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Diversification of Cropping Systems for Different Integrated Farming System Models under Irrigated Situation of Southern Telangana Zone, Telangana, India

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Authors' contributions

This work was carried out in collaboration among all authors. Author CPK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MG and GKR managed the analyses of the study. Authors KN, SHKS, AAQ, MA and KC managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

A long-term field experiment was undertaken during the year 2019-20 (third year of the experiment) at college farm, AICRP on Integrated Farming Systems unit, PJTSAU, Hyderabad to evaluate productivity and profitability of cropping systems for different farming systems under irrigated situation on a sandy loam soil of Southern Telangana Zone (STZ), Telangana. Among the ten cropping systems evaluated, sweet corn – vegetable system (tomato) was found to be more remunerative with B:C ratio 3.30 followed by okra – marigold – beetroot system with B:C ratio 3.0. Among the ecological cropping systems for improving soil health, pigeonpea + greengram (1:7) –

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sesame cropping system recorded higher BC ratio (2.02) compared to Bt cotton + green gram (1:3) – groundnut cropping system (1.78). Out of the two systems evaluated to meet the household nutritional security, pigeon pea + groundnut (1:7) – fingermillet system recorded higher BC ratio (1.85) compared to pigeon pea + maize (1:3) – groundnut. Within the two fodder crops/cropping systems, fodder maize – lucerne system resulted in higher B:C ratio (1.65).

Keywords: Cropping systems; rice grain equivalent yield (RGEY); system productivity and system profitability.

1. INTRODUCTION

Cropping system is an important component of a farming system representing a cropping pattern adopted on a farm, which is supposed to increase food production. It involves interaction with farm resources, other farm enterprises and available technology, which determine their make-up [1]. The sustainability of Indian agriculture is being threatened by sharp declining factor productivity due to deteriorating soil quality, imbalanced use of fertilizers and escalating cost of production [2]. The food production must keep pace with the country's increasing population, demanding not only the food security but also nutritional security. Therefore, to achieve sustainability and productivity, efforts must be focused on reversing the trend in monoculture by adopting efficient cropping systems. Hence, sustainable increase in crop yields is needed to ensure food security in India. Increasing population and shrinking land resources are exerting considerable pressure on land resource due to intensive cultivation. Over exploitation of land resources is leading to degradation of soil rapidly. It is also a fact that highly productive lands have been diverted from agriculture to infrastructural development, urbanization, and other related activities. Under these circumstances, the only viable option is to enhance the productivity vertically to meet the production goals [3]. Therefore, there is an urgency to adopt crop diversification and different inter-cropping systems is the fastest way of sustaining productivity, yet ever increasing energy costs, limit input availability and enhance farmers income. Several workers [4] and [5] in the recent past reported that the productivity and income is far higher when integrated farming systems are practiced than crops alone. About 91.1 million tonnes of green fodder is required to meet the basic demand of 40 kg green fodder per adult animal per day [6]. So, there is need of inclusion of crops like fodder cowpea, sunhemp, fodder sorghum and fodder maize in cropping systems to solve the problem of fodder scarcity. In view of this farming system perspective, inclusion of ecological cropping system for improving soil health, cropping systems to meet the household nutritional security, cropping systems for round the year green / dry fodder production and cropping systems involving vegetables and other high value crops are to be studied for their productivity and sustainability. Hence, the present study was undertaken.

2. MATERIALS AND METHODS

The study was conducted at college farm of All India Coordinated Research Project on Integrated Farming Systems, Professor Jayashankar Telangana Sate Agricultural University, Rajendranagr during 2019-2020. The soil of the experimental field was sandy loam soil. The experiment was laid out with ten cropping systems as treatments in Randomized Block Design (RBD) with three replications. The ten combinations of cropping sequence tested were T_1: Rice – Maize, T_2: Bt cotton – Fallow, T_3: Bt cotton + Greengram(1:3) – Groundnut, T_4: Pigeon pea + Greengram (1:3) – Sesame, T_5: Maize + Pigeon pea (1:3) – Groundnut, T_6: Pigeon pea + Groundnut (1:7) – Ragi, T_7: Fodder sorghum + Fodder cowpea (1:2) – Horsegram – Sunhemp, T_8: Fodder maize – Lucerne, T_9: Sweet corn – Vegetables (Tomato) and T_{10}: Bhendi – Marigold – Beetroot during *kharif* and *rabi* seasons respectively. Each treatment was allocated randomly initially and replicated three times. All the crops in different cropping systems were raised in accordance with recommended package of practices. Crop sequences during *rabi* were taken up as and when the preceding kharif crops were harvested in the respective plots. Economic yield and stover/straw/stalk yield were recorded individually for all the crops in cropping systems. For comparison of different crop sequences, the yields of all the crops were converted in to rice grain equivalent yield on price basis.

