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Sustainable Land Use Diversification and Investment Potential in Peri-urban, Semi-urban and Rural Areas of Telangana State, India

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ABSTRACT: A study was carried out in Telangana State of India using net returns accrued from crops, fruit trees and livestock in three distressed districts namely Adilabad, Nalgonda and Warangal. The study identified sustainable and profitable land uses, estimated credit requirement and formulated credit investment action plan. A total of 270 respondents were selected from three districts at 90 respondents per district. Profitable annual and perennial crops and livestock enterprises were identified based on the calculated value of system index and benefit-cost ratio. Benefit-cost ratio varied from 1.58 in cotton + pigeonpea intercropping system in rural areas to 3.98 in soybean + pigeonpea in peri-urban agriculture in Adilabad, from 1.69 in the production of chillies to 2.65 in cotton + pigeonpea in rural areas of Nalgonda and from 1.71 in the production of vegetables in rural to 7.14 in the production of turmeric in peri-urban agriculture in Warangal. The economic indicators taking a lifespan of 15 years for fruit trees showed a payback period of 5 and 7 years; BCR of 1.61 and 2.07 and NPV of ₹ 267 crores and ₹ 109 crores constant at 2010 prices for sweet orange and mango in Nalgonda and Warangal districts, respectively. Every one rupee invested in sweet orange and mango fruit trees provide an income of ₹ 1.61 and ₹ 2.07, respectively. Every one rupee invested on rearing of large ruminants for dairy accrues ₹ 3.04, ₹ 3.44 and ₹ 3.32 while small ruminants rearing gives ₹ 4.05, ₹ 5.28 and ₹ 5.54 in Adilabad, Nalgonda and Warangal districts, respectively. A district level investment action plan taking full credit requirement for crops, fruit trees and livestock was formulated which has policy implication as there is a large credit demand from the farming community.

Key words: Profitable and sustainable land use, credit requirement, system index, benefit-cost ratio, Telangana State

Diversification in irrigated agriculture in general and in rainfed areas in particular has been identified as an important strategy to meet food, fodder and nutritional security, income growth, poverty alleviation, employment generation, development of rural sector, positive ecological and environmental impacts (FAO, 2001). Diversification helps in judicious use of available land, labour, water and other resources for realizing regular income flow to the farmers (Acharya, 2003). Diversification is a dynamic and continuous process to adjust with changing circumstances and market forces which act as an engine for agricultural growth (Hegde *et al*., 2003., Kumar and Mittal, 2003). Planning Commission, Government of India in its X Plan Document (Vol. II, Section 5.1.63) has also emphasized the importance of diversification of land use and needed support for higher profitability to the farmers in general while small and marginal farmers (SMFs) in particular. Osman *et al*. (2009) endorsed that the watershed development programme showed higher impact on deriving net returns per ha as well as higher index value of diversification compared to pre-programme period (before watershed). Rao and Sujatha (2006) emphasized that diversification of agriculture through alternate land use systems would not deprive farmers from production of arable crops. Diversification into horticulture is one of the potential sources for income growth in dryland areas with supplemental irrigation but requires higher investment. Thus, there is a need for formulating farmer-centric investment action plan of credit support as soft loan for promoting profitable and sustainable land uses involving promising crops, fruit trees and livestock. In this context, it is hypothesized that the sustainable and profitable land uses including crops, vegetables, fruit trees and livestock are more remunerative than that of conventional cropping systems. The objectives of the study are to:

i. identify sustainable and profitable land uses,

ii. formulate an implementable action plan for sustainable diversification,

iii. make an estimate of the credit requirement for implementing the action plan in the study area, and

iv. suggest suitable policy measures and support mechanism for up-scaling the promising land uses.

Materials and Methods

Study area

The data used in this paper are part of a survey using structured questionnaire on land use diversification opportunities in three distressed districts, *viz.*, Adilabad (longitudes 77^0 46' to 80^0 01' E , latitudes 18^0 40' to 19^0 56' N, 264 m above mean sea level; black soils and mean annual rainfall 1050 mm), Nalgonda (78^0 40'to 80^0 05' E, 16^0 25' to 17^0 60' N, 420 m above mean sea level; red soils & mean annual rainfall 650 mm) and Warangal (78^0 49' to 84^0 43' E, 17^0 19' to 18^0 36' N, 301 m above mean sea level, mixed red and black soils and mean annual rainfall 950 mm) of Telangana State in India. The study villages for survey were identified

showing large variability in two time periods (1998 & 2008) based on satellite images of IRS-1D and IRS-P6 (1:50,000 scale). Villages identified within peri-urban were close to district headquarters, semi-urban upto the distance of 50 km from district headquarters having a mix of both urban and rural socio-economic settings and rural area (remote village settings) of the three districts. Among the several villages identified, a set of three villages were selected randomly each for peri-urban, semi-urban and rural area in each district. The selected villages are representative to the present study wherein the farmers have adopted different farming systems.

