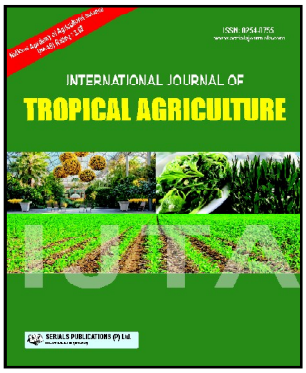

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Marginal Lands Productivity and Fertility Increased by Different Agroforestry Systems in Semi-arid Tropics of Telangana State, India

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Abstract: In *Melia azedarach* based agri-silvi system the grain and straw yield (2100 and 3571 kg ha^{-1}) of rainfed foxtail millet significantly influenced by 75% RD N + 25 % N Poultry manure. Same trend continued with nutrient content and uptake of NPK in grain and straw (1.30, 0.236, 0.49 and 0.63, 0.133, 2.52%; 25.14, 5.00, 10.24 and 22.47, 4.24, 90.12 kg ha^{-1} respectively. Regarding soil parameters, the conjoint use of 75% RD N + 25% N Poultry manure showed significant effect on OC (0.59%) and available NPK (150.0, 24.95, 210.0 kg ha^{-1}) followed by 100% RDF (0.55% and 147.0, 24.00, 216.0 kg ha^{-1}). In silvi-medicinal system, there was no significant effect of manures either alone or combination seed yield of *Terminelia bellarica*. The results further showed that manures alone and combined showed significant effect on fresh yield attributing parameters of *Aloe vera* over control. The highest fresh number of leaves recorded in application of Neemcake treatment (35800) followed by FYM 5 + Vermicompost 2t ha^{-1} (34000) and FYM 10 t ha^{-1}, 32000. In case of fresh leaf and juice content the highest recorded in FYM + VC (8.8 t ha^{-1} and 76.3%) > Neemcake (8.5 t ha^{-1} and 75%). In mango based agri-horti system the Cowpea + Curryleaf + Moringa in *kharif* season followed by safflower in *rabi* produced significantly higher net returns of Rs. 66,290 ha^{-1} with B:C ratio 3.27 followed by black gram + curry leaf + moringa system in *kharif* and safflower in rabi produced higher net returns of Rs. 61572 ha^{-1} with B:C ratio 3.04. Regarding soil parameters, there is significant effect on OC and available N by legume crops than non legumes with nutrient management treatments. The highest content was found with cowpea (0.60% and 169.7 kg ha^{-1}) followed by horsegram (0.60% and 165.0 kg ha^{-1}) and black gram (0.50% and 158.0 kg ha^{-1}). In *Melia dubia* based silvi-pasture system, there was significant effect by type of fodder *i.e.* maize and sorghum and Nutrient management treatments. Between two fodders the highest fresh forage biomass recorded by maize (4952 kg ha^{-1}) than sorghum (4476 kg ha^{-1}). In case of nutrient management practices the fresh biomass significantly influenced by 50% RD N + 50% N FYM (5387 kg ha^{-1}) > 75% RD N + 25 % N Poultry manure (5200 kg ha^{-1}) > 100% RDF (4987 kg ha^{-1}). Regarding quality parameters the

crude protein and fiber significantly influenced by type of fodder. The highest being in fodder maize (5.16 and 27.41%) compared to sorghum (4.64 and 32.86%). Similarly the quality was also significantly affected by nutrient management treatment 50% RD N + 50% N FYM (5.28 and 4.64%) in maize. Whereas, in sorghum the significant effect of crude fiber observed in FYM 10t ha^{-1} (32.57 %). Pertaining to soil parameters the OC and available N and P significantly affected by type of fodders and nutrient management over farmers practice *i.e.* FYM 10 t ha^{-1}. The highest OC content recorded in fodder maize (0.52%) than sorghum (0.46%). Significant effect of available N and P found with fodder sorghum (152.0 and 51.00 kg ha^{-1}) than maize (109 and 22.42 kg ha^{-1}).

Key words: Marginal lands, agroforestry systems, nutrient management, organics, inorganics.