Rice equivalent yield (REY) was calculated as follows:

REY (kg ha^{-1}) = Economical yield of a crop *e.g.* wheat (kg ha^{-1})x Price (Rs kg^{-1}) of same crop *e.g.* wheat/Price (Rs kg^{-1}) of rice

The economic analysis of the experiment was carried out by taking into consideration the prevailing prices of inputs used and the outputs realized. The cost of cultivation of different crops individually has been calculated. The yields of different crops in various cropping systems were converted into gross returns in rupees. Net returns for each cropping system were calculated by deducing cost of cultivation from gross returns. B: C ratio was also calculated for each cropping system. The various formulae used are given below:

Net returns (Rs ha^{-1}) = Gross returns (Rs ha^{-1}) – Cost of cultivation of crop (Rs ha^{-1})

B:C ratio = Net return (Rs ha^{-1})/ Cost of cultivation (Rs ha^{-1})

2.1 Data Analysis and Statistics

The experimental data was analysed by adopting RBD statistical tool and analysis of variance was worked out as suggested by Rao [7].

3. RESULTS AND DISCUSSION

3.1 Productivity and Economics of Crops and Cropping Systems

The performance of different high value crops in terms of rice grain equivalent yield during *kharif* 2019 indicated that sweet corn crop recorded significantly higher rice grain equivalent yield (9005 kg ha^{-1}) over other field and vegetable crops evaluated in different cropping systems (Table 1). Sweet corn and okra were tested under cropping systems involving high value crops and sweet corn (9005 kg ha^{-1} and Rs.1,09,727 net returns) was found to be more remunerative than okra (6884 kg ha^{-1} with 82,420 Rs ha^{-1} net returns). Among the ecological cropping systems for improving soil health, Bt cotton + Greengram (1:3) cropping system recorded significantly higher rice grain equivalent yield (7676 $kgha^{-1}$) than Pigeon pea + Greengram (1:3) (6133 kg ha^{-1}) cropping system. However, because of lower cost of cultivation, Pigeon pea + Greengram (1:3) (6133 kg ha^{-1}) cropping system recorded higher net returns (Rs. 82,798) compared to Bt cotton + Greengram (Rs. 88,804). However, Bt cotton and pigeonpea yields were not influenced by different intercropping systems. This might be due the fact that after the harvest of inter crops, competition reduced thereby water and nutrient availability was not affected. Kumawat et al. [8] and Singh et al. [9] reported the similar results with different intercropping systems. Out of the two systems tested to meet the household nutritional security, both Pigeon pea + Maize (1:3) and Pigeon pea + Groundnut (1:7) systems were on par with each other and recorded almost similar rice grain equivalent yields of 7833 and 8801 kg ha^{-1} respectively. This might be due to the absence of competition between pigeonpea and intercrops for growth resources such as nutrients, moisture, solar raditation because maize and groundnut crops were harvested before flowering period of pigeonpea and groundnut being leguminous crop show no competition of resources. These results are close conformity with the findings of Kumar et al. [10]. Out of the two fodder crops, fodder sorghum + fodder cowpea (1:2) (4512 kg ha^{-1}) and fodder maize (4241 kg ha^{-1}) systems were on par with each other. Rice and Bt cotton were tested as pre-dominant cropping systems of the region and recorded almost similar rice grain equivalent yields with 5728 and 5885 kg ha^{-1} respectively. These results were supported by Pragathi Kumari et al. [11].

