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Agriculture Trend and Strategies to Improve the Agriculture under Limited Resource Conditions

Dr. R. Velusamy[1]

Abstract

The major focus of the present study is to assess the productivity gap and production shortfalls, to suggest the location specific varieties, technologies, input and resource management to bring down the yield gap. The results indicated that the annual growth rates were negative for cotton (-13.24 per cent), sunflower (-6.12 per cent) paddy (-1.8 per cent), cumbu(-3.8 per cent), cholam (-1.17 per cent) and gingelly (-3.14 per cent) and it was positive in case of maize (24.81 per cent), greengram (10.73 per cent), coconut (4.10 per cent), chillies (2.99 per cent), blackgram (2.45 per cent) and banana (1.78 per cent). The yield gap for paddy varies from 14 per cent to 36 per cent, pulse crop with 56 per cent to 67 per cent, oil seed crops with 32.46 per cent to 72.15 per cent and cotton crop with 66.33 to 80.95 per cent. The suggested potential varieties of paddy to reduce the yield gap are ADT 36, ASD 16, ADT 39, ASD 18 and MDU 5 and for blackgram Vamban 4 and Vamban 5.

Key Words: Agriculture trend, strategies, limited resource conditions

1. Introduction

In Agriculture, over the years many changes have occurred due to many factors namely decreased & uneven distribution of rainfall, drought, labour shortage, natural calamities, manmade problems like conversion of agriculture land to home and business purposes. Also the cultivable area is reduced, rainfed area is increased, some crops washed out from particular area and some new crops occupied more area and ultimately yield output from crops drastically reduced. Finding the present position of agriculture crop, crop yield and productivity under the situation of decreasing trend of resources is the basic idea of present study.

[1] Assistant Professor (Agricultural Extension), Department of Social Sciences, Horticultural College and Research Institute, Periyakulam -625 604, Tamil Nadu Agricultural University, Tamil Nadu, India

A holistic, or systems-oriented approach, is preferable because it can address the difficult issues associated with the complexity of food and other production systems in different ecologies, locations and cultures. Achieving the potential yield of particular crop/ variety under limited resource conditions is essential to meet the food requirements. Yield potential also called potential yield, is the yield of a crop cultivar when grown with water and nutrients non-limiting and biotic stress effectively controlled (Evans, 1993 and Van Ittersum and Rabbinge, 1997). Under limited resource conditions alternate land use systems is very important to utilize the available resources and to achieve the targeted result. Over the few decades rapid economic development, associated with the population explosion and growing urbanization, resulted in an increased demand of water for irrigation, domestic and industrial purposes (Ravikumar and Somashekar, 2010).

Katyal, *et al.* (1993) reported that alternate land-use systems viz., agro-forestry, agri-horticulture, silvipastoral, and dryland horticulture under a rainfed agro-ecosystem generates continuous and stable income and meets food, fodder, fuel and fruit requirements. The results of an experiment conducted on degraded soil at Rajkot revealed that an alley cropping system of *Leucaena* + groundnut could provide insurance against drought, besides higher monetary returns (S. K. Das and C. J. Itnal 2005). The land resources will play major role in production and productivity in agriculture. The higher blackgram yield in rainfed conditions under treatments Zero tillage direct drilling of seeds and fertilizers at 2^{nd} days after harvesting of rice and Zero tillage direct drilling of seeds and fertilizers at 2^{nd} days after harvesting of rice might be due to higher plant population and other growth characters as well as yield attributing characters resulted due to better availability of moisture and nutrients during growth period. (Tej Ram Banjara et al.,2015).

In Tamil Nadu, Thoothukudi district is one of the important district where the agriculture is in decreasing trend. The average rainfall of the Thoothukudi District is below 700 mm. Therefore, successful crop production depends heavily on the success / failure of monsoon thus making agricultural production riskier in many parts of the district. Most of the crops except paddy, banana, and coconut are cultivated in rainfed situation. Limited availability of surface and groundwater in all taluks is a major weakness for the agricultural development in the district. The area under rainfed crops in the district has been increasing over the years from the inception of Thoothukudi district due to increasing scarcity of labour and stagnation in yield and profitability of crops. Also tremendous increase in migration from rural to urban areas.