Data collection and analysis

Field survey was conducted in Adilabad, Nalgonda and Warangal districts of Telangana State, India (Figure 1). A total of 270 households (HHs) were interviewed, i.e., 90 from each district. In all the three districts, peri-urban, semi-urban and rural area represent 30 HHs each covering marginal (10), small (10) and large (10) categories of farmers. These HHs were selected based on random sampling with proportion to stratum size. The socio-economic and demographic background of the farmers in the study area reveals that the marginal farmers have poor economic resources with land holding size less than 1.0 ha, education up to elementary/ primary level (5th standard) and average family size of 6-7 members while large farmers have rich economic resources with land holding size more than 2.0 ha, higher education (10th standard to graduate level) and average family size of 3-4 members; and small farmers have moderate economic resources (via-media between marginal and large farmers category) with land holding size between 1.0-2.0 ha, education (between 5th and 10th standard) and average family size being 5-6 members.

A pilot study was conducted during July and August 2010 through focused group discussion (FGD) in the three districts prior to final survey during April and May 2011. Data pertaining to crops, fruit trees and livestock statistics at district level were compiled from the (Government) records of Department of Bureau of Economics and Statistics, Hyderabad, India and offices of the Chief Planning Officers (CPOs) of Adilabad, Nalgonda and Warangal districts depending on their relative merits of accuracy, reliability and availability. The data were analyzed to work out costs and returns of crops. Total cost of cultivation included all

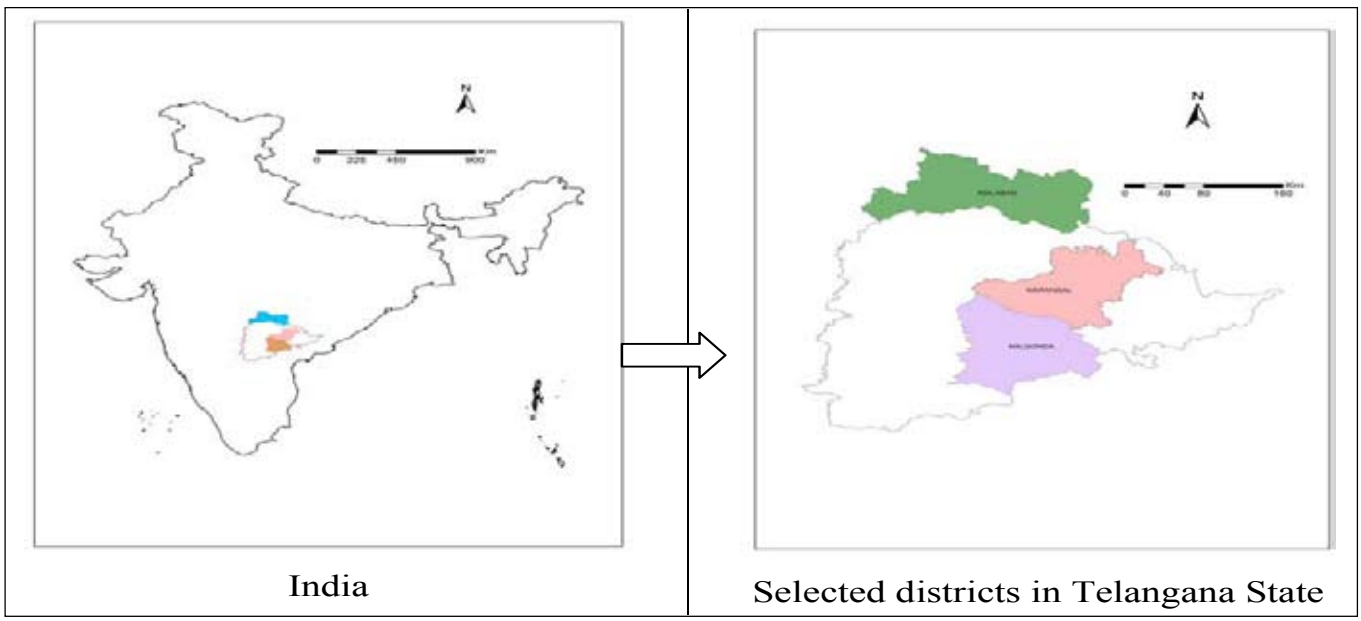

Fig. 1 : Location map of districts in Telangana State

paid out costs or expenses incurred in cash on production inputs such as, hired human and bullock labour/traction power, seed, manure (purchased), fertilizer, plant protection chemicals, irrigation charges and interest paid on crop loan.

