

Comparing Performance of Various Crops in Rajasthan state based on Market Price, Economic Prices and Natural Resource Valuation

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ABSTRACT

The study has assessed the performance of different crops and cropping pattern in the state of Rajasthan using alternative price scenarios like market prices; economic prices (net out effect of subsidy) and natural resource valuation (NRV) considering environmental benefits like biological nitrogen fixation and greenhouse gas costs. The study has used unit-level cost of cultivation data for the triennium ending 2013-14 which were collected from Cost of Cultivation Scheme, MPUAT, Udaipur (Raj.) for the present study. It has analyzed crop-wise use of fertilizers, groundwater, surface water and subsidies. The secondary data of cropping pattern was also used from 1991-95 to 2011-14 from various published sources of Government of Rajasthan. The study that even after netting out the input subsidies and effect on environment and natural resources, the cotton-vegetables cropping pattern was found more stable and efficient because of the higher net return of ₹ 102463 per hectare with the next best alternate cropping patterns like clusterbean-chillies (₹ 86934/ha), cotton-wheat (₹ 69712/ha), clusterbean-wheat (₹ 64987/ha) etc. under the set of marketing infrastructure, minimum support prices, agricultural technological know-how, climatic conditions in the various zones, available irrigation facilities. The study has pointed out that the grower farmers may not move towards the diversification until incentivized by economically attractive alternate cropping patterns.

Keywords: Crop diversification, cropping intensity, market price, economic price and natural resource valuation

Agricultural land use study has acquired special significance in the realm of the present day problem oriented studies of the growth and resource utilization. At present, per capita availability of cultivable land in India has declined from 0.48 hectare in 1951 to 0.12 hectare in 2014-15 which would be declined to 0.08 hectare in 2050. Agricultural land of India is 182 million hectares and 67 million hectares constitute forest land. Rajasthan with its huge geographical area of 342.7 lakh hectares is the largest state of India. The state is predominantly an agriculture state with 75 per

cent population living in rural areas. Agriculture and allied activities contributed 26.54 per cent of Net State Value Added at constant price 2011-12 while its share in Gross State Value Added is 25.92 per cent during 2016-17 (Economic Review, 2017-18). Agriculture is the single largest sector of the state economy employing 70 per cent labour force directly and indirectly. Rajasthan state has witnessed an extreme level of groundwater over-exploitation. Total annual groundwater draft in the state is 15.71 billion cubic meter which is higher than the sustainable limit of 11.26 billion cubic meter.

Central ground water board has categorized 164 blocks out of 248 blocks as over-exploited which is 68.33 per cent of total assessment unit. Only 17.74 per cent (44 blocks) of the total blocks were categorized in safe category (CGWB, 2017). The Net area irrigated by all sources during 2015-16 was 79.38 lakh hectares as against 78.82 lakh hectare in 2014-15 showing an increase of 0.71 percent. The net irrigated area during 2015-16 constituted 44.04 percent of net area sown in the state. In the Rajasthan state (Agriculture Statistics of Rajasthan, 2015-16), cropping pattern is inefficient in terms of resource use and unsustainable from natural resource use point of view.

This leads to serious misallocation of resources, efficiency loss, indiscriminate use of land and water resources, and it adversely affects long term production prospects. Crop selection at regional level is one such challenge which can be addressed using optimum crop planning. As such regional crop planning is very crucial that helps to formulate region specific crop planning which would optimize the level of each activity of different crops, level of input use and output produced under different resource endowments and price scenarios. It involves area allocation for each of these crops, the sequencing of crops, and the irrigation plans. Best suitable crops and other enterprises should be selected so as to achieve some set of goals particular to the region. Typically, these goals involve the maximization of net income, the minimization of cost, the maximization of total area cultivated, and/or the minimization of irrigation water. Keeping in view the above considerations, a research study entitled “Comparing Performance of Various Crops in Rajasthan state based on Market Price, Economic Prices and Natural Resource Valuation” was conducted.

METHODOLOGY

The study was conducted based on plot level secondary data. The data were collected from the 600 representative households of 60 cluster villages during each year of the block period (2011-12 to 2013-14) from the Cost of Cultivation Scheme, Rajasthan. The secondary data were collected from various published records and reports of Government of Rajasthan and Government of India from the year 1990-91 to 2013-14.