INTRODUCTION

To meet the ever growing population there is a need to increase food grain production in India. The percapita availability of land for agriculture is decreasing year by year. Therefore, the area not utilized under waste, marginal and degraded lands has to be brought under cultivation by many ways. Generally the productivity and fertility of such lands are low, hence not suitable for normal agriculture. But with land use management the productivity and fertility of such soils increased by adaptation of different agroforestry (Pathak *et al.* 1996). Among them the adapting agroforestry is the best way to increase the productivity and fertility effectively in marginal and degraded lands. Off late agroforestry is an appropriate and efficient land use systems for dry lands, site improvement and also for optimization of productivity of agricultural crops as well as forest crops (Dagar and Singh, 2001). The ever growing demands of the increasing population for food, fodder, fuel, fiber, timber, etc., requires emphasis on checking land degradation for which agroforestry practices are considered a most vital technology and a potential farming system for minimizing the land degradation (Sharma, 2014).

There is a great risk of growing food grains in marginal, degraded wastelands unless proper management is taken. Basically the fertility and nutrient status of marginal lands is very poor. Even under such situation, there is lot of scope to increase the productivity and sustainability in semi-arid tropics of Telangana State by adapting different agroforestry models. Among the systems, the important are agri-silvi, agri-horti, silvi-pastoral, horti-pastoral, silvi-medicinal, block plantations, boundary plantations (Roy, 2016). Keeping in view of above facts an attempt was made through field experiments to find out the effect of organic manures, biofertilizers along with chemical fertilizer combination on yield, nutrient content and available nutrients of different intercrops in agri-silvi, agri-horti, silvi-medicinal and silvi-pastoral systems.

Off late, *Melia dubia* and *Melia azedarach* is a fast growing tree suitable in different type of soils considered as a multipurpose tree because of its multi directional and wide uses in agriculture, agroforestry and industry (Prasad *et al.* 2011 and Dhyani *et al.* 2013). Mango is one of the very important commercial fruit crop in semi-arid areas of Telangana State. Both Curry leaf and Moringa are suitable filler plants easy to maintain in mango rows at early stage to get quick returns. *Terminelia bellarica a* medicinal tree and *Aloe vera* a herbal crop is suitable easy to take up in marginal lands. Keeping in mind about the food security and improvement of soil fertility, the food grain and fodder crops were given due importance such as millets, legumes, cereal fodders under rainfed conditions in agri-silvi, agri-horti, silvi-pastoral systems respectively. All the inter crops selected in different agroforestry systems were low input short duration crops with multiuses suitable

in semi-arid area (Agricultural Statistics, 2012). Similarly medicinal trees and herbal crops are also gaining importance and performing well in even under poor fertility status of marginal lands.

MATERIALS AND METHODS

The field experiments on nutrient management was conducted in different agroforestry systems finger millet in *Melia azedarach* based agri-silvi, legumes and non legumes in mango based agri-horti, fodder maize and sorghum in *Melia dubia* based silvi-pastoral and *Aloe vera* in medicinal tree *Terminelia bellarica* based silvi-medicinal system at Agroforestry research block, Professor Jayashankar Telangana State Agricultural University, Rajendranagar campus, Hyderabad, T.S. Three agroforestry experiments were laid out in randomized block design, replicated thrice with seven treatment combinations applied to inter crops and one experiment in split plot design with four replications and six treatment combinations. The sources of organic manures were FYM, vermicompost, poultry manure, Neemcake, biofertilizers as Azospirillum, PSB and inorganic fertilizers as urea, single super phosphate, muriate of potash.

The experimental soil was red sandy loam texture, neutral, non-saline and medium in organic carbon, low to medium in available NPK. The soil parameters and plant nutrient contents were analysed by adapting standard procedures (AOAC, 1980).

RESULTS AND DISCUSSION

I. Agri-silvi Culture System-*Melia Azedarach* + Foxtail Millet (*Kharif*, 2015)

Among different combinations and alone treatments the best treatments effect were highlighted. In *Melia azedarach* (3 years age) based agri-silvi system the rainfed foxtail millet significantly influenced the grain and straw yield (2100 and 3571 kg ha^{-1}) by the nutrient management practice *i.e.* 75% RD N + 25 % N Poultry manure (Table 1). This might be due to more availability of nutrients and better soil conditions by the combined application of both organics and inorganics (Aariff Khan and Krishna, 2016). The B:C ratio was highest in 75% RD N + Azospirillum + PSB 5 kg ha^{-1} (1.84) followed by 75% RD N + 25% N poultry manure (1.72). The highest B:C ratio in biofertilizer combination treatment is due to low cost of inputs used. Pertaining to nutrient content in both grain and straw, the highest content of NPK (Table 2) recorded in 75% RD N + 25% N Poultry manure (1.30, 0.236, 0.49 and 0.63, 0.133, 2.52%). Correspondingly the same treatment registered (Table 3) higher NPK uptake (25.14, 5.00, 10.24 and 22.47, 4.24, 90.12). This is attributed to better crop growth and removal of nutrients from soil might be due to increased efficiency of chemical fertilizers in the presence of organics (Pallavi *et al.* 2015).