System indices were calculated to identify sustainable crops among various crops grown by the farmers and were measured as the ratio of per hectare net returns accrued of each crop and average net returns accrued per ha of all crops grown in the area (Sankhayan, 1983). Benefit-cost ratio (BCR) was calculated as the ratio of gross returns derived from sale of the produce at the prevailing market price (at 2010 constant) and the total costs incurred on the inputs used in the production of a crop (Chopra and Subba Rao, 1996., Shaik Haffis and Reddy, 1999; Gangwar *et al*., 2008). Economic analysis of fruit trees including BCR, payback period (PBP) and net present value (NPV) of fruit trees such as, sweet orange and mango with prediction to the future (15 years duration) were attempted for Nalgonda and Warangal districts, respectively using the methodology adopted by Gittinger (1984) to know the economic viability like whether the system would be profitable after 10/15 years at 12% interest rate. As such, implementable investment action plan of credit requirement was formulated for each sustainable and profitable crop, fruit tree, cow and buffalo (milch animal, large ruminants) and sheep and goat (meat animal, small ruminants) for each

district based on total cost incurred per ha multiplied by total area (in ha) under respective crop/tree the while for dairying and sheep & goats rearing, number of HHs interested in undertaking livestock enterprise multiplied by total amount of credit investment required for each HH.

Results and Discussion

System indices

The calculated values of indices of crops that registered <1.0 (not sustainable) were discarded but only those registered ≥1.0 were considered as sustainable. As such, among the various crops cultivated in peri-urban area of Adilabad district, chillies (*Capsicum frutescens* L.) (2.45), cotton (*Gossypium hirrsutum* L.) (1.42), irrigated rice (*Oryza sativa* L.) (1.38), vegetables (1.37), soybean (*Glycine max* L.) intercropping with pigeonpea (*Cajanus cajan* L.) (1.22) and cotton + pigeonpea (1.15) intercropping systems found sustainable (Table 1). In semi-urban area, cotton (1.45), cotton + pigeonpea (1.18) and soybean + pigeonpea (1.05) were identified as sustainable. As regards to rural area in this district, vegetables attained a maximum level of 2.16 followed by irrigated rice crop (1.93), sorghum (*Sorghum bicolor* L.) intercropping with pigeonpea (1.32) and cotton (1.00).

Table 1 : Sustainable and profitable crops and cropping systems in peri-urban, semi-urban and rural areas in Adilabad district

Crop	Peri-urban			Semi-urban			Rural		
	Net returns (₹/ha)	System index (S_i)	BCR	Net returns (₹/ha)	System index (S_i)	BCR	Net returns (₹/ha)	System index (S_i)	BCR
Rainfed									
Cotton	43100	1.42*	2.42	50460	1.45*	2.82	15110	1.00*	1.58
Cotton + pigeonpea	35130	1.15*	2.02	41200	1.18*	2.50	-	-	-
Soybean	29390	0.96NS	3.53	25085	0.72NS	2.97	5875	0.39NS	1.59
Soybean + pigeonpea	37207	1.22*	3.98	36575	1.05*	3.32	5255	0.35NS	1.40
Sorghum	8750	0.29NS	2.75	-	-	-	-	-	-
Sorghum + pigeonpea	12000	0.39NS	3.18	-	-	-	19925	1.32*	3.15
Rice (Rainfed)	-	-	-	-	-	-	170	0.01NS	1.02
Groundnut	6750	0.22NS	1.45	-	-	-	-	-	-
Chillies (Veg)	74500	2.45*	2.89	-	-	-	-	-	-
Chickpea	20098	0.70NS	2.76	21280	0.61NS	2.95	-	-	-
Til	15000	0.49NS	3.00	-	-	-	-	-	-
Irrigated									
Rice	41888	1.38*	3.68	-	-	-	29075	1.93*	2.82
Hybrid rice seed production	-	-	-	-	-	-	12500	0.83NS	1.25
Vegetables	41700	1.37*	2.79	-	-	-	32500	2.16*	2.08
$\overline{X}$	30459			34920			15051		

* = Sustainable (≥1.0), NS = Not sustainable (<1.0), BCR = Benefit-cost ratio

In peri-urban area of Nalgonda district, sweet orange (*Citrus sinensis* L.) production ranked first and registered a substantially higher value of index (4.72) followed by *rabi* rice (1.03) and cotton (1.01) while in semi-urban area, sweet orange (1.82) and vegetables (1.22) emerged as sustainable crops (Table 2). Even in rural area in this district, the production of sweet orange gained a momentum and registered a maximum value of index (3.48) followed by chillies (2.50), cotton + pigeonpea (1.86) and *rabi* rice (1.12).

Table 2 : Sustainable and profitable crops and cropping systems in peri-urban, semi-urban and rural areas in Nalgonda district