Changes in Cropping Pattern

To capture the extent of diversification in the state, Simpson’s Index (SI) of Diversification has been employed to measure degree of crop diversification and was explained as follows:

$$SI = 1 - \sum (pi / \sum pi)^2$$

Where,

pi is the area proportion of the *i*th crop in total cropped area and

i = 1,2,3,...n. is the number of crops

The value of index increases with the increase in diversification and assumes 0 (zero) value in case of perfect concentration. The crop diversification study was based on time-series data for the time period 1990-91 to 2013-14.

The performance of different crops were assessed by comparing net returns under alternative scenario. These are: (i) Market Price (ii) Economic Price and (iii) Natural Resource Valuation Technique (Raju *et al.* 2015).

Net Returns at Market Prices (NR_{MP})

Net returns at market price was defined as the gross return (value of main product and by product) less variable costs (Cost A1 + imputed value of family labour) at market price actually paid and received by the farmer or imputed in some cases.

$$NR_{MP} = GR - VC \quad \dots(i)$$

Where,

NR_{MP} – Net return at market price,

GR- Gross Returns and

VC- Variable Cost.

Cost A₁ as defined in Manual on Cost of Cultivation Scheme, DES, New Delhi includes all actual expenses in cash and kind in production by the farmer. Some of the components of cost A₁ directly retrieved from the unit level data set of cost of cultivation scheme, while few are estimated for example: depreciation of implements and farm building, interest on working capital has been computed by using the method elaborated in the manual on CCS.

The imputed value of family labour has been calculated as:

Imputed Value of Family Labour = Working Hours of Family Labour × Labour Wage Rate per Hour

Net Returns at Economic Price (NR_{EP})

Net return at economic price was defined as the difference between net return or income at market price and subsidies on inputs like fertilizers and irrigation used in crop production.

$$i.e. NR_{EP} = NR_{MP} - \text{Subsidy} \quad \dots(ii)$$

Thus, subsidy component has internalized into the model, by covering two aspects viz., fertilizer subsidy and irrigation subsidy. Fertilizer subsidy consisted subsidy on nitrogen (N) and combination of Phosphorous (P) and Potassium (K). The total irrigation subsidy included canal, electricity and diesel subsidy and has been distributed over selected crops based on area under irrigation of each crop. Crop wise irrigation subsidy has two components: Ground water subsidy and Surface water subsidy. Ground water subsidy was estimated by initially calculating the crop-wise ground water use, i.e.

Groundwater use (cubic metre) = Irrigation hours (hrs/ha) × Groundwater draft (cum/hr)

The irrigation hours (hrs/ha) for each crop were taken from plot-wise CCS data. CCS does not collect information of ground water draft. Therefore, the groundwater draft was estimated using the following formula:

$$\text{Ground water draft (lit/sec)} = \frac{HP \times 75 \times \text{Pump Efficiency}}{\text{Total Head (m)}}$$

The information on horse power (HP) of the pumps owned by the farmers was available in CCS data set. For the households purchasing groundwater, average HP of the pumps (estimated separately for electric and diesel) in respective tehsil can be taken as proxy. Pump efficiency was assumed to be 40 per cent. The total head was obtained as per below equation:

Total head = Water level (mbgl) + Draw down (m) + Friction loss (10% of water level + Draw down)

Net Returns based on Natural Resource Valuation (NR_{NRV})

Net return based on Natural Resource Valuation (NRV) technique has taken care of nitrogen fixation by legume crops and Green House Gas (GHG) emission from crop production. As such NR_{NRV} was computed by adding value of nitrogen fixation by legume crops at economic price of nitrogen (Value of N) and deducting the imputed value of increase in GHG emission cost to the atmosphere.

$$i.e. NR_{NRV} = NR_{EP} + (\text{Value of N} - \text{cost of GHG}) \quad \dots(iii)$$

Thus, legumes are environment-friendly crops and are different from other food plants because of the property of synthesizing atmospheric nitrogen into plant nutrients. As such, the economic valuation has been done by taking into account the positive externality of legume crops by biological nitrogen fixation and the negative externality of GHG emissions.