Regarding soil parameters, there was no significant effect by different treatments on pH and EC (Table 4). But there is significant effect on OC

Table 1
Yield of foxtail millet as influenced by nutrient management in *Melia azedarach* based agri–silvi culture system (Age of trees 3 years) *Kharif, 2015*

	Yield (kg ha^{-1})		*B:C Ratio*
Treatment	*Grain*	*Straw*	
T_1 FYM 10 t ha^{-1} with trees	1610	2255	1.13
T_2 100% RDF (40-20-20 NPK kg ha^{-1})	1995	3491	1.48
T_3 75%N + 25% N FYM	1861	2976	1.61
T_4 75% RD N + 25% N Vermicompost	1775	2612	1.52
T_5 75% RD N + 25% N Poultry manure	2100	3571	1.72
T_6 75% RD N + *Azospirillum* + PSB each 5 kg ha^{-1}	1795	2692	1.84
T_7 Sole crop without trees	2081	3507	1.59
Sem+	99	138	–
CD (P = 0.05)	305	424	–

Table 2
Nutrient content (%) of foxtail millet as influenced by nutrient management in *Melia azedarach* based agri-silvi system

	Grain (%)			*Straw*		
Treatment	*N*	*P*	*K*	*N*	*P*	*K*
T_1 FYM 10 t ha^{-1}	1.02	0.225	0.38	0.48	0.125	2.05
T_2 100% RDF	1.28	0.236	0.46	0.60	0.133	2.36
T_3 75%N + 25% N FYM	1.25	0.232	0.40	0.60	0.130	2.40
T_4 75% RD N + 25% N VC	1.10	0.228	0.42	0.55	0.129	2.20
T_5 75% RD N + 25% N PM	1.30	0.236	0.49	0.63	0.133	2.52
T_6 75% RD N + *Azospirillum* + PSB each 5 kg ha^{-1}	1.18	0.230	0.44	0.53	0.127	2.35
T_7 Sole crop without trees	1.28	0.234	0.45	0.59	0.130	2.42
Sem +	0.03	0.002	0.016	0.029	0.0004	0.051
CD (P = 0.05)	0.09	0.007	0.049	0.090	NS	0.157

Table 3
Nutrient uptake of foxtail millet as influenced by nutrient management in *Melia azedarach* based agri-silvi system

	Uptake (kg ha^{-1})								
	Grain			*Straw*			*Total plant uptake (kg ha^{-1})*		
Treatment	*N*	*P*	*K*	*N*	*P*	*K*	*N*	*P*	*K*
T_1 FYM 10 t ha^{-1} with trees	17.58	3.63	6.14	10.90	2.81	46.16	28.48	6.44	52.30
T_2 100% RDF(40–20–20 NPK kg ha^{-1})	23.44	4.70	8.99	20.85	4.65	82.45	44.29	9.35	91.44
T_3 75%N + 25% N FYM	20.05	4.31	7.46	17.80	3.87	71.49	37.85	8.18	78.95
T_4 75% RD N + 25% N VC	20.64	4.04	7.44	14.41	3.67	57.56	35.05	7.71	65.00
T_5 75% RD N + 25% N PM	25.14	5.00	10.24	22.47	4.24	90.12	47.61	9.24	100.36
T_6 75% RD N + *Azospirillum* + PSB each 5 kg ha^{-1}	19.94	4.13	7.93	14.23	3.41	63.40	34.17	7.54	71.33
T7 Sole crop without tree 100% RDF	25.02	4.87	9.38	20.67	4.55	84.97	45.69	9.42	94.35
Sem+	1.21	0.211	0.53	0.95	0.25	4.41	–	–	–
CD (P = 0.05)	3.73	0.651	1.62	2.94	0.77	13.58	–	–	–

and available NPK content. The conjoint use of 75% RD N + 25% N Poultry manure showed significant effect on OC (0.59%) and available NPK (150.0, 24.95, 210.0 kg ha^{-1}) followed by 100% RDF (0.55% and 147.0, 24.00, 216.0 kg ha^{-1}). The higher availability of nutrients may be attributed due to addition of mineral fertilizer NPK along with organic sources reduced the C:N ratio and thus increased the rate of decomposition resulting the faster availability of nutrients from organic manures (Nandal and Ravikumar, 2010).