The performance of different crops in terms of rice grain equivalent yield during *rabi* and *summer* 2019-20 indicated that marigold followed by beetroot crop (T_{10}) recorded significantly higher rice grain equivalent yield (33934 kg ha^{-1}) over other crops evaluated in different cropping systems (Table 2). However, because of low cost of cultivation, tomato crop (T_{10}) recorded (14957 $kgha^{-1}$ with 227139 Rs ha^{-1} net returns and 4.80 BC ratio) and was found to be more remunerative than marigold followed by beetroot crop. These results are in line with that of Kharub et al. [12] who evaluated the relative productivity of six rice-based crop sequences at Karnal (Haryana) taking wheat as a cereal crop and observed that wheat equivalent yield was maximum (197.1-200.3 q ha^{-1}), with rice - potato - wheat system followed by rice - vegetable pea-wheat system (173.5-173.8 q ha^{-1}). They have also reported that these systems resulted in additional wheat equivalent yield of 48-71 q/ha over the rice -wheat system.

Among the ecological cropping systems involving pulses/green manures and other crops for

improving soil health, groundnut crop recorded significantly higher rice grain equivalent yield (6251 kg ha^{-1}) and net returns (74620 $Rsha^{-1}$) than sesame (2696 kg ha^{-1} with net returns of 24523 Rs ha^{-1}) crop. Out of the two systems tested to meet the household nutritional security, groundnut crop recorded significantly higher rice grain equivalent yield (7113 kg ha^{-1}) and net returns (90425 $Rsha^{-1}$) than ragi. Out of the two fodder crops, lucerne crop (2990 kg ha^{-1}) resulted in comparatively higher rice grain equivalent yield over horsegram followed by sunhemp crops, though both the systems were on par with each other. Rice – Maize was tested as pre-dominant cropping systems of the region and recorded rice grain equivalent yield of 5557 $kgha^{-1}$ with net returns of 66,235 $Rsha^{-1}$. Pragathi Kumari et al. [13] have reported similar results on the study which was conducted with the same cropping systems.

Fig. 1. Intercropping of Bt cotton (1) with greengram (3)

Fig. 2. Identification of different cropping systems module for different farming systems experiment at AICRP on IFS unit

Fig. 3. Pigeonpea (1)+ greengran (6) intercropping at AICRP on IFS

Fig. 4. Pigeonpea (1)+Groundnut(7) intercropping

Table 1. Performance of crops in various cropping systems during *kharif*, 2019

Treatments			Grain yield (kg ha^{-1})		Straw/ Stover yield (kg ha^{-1})		Productivity (Rice grain Equivalent Yield kg ha^{-1})			Profitability (Rs ha^{-1})			
							Grain	Straw	Total	Cost of cultivation (Rs. ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns	
												Rs. ha^{-1}	Rs. Re^{-1}
A1	T1	Rice	5390	0	6197	0	5390	338	5728	47158	105104	57946	1.23
	T2	Bt cotton	1943	0	4444	0	5825	61	5885	46923	107994	61071	1.30
A2	T1	Bt cotton + Greengram (1:3)	1910	466	4406	947	7512	163	7676	52043	140847	88804	1.71
	T2	Pigeon pea + Greengram (1:6)	1192	568	3775	1199	5951	182	6133	29747	112545	82798	2.78
A3	T1	Pigeon pea + Maize (1:3)	564	5858	1787	7478	432	7402	7833	53957	143743	89786	1.66
	T2	Pigeon pea + Groundnut (1:7)	1240	1506	3996	2383	8097	704	8801	53025	161489	108464	2.05
A4	T1	Fodder sorghum + Fodder Cow pea (1:2)	0	0	12648	19166	0	4512	4512	28519	82796	54277	1.90
	T2	Fodder maize	0	0	38911	0	0	4241	4241	26367	77822	51455	1.95
A5	T1	Sweet corn	15253	0	18642	0	7481	1524	9005	55513	165240	109727	1.98
	T2	Bhendi	6296	0	1588	0	6862	22	6884	43897	126317	82420	1.88
	S Em+								374.0				
	CD (0.05)								1120.0				
	CV (%)								9.7				

Sale price for Grain (kg^{-1}) : Rice = Rs 18.35, Maize = Rs 17.6, Groundnut = Rs 50.9, Bhendi = Rs 20.00, Bt Cotton = Rs 55.0, Greengram = Rs 70.5, Pigeonpea = Rs 58.0, Sweet corn = Rs 9.00
Sale price for stover (kg^{-1}) : Rice = Rs 1.00 Maize = Rs 1.00, Bhendi = Rs 0.25, Groundnut = 5.00, Greengram = Rs 2.00, Sweet corn = Rs 1.5, Bt cotton = 0.25, Pigeonpea = Rs 0.25, Fodder sorghum = Rs 2.00, Fodder cowpea = 3.00, Fodder maize = 2.00