RESULTS AND DISCUSSION

Changes in Cropping Pattern

Table 1 indicated that Rajasthan state is basically a foodgrain production state as it occupies more than 50 per cent share of gross cropped area under foodgrains since 1991-95 to 2011-14. There was a sharp decline of 5.46 per cent in the cereals from 43.12 per cent in the year 1991-95 to 37.66 per cent in the year 2011-14 because of decrease in area under bajra by about 6.0 per cent from 24.41 per cent in the year 1991-95 to 18.77 per cent in the year 2011-14 followed by sorghum (1.28%), maize (0.88%) and paddy (0.04%). An increase in area under total pulses was about 2.0 per cent from 14.81 per cent in the year 1991-95 to 16.52 per cent in the year 2011-14 due to an increase in area under greengram by 3.50 per cent. The share of total oilseeds was 17.30 per cent in the year 1991-95 which has increase to 19.43 per cent in the year 1996-2000, thereafter, it decreased and reached to 17.72 per cent in the year 2006-10. Further, it was increased to 20.15 per cent in the year 2011-14. The share of total spice has shown an increase about 1.59 per cent from 1.38 per cent in the year 1991-95 to 2.97 per cent in the year 2011-14 due to major increase in area under cumin from 0.70 per cent in the year 1991-95 to 1.77 per cent

in the year 2011-14 followed by coriander (0.25%). The crops like garlic, onion, potato, ajwain, isabgol, cotton and clusterbean has shown an increase in share of area during the study period.

Table 1: Changes in Cropping Pattern during 1990-91 to 2011-14 in Rajasthan state (per cent of GCA)

Crops	1991-95	1996-2000	2001-05	2006-10	2011-14
Bajra	24.41	21.10	24.38	23.03	18.77
Maize	3.33	3.08	3.56	3.03	2.45
Sorghum	3.81	2.77	3.26	2.89	2.53
Paddy	0.57	0.79	0.64	0.57	0.53
Wheat	9.83	11.79	10.68	8.28	12.17
Barley	1.18	1.01	0.99	0.86	1.22
Total Cereals	43.12	40.55	43.50	38.66	37.66
Pegionpea	0.13	0.15	0.11	0.09	0.07
Greengram	1.60	2.51	3.40	4.07	4.11
Blackgram	0.62	0.72	0.95	0.58	0.79
Mothbean	5.16	5.02	5.86	5.57	4.68
Pea	0.03	0.06	0.14	0.01	0.02
Gram	6.83	8.85	4.40	3.85	6.36
Lentil	0.06	0.17	0.10	0.04	0.14
Cowpea	0.37	0.51	0.62	0.55	0.35
Total Pulses	14.81	17.98	15.59	14.75	16.52
Total Foodgrains	57.93	58.53	59.09	53.41	54.18
Sesamum	2.73	1.42	1.55	1.38	1.83
Groundnut	1.30	1.35	1.23	1.41	1.62
Soybean	1.22	2.48	3.02	3.45	3.86
Castorseed	0.10	0.22	0.38	0.53	0.83
Rapeseed & Mustard	11.18	12.51	10.10	10.56	10.38
Taramira	0.58	1.36	0.95	0.38	1.65
Linseed	0.18	0.07	0.02	0.01	0.01
Sunflower	0.02	0.01	0.00	0.00	0.00
Total Oilseeds	17.30	19.43	17.26	17.72	20.15
Coriander	0.55	0.82	0.83	0.68	0.80
Cumin	0.70	0.75	1.34	0.60	1.77
Fenugreek	0.12	0.16	0.26	0.17	0.28
Fennel	0.01	0.02	0.03	0.03	0.12
Total Spices	1.38	1.76	2.47	1.48	2.97
Garlic	0.03	0.06	0.09	0.07	0.18
Onion	0.07	0.11	0.16	0.15	0.23
Chillies	0.22	0.20	0.09	0.03	0.04
Potato	0.01	0.01	0.02	0.03	0.04
Ajwain	0.06	0.08	0.06	0.05	0.07
Isabgol	0.00	0.34	0.52	0.57	0.81
Tobacco	0.03	0.03	0.05	0.01	0.00