In this situation studying the trend of agricultural and horticultural crops in Thoothukudi district and agriculture position over the years and developing strategies is very important one to prepare the plan for the improvement of agriculture. Keeping this in view the study was undertaken with the following objectives:

1. To assess the trend of major agricultural and horticultural crops over the years
2. To estimate the yield gap of major agricultural and horticultural crops
3. To identify the possible strategies / solutions to reduce the yield gap of major agricultural and horticultural crops

2. Materials and Methods

The study was conducted in three dimensions namely assessing the trend of potential major agricultural and horticultural crops, yield gap of potential crops and strategies formulation to reduce the yield gap in participation with farmers and extension functionaries. The area under crops for the three years namely 2008-09, 2009-10 and 2010-2011 were taken and average was worked out and the percentage of each crop to total crop area was worked out. The cumulative percentage was worked out for all the crops. Crops comes up to the 80.00 in cumulative percentage were considered and selected as major crops. Major crops were selected separately for both agricultural and horticultural crops. The area, production and productivity for each selected major agricultural and horticultural crops were collected from the inception of Thoothukudi district (1986) up to the year 2010-2011 and trend analysis was worked out by using least square model (Wilks (1995)

$$P \alpha \prod_{i=1}^{N} \left\{ \exp\left[-\frac{1}{2}\left(\frac{y_i - (a + bx_i)}{\sigma_i} \right)^2 \right] \Delta y \right\}$$

The yield gap for selected major crops were calculated based on the potential yield of the crop, maximum yield obtained by progressive farmers in crop cutting experiments and average yield of the crop in crop cutting experiments. Overall yield gap was estimated by using method adopted by Chuc et.al (2006).

After the estimation of yield gap the reasons/ causes for yield gap were ascertained by participative discussion method namely focus group discussion (Cameron, J. (2005) with progressive farmers of major agricultural and horticultural crops concerned, field level extension functionaries of agriculture and allied departments, scientist from the agricultural research station of Thoothukudi district and scientist from Krishi Vigyan Kendra of Thoothukudi district. Also the recommendations or possible solutions were discussed in second focus group discussion meeting for the identified reasons of yield gap.

3. Results and Discussions

3.1 Major Potential Agricultural and Horticultural crops of Thoothukudi district

In Thoothukudi district sixteen agricultural crops are cultivated both in irrigated and rainfed situation. Out of 16 crops, 9 agricultural crops were selected as potential crops based on the cumulative percentage total (Table 1). Among these crops, blackgram covers 21.95 percentage of total crop area, greengram covers 20.56 percentage, paddy covers 13.77 per cent, maize with 9.96 per cent, cumbu with 7.50 percentage, cholam with 6.03 percentage, cotton with 2.36 percentage, sunflower with 1.14 percentage and gingelly with 1.11 percentage. The nine crops cumulatively covers 84.08 percentage of total agricultural cropped area.

In Thoothukudi district twelve horticultual crops are cultivated in irrigated situation. Out of 12 crops, 3 horticultural crops were selected as potential crops based on the cumulative percentage total(Table 2). Among these crops chillies covers 37.03 percentage of total crop area, banana covers 27.37 percentage and coconut covers 16.46 percentage of total horticultural crop area. The three crops cumulatively covers 80.86 percentage of total horticultural cropped area.

3.2. Trend in area, Production and Productivity

It could be observed from the Table 3 that the annual growth rates of area for the period between 1986-87 and 2010-11 were negative for the selected major crops like cotton (-13.24 per cent), sunflower (-6.12 per cent) paddy (-1.8 per cent), cumbu (-3.8 per cent), cholam (-1.17 per cent) and gingelly (-3.14 per cent) and it was positive in case of maize (24.81 per cent), greengram (10.73 per cent), coconut (4.10 per cent), chillies (2.99 per cent), blackgram (2.45 per cent) and banana (1.78 per cent).