Table 2. Performance of crops in various cropping systems during *rabi* and *summer*, 2019-20

Trt	Cropping sequence	Economic yield (kg ha^{-1})		Straw yield (kg ha^{-1})		Rice grain equivalent yield (kg ha^{-1})				
		Rabi	*Summer*	*Rabi*	*Summer*	Grain *Rabi*	*Summer*	Straw *Rabi*	*Summer*	Total
T1	Maize	5395		7020		5174		383		5557
T2	Fallow	0		0		0		0		0
T3	Groundnut	2016		2420		5592		659		6251
T4	Sesame	756		1658		2673		23		2696
T5	Groundnut	2144		4281		5946		1167		7113
T6	Ragi	1832		3845		3145		52		3197
T7	Horsegram - Sunhemp			8973	15467	0		978	1264	2242
T8	Lucerne			27430		0		2990		2990
T9	Tomato	27309		5528		14882		75		14957
T10	Mariegold - Beetroot	14945	17122	7911	4554	24433	9331	108	62	33934
	CD (at 5%)									2511
	SEm ±									838
	CV (%)									11

Sale price for grain (kg^{-1}): Maize = Rs 17.6, Rice = Rs 18.35, Tomato = Rs 10.0, Groundnut = Rs 50.9, Sesame = Rs 64.85, Fingermillet = Rs 31.5, Marigold = Rs 30.00, Beetroot = Rs 10.00
Sale price for stover (kg^{-1}): Maize = Rs 1.00, Rice = Rs 1.00, Tomato = Rs 0.25, Groundnut =Rs 5.00, Sesame =Rs 0.25, Fingermillet = Rs 0.25, Horsegram = Rs 2.0, Sunhemp = Rs1.5, Lucerne = Rs 2.0, Marigold = Rs 0.25, Beetroot = Rs 0.25

Table 3. Performance of crops in various cropping systems during 2019-20

Treatments		*Kharif* (2019)				*Rabi* (2019-20)		Summer (2019-20)		Rice Grain Equivalent Yield (kg ha^{-1})						Productivity			
Kharif-Rabi		Grain yield (kg ha^{-1})		Straw/ Stover yield (kg ha^{-1})		Grain Yield	Straw/Stalk/ Stover yield	Grain Yield	Stover yield	*Kharif*		*Rabi*		Summer		(RGEY kg ha^{-1})			
		Main crop	Inter crop	Main crop	Inter crop	(kg ha^{-1})	(kg ha^{-1})	(kg ha^{-1})	(kg ha^{-1})	Grain	Straw	Grain	Straw	Grain	Straw	*Kharif*	*Rabi*	*Summer*	*System*
T1	Rice-Maize	5390	0	6197	0	5395	7020			5390	338	5174	383			5728	5557	0	11284
T2	Bt Cotton	1943	0	4444	0	0	0			5825	61	0	0			5885	0		5885
T3	Bt cotton+Greengram (1:3)- Groundnut	1910	466	4406	947	2016	2420			7512	163	5592	659			7676	6251	0	14573
T4	Pigeon pea + Greengram (1:6) - Sesame	1192	568	3775	1199	756	1658			5951	182	2673	23			6133	2696	0	8829

Treatments		*Kharif* (2019)				*Rabi* (2019-20)		Summer (2019-20)		Rice Grain Equivalent Yield (kg ha^{-1})						Productivity			
Kharif-Rabi		Grain yield (kg ha^{-1})		Straw/ Stover yield (kg ha^{-1})		Grain Yield	Straw/Stalk/ Stover yield	Grain Yield	Stover yield	*Kharif*		*Rabi*		Summer		(RGEY kg ha^{-1})			
		Main crop	Inter crop	Main crop	Inter crop	(kg ha^{-1})	(kg ha^{-1})	(kg ha^{-1})	(kg ha^{-1})	Grain	Straw	Grain	Straw	Grain	Straw	*Kharif*	*Rabi*	*Summer*	*System*
T5	Pigeon pea+Maize (1:3)-Groundnut	564	5858	1787	7478	2144	4281			432	7402	5946	1167			7833	7113	0	14946
T6	Pigeonpea + Groundnut (1:7) - Ragi	1240	1506	3996	2383	1832	3845			8097	704	3145	52			8801	3197	0	11998
T7	Fodder sorghum + Fodder cowpea (1:2) – Horsegram - Sunhemp	0	0	12648	19166		8973		15467	0	4512	0	978		1264	4512	978	1264	6754
T8	Fodder maize - Lucerne	0	0	38911	0		27430			0	4241	0	2990			4241	2990	0	7231
T9	Sweetcorn-Vegetables (Tomato)	15253	0	18642	0	27309	5528			7481	1524	14882	75			9005	14957	0	23962
T10	Okra – Marigold - Beetroot	6296	0	1588	0	14945	7911	17122	4554	6862	22	24433	108	9331	62	6884	24541	9393	40817
	S Em+															363	762		861
	CD (0.05)															1088	2282		2579
	CV (%)															9.8	17		19.0