Sugarcane	0.12	0.12	0.05	0.03	0.02
Cotton	1.44	3.03	2.28	1.43	1.81
Clusterbean	7.44	9.52	10.69	12.79	15.60
Other Crops	11.93	6.82	7.22	12.25	3.90
GCA ('000 ha)	19455	20676	19195	21992	25145
	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)
Cropping Intensity (%)	127	134	130	138	150
Crop Diversification Index (S.I.D.)	0.87	0.87	0.87	0.86	0.88

Source: Various Issues of Statistical Abstract of Rajasthan, Agricultural Statistics of Rajasthan, Government of Rajasthan.

The clusterbean contributed remarkable share in gross cropped area and has shown significant increase about 8.0 per cent share of area from 7.44 per cent in the year 1991-95 to 15.60 per cent in the year 2011-14 due to its commercial use as guar gum etc. whereas chillies, tobacco, sugarcane has shown slight decrease in area during the study period. The other crops like sugarcane, mehandi, jute, etc. also contributed the remarkable share in gross cropped area during the year 1991-95, it was 11.93 per cent but decreased to 7.22 per cent in the year 2001-05.

Thereafter, it was significantly increased to 12.25 per cent during the year 2006-10 and further it was again significantly declined to 3.90 per cent in the year 2011-14. During the overall study period, the cropping intensity has increased by 23 per cent (127% to 150%). It seems that because of increase in irrigation facilities and technological development efforts, the intensity of crop cultivation has increased in the state. The crop diversification index has slightly increased by 0.01 (0.87 to 0.88) but closer to one thus indicated that there was more diversification of crops from sowing of traditional crops like bajra, maize, paddy, sorghum, sesamum, groundnut, *kharif* pulses, wheat, barley, gram and rapeseed & mustard towards the high value crops like castorseed, clusterbean, soybean, cotton, cumin, fennel, coriander, ajwain, isabgol, opium, vegetables, fruit orchards etc. Thus, it can be concluded that total pulses, total oilseeds, total spices, garlic, onion, potato, ajwain, isabgol, cotton and clusterbean has shown an increase in the percentage share of area during the study period while total cereals, total foodgrains, chillies, tobacco, sugarcane and other crops has shown a decrease in share of area from the period 1991-95 to 2011-14.

Comparative Cost and Returns based on Market Price (MP)

The comparative returns at market price along with variable cost for various crops in Rajasthan during TE 2013-14 were analyzed and presented in Table 2. Among the *kharif* crops, cotton cultivation in Rajasthan state has shown the highest variable cost of cultivation *i.e.* ₹ 51787 per hectare followed by paddy (₹ 52870/ha), groundnut (₹ 34568/ha) and it was observed lower the cost of cultivation in sesamum (₹ 12234/ha) whereas among the *rabi* crops, the variable cost was highest in onion cultivation (₹ 71069/ha) followed by garlic (₹ 69808/ha), berseem (₹ 54165/ha) and it was found lowest in coriander (₹ 18278/ha). The crops like wheat, barley, bajra, maize, sorghum and rapeseed & mustard requires the lower cost of cultivation.

Table 2: Comparative Cost and Returns of Various Crops based on Market Price in Rajasthan during TE 2013-14 (₹/ha)

Sl. No.	Crops	Variable Cost (A1+FL)	Gross Return	Net Return at Market Price
A Kharif Crops				
1	Bajra	19585	24403	4818
2	Sorghum	16799	20611	3812
3	Maize	25720	32901	7181
4	Paddy	52870	74571	21700
5	Cowpea	13276	15288	2012
6	Blackgram	15225	18017	2793
7	Greengram	21231	30076	8846
8	Mothbean	14135	9379	-4756
9	Lentil	22549	40780	18231
10	Sesamum	12234	21429	9195
11	Soybean	17499	36576	19077
12	Groundnut	34568	56124	21555
13	Castorseed	25541	53344	27803
14	Cotton	51787	93216	41430
15	Clusterbean	18406	48111	29705
B Rabi Crops				
1	Wheat	32285	70308	38022
2	Barley	30904	58809	27904
3	Gram	18763	38776	20014
4	Rapeseed & Mustard	22585	53781	31195
5	Cumin	23047	31984	8937
6	Coriander	18278	46917	28639
7	Fenugreek	23256	39272	16016

8	Onion	71069	90588	19519
9	Garlic	69808	101066	31258
10	Chillies	48559	106496	57936
11	Vegetable	37714	105352	67638
12	Berseem	54165	72794	18630

Source: Plot Level Cost of Cultivation Data of Rajasthan (TE 2013-14).