II. Silvi-medicinal System (2014-15)

In *Terminelia bellarica* tree based medicinal plant system, the results revealed that (Table 5) the establishment, survival and growth performance of *Aloe vera* in alleys of *Terminelia bellarica* (10 years age)

Table 4
Soil properties and available nutrients of foxtail millet as influenced by nutrient management in *Melia azedarach* in agri-silvi system

				Available Nutrient (kg ha^{-1})		
Treatment	*pH*	*EC (dSm^{-1})*	*OC (%)*	*N*	*P*	*K*
T_1 FYM 10 t ha^{-1}	6.85	0.019	0.42	134	19.75	209
T_2 100% RDF	6.92	0.022	0.55	147	24.00	216
T_3 75%N + 25% N FYM	6.78	0.029	0.50	140	22.95	212
T_4 75% RD N + 25% N VC	6.90	0.018	0.46	139	21.78	207
T_5 75% RD N + 25% N PM	7.03	0.028	0.59	150	24.95	219
T_6 75% RD N + *Azospirillum* + PSB 5 each kg ha^{-1}	6.88	0.032	0.49	139	23.00	212
T_9 Sole crop without trees	6.79	0.025	0.51	143	24.15	217
Sem +	0.07	0.004	0.03	1.7	0.86	1.6
CD (P = 0.05)	NS	NS	0.09	5.2	2.65	5.0
Initial soil	6.97	0.024	0.38	139	18.80	211

Table 5
Seed yield of *Terminelia bellarica* and yield attributing parameters of fresh leaf *Aloe vera* yield as influenced by different manures in silvi–medicinal system, Age of trees 10 years

		Aloe vera parameters		
Treatment	*Seed yield (kg ha^{-1})*	*No. of fresh leaves (thousands ha^{-1})*	*Fresh leaf weight (t ha^{-1})*	*Juice (%)*
T1 FYM 10 t ha^{-1}	2850	32.0	8.1	73.2
T2 Vermi compost 4 t ha^{-1}	3150	29.6	7.4	74.8
T3 Neem cake 2 t ha^{-1}	3024	35.8	8.5	75.5
T4 FYM 5 + Neemcake 1 t ha^{-1}	3085	27.6	7.9	75.2
T5 FYM 5+ Vermicompost 2 t ha^{-1}	3275	34.0	8.8	76.3
T6 VC 2 + N C 1 t ha^{-1}	3010	28.5	7.1	75.0
T7 Control (No Manure)	2805	26.0	6.0	72.0
Mean	3028	30.5	7.69	74.6
Sem +	111.5	1.58	0.49	0.75
CD (P = 0.05)	NS	4.9	1.52	2.32

grown in marginal lands was good. There was no significant effect of manures either alone or combination seed yield of *Terminelia bellarica*. This may be assumed that the grown up trees are having well spread deeper root system resulting better mining of nutrients and moisture from sub soil (Karikalan *et al.* 2002; Dutta and Thakur, 2004).

The results further showed that manures alone and combined showed significant effect on fresh yield attributing parameters of *Aloe vera* over control. The highest fresh number of leaves recorded in application of Neem cake treatment (35800) followed by FYM + Vermicompost 5+2t ha^{-1} (34000) and FYM 10 t ha^{-1}, 32000 (Nagarajaiah,

et al. 2012). In case of fresh leaf and juice content the highest recorded FYM + VC (8.8 t ha^{-1} and 76.3%) > Neemcake (8.5 t ha^{-1} and 75%). Similar results found in different agroforestry systems by Thakur *et al.* (2014) and Suvera *et al.* (2015).