Sale price for Grain (kg^{-1}) : Rice = Rs 18.35, Maize = Rs 17.6, Groundnut = Rs 50.9, Bhendi = Rs 20.00, Bt Cotton = Rs 55.0, Greengram = Rs 70.5, Pigeonpea = Rs 58.0, Sweet corn = Rs 9.00, Sesame = Rs 64.85, Fingermillet = Rs 31.5, Marigold = Rs 30.00, Beetroot = Rs 10.00

Sale price for stover (kg^{-1}) : Rice = Rs 1.00 Maize = Rs 1.00, Bhendi = Rs 0.25, Groundnut = 5.00, Greengram = Rs 2.00, Sweet corn = Rs 1.5, Bt cotton = 0.25, Pigeonpea = Rs 0.25, Fodder sorghum = Rs 2.00, Fodder cowpea = 3.00, Fodder maize = 2.00, Tomato = Rs 0.25, Sesame =Rs 0.25, Fingermillet = Rs 0.25, Horsegram = Rs 2.0, Sunhemp = Rs1.5, Lucerne = Rs 2.0, Marigold = Rs 0.25, and Beetroot = Rs 0.25

Table 4. Economics of crops in various cropping systems during 2019-20

Treatment		*Kharif*				*Rabi*				Summer				System	
Kharif-Rabi		**Cost of cultivation (Rs. ha^{-1})**	**Gross returns (Rs. ha^{-1})**	**Net returns**		**Cost of cultivation (Rs. ha^{-1})**	**Gross Returns (Rs. ha^{-1})**	**Net returns**		**Cost of cultivation (Rs. ha^{-1})**	**Gross returns (Rs. ha^{-1})**	**Net returns**		**Net returns**	
				Rs. ha^{-1}	**Rs. Re^{-1}**			**Rs ha^{-1}**	**Rs. Re^{-1}**	**Rs ha^{-1}**	**Rs. ha^{-1}**	**Rs. ha^{-1}**	**Rs. Re^{-1}**	**Rs ha^{-1}**	**Rs Re^{-1}**
T1	Rice-Maize	47158	105104	57946	1.23	35731	101966	66235	1.85	0	0	0	0	120487	1.49
T2	Bt Cotton	46923	107994	61071	1.30	0	0	0	0.00	0	0	0	0	61071	1.33
T3	Bt cotton+Greengram (1:3)- Groundnut	52043	140847	88804	1.71	40094	114714	74620	1.86	0	0	0	0	160175	1.78
T4	Pigeon pea + Greengram (1:6) - Sesame	29747	112545	82798	2.78	24940	49463	24523	0.98	0	0	0	0	109112	2.02
T5	Pigeon pea+Maize (1:3)-Groundnut	53957	143743	89786	1.66	40094	130519	90425	2.26	0	0	0	0	162465	1.76
T6	Pigeonpea + Groundnut (1:7) - Ragi	53025	161489	108464	2.05	24468	58669	34201	1.40	0	0	0	0	140888	1.85
T7	Fodder sorghum + Fodder cowpea (1:2) – Horsegram - Sunhemp	28519	82796	54277	1.90	14994	17946	2952	0.19	12334	23201	10867	0.88	70588	1.30
T8	Fodder maize - Lucerne	26367	77822	51455	1.95	25920	54859	28939	1.12	0	0	0	0	83441	1.65
T9	Sweetcorn-Vegetables (Tomato)	55513	165240	109727	1.98	47330	274469	227139	4.80	0	0	0	0	331786	3.30
T10	Okra – Marigold - Beetroot	43897	126317	82420	1.88	75464	450328	291150	3.85	44933	172359	110829	2.46	484399	3.00

Sale price for Grain (kg^{-1}): Rice = Rs 17.7, Maize = Rs 17.0, Groundnut = Rs 48.9, Bhendi = Rs 20.00, Bt Cotton = Rs 54.5, Greengram= Rs 69.75, Pigeonpea = Rs 56.75, Sweet corn = Rs 9.0, Tomato = Rs 10.0, Sesame = Rs 62.49, Fingermillet = Rs 28.97, Marigold = Rs 50.00, Beetroot = Rs 10.00.