Crop	Peri-urban			Semi-urban			Rural		
	Net returns (₹/ha)	System index (S_i)	BCR	Net returns (₹/ha)	System index (S_i)	BCR	Net returns (₹/ha)	System index (S_i)	BCR
Rainfed									
Cotton	26325	1.01*	2.19	20135	0.46NS	1.65	12365	0.46NS	1.47
Cotton + pigeonpea	14430	0.55NS	1.75	-	-	-	49750	1.86*	2.65
Pigeonpea	3600	0.14NS	1.48	-	-	-	13140	0.49NS	2.31
Greengram + pigeonpea	1125	0.04NS	1.12	-	-	-	-	-	-
Maize	-	-	-	-	-	-	9000	0.34NS	2.20
Sorghum	-	-	-	-	-	-	4400	0.16NS	2.33
Pearlmillet	-	-	-	-	-	-	5875	0.22NS	2.04
Groundnut (K)	-	-	-	-	-	-	24100	0.90NS	1.94
Castor	- 6875	- 0.26NS	0.45	-	-	-	5500	0.21NS	1.44
Sunflower	-	-	-	-	-	-	9500	0.36NS	1.88
Chillies	-	-	-	-	-		66700	2.50*	1.69
Vegetables (K)	-	-	-	41575	0.94NS	1.89	-	-	-
Irrigated									
Groundnut (R)	-	-	-	-	-	-	25625	0.96NS	2.02
Vegetables (R)	-	-	-	53750	1.22*	2.02	26000	0.97NS	1.86
Rice (K)	20130	0.77NS	1.92	33890	0.77NS	2.61	26225	0.98NS	2.09
Rice (R)	26815	1.03*	2.11	34975	0.79NS	2.52	29900	1.12*	2.43
Sweet orange	123400	4.72*	2.59	80175	1.82*	2.18	92900	3.48*	2.32
$\overline{X}$	26119			44083			26732		

* = Sustainable (>1.0), NS = Not sustainable (<1.0), K = Kharif crops grown during rainy season, (June-Oct), R = Rabi crops grown during post rainy season, (Oct/Nov-Jan/Feb), BCR = Benefit-cost ratio

In Warangal district, two crops *viz.,* turmeric (5.08) and vegetables (1.52) in peri-urban and three crops namely, mango (1.88), turmeric (1.47) and chillies (1.46) in semi-urban were found sustainable (Table 3). While in rural area in this district, as many as six crops viz., cotton (2.17), *rabi* greengram (*Vigna radiata* L.) (1.30), *rabi* rice (1.30), *kharif* greengram (1.24), *kharif* irrigated rice (1.16), and vegetables (1.02) were found sustainable.

Cotton was identified as a sustainable and profitable crop in all the three situations in Adilabad district by registering system index ≥1.0 and BCRs 1.58 to 2.82. This is attributed mainly due to better soil type (medium to deep Vertisols) and higher amount of rainfall (>1000 mm). Bhosale *et al*. (2004) also found cotton as a sustainable crop in their findings. More than 90% HHs reported a need of improved implements for inter-cultivation operations and seeding devices for cotton and soybean.

Sweet orange is traditionally a promising and predominant fruit tree crop that has gained momentum and fared better than other crops in respect of economic benefits accrued in all the three parts i.e., peri-urban, semi-urban and rural in Nalgonda district. Interestingly, in Warangal district, vegetable crops and turmeric in peri-urban area and chillies, mango and turmeric in semi-urban area were found sustainable, whereas in rural part, as many as six crops viz., cotton, *kharif* and *rabi* greengram, *kharif* and *rabi* irrigated rice and vegetables were found as sustainable. This is attributed mainly due to the fact that agriculture in rural parts of Warangal district is

better endowed with good natural resources mainly irrigation water. Ninety one percent of total land under cultivation in rural parts is mainly fed by irrigation tanks compared to that of peri-urban 36% and semi-urban 28%. The district has 4713 number of tanks compared to a total of 35941in the Telangana state (www.irrgation.telangana.gov.in/icad/minorReports). It is evident that under tank irrigation, the cultivation of vegetables crops was common but the diversity of vegetable production was high in all the three situations of Warangal district. This was in confirmation with the results reported by Jacobi *et al*. (2009) from Hyderabad, India where the farmers grew different vegetables such as tomato (*Lycopersicum esculentum* Mill.), brinjal (*Solanum melongena* L.) and cauliflower (*Brassica oleracea* L.) to avoid lower prices from the glut of market during the peak season. Similarly Shaik Haffis *et al*. (1990) observed higher crop diversification due to improved water resources after implementation of Watershed Development Programme.

Benefit-cost ratio (BCR)

Across sustainable crops and three situations in Adilabad, the calculated value of BCR ranged between 3.98 in soybean + pigeonpea intercropping system in peri-urban agriculture and 1.58 in cotton + pigeonpea intercropping system in rural areas (Table 1). It indicates that every 1 rupee invested on the two intercropping systems, provides an income of ₹ 3.98 and ₹ 1.58, respectively. In Nalgonda, the BCR varied from 1.69 in the production of chillies to 2.65 in cotton + pigeonpea intercropping in rural area across the three situations (Table 2). In Warangal, BCR ranged between 7.14 in the production of turmeric in peri-urban agriculture and 1.71 in the production of vegetables in rural area across the three situations (Table 3).

