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Sagina Venkatesh
M.Sc. (Ag.), Department of Agricultural Economics, I.A.S., Banaras Hindu University, Varanasi, Uttar Pradesh, India

Chandra Sen
Professor, Department of Agricultural Economics, I.A.S., Banaras Hindu University, Varanasi, Uttar Pradesh, India

Correspondence
Sagina Venkatesh
M.Sc. (Ag.), Department of Agricultural Economics, I.A.S., Banaras Hindu University, Varanasi, Uttar Pradesh, India

Decomposition analysis and sustainability of cropping pattern in Andhra Pradesh, India

Sagina Venkatesh and Chandra Sen

Abstract
The development of agriculture seems to hold the key progress to our economy as a whole. Presently the area under crops has been decreasing, so there is a need to increase the production by adopting modern techniques that enhances the total productivity of the crops. Shift in cropping pattern is a global experience since it is subject to change in technology, market factors and economic position of producers and consumers. Cropping pattern has been changing along with the time period. The area, yield and interaction effect of crops like paddy, cotton and maize was found to be increasing when compared to other crops as these crops are fetching high yield and high prices in the market.

Keywords: Agriculture, Andhra Pradesh, cropping pattern, decomposition and sustainability

Introduction
Cropping pattern is the proportion of area under various crops at a point of as it changes over space and time. The cropping patterns of a region are closely influenced by the geo-climatic, socio-economic, historical and political factors (Hussain, M. 1996) patterns of crop land use of a region are manifestation of combined influence of physical and human environment. Differences in attitude towards the rural land in the level of prosperity and technology have produced changes in emphasis. Their effects on both landscape and land use studies are likely to be far reaching (Coppock, 1968). Weather plays a decisive role in determining the existing cropping pattern. Cropping pattern is also depending on terrain, topography, slope, soils and availability of water for irrigation use of pesticides, fertilizers and mechanization.

Emerging Problems in Cropping Pattern
Over the years the emerging scenario in the cropping pattern points to the following observations.

- The dominance of cereal crops in the food grains points to the poverty of people. It meets the demand of the low-income people, in whose case a large proportion of income is spent on cereals. Even pulses which are the source of protein for this class of people is not grown on a significant scale.
- The predominance of food grains group together with the fact that a significant proportion of agricultural production is concentrated in small farms, leads one to conclude that much of the cultivation is for self-consumption.
- The fact that large areas remains under food grains shows that land productivity has not increased at par with technological possibilities.
- Despite significant changes in cropping pattern, the shift towards high valued commercial crops has been very small. The result is an insignificant impact on the growth of the crop output.

Andhra Pradesh grows 28 important crops during both seasons put together. The important crops grown are Rice, Maize, Pulses, Groundnut, Cotton, Chillies, Tobacco, Sugarcane etc.
The present study was under taken to examine the various aspects of the cropping pattern of Andhra Pradesh with special reference to it's' dynamics and factors associated as area and yield affects the production in existing cropping pattern. The specific objectives of the study are as follows:

- To decompose the production into area, yield and their interaction effects.
- To suggest means and ways for sustainable cropping pattern.

Research Methodology

Depending upon the objectives of the study, secondary data were used in study. In present study, the data were collected for major crops of kharif and rabi and for each year at state level. In present study the data were used from 2003-04 to 2014-15. On the basis of 12 years data in which 2003-04 was taken as base year. In order to minimize the irregular fluctuation in time series data, the three years average (triennium) was worked out where ever it is required.

Decomposition of major crops production into area, yield and their interaction effects

For estimation of contribution of area and yield towards change in production (positive/ negative) for base year and current year were estimated using the following model.

