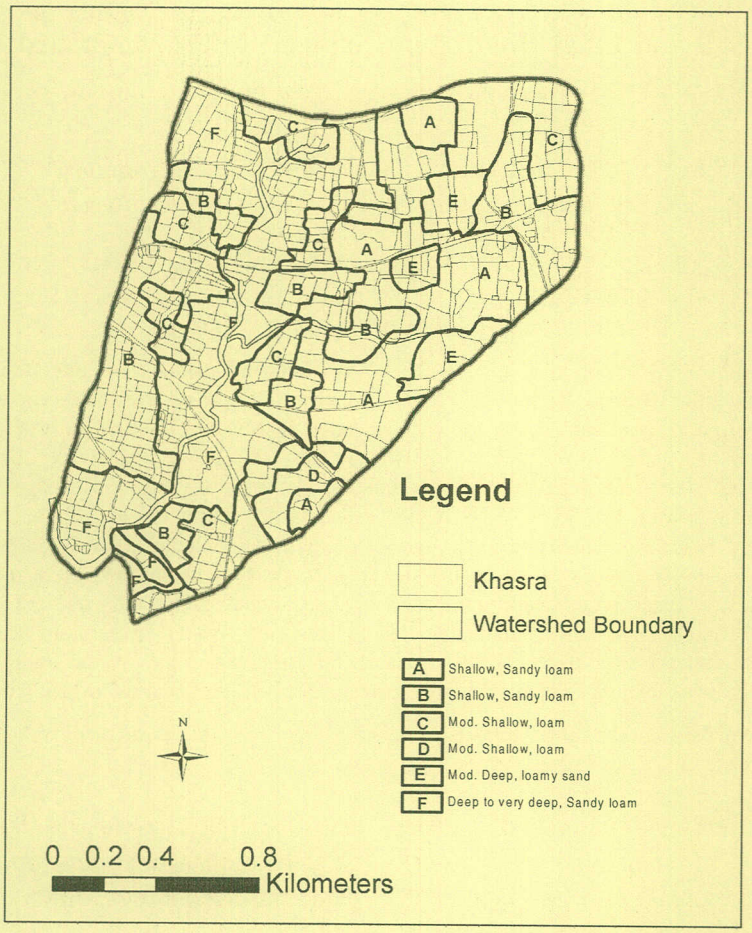

Fig. 1. Khasra-wise soil map of Changeri watershed.

only on the 16% area. The district as such represents hot, dry, semi-arid (Aravalli East Upland) AESR 4.2 with LGP of 90-120 days where a sample watershed (257 ha) in Khempur catchment was selected. The rainfall received in the watershed was 234, 324 and 434 mm in the years 2002, 2003 and 2004, respectively.

The detailed soil survey of the micro-watershed was done on 1:4000 scale and the soil map showed the variation of soil depth, texture and $CaCO_3$. Map units A and B, occur on hills and associated valley and soils with 50 to 60 mm AWC belong to loamy and coarse loamy family of Lithic and Typic Haplustepts. Map units C and D comprise medium deep soils (50-75 cm), with 90 mm AWC and the soils are classified as a member of fine loamy, mixed calcareous, hyperthermic family of Typic Haplustepts. The soils in map units E and F are deep to very deep with AWC, ranging from 125 to 160 mm. These are classified as a member of fine loamy, mixed with hyperthermic

family of Typic Haplustepts. The village Khasara-wise map of the watershed was digitized simultaneously with soil map in GIS and the same was superimposed on soil map for an understanding the soil characteristics of each farm (Fig. 1). The results showed that medium and large farmers dominantly hold slightly eroded deep to very deep fine loamy soils on nearly level plain, while marginal to small farmers are blessed with moderately to severely eroded shallow soils on 3 to 8% slope.

Based on the size of holding socio-economic survey of 130 farm families was accomplished during the year 2000. The socio-economic condition and information on area of different crops, number of irrigations and productivity of each of them was attached with the combined Khasara and soil map data in GIS for an understanding of relationship among soil type and holding size (Table 1).