III. Agri-horti System

Mango/Curryleaf/Moringa + Kharif and *Rabi (2014-15)*

In mango based agri-horti system the filler plants such as curryleaf and moringa for planted in mango (3 years age) to get quick returns from local market. After planting the mango plants attain to harvest for first time, and an average 20 fruits $plant^{-1}$ recorded which accounts 375 kg ha^{-1}. Eight crops both legumes, non legumes such as millets, oil seeds, flower crop, were grown in *kharif* under rainfed condition followed by safflower as sole crop in *rabi* in entire system. *Kharif* crops yield was recorded on equivalent basis. The results revealed that (Table 6) all the *kharif* crops were grown successfully under rainfed condition. The cost of expenditure was less in pearl millet (Rs. 8,500) followed by Horsegram (Rs. 10000), Black gram (Rs. 11500) = Cowpea (Rs. 11500), Sorghum (Rs. 12300), Gourgum (Rs. 12500) = Castor (Rs. 12500) and Marigold (Rs. 12650) (Singh, *et al.* 2008). Cowpea + Curryleaf + Moringa in mango based system in *kharif* season followed by safflower in rabi season produced significantly higher net returns of Rs. 66,290 ha^{-1} with B:C ratio 3.27 followed by black gram + curry leaf + moringa system in *kharif* and safflower in *rabi* produced higher net returns of Rs. 61572 ha^{-1} with B:C ratio 3.04. (Ravitchandirane and Haripriya, 2011 and Sunil Kumar *et al.* 2015).

Regarding soil parameters (Table 7) there is no significant effect on pH and EC by different crops in *kharif*. But there is significant effect on OC and available N by legume crops then non legumes in the system. The highest content was found with cowpea (0.60% and 169.7 kg ha^{-1}) followed by horsegram (0.60% and 165.0 kg ha^{-1}) and black gram (0.50% and 158.0 kg ha^{-1}) (Kumar *et al.* 2013 and Aariff Khan *et al.* 2015).

Table 6
Grain yield and economics of different intercrops in Mango + Curry leaf + Moringa in agri-horti system (2014–15), Age of mango trees 3 years

	Kharif			*Rabi*				
Treatments	*Intercrop yield kg ha^{-1}*	*Grass Returns (Rs. ha^{-1})*	*Cost of cultivation*	*Intercrop yield kg ha^{-1}*	*Grass Returns (Rs. ha^{-1})*	*Cost of cultivation*	*Net returns (Rs. ha^{-1})*	*B:C ratio*
Sorghum + Curryleaf + Moringa	1250* *378 (C) 400 (M)	16250 9450 12000	12300	493 (S) 300 (C) 320 (M)	17255 7500 9600	8750	50,500	2.40
Pearlmillet + Curry leaf + Moringa	656* 350 (C) 380 (M)	7872 8750 11400	8500	478 (S) 302 (C) 320 (M)	16730 7550 9660	8750	44,602	2.58
Castor + Curry leaf + Moringa	616* 359 (C) 372 (M)	24640 8750 11160	12500	493 (S) 296 (C) 330 (M)	17255 7400 9900	8750	57,495	2.70
Cowpea + Curry leaf + Moringa	883* 362 (C) 368 (M)	28256 9050 11040	11500	517 (S) 318 (C) 342 (M)	19985 7950 10260	8750	66,291	3.27

Contd. Table 6

	Kharif			*Rabi*				
Treatments	*Intercrop yield kg ha^{-1}*	*Grass Returns (Rs. ha^{-1})*	*Cost of cultivation*	*Intercrop yield kg ha^{-1}*	*Grass Returns (Rs. ha^{-1})*	*Cost of cultivation*	*Net returns (Rs. ha^{-1})*	*B:C ratio*
Horse gram + Curry leaf + Moringa	502* 342 (C) 382 (M)	20080 8550 11446	10000	517 (S) 268 (C) 318 (M)	18095 6700 9540	8750	57,175	3.13
Black gram + Curry leaf + Moringa	677* 350 (C) 380 (M)	24372 8750 11400	11500	540 (S) 340 (C) 330 (M)	18900 8500 9900	8750	61,572	3.04
Guar gum + Curry leaf + Moringa	530* 370 (C) 400 (M)	15900 9250 12000	12500	486 (S) 320 (C) 320 (M)	17010 8000 9600	8750	50,510	2.49
Marry gold + Curry leaf + Moringa	976* 380 (C) 360 (M)	24400 9500 10800	12650	540 (S) 310 (C) 340 (M)	18900 7750 10200	8750	60,510	2.81
Curry leaf + Moringa (No inter crop)	380 (C) 370 (M)	9500 11100	7000	300 (C) 350 (M)	7500 10500	5800	26600	2.06
CD (P = 0.05)	–	–	–	NS	–	–	5845	–

Rates considered (Rs q^{-1}) S-1300, Pearl millet-1200, Caster-4000, Cowpea-3200, Horse gram-4000, Gurgum-3000, Block gram-3600, Marry gold-2500, Curry leaf-2500 Moringa-3000, Safflower-3500.