Sale price for stover (kg^{-1}) : Rice = Rs 1.00 Maize = Rs 1.00, Bhendi = Rs 0.25, Groundnut = 5.00, Greengram = Rs 2.00, Bt cotton = 0.25, Pigeonpea = Rs 0.25, Fodder sorghum = Rs 2.00, Fodder cowpea = 3.00, Fodder maize = 2.00, Tomato = Rs 0.25 Sesame =Rs 0.25, Fingermillet = Rs 0.25, Horsegram = Rs 2.0, Sunhemp = Rs1.5, Lucerne = Rs 2.0, Marigold = Rs 0.25, Beetroot = Rs 0.25

Regarding system productivity, Okra–Marigold–Beetroot system recorded significantly higher rice grain equivalent yield (40817 kg ha^{-1}) over other crops evaluated in different cropping systems (Tables 3 and 4). Among the cropping systems involving vegetables and other high value crops for income enhancement, Sweet corn –Tomato system was found to be more remunerative (36434 $kgha^{-1}$ with 4,81,785 $Rsha^{-1}$ net returns) than Okra – Marigold – Beetroot because of lower cost of cultivation though recorded higher rice grain equivalent yield. Among the ecological cropping systems, *Bt* cotton + Greengram (1:3)- Groundnut cropping system recorded significantly higher rice grain equivalent yield (14573 $kgha^{-1}$) and net returns (160175 Rs ha^{-1}) than Pigeon pea + Greengram (1:6) - Sesame (8829 kg ha^{-1}) cropping system. However, due to lower cost of cultivation, Pigeonpea + Greengram (1:6) – Sesame system recorded higher BC ratio compared to *Bt* cotton + Greengram (1:3)- Groundnut cropping system. Out of the two systems tested to meet the household nutritional security involving cereals / pulses / oilseeds, Maize + Pigeon pea (1:3) – groundnut system reported to be more remunerative (11998 $kgha^{-1}$ RGEY with 140888 Rs ha^{-1} net returns and 1.85 B:C ratio) than Pigeon pea + Groundnut (1:7) - ragi system. Nagar et al. [14] also reported similar effect of intercropping on seed yield of pigeonpea. Out of the two fodder crops/cropping systems, Fodder maize – Lucerne (1.65 BC ratio) system resulted in higher rice grain equivalent yield (7231 $kgha^{-1}$) and net returns (83441 Rs ha^{-1}) than fodder sorghum + fodder Cow pea (1:2) – Horsegram – Sunhemp system (6754 kg ha^{-1} with 1.30 BC ratio). Rice and Bt cotton were tested as pre-dominant cropping systems of the region and rice – maize system recorded higher rice grain equivalent yield (11284 $kgha^{-1}$) and net returns (120487 Rs ha^{-1}) than Bt cotton alone (5885 $kgha^{-1}$). Cultivation involving sole crop or without intercropping results in decline in terms of productivity. In two years, cotton – legume – corn rotation, yield increase to the tune of 11 per cent was recorded as compared to continuous cotton grown without legumes [15]. Six Bt cotton based double cropping systems viz., two millets, two pulses and two oilseed crops were evaluated to identify the most profitable, productive and sustainable system. Amongst them, Bt cotton - maize recorded the highest seed cotton equivalent yield [16]. This indicate that in order to attain high productivity, intercropping plays a vital role.

4. CONCLUSION

Under high value crops, sweet corn - vegetable system (tomato) was more remunerative followed by okra – marigold – beetroot system. Among the ecological cropping systems, pigeonpea + greengram (1:6) – sesame, under the cropping systems for household nutritional security, pigeonpea + maize (1:3) - groundnut system, under two fodder crops/cropping systems, fodder maize – lucerne system and under predominant cropping systems, rice – maize systems were most profitable and can highly be recommended for different farming systems of Southern Telangana Zone of Telangana.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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