The gross return among the *kharif* crops has shown highest by cotton growers with ₹ 93216 per hectare followed by paddy (₹ 74571/ha), groundnut (₹ 56124/ha) and gross return lowest produced by mothbean (₹ 9379/ha) while among *rabi* crops, the gross return was highest in chillies production (₹ 106496/ha) followed by vegetables (₹ 105353/ha), garlic (₹ 101066/ha), onion (₹ 90588/ha), wheat (₹ 70308/ha) and it was found lowest by cumin production *i.e.* ₹ 31984 per hectare. The net return over variable cost was seen highest among *kharif* crops in cotton cultivation *i.e.* ₹ 41430 per hectare followed by clusterbean (₹ 29705/ha), castorseed (₹ 27803/ha) and lowest return observed in cowpea production (₹ 2012/ha). Whereas among *rabi* crops, the vegetable production has shown the highest net return over variable cost of ₹ 67638 per hectare followed by chillies (₹ 57936/ha), wheat (₹ 38022/ha) and lowest was seen in cumin cultivation (₹ 8937/ha). Mothbean cultivation in Rajasthan has shown the negative net return over variable cost of (₹ -4756/ha). Results from the table indicated that cotton-vegetable combination of cropping pattern in overall Rajasthan has shown the highest return at market price of ₹ 109068 per hectare followed by cotton-chillies (₹ 99366/ha) and cotton-wheat (₹ 79452/ha).

Net returns based on economic price (EP)

The net returns based on economic prices for various crops in Rajasthan during TE 2013-14 were analyzed by deducting the input subsidies like NPK, electricity and diesel subsidies and has been presented in Table 3. Among all the crops, paddy cultivation received the highest NPK subsidy of ₹ 5046 per hectare followed by wheat (₹ 3195/ha), garlic (₹ 2841/ha), coriander (₹ 2617/ha) and cotton (₹ 2594/ha) because of the intensive use of fertilizer component in producing of these crops and lowest subsidy received by cowpea (₹ 17/ha). Electricity subsidy was highest use in onion cultivation

(₹ 2678/ha) followed by wheat (₹ 2284/ha) and barley (₹ 1667/ha) and it was found lowest in sorghum (₹ 15/ha) whereas onion cultivation has also shown the highest use of diesel subsidy of ₹ 360 per hectare followed by vegetables (₹ 307/ha), barley (₹ 290/ha) and lowest was use in greengram cultivation of ₹ 1/ha. However, in overall total subsidy, wheat crop has received the highest total subsidy of ₹ 5714 per hectare followed by paddy (₹ 5492/ha), onion (₹ 5012/ha), garlic (₹ 4481/ha) because of the higher use of fertilizer, electricity and diesel component in the cultivation of these crops and lowest was used in mothbean (₹ 50/ha). After deducting the total subsidies from the net return at market prices, the net return based on economic prices was found highest in cotton cultivation with ₹ 37587 per hectare followed by clusterbean (₹ 29329/ha), castorseed (₹ 26288/ha) and it was seen lowest in cowpea (₹ 1939/ha) among the *kharif* crop while among the *rabi* crops, vegetables has shown the highest net return of ₹ 65111 per hectare followed by chillies (₹ 54307/ha), wheat (₹ 32308/ha) and lowest was found in cumin cultivation (₹ 7036/ha). Among all the crops, the net return based on economic prices has shown the negative performance in the mothbean cultivation (-₹ 4806/ha).