Area effect: shows percentage share of area in total production.

$$AE = \frac{(An - Ao)\,Yo}{(Pn - Po)} \times 100$$

Yield effect: shows percentage share of average yield in total production.

$$YE = \frac{(Yn - Yo)\,Ao}{(Pn - Po)} \times 100$$

Interaction effect: shows percentage share of area and yield (simultaneous variation) interaction towards total production.

$$IE = \frac{(Yn - Yo)\,(An - Ao)}{(Pn - Po)} \times 100$$

Where,
Ao = Triennium average of area in base year
Po = Triennium average of production in base year
Yo = Po/Ao or Triennium average of yield in base year
An = Triennium average of area in current year
Pn = Triennium average of production in current year
Yn = Pn/An or Triennium average of yield in current year

Results and Discussion

Decomposition analysis of major crops

For estimation of contribution of area and yield towards increase/ decrease in production of major crops for the period of study, the simple decomposition model was used. Basically, interaction of area and yield together is a part of production; hence, these effects are computed and presented in table 1

Table 1: Relative contribution of area and yield in production of Major crops in Andhra Pradesh state.

Crop	Area effect	Yield effect	Interaction effect
Paddy (kharif)	65.49	30.65	2.31
Sugarcane	128.40	-30.68	3.63
Groundnut	76.21	32.78	-10.19
Cotton	10.29	3.25	3.04
Other kharif crops	-387.05	4981.06	-301.96
Paddy (rabi)	45.44	50.53	3.13
Maize	86.08	4.87	9.10
Blackgram	-17.85	129	-9.77
Other rabi crops	-859.73	11526.06	-488.71

The main factor responsible for increase in production of Paddy (kharif) found to the area effect (+65.49%) followed by yield effect (+30.65%) and the interaction effect (+2.31%).
The main factor responsible for increase in production of Cotton found to the area effect (+10.29%) followed by yield effect (+3.25%) and the interaction effect (+3.04%).
The main factor responsible for increase in production of Maize found to the area effect (+86.08%) followed by yield effect (+4.87%) and the interaction effect (+9.10%). The main factor responsible for increase in production of Paddy (rabi) found to the area effect (+45.44%) followed by yield effect (+50.53%) and the interaction effect (+3.13%).

Sustainability of cropping pattern

Cropping pattern is a dynamic concept as it changes over space and time. The cropping patterns of a region are closely influenced by the geo-climatic, socio-cultural, economic, historical and political factors. The physical environment (physiographic, climate, soils and water) imposes limits on the growth and distribution of plants and animals. Depending on the terrain, topography, slope, temperature, amount and reliability of rainfall, soils and availability of water for irrigation, the cropping patterns vary from region to region. The perception and assessment of environment also guide to grow certain crops in a region. Those areas of the world where physical diversities are less, the cropping patterns are less diversified.
Moreover, the land tenancy, ownership of land, size of holdings and size of fields also impose restrictions on the cropping patterns of a region. In the areas of small holdings, the farmers tend to be subsistent despite innovation diffusion. Contrary to this, the farmers with large holdings have more risk bearing capacity and they have relatively high degree of commercialization. The cropping patterns of a region or areal unit may be determined on the basis of a real strength of individual crops. The first, second and third ranking crops of an a real unit may be called as the dominant crops of that unit. These crops, if occupying more or less the same percentage of the total cropped area, shall be competing for area with each other and the farmer will decide which crop may fetch him more profit in a given year under the prevailing rainfall and demand, supply and commodity price condition.
In general, for the determination of cropping patterns of a region, the minor crops (crops occupying insignificant proportion of the total cropped area) are eliminated. On the availability of an alternative more efficient crop than the existing ones, new cropping patterns may emerge in a region. The cropping patterns may be intensified with the help of high yielding short duration varieties. Any cropping sequence to be adopted by the cultivators should be flexible.

The suitability of a crop and cropping pattern may be judged on the basis of the following:

1. The crop should not accentuate certain diseases as a result of a fixed continuous rotation.
2. The crop should not exhaust on some specific plant

nutrients from a particular depth of the soil.
3. The crop should be fertility building and soil improving.
4. The crop should fetch handsome return to the cultivator and should provide the farmer employment and income all the year round. Moreover, the crop should ensure the optimum utilization of his resources, particularly inputs like irrigation water, chemical fertilizers, insecticides, pesticides, equipment's, power and family labour.

Following are the major components to maintain sustainable agricultural system:

- Soil and water conservation to prevent degradation of soil productivity.
- Efficient use of limited irrigation water without leading