Table 3 : Sustainable and profitable crops and cropping systems in peri-urban, semi-urban and rural areas in Warangal district

Crop	Peri-urban			Semi-urban			Rural		
	Net returns (₹/ha)	System index (S_i)	BCR	Net returns (₹/ha)	System index (S_i)	BCR	Net returns (₹/ha)	System index (S_i)	BCR
Rainfed									
Cotton	34120	0.79^{NS}	2.02	39155	0.92^{NS}	2.21	80000	2.17^{*}	3.00
Sorghum	-	-	-	8750	0.21^{NS}	3.33	-	-	-
Maize	23250	0.54^{NS}	2.24	-	-	-	25000	0.68^{NS}	3.00
Greengram	-	-	-	-	-	-	45675	1.24^{*}	5.56
Blackgram	-	-	-	-	-	-	17575	0.48^{NS}	2.70
Groundnut	17500	0.41^{NS}	1.87	17500	0.41^{NS}	1.87	8275	0.22^{NS}	1.41
Sunflower	7500	0.17^{NS}	1.60	-	-	-	-	-	-
Chillies	-	-	-	62145	1.46*	2.15	25000	0.68^{NS}	1.50
Cowpea	-	-	-	-	-	-	2500	0.07^{NS}	1.33
Mango	-	-	-	80000	1.88*	2.77	-	-	-
Irrigated									
Rice (K)	28470	0.66^{NS}	2.24	28640	0.67^{NS}	2.37	42960	1.16^{*}	2.65
Rice (R)	-12500	-0.29^{NS}	0	-	-	-	47850	1.30^{*}	2.44
Greengram (R)	-	-	-	-	-	-	47850	1.30^{*}	4.13
Vegetables	65750	1.52*	2.34	-	-	-	37500	1.02^{*}	1.71
Turmeric	219290	5.08*	7.14	62500	1.47*	2.25	-	-	-
Sweet orange	5000	0.12^{NS}	1.25	-	-	-	-	-	-
Banana	-	-	-	41670	0.98^{NS}	2.00	-	-	-
$\overline{X}$	43153			42545			34562		

* = Sustainable (>1.0), NS = Not sustainable (<1.0), K = Kharif, R = Rabi, BCR = Benefit-cost ratio

The BCR of turmeric was substantially higher in peri-urban agriculture than that of semi-urban in Warangal district, which is mainly due to the better access to market. Moreover, higher BCRs also accrued in cultivation of vegetables after turmeric. Majority of urban farm HHs preferred short duration crops such as leafy vegetables to accrue higher profits per unit area compared to grain crops in peri-urban in India (Jocobi et al., 2009) and in Sudan (Sahar, 2012). Therefore, an immense need to upscale the farmer-centric investment action plan in peri-urban area of Warangal district was necessary to bring maximum diversification of this crop. In rural part of Warangal district, greengram fared better among different crops cultivated. This was mainly attributed to better price realization and access to irrigation facilities.

Economic analysis of tree plantations

In addition to the system analysis of seasonal crops, analysis of perennial crops in the sample districts was also attempted. Economic analysis of tree plantations revealed that the payback period (PBP) for recovering the credit investment estimated at 12% discount rate for a life span of 15 years is ₹ 537 crores and ₹ 232 crores constant at 2010 prices in case of sweet orange and mango plantations registered as 5 and 7 years implying shorter period of time in Nalgonda and Warangal districts, respectively (Table 4). While the BCRs calculated with prediction to the future 15 years duration were 1.61 and 2.07, respectively. It indicates that on every one rupee investment made on sweet orange and mango cultivation would give a dividend of ₹ 1.61 and ₹ 2.07, even after the period of 15 years, respectively in Nalgonda & Warangal districts. The net present value (NPV) at the end of 15th year registered as ₹ 267 crores and ₹ 109 crores constant at 2010 prices in case of sweet orange and mango in Nalgonda and Warangal districts, respectively. However, the economic lifespan for sweet orange and mango is 20 and 40 years, respectively. The returns on investments made earlier on horticulture were marginal but are now higher (Fan and Hazell, 1997), attributed mainly to change in food habits that translate into remunerative prices to fruits. There are huge opportunities for investment in developing appropriate infrastructure including grading, packaging, cold storage and processing facilities besides generic forward and backward linkages. Higher BCRs derived from fruit trees than that of cereals (sorghum, maize and rice) in Nalgonda and Warangal districts imply that growing fruit trees is economically viable but may lead to glut in the market unless a suitable infrastructure is developed for value addition and export. Since the twin goals of food and nutritional security and higher income of farmers are to be met, diversification of land use can be done for generating optimal outputs and income, keeping in view the domestic demand and export potential. Efforts are being made in India to expand area under fruit cultivation because of favorable soil and climatic conditions. Hence, the sustainable and profitable land uses studied for the three districts need to be expanded horizontally and vertically with needed credit support system for making rainfed agriculture viable and doable. In view of under-investment in production of crops, fruit trees and livestock sectors in the three districts, the policy implication calls for support from donors like apex bank of India, viz. National Bank for Agriculture and Rural Development (NABARD), Central Government and donor agencies.