Table 3: Crop-wise Net Returns based on Economic Price in Rajasthan during TE 2013-14 (₹/ha)

Sl. No.	Crops	NPK Subsidy	Electricity Subsidy	Diesel Subsidy	Total Subsidy	Net Return at Economic Price
A Kharif Crops						
1	Bajra	792	150	19	961	3857
2	Sorghum	727	15	99	841	2972
3	Maize	2553	238	100	2891	4290
4	Paddy	5046	445	—	5492	16209
5	Cowpea	17	56	—	73	1939
6	Blackgram	489	19	—	508	2284
7	Greengram	462	65	—	527	8318
8	Mothbean	21	30	—	50	-4806
9	Lentil	1781	160	98	2039	16192
10	Sesamum	102	252	6	360	8835
11	Soybean	597	75	—	672	18406
12	Groundnut	1353	713	40	2106	19450
13	Castorseed	562	934	20	1515	26288
14	Cotton	2594	1037	211	3843	37587
15	Clusterbean	214	151	10	376	29329

B Rabi Crops						
1	Wheat	3195	2284	236	5714	32308
2	Barley	1731	1667	290	3687	24217
3	Gram	493	336	38	867	19147
4	Rapeseed & Mustard	2072	1137	150	3360	27836
5	Cumin	878	981	41	1900	7036
6	Coriander	2617	820	4	3441	25198
7	Fenugreek	963	983	83	2029	13987
8	Onion	1973	2678	360	5012	14507
9	Garlic	2841	1505	135	4481	26777
10	Chillies	1954	1643	33	3630	54307
11	Vegetable	1029	1192	307	2527	65111
12	Berseem	2547	1439	64	4049	14580

Source: Estimated using Plot Level Cost of Cultivation Data of Rajasthan (TE 2013-14).

Note: Subsidy @ ₹ 24.00/kg of N, ₹ 24.27/kg of P and ₹ 23.19/kg of K for TE 2013-14, Diesel Subsidy @ ₹ 12.95 per litre, Electricity subsidy @ ₹ 3.03 per unit during TE 2013-14.

Net returns based on natural resource valuation (NRV)

The net returns based on natural resource valuation for various crops in Rajasthan during TE 2013-14 were analyzed by taking into account the positive impact of biological nitrogen fixation through the legume crops and negative impact of GHG emissions and has been presented in Table 4. The legume crop like groundnut has shown the highest economic contribution of ₹ 4560 per hectare through biological nitrogen fixation followed by soybean (₹ 3865/ha) and gram (₹ 3140/ha) while lentil fixed the nitrogen worth ₹ 1993 per hectare.

Table 4: Crop-wise Net Returns based on Natural Resource Variation in Rajasthan during TE 2013-14 (₹/ha)

Sl. No.	Crops	Value of Nitrogen	Value of GHG	Net Return at NRV
A Kharif				
1	Bajra	0	112	3745
2	Sorghum	0	112	2860
3	Maize	0	159	4131
4	Paddy	0	1128	15081
5	Cowpea	3110	97	4952
6	Blackgram	2506	97	4693
7	Greengram	2235	97	10456
8	Mothbean	2235	97	-2668

9	Lentil	1993	NA	18185
10	Sesamum	0	115	8720
11	Soybean	3865	115	22156
12	Groundnut	4560	115	23895
13	Castorseed	0	115	26173
14	Cotton	0	NA	37587
15	Clusterbean	3533	NA	32862
B Rabi				
1	Wheat	0	183	32125
2	Barley	0	112	24105
3	Gram	3140	97	22190
4	Rapeseed & Mustard	0	115	27721
5	Cumin	0	NA	7036
6	Coriander	0	NA	25198
7	Fenugreek	0	NA	13987
8	Onion	0	NA	14507
9	Garlic	0	NA	26777
10	Chillies	0	235	54072
11	Vegetable	0	235	64876
12	Berseem	0	NA	14580

Source: Estimated by using Plot Level Cost of Cultivation data for TE 2013-14 and based on Peoples et al. (1995), IIPR (2003) and IARI (2014).