Results and Discussion

Maize is the staple food crop, consistently grown on 50-60% area of the watershed from 2000-03. During the period around 80% of the farmers had followed the crop rotation. Area under sorghum for fodder was increased during 2003 because of sub-optimal rain, which was insufficient for producing grains. During 2004 the area was shifted to other value-added crops because of good rainfall. The area under groundnut remained unchanged in 2002 and 2003; however, it was increased in 2004 because of higher market prices. Area under sesame was the highest during 2002 because of low rainfall (234 mm) in the watershed. Rainfall was higher in the subsequent years 2003 (324 mm) and 2004 (434 mm). Consequently the area under sesame was reduced drastically (Table 2). The area under clusterbean was doubled in the year 2003 because of increased market price. However, during 2004 price declined consequently the area was also reduced. Soybean crop has been recently introduced; its expansion was not much because of higher water requirement.

The area under mustard was highest in 2001-02 and it was reduced considerably in 2002-03 because of subnormal rainfall. The crop acreage again increased in 2003-04 with better rainfall and good market prices. The observation is in agreement with Gulati

Table 1. Category of farmers and soil description in year 2000

Category	Holding size (ha)	No. of farmers	Soil description
Marginal	<0.5	25	Moderately eroded soils (around 60%) are dominantly 40-50 cm deep on 3-8% slope
Small	0.5-1.0	31	Moderately eroded soils (around 42%) are 40-50 cm deep on 3-8% slope
Semi-medium	1.0-2.0	37	Moderately eroded soils (around 42%) are 40-50 cm deep on 3-8% slope
Medium	2.0-5.0	31	Slightly eroded soils (around 90%) are 65-100 cm deep on 1-3% slope
Large	>5.0	6	Slightly eroded soils are 65-100 cm deep on nearly level plain (<1%)

Table 2. Crop area in Changeri watershed

Crop/year	2002		2003		2004	
	Area (ha)	Price, Rs. (100 kg)	Area (ha)	Price, Rs. (100 kg)	Area (ha)	Price, Rs. (100 kg)
Kharif						
Maize	82.97	477	82.59	566	83.91	491
Groundnut	12.30	1258	12.60	1576	34.40	1724
Sorghum	12.80	448	34.00	626	11.20	458
Sesame	19.00	1606	17.60	2426	11.50	2801
Soybean	0.00	882	0.90	1183	2.84	1425
Rabi						
Wheat	6.20	670	1.90	591	3.80	620
Mustard	40.00	1156	5.90	1372	18.80	1764
Cumin	3.10	9000	11.30	8000	2.40	7000

Prices source: Krishi Mandi, Fatehnagar.

and Kelley (1999). They concluded that prices are the main motivating factors in changing the land use over time. Similarly the area under wheat was also highest in 2001-02 and declined thereafter because of low rainfall. Farmers were forced to go for low water requiring crops like cumin. The area under this crop was the highest in 2002-03 due to low water requirement and higher prices. In the year 2003-04 the area was brought under mustard because cumin field harbors many pests and diseases after two successive years of cultivation. The area under barley was continuously declining because of agricultural drought in the watershed and other low water requiring crop cumin/ mustard became more popular.

Reasons for yield gap in the watershed

Average yield obtained by the medium to large farmers was 25-40% higher as compared to small to marginal farmers (Table 3). Yield variation was higher in maize as compared to groundnut in rainfed situation. The yield gap was maintained for mustard crop in rabi, while it was narrowed down for wheat under irrigated conditions. Rathore and Kalla (2003) also observed significant difference in yield on the farms of marginal, small and large

Table 3. Land holding in relation to area and yield in Changeri watershed (2000)

Category	Maize		Groundnut		Wheat		Mustard	
	Area (ha)	Yield (kg ha^{-1})	Area (ha)	Yield (kg ha^{-1})	Area (ha)	Yield (kg ha^{-1})	Area (ha)	Yield (kg ha^{-1})
Marginal	7.60	890	–	–	2.40	2750	2.48	800
Small	15.80	960	2.16	900	5.44	3120	6.48	730
Semi-medium	26.30	970	4.00	960	6.00	3040	7.12	790
Medium	31.28	1400	7.60	1160	11.00	3410	9.28	1080
Large	15.20	1500	0.56	1340	3.52	3590	3.04	1190

farmers in the watersheds. Similar observation was made by Gaddi *et al.* (2002) and Singh *et al.* (2002). The basic reason for low yield in marginal and small farmers was that about 60% of land holdings in marginal category and 42% land holding of small category were having shallow soils (<50 cm soil depth, slope ranging from 3-8% and with moderate erosion) with 50-60 AWC (Table 1). On the other hand almost all the land holding of medium to large farmers were having moderately deep to deep soils (>75 cm) with AWC of 90-160 mm. The result corroborates with the observation of Reddy and Sen (2004).

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