Farmers' preference to rearing of milch animals

Majority (70%) of farm HHs with BCR 2.94 preferred dairy enterprise in semi-urban situation in Nalgonda district followed by peri-urban (63% HHs with BCR 2.95) and rural (43% HHs with BCR 3.56) as against the district average of 59% with BCR 3.15. In Warangal district, as high as 70% HHs with BCR 3.20 preferred dairy enterprise in rural situation followed by 30% HHs with BCR 3.56 in peri-urban and 20% HHs with BCR 3.19 in semi-urban as against the district average of 40% HHs with BCR 3.32. Although, the farmers' preference to dairy enterprise was lower in Adilabad district (20% HHs), yet within the district, 27% of farm HHs in peri-urban preferred dairy enterprise with BCR 2.96 followed by rural and semi-urban (Table 5).

Table 4 : Payback period, benefit-cost ratio and net present value of horticultural crops with prediction to the future in Nalgonda and Warangal districts of Telangana state

(Constant at 2010)

District	Fruit tree	Credit requirement estimated based on total cost of cultivation (₹ in crores)	Prediction to the future at 12% discount rate					
			10 years			15 years		
			PBP (Years)	BCR	NPV (₹ in crores)	PBP (years)	BCR	NPV (₹ in crores)
Nalgonda	Sweet orange	537	5	2.48	223	5	2.35	267
Warangal	Mango	232	7	1.61	56	7	2.07	109

PBP: Payback period, BCR: Benefit-cost ratio, NPV: Net present value

Table 5 : Percentage of farm households planning for dairy and sheep & goats rearing based on returns on investment in Adilabad, Nalgonda and Warangal districts of Telangana state

District/sub-region	Dairy		Sheep & goats rearing	
	% of HHs	BCR*	% of HHs	BCR
Adilabad				
Peri-urban	27	2.96	7	4.00
Semi-urban	13	3.38	7	4.10
Rural	20	2.77	-	-
District level	20	3.04	7	4.05
Nalgonda				
Peri-urban	63	2.95	20	3.82
Semi-urban	70	2.94	-	-
Rural	43	3.56	10	6.74
District level	59	3.15	15	5.28
Warangal				
Peri-urban	30	3.56	13	4.42
Semi-urban	20	3.19	30	6.66
Rural	70	3.20	-	-
District level	40	3.32	22	5.54

* thecomponent of cost of maintenance involved was considered by excluding the imputed cost of human labour while calculating BCR

Farmers' preference to sheep & goats rearing

As regards to sheep & goats rearing, although higher BCRs (≥4.0) registered, only 7% of the HHs shown preference both in peri-urban and semi-urban part of Adilabad district (Table 5). However, no attention was being paid by the HHs of rural part of this district. Similar situation was noticed in the semi-urban and rural parts of Nalgonda and Warangal districts too. The preference made by the HHs on this enterprise was moderate to the extent of 20% and 10% in peri-urban and rural parts of Nalgonda district with BCRs 3.82 and 6.74, respectively. While in peri-urban and semi-urban parts of Warangal district, the HHs' preference to this sector was 13 and 30% with BCRs 4.42 and 6.66, respectively. Thus, it may be inferred that farmers have higher preference for dairying compared to sheep & goats rearing in all the three situations in the three selected districts (Table 5).

Misra (2006) endorsed that integration of livestock with crop production in rainfed farming would give both short-term benefits and long-term sustainability through optimum utilization of available resources and risk minimization. Nguyen Van Hao and Than Xuan Dong (2005) studied farming systems in upland areas of South Eastern Vietnam and indicated that integration of goats with existing cropping system increased the average annual gross income from US $ 420 to US $ 1983 after four years of implementation. Although, higher BCRs with sheep & goats rearing were obtained compared to dairying, it was totally neglected by the HHs in the rural segment of Adilabad district, semi-urban and rural segments of Nalgonda and Warangal districts, respectively. This is attributed to the lack of access to common pool resources (CPRs) and fenced areas under tree plantations (Osman *et al*., 2001). Moreover, higher incidence of diseases are reported by the HHs in small ruminants compared to large ruminants (dairying). Okuthe & Buyu (2006) and Rubaire Akiki *et al*. (2006) found that the forages harvested from open access lands were also inflicted with the risk of tick-borne diseases and parasites. Added to this problem, tending the small ruminants to a large distance for grazing was another problem due to shortage of fodder. Similar problem was noticed in Uganda where fodder scarcity was a major limiting factor as the cultivation of fodder was beyond the scope due to lack of land (Kantongole, 2009; Kantongole *et al*., 2011).

District level investment action plan of credit for agriculture sector

The sustainable cropping pattern showed that cotton registered higher area (292000 ha) under cultivation while rice occupied lower area (30800 ha) in Adilabad district as a whole; rice and pigeonpea registered a maximum (310700 ha) and minimum (37500 ha) area under cultivation in Nalgonda district., and rice and chillies registered maximum and minimum area under cultivation of 198000 ha and 13990 ha in Warangal district, respectively.