* Intercrop yield

(C) – Curry leaf yield (Filler crop)

(M) – Moringa pod yield (Filler crop)

(S) – Safflower

Table 7

Soil Properties and available nutrient of different type of inter crops in mango based agri-horti system

Treatment	*pH (dSm^{-1})*	*EC (%)*	*OC*	*Available N (kg ha^{-1})*
T1 Mango + Curry Leaf (Control without crop)	6.92	0.243	0.48	149.8
T2 Sorghum	6.91	0.250	0.49	157.5
T3 Pearl millet	6.66	0.225	0.52	150.8
T4 Castor	6.82	0.210	0.57	153.0
T5 Cowpea	6.99	0.233	0.60	169.7
T6 Horse gram	7.00	0.227	0.60	165.0
T7 Black gram	7.05	0.235	0.58	162.5
T8 Gaur gum	6.65	0.270	0.55	158.0
T9 Marigold	7.09	0.224	0.55	155.3
CD (P = 0.05)	NS	NS	0.09	10.7
Initial Soil	6.94	0.240	0.47	151.5

IV. Silvi-pasture System-*Melia Dubia* +Fodder Maize/Sorghum (*Kharif*, 2015)

There was significant effect by main (type of fodder *i.e.* maize and sorghum) and sub treatments (Nutrient management) in *Melia dubia* based silvi-pasture system. However, there was no significant by interactions. Between two fodders (Table 8) the highest fresh forage biomass by maize (4952 kg ha^{-1}) followed by sorghum (4476 kg ha^{-1}), But sorghum took very short period to harvest *i.e.* 60 days only whereas, maize took 75 days. In case of nutrient management practices the fresh forage biomass significantly influenced by 50% RD N + 50% N FYM (5387 kg ha^{-1}) followed by 75% RD N + 25 % N Poultry manure (5200 kg ha^{-1}) > 100% RDF (4987 kg ha^{-1}). This might be attributed to accumulation

of more photosynthetic activity and available nutrients (Ram, *et al.* 2016). Regarding quality parameters the crude protein and fiber (Table 9) significantly influenced by type of fodder the highest recorded in fodder maize (5.16 and 27.41%) than sorghum (4.64 and 32.86%). Similarly the quality was also significantly affected by nutrient management treatment 50% RD N + 50% N FYM (5.28 and 4.64%) in maize, whereas in sorghum the significant effect of crude fiber observed in FYM 10t ha^{-1} (32.57%).

Pertaining to soil parameters (Table 10) the OC and available N and P contents was significantly affected by type of fodders and nutrient management over farmers practice FYM 10 t ha^{-1}. But there is no significant effect by interactions. The highest OC content recorded in fodder maize (0.52%) than sorghum (0.46%). This is due addition of tree litter and decomposition of roots of weeds in the rhizosphere (Devarana Vadgi *et al.* 2003). In case of available N and P the significant effect found with fodder sorghum (152.0 and 51.00 kg ha^{-1}) than maize (109 and 22.42 kg ha^{-1}). The reason may be due to short duration of sorghum and the applied mineral fertilizer was less utilized than maize comparatively utilized more effectively (Singh *et al.* 2008).

Table 8
Fresh forage biomass (kg ha^{-1}) of cereal fodders as influenced by nutrient management in *Melia dubia* based silvi–pasture system (*Kharif*, 2015), Age of trees 4 years

Treatment	*Type of Fodder (Main)*		
Nutrient Management (Sub)	*M1 Maize*	*M2 Sorghum*	*Mean*
S1 FYM 10 t ha^{-1}	3350	3025	3187
S2 100% RDF (100-60-40 M/ 100-40-30 S, NPK kg ha^{-1})	5215	4760	4987
S3 75% RD N + 25% N FYM	5070	4510	4790
S4 50% RD N + 50% N FYM	5685	5089	5387
S5 75% RD N +25% N Poultry Manure	5430	4970	5200
S6 Sole fodder crop without trees	4960	4500	4714
Mean	4952	4476	–
Treatment	Sem +	CD (P = 0.05)	–
Main	84.0	376.0	–
Sub	156.0	450.0	–
Interaction	NS	NS	–

Finally it is concluded adapting different agroforestry systems are very suitable, viable and economical as there is less risk and easy management in marginal, degraded and waste lands in semi-arid tropics of Telangana State. The intercrops selected are millets, legumes, oil seed, cereal fodders were successfully grown in marginal lands showing good response with low inputs and irrigation sources. The soil enrichment also done by following the nutrient management with locally available organic sources combined with inorganics. Among different nutrient management practices followed in agroforestry systems the integrated use of 75% RD N + 25% N poultry manure is superior and on par sole crop with out trees in obtaining yield as well as improvement of soil fertility in terms of OC and available NPK.