Over the years the area under the paddy has reduced considerably and it shows the negative trend. But the productivity was increased and it shows a positive trend. Several modern technologies to increase the productivity of paddy by State Agricultural University and continuous extension efforts by state department extension personnel might be the reasons for the positive trend of paddy productivity. The same trend was observed in cumbu, cotton, sunflower and gingelly. In contradiction to above trend pulse crop namely blackgram and greengram occupied more area over the years but the productivity shows negative trend due to increased rainfed area and pulses are mostly cultivated under rainfed. The same trend was observed in chillies and onion crops.

3.3. Yield Gap

It could be observed from the Table 4 that yield gap for paddy varies from 14 per cent to 36 per cent depends on variety. It implies that there are chances for increasing the yield of paddy up to 36 per cent when compared to present yield.

In pulse crop the yield gap was varies from 56 per cent to 67 per cent. It clearly noted that there was vast scope to get more yield by adopting integrated crop management practices. Pulses are cultivated under rainfed conditions might be the reason for higher yield gap in pulses. Regarding maize crop fifty per cent of yield gap was present. Farmers are mostly cultivating hybrid under rainfed conditions and forty per cent yield gap was present. This findings is in line with findings of Wani (2003)

The oil seed crops namely sunflower and gingelly are cultivated under rainfed situation and it leads to yield gap from 32.46 per cent to 72.15 per cent. The cotton crop with huge yield gap of 66.33 to 80.95 per cent. Coconut crop was cultivated under irrigated with proper integrated crop management practices in this district and it leads to low yield gap of 27.07 per cent.

3.4 Strategies to narrow down the yield gap

Two focus group discussion meeting was conducted by involving progressive farmers of concerned crops, field level extension functionaries of agriculture and allied departments, scientists from agricultural research stations and Krishi Vigyan Kendra of Thoothukudi district. The outcomes of participative discussions were presented as follows.

Focus group discussion results revealed that majority of the farmers and stake holders were expressed that they are in need of short duration variety to utilize the rainfall for paddy, drought tolerant variety in coconut, blackgram, greengram, cholam, cumbu, chillies, cotton, maize, gingelly and in sunflower. In second focus group discussion the scientists have recommended research may be conducted in paddy with the character of variety ASD 19 and BPT to utilize the rainfall and water availability in the tank system. Also they recommended K1 and APK 1 variety for blackgram, K1, CO(Gg) – 6, CO(Gg)-7 variety for greengram, TKSV 0809 and K8 variety for cholam, CoCu 9 for cumbu, PMK 1 variety for chillies, CoH(M)6 hybrid for maize, TMV 3 variety for gingelly and CO(SFV) 5 (Autogamy), CO2 hybrid, Sunfred 275 for sunflower as drought tolerant variety / hybrids.

Majority of the participants expressed that non availability of seed material and inputs in time in blackgram, greengrm, chillies and maize and non availability of good quality planting materials in banana. Scientists have recommended that steps may be taken by the department of agriculture and department of horticulture for the timely supply of seeds. Also they recommended to establishment of nursery for planting materials for horticultural crops. These results are in line with the results of Signh et. Al (1998)

Majority of the participants were reported that pest and disease problem in banana, yellow mosaic virus in blackgram, eryophyte mite in coconut and weevil in cotton. Scientist have recommended that training and demonstration may be conducted in integrated pest and disease management in the crops concerned. This results are similar with the results of Royal Society (2009) and Flood (2010). Also the participants stated that flower dropping in cotton, low yield in coconut and reduced nut size in coconut as major issues. Scientists have recommended that steps may be initiated to conduct the training and demonstration in integrated nutrient management. The results are similar with the results of Rajula Shanthy and subramaniam (2015).

All the participants reported that middle man problem and low price for produce for banana, paddy, blackgram, cumbu, cotton, maize, and gingelly as issues. Scientists have recommended that procurement centre may be established for each crop and minimum support price may be fixed by government as like paddy crop. Also they recommended that needed number of procurement centre may be established based on the crops cultivated. These results are similar to the findings of Singh et.al. (1998) The scientists recommended that value addition training may be conducted in banana, chillies, pulses, oilseeds, cumbu, cholam and maize to get better price for their produce. In addition to this, market price information for produce also may be provided to the farmers.