The credit requirement (100%) for cultivating total area of 504800 ha (as per district statistics) with sustainable and profitable annual crops such as cotton, soybean, rice and pigeonpea in the Adilabad district was estimated to be over ₹1394 crores (Table 6). While at 50% level, it works out to ₹ 694 crores. Similarly, the total credit requirement at 100% level for cultivating rice, cotton and pigeonpea crops in an area of 454400 ha in Nalgonda district was worked out to be ₹ 1122 crores. In Warangal district, it was estimated to be over ₹1238 crores (100% level) for cultivating rice, cotton, greengram and chillies in an area of 393790 ha. Fifty per cent credit requirement for cultivating the area under the crops as cited above in Nalgonda and Warangal districts amounted to about ₹ 561 and ₹ 619 crores, respectively (Table 6).

Agricultural sector had been constrained with poor investment capacity of the farmers resulting in poor management and exploitation of yield potential, particularly in the three distressed districts of Telangana State. Strengthening of efforts through district level investment action plan of credit mobilization in these districts may help in realizing the full yield potential and face challenges to feed the people in the coming decades. Efforts may be made for further strengthening of credit policy to enhance the nation's foreign exchange reserves by exporting the commodities such as cotton, sweet orange, mango and rice as it will be a win-win situation for both the farmers as well as the country.

Table 6: District level action plan of credit requirement for agricultural sector in Adilabad, Nalgonda and Warangal districts of Telangana State (₹ in crores)

(Constant at 2010)

District/major crops	Total cost of cultivation (₹ /ha)	Area under cultivation in the district* (ha)	Total credit requirement (₹ in crores)	
			50% level	100% level
Adilabad				
Cotton	37140	292000	542	1084
Soybean	16140	120000	97	194
Pigeonpea	10980	62000	34	68
Rice	15660	30800	24	48
District level		504800	697	1394
Nalgonda				
Rice	23820	310700	370	740
Cotton	32100	106200	170	341
Pigeonpea	10980	37500	21	41
District level		454400	561	1122
Warangal				
Rice	26700	198000	265	529
Cotton	38400	158700	305	610
Greengram	10200	23100	11	23
Chillies	53880	13990	38	76
District level		393790	619	1238

* relates to the year, 2008-09

Sources: 1) Bureau of Economics and Statistics, Hyderabad, India

2) Offices of the Chief Planning Officer (CPO) of the respective districts

District level investment action plan of credit requirement for the area proposed by the farmers under horticulture sector

Twenty two per cent of farm HHs were planning an additional area of 39970 ha under horticultural crops such as vegetables (7% HHs) and mango (15% HHs) in Adilabad district. The total credit requirement for growing these two crops on the area cited above at 100% and 50% levels was estimated as ₹ 166 crores and ₹ 83 crores, respectively (Table 7). Similarly, the credit support needed by the farmers to go-in-for sweet orange on an area of 66940 ha worked (at 100% level) to ₹ 537 crores in Nalgonda while ₹ 232 crores as credit is estimated for raising mango in Warangal in an area of 51640 ha. The credit requirement (at 50% level) for raising the sweet orange and mango on the area allocated was estimated as ₹ 269 crores and ₹ 116 crores for Nalgonda and Warangal, respectively.

Higher credit requirement estimated for horticulture sector for Nalgonda district (₹ 537 crores) compared to Adilabad (₹ 166 crores) and Warangal (₹ 232 crores) districts is due to the reason that Nalgonda is predominantly sweet orange growing district of Telangana State in India compared to the other two districts.

District level investment action plan of credit requirement for dairy development sector

Each HH was planning to maintain four milch animals. Majority (59%) of HHs were planning for dairy enterprise in Nalgonda district followed by 40% HHs in Warangal and 20% HHs in Adilabad district (Table 8). The credit requirement (at 100% level) for undertaking the task of dairy development was estimated to be about ₹ 4937 crores constant at 2010 prices in Nalgonda district followed by Warangal (about ₹ 1805 crores) and Adilabad (about ₹ 872 crores). The credit requirement at 50% level registered ₹ 2468, 902 and 436 crores in case of Nalgonda, Warangal and Adilabad districts, respectively

District level investment action plan of credit requirement for sheep & goats rearing enterprise

Each HH was planning to maintain 10 units of sheep and goats. Among the three selected districts, 14% of HHs were planning for sheep & goats rearing enterprise in Warangal district followed by 10% HHs in Nalgonda and 4% HHs in Adilabad district (Table 8). While the credit requirement (at 100% of investment level) for promotion of sheep & goats rearing enterprise was estimated at around ₹ 165, 167 and 55 crores in case of Warangal, Nalgonda and Adilabad districts, respectively.