Terminelia bellarica based silvi-medicinal system is also easily possible to adapt and even in the degraded low fertility status of marginal lands provided market facility is available. The mango based agri-horti system is very viable and profitable, as rainfed crops were grown in *kharif* and sole crop safflower showed good response with combination of both organics and inorganics and on grain yield and improvement in OC and available NPK. In case of *Melia dubia* based silvi-pastoral system, cereal fodder maize is superior than sorghum in terms of higher fresh biomass, quality aspects. Combination of 50% RD N + 50% N FYM is better in recording higher fresh biomass, crude protein and fiber, besides in increasing the soil fertility in marginal lands.

Table 9
Quality parameters of cereal fodders as influenced by nutrient management in *Melia dubia* based silvi-pasture system

	Type of fodder (Main)					
Treatment	*Crude Protein (%)*			*Crude Fiber (%)*		
Nutrient management (Sub)	*M1 Maize*	*M2 Sorghum*	*Mean*	*M1 Maize*	*M2 Sorghum*	*Mean*
S1 FYM 10 t ha^{-1}	4.18	3.75	3.96	34.90	30.25	32.57
S2 100% RDF	5.23	5.00	5.11	32.75	27.80	30.27
S3 75% RD N + 25% N FYM	5.26	4.62	4.94	33.20	27.20	30.20
S4 50% RD N + 50% N FYM	5.56	5.00	5.28	30.80	25.50	28.15
S5 75% RD N + 25% N PM	5.62	4.81	5.21	31.65	26.10	28.87
S6 Sole fodder crop	5.10	4.68	4.89	33.90	27.60	30.75
Mean	5.16	4.64	4.90	32.86	27.41	–
Treatment	Sem +	CD (P = 0.05)	–	Sem+	CD (P = 0.05)	–
Main	0.025	0.112	–	0.26	1.15	–
Sub	0.109	0.314		0.78	2.50	
Interaction	NS	NS		NS	NS	

Table 10
Soil properties and available nutrients of cereal fodders as influenced by nutrient management in *Melia dubia* based silvi-pasture system

	Type of fodder								
	Available Nutrient (kg ha^{-1})								
Treatment (Main)	*OC (%)*			*N*			*P*		
Nutrient Management (Sub)	*M1 Maize*	*M2 Sorghum*	*Mean*	*M1 Maize*	*M2 Sorghum*	*Mean*	*M1 Maize*	*M2 Sorghum*	*Mean*
S1 FYM 10 t ha^{-1}	0.42	0.38	0.40	104	151	127	16.85	47.50	32.17
S2 100% RDF	0.54	0.46	0.50	108	149	128	19.90	51.85	35.87
S3 75% RD N + 25% N FYM	0.51	0.43	0.47	106	153	129	23.70	49.30	36.50
S4 50% RD N + 50% N FYM	059	0.52	0.55	110	156	133	26.00	52.75	39.37
S5 75% RD N + 25% N PM	0.58	0.50	0.48	114	151	132	27.30	53.90	40.60
S6 Sole fodder crop	0.48	0.47	0.47	111	151	131	20.75	50.70	35.72
Mean	0.52	0.46	–	109	152	–	22.42	51.00	–
–	Sem +	CD (P = 0.05)	–	Sem +	CD (P = 0.05)	–	Sem +	CD (P = 0.05)	–
Main	0.003	0.013	–	0.24	1.1	–	0.26	1.18	–
Sub	0.024	0.070	–	2.52	7.27	–	1.10	3.17	–
Interaction	–	NS	–	–	NS	–	–	NS	–
Initial Soil		0.42			105			15.50	

REFERENCES

Aariff Khan, M.A and Krishna, A. (2016), Response of minor millet crops by nutrient management practices in marginal lands of *Melia azedarach* based agri-silvi system.

International Journal of Tropical Agriculture, **34**:451-459.

Aariff Khan, M.A., Rajesh, P., Pratapkumar Reddy, A and Krishna, A. (2015), Nutrient management in different millet crops under Pongamia based agri-silvi system in Semi-arid region of Telangana State, India. *International Journal of Tropical Agriculture.* **33** (2):1661-1667.

Agricultural Statistics at Glance. (2012), Directorate of Economics and Statistics. Ministry of Agriculture. Government of India, p:65-68.

AOAC. (1980), Association of Official Analytical Chemists. Official and Tentative Methods of Analysis. Washington, D.C.