Also they recommended cold storage facilities for chilies and banana may be established to avoid price loss during surplus production period. All the farmers were expressed that low capacity and poor maintenance of system tank and wastage of water in system tank is one of the major issue. Scientist recommended that system tank may be desilted and also proper education may be provided to farmers for effective utilization of irrigation water in system tank. These findings are in line with findings of Sengupta (1985) and sivasubramaniyan (2006)

4. Conclusion

Based on the analysis the following conclusions were made

4.1 Bridging the Yield Gap

The suggested potential varieties of paddy to reduce the yield gap for Early kar, kar, late sambs, pishanam and semi dry seasons are ADT 36, ASD 16, ADT 39, ASD 18 and MDU 5 respectively. With respect to blackgram, Vamban 4, Vamban 5 has more yield potential and the same is suggested for bridging the yield gap. Establishment of cold storage facilities at pulse growing areas is essential. Cultivation of K1, CO (Gg) – 6 and CO (Gg) – 6 varieties with intensive adoption of technologies would raise the production of greengram. For effective utilization of minimum rainfall the drought tolerant cholam variety namely K8, TKSV 0809, SPV 1489 and CSV 17 are recommended to get higher production. Cost effective management practices with Co Cu 9 cumbu variety would increase the production of cumbu in the district. Intensive cultivation of PMK 1 chillies variety with proper guidance from Agriculture department officials would increase the production of chilies. Establishment of procurement center for millets in millets growing blocks and providing value addition training would pave the way for higher income for famers.

4.2. Input Supply System

The annual requirement of seed and fertilizer for the selected crops, viz., paddy, green gram, blackgram, chillies, banana, coconut, sunflower, gingelly, cholam, cumbu, cotton and maize should be estimated considering the projected area under these crops and it will be distributed in proper time.

4.3. Storage and Marketing Infrastructure

The cold storage facility could be created in Thoothukudi, Kayathar and Ottanchathiram. Regulated market godown in all the blocks of Thoothukudi district may be established. In addition to paddy procurement centre, a maize and pulse procurement centre may be established in pulses and maize growing areas. Establishment of banana market complex in Thoothukudi, Srivaikundam, Karungulam, Thiruchendur and Alwarthirunagari is essential.

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Table 1: Major potential crops identified based on the cumulative percentage (Agriculture)

Sl.No	Crop	Area (ha)			Average (3 years)	Average Total area sown for three years (ha)	Percentage of crop to total area	Cumulative percentage of area
		2008-09	2009-10	2010-11				
1	Blackgram	30351	30473	37923	32916	149975	21.95	21.95
2	Green gram	28736	28366	35400	30834	149975	20.56	42.51
3	Paddy	22401	19549	20007	20652	149975	13.77	56.28
4	Maize	12650	13321	17495	14489	149975	9.66	65.94
5	Cumbu	11706	12640	9390	11245	149975	7.50	73.44
6	Cholam	9406	8782	8958	9049	149975	6.03	79.47
7	Cotton	3634	3766	3230	3543	149975	2.36	81.83
8	Sunflower	1946	1938	1254	1713	149975	1.14	82.98
9	Gingely	2174	1684	1120	1659	149975	1.11	84.08

Source: Season and crop reports (1986-87 to 2010-11)

Table 2: Major potential crops identified based on the cumulative percentage (Horticulture)

Sl. No	Crop	Area (ha)			Average (3 years)	Average Total area sown for three years (ha)	Percentage of crop to total area	Cumulative percentage of area
		2008-09	2009-10	2010-11				
1	Chillies	14249	14177	11664	13363	36084	37.03	37.03
2	Banana	9849	9760	10016	9875	36084	27.37	64.40
3	Coconut	6034	5910	5876	5940	36084	16.46	80.86

Source: Season and crop reports (1986-87 to 2010-11)

Table 3: Trend in Area, production and yield of major crops (1986-87 to 2010-2011)