Table 7 : District level action plan of credit requirement for horticulture sector in Adilabad, Nalgonda and Warangal districts of Telangana state in India (₹ in crores)

(Constant at 2010)

District/major crops	% of HHs planning for horticulture*	Area allocated for horticultural crops** (ha)	Total cost of cultivation estimated (₹/ha)***	Total credit requirement (₹ in crores)	
				50% level	100% level
Adilabad					
Mango	15	27250	49980	68	136
Vegetables	7	12720	23340	15	30
Nalgonda					
Sweet orange	24	66940	80220	269	537
Warangal					
Mango	23	51640	45000	116	232

* indicates figures based on sample farmers
** indicates calculated figures based on the (sample) farmers' planning to grow horticultural crops
*** it is the unit cost (per ha) till the establishment say 4-5 years

Table 8 : District level action plan of credit requirement for dairy and sheep & goats rearing enterprises in Adilabad, Nalgonda and Warangal districts of Telangana State in India (₹ in crores)

(Constant at 2010)

District	Total number of HHs in the district	No. of HHs planning for[1]		Credit required/ HH (₹/unit of enterprise)		Total credit requirement (₹ in crores)			
						50% level		100% level	
		Dairy	Sheep & goats rearing	Dairy	Sheep & goats rearing	Dairy[2]	Sheep & goats rearing[3]	Dairy[2]	Sheep & goats rearing[3]
Adilabad	454211	90842 (20)	18168 (4)	96000	30000	436	28	872	55
Nalgonda	697272	411390 (59)	69727 (10)	120000	24000	2468	83	4937	167
Warangal	561267	224507 (40)	78577 (14)	80400	21000	902	83	1805	165

Note: Figures in parantheses indicate percentages to total number of HHs in the district
1 indicates calculated figures based on percentage of sample HHs planning for the livestock sector
2 indicates calculated figures based on the farmer's planning to maintain 4 milch animals (on an average) at purchase price of each milch animal @ ₹ 24000, ₹ 30000 and ₹ 20100 at Adilabad, Nalgonda and Warangal districts, respectively.
3 indicates calculated figures based on the farmer's planning to maintain 10 units of sheep & goats (on an average) at purchase price of each animal @ ₹ 3000, ₹ 2400 and ₹ 2100 at Adilabad, Nalgonda and Warangal districts, respectively.

The credit requirement at 50% level registered ₹ 83, 83 and 28 crores in case of Warangal, Nalgonda and Adilabad districts, respectively.

The credit requirement / HH registered opposite relationship between Adilabad (lower) and Nalgonda (higher) for dairy development. This is due to the variation in market price of the milch animal which was lower in Adilabad (₹ 24000) than that of Nalgonda (₹ 30000). Similar situation was observed between the HHs (14%, 10% and 4%) planning to maintain 10 units of sheep & goats per HH and the credit requirement (₹ 2100, ₹ 2400 and ₹ 3000 per animal) which registered an opposite trend with the serial order of districts *viz.,* Warangal, Nalgonda and Adilabad. As the farmers are willing to contribute 25% of the total credit requirement of livestock *viz.,* dairying and sheep & goats rearing, the rest (75%) can be met through the bank as soft loan under the implementable investment action plan. More important, the process of institutional credit investment is to be made more farmer-friendly with efficient delivery system and geared towards reducing the risk in production of crops, fruits, meat and milk.

District-wise total credit requirement for agriculture, horticulture and livestock sectors

Higher share of credit requirement (53.3%) registered in case of Nalgonda district followed by Warangal (27.1%) and Adilabad (19.6%) out of three districts' total credit requirement of ₹ 12690 crores (Table 9). Dairy as an enterprise of livestock sector claimed higher amount of credit requirement accounting 73% followed by agricultural sector (16.6%), horticulture (7.9%) and sheep & goats rearing (2.5%) out of total credit requirement of ₹ 6763 crores for Nalgonda district. The case is similar for Warangal district where the dairy development registered higher share (52.5%) of credit requirement followed by agriculture (36%) *albeit* horticulture (6.7%) and sheep & goats rearing (4.8%) out of ₹ 3440 crores of district total credit requirement. While in case of Adilabad district, the lion's share of credit requirement (56%) went to agricultural sector followed by livestock sector for dairy development (35.1%), horticulture (6.7%) and sheep & goats rearing (2.2%). Dairy development appears to be the major sector demanding higher share in the credit portfolio in two districts namely Nalgonda and Warangal while agriculture in case of Adilabad indicating variability in credit need.

Table 9 : District-wise credit requirement for agriculture, horticulture and livestock sectors (₹ in crore)

District	Agriculture	Horticulture	Livestock		Total
			Dairy	Sheep & goat rearing	
Adilabad	1394 (56.0)	166 (6.7)	872 (35.1)	55 (2.2)	2487 (100)
Nalgonda	1122 (16.6)	537 (7.9)	4937 (73.0)	167 (2.5)	6763 (100)
Warangal	1238 (36.0)	232 (6.7)	1805 (52.5)	165 (4.8)	3440 (100)
Total	3754 (29.6)	935 (7.4)	7614 (60.0)	387 (3.0)	12690 (100)

Note: Figures in parentheses indicate per cent of total

Conclusions

From the present study, it may be inferred that horticulture and dairy sectors were found to be profitable enterprises compared to conventional agriculture with seasonal field crops, however, its replication was constrained by poor economic base of the farming community in the three distressed districts of Telangana State in India. An integration of agriculture, horticulture and livestock sectors will pave the way for meeting the aspirations at various levels namely, farming community, state and country. This also calls for needed support mechanism and farmer-friendly investment action plan.

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