Dagar, J.C and Singh, G. (2001), Evaluation of crops in Agroforestry with *Casurina equisetifolia* (Linn.) plantation. *Indian Journal of Agroforestry,* **3**:49-50.

Devarana Vadgi, S.B. Hunshal, C.S, Wajo, S.Y. Poddar, R.S. and Patil, M.B. (2003), Economic Evaluation of Sorghum Based Agri-silvi cultural System, *J. Farming Systems Research & Development,* **9**(2):173-175.

Dhyani, S.K., Handa, A.K and Uma. (2013), Area under agroforestry in India:An assessment for present status and future prospective. *Indian Journal of Agroforestry,* **15**(1):1-11.

Dutta, V and Thakur, P.S. (2004), Bio-economics of cropping systems combining medicinal and aromatic herbs with commercial timber tree species. *Indian Journal of Agroforestry*, **6**:1-7.

Karikalan, T.V., Yassin, M.M, Divya, M.P and Gopi, D. (2002), Effect of intercropping and nitrogen management on growth and yield of medicinal plants under kapok. *Indian Journal of Agroforestry,* **4**(2):88-93.

Kumar, A, Kumar, M, Nandal, D. P. S and Kaushik, N. (2013), Performance of wheat and mustard under *Eucalyptus tereticornis* based agri silvi culture system. *Range Management and Agroforestry,* **34**:192-195.

Nagarajaiah, C., Kittur, B.H, Muthamath, U and Venkatesh, L. (2012), Evaluation of medicinal and aromatic crops under teak-based agroforestry system. *Environment and Ecology*, **30**(1):221-225.

Nandal, D. P. S and Ravikumar. (2010), Influence of *Melia azedarach* based land use system on economics. *Indian Journal of Agroforestry,* **15**:23-26.

Pallavi, Ch., Joseph, B., Aariff Khan, M.A and Hemalatha, S. (2015), Yield, nutrient content, uptake, and Available nutrient status of Finger millet as influenced by Nutrient Management in Agri-silvi System. *International Journal of Current Research*, **7**(11): 22311-22314.

Pathak, P.S. Gupta, S.K and Singh, P. (1996), IGFRI Approaches:Rehabilitation of Degraded lands. IGFRI, Jhansi, pp. 1-23.

Prasad, J. V. N. S., Korwar, G. R., Rao, K.V., Srinivas, K., Srinivasarao, Ch., Peddababu, B., Venkateswarlu, B., Rao, S. N and Kulakarni, H.D. (2011), On-farm evaluation of two fast growing trees for biomass production for industrial use in Andhra Pradesh, Southern India. *New Forests,* **42**:51-61.

Ram, S.N. Roy, A.K and Shukla, A.K. (2016), Effect of moisture conservation practices on performance of Anjan (*Hardwickia binata*) tree based silvi-pasture systems. *Range Management and Agroforestry*, **37**(2): 222-227.

Ravitchandirane V and Haripriya, K. (2011), Intercropping with medicinal plants in mango cv Alphonso. *Plant Archives*, **11**(1): 413-416.

Roy, M.M. (2016), Agroforestry on dry and degraded lands present status and future prospects.

Range Management and Agroforestry, **35**: 1-11.

Sharma, K. C. (2014), Production potential of fodder crops sequence in association with ber (*Zizypus mauritiana* L) under agri-horticulture system in hot arid ecosystem of western India. *Range Management and Agroforestry,* **35**: 188-192.

Singh, R.A, Shamim, Singh, P.V, Singh, M.K and Pandey, R.K. (2008), Agri and vege-hroti systems with mango in Gangetic alluvial tract of UP. *The Asian Journal of Horticulture,* **3**(2):226-228.

Sunil Kumar, Shukla, A.K and Singh, H.V. (2015), Efficient utilization of interspaces of *Emblica officinalis* orchard through intercropping under rainfed condition. *Range Management and Agroforestry,* **36**(2): 188-193.

Suvera, A.H, Thakur, N.S and Jha, S.K. (2015), Herbage and essential oil yield of *Ocimum* spp intercropped under *Pongamia pinnata* based silvi-medicinal systems in Gujarat, India. *The Bioscan,* **10**(1): 81-85.

Thakur, N.S, Verma, K.S and Rana, R.C. (2014), Growth and yield performance of Ahwagandha (*Withania somnifera*) under agroforestry. *Indian Journal of Agricultural Science*, **84**(8): 937-941.