Sl.No	Crops	Area (%)	Production (%)	Productivity (%)
1	Paddy	-1.805	0.984	2.841
2	Blackgram	2.450	1.085	-1.332
3	Greengram	10.733	8.266	-2.227
4	Maize	24.808	35.108	10.656
5	Cumbu	-3.823	-1.274	2.649
6	Banana	1.775	4.490	2.667
7	Chillies	2.994	1.917	-1.045
8	Cholam	-1.168	-3.087	-1.942
9	Coconut	4.065	3.356	-0.681
10	Cotton	-13.238	-10.346	3.333
11	Sunflower	-6.121	-3.079	3.240
12	Gingelly	-3.144	-1.970	1.211
13	Ragi	-10.682	-14.107	-3.833
14	Groundnut	-6.486	-6.153	0.356
15	Onion	5.470	2.808	-2.524
16	Sugarcane	9.835	8.518	-1.199

Source: Season and crop reports (1986-87 to 2010-11)

Table 4: Yield gap of the identified potential crops in Thoothukudi District Kg / ha

Sl.No	Crop	Variety	Potential yield (A)	Progressive farmer maximum yield (B)	Average yield (C)	Yield Gap I (A-B)	Yield gap I %	Yield Gap II (B-C)	Yield gap II %	Over all Yield Gap (A-C)	Over all yield gap %
1	Paddy (Irrigated)	ASD 16*	5600	4750	4473	850	15.18	277	5.83	1127	20.13
		ADT 43*	5900	5550	5059	350	5.93	491	8.85	841	14.25
		BPT5204	5242	3405	3315	1837	35.04	90	2.64	1927	36.76
		ADT 36	4000	3750	3400	250	6.25	350	9.33	600	15.00
2	Blackgram (Rainfed)	VBN 3	775	380	254	395	50.97	126	33.16	521	67.23
		VBN 4	780	500	272	280	35.90	228	45.60	508	65.13
3	Greengram (Rainfed)	VBN 2	750	530	324	220	29.33	206	38.87	426	56.80
		CO 6	900	766	309	134	14.89	457	59.66	591	65.67
		CO 7	978	759	382	219	22.39	377	49.67	596	60.94
4	Maize (Rainfed)	NK6240	8000	5760	3912	2240	28.00	1848	32.08	4088	51.10
5	Cumbu (Rainfed)	Pionner 86 M 33	3600	2934	1394	666	18.50	1540	52.49	2206	61.28
6	Cholam (Rainfed)	PAC 501	7600	4345	3544	3255	42.83	801	18.43	4056	53.37
		K Tall	3750	3000	2400	750	20.00	600	20.00	1350	36.00
7	Banana (Irrigated)	Poovan	50000	42500	30000	7500	15.00	11500	27.06	20000	40.00
		Local	45000	36000	23000	9000	20.00	11000	30.56	22000	48.89
8	Chillies (Rainfed)	Local**	2679	1480	1120	1199	44.76	360	24.32	1559	58.19
		K 1	3000	2500	1700	500	16.67	800	32.00	1300	43.33
9	Coconut (Irrigated) In Nos.	East coast tall ***	18000	17210	13127	790	4.39	4083	23.72	4873	27.07
10	Sunflower (Rainfed)	Gangakaveri	2400	1910	1621	490	20.42	289	15.13	779	32.46
		Co4	1500	970	524	530	35.33	446	45.98	976	65.07
11	Gingelly (Rainfed)	TMV 3	400-650	420	181	230	35.38	239	56.9	469	72.15
12	Cotton (Rainfed)	SVPR 2	2000	640	381	1360	68	259	40.47	1619	80.95
		MCU 5	1850	850	368	1000	54.05	482	56.71	1482	80.11
		RCH2 BT	3200	1981	1068	1219	38.09	913	46.09	2132	66.63

Source: Crop Production Guide, Crop Cutting experiments yield of Thoothukudi district and Adoptive research trail (*) of Thoothukudi district and On farm testing experiments of RRS, Paramakudi (**) OFT experiments of KVK Ramnathapuram(***)