Paddy cultivation caused the highest negative externalities through the producing GHGs costing ₹ 1128 per hectare whereas the minimum GHG costs were incurred by cowpea, blackgram, greengram, mothbean and gram valued at ₹ 97 per hectare. Among the *kharif* crops, cotton cultivation has shown the highest net return based on natural resource valuation of ₹ 37587 per hectare followed by clusterbean (₹ 32862/ha), castorseed (₹ 26173/ha) and it was found lowest in sorghum of ₹ 2860 per hectare whereas among the *rabi* crops, the vegetables has shown the highest net return of ₹ 64876 per hectare followed by chillies (₹ 54072/ha), wheat (₹ 32125/ha) and it was observed lowest in cumin cultivation of ₹ 7036 per hectare. Mothbean has also shown the negative return (₹ 2668/ha) after adding the benefits of biological nitrogen fixation and deducting the GHG costs.

Comparative Returns of Crops using Various Approaches of Valuation

A comparative picture of net returns from various crops based on market prices, economic prices and natural resource valuation in Rajasthan during TE

2013-14 were analyzed and presented in Table 5.

Table 5: Net Returns from Different Crops using Various Approaches of Valuation in Rajasthan during TE 2013-14 (₹/ha)

Sl. No.	Crops	Net Return at Market Price	Net Return at Economic Price	Net Return at Natural Resource Valuation
A Kharif Crops				
1	Bajra	4818	3857	3745
2	Sorghum	3812	2972	2860
3	Maize	7181	4290	4131
4	Paddy	21700	16209	15081
5	Cowpea	2012	1939	4952
6	Blackgram	2793	2284	4693
7	Greengram	8846	8318	10456
8	Mothbean	-4756	-4806	-2668
9	Lentil	18231	16192	18185
10	Sesamum	9195	8835	8720
11	Soybean	19077	18406	22156
12	Groundnut	21555	19450	23895
13	Castorseed	27803	26288	26173
14	Cotton	41430	37587	37587
15	Clusterbean	29705	29329	32862
B Rabi Crops				
1	Wheat	38022	32308	32125
2	Barley	27904	24217	24105
3	Gram	20014	19147	22190
4	Rapeseed & Mustard	31195	27836	27721
5	Cumin	8937	7036	7036
6	Coriander	28639	25198	25198
7	Fenugreek	16016	13987	13987
8	Onion	19519	14507	14507
9	Garlic	31258	26777	26777
10	Chillies	57936	54307	54072
11	Vegetable	67638	65111	64876
12	Berseem	18630	14580	14580

Source: Plot Level Cost of Cultivation Data of Rajasthan (TE 2013-14).

After subtracting the input subsidies on fertilizers, electricity and diesel, there was a moderate to high decline in net return from the cultivation of various crops in the Rajasthan state. The impact of subsidies was so large in some cases. The withdrawal of input subsidies reduced the net return from maize to about 40 per cent followed by onion (25.68%) and paddy (25.30%). Due to high rate of profitability

from the cultivation of vegetables, chillies, cotton, wheat, clusterbean and castorseed, the removal of input subsidies lowered the net income sharply. The profitability level of legume crops have increased by the biological nitrogen fixation while other crops have reduced the profitability level due to the GHG costing from various crops. After netting out the input subsidies and effect on environment and natural resources, the cotton-vegetables cropping pattern was found more stable and efficient because of the higher net return of ₹ 102463 per hectare with the next best alternate cropping patterns like clusterbean-chillies (₹ 86934/ha), cotton-wheat (₹ 69712/ha), clusterbean-wheat (₹ 64987/ha).

CONCLUSION

Finally, it can be concluded that even after netting out the input subsidies and effect on environment and natural resources, the cotton-vegetables cropping pattern was found more stable and efficient because of the higher net return of ₹ 102463 per hectare with the next best alternate cropping patterns like clusterbean-chillies (₹ 86934/ha), cotton-wheat (₹ 69712/ha), clusterbean-wheat (₹ 64987/ha) etc. under the set of marketing infrastructure, minimum support prices, agricultural technological know-how, climatic conditions in the various zones, available irrigation facilities. Further, it can be say that the grower farmers may not move towards the diversification until incentivized by economically attractive alternate cropping patterns. The factors that are not captured by the market like subsidies is the direct cost to the society, factors affecting the natural resources and environment as nitrogen fixation and greenhouse gas costs, need to be considered and should be internalized through appropriate policies. Reckoning such costs and return alters the level of net income from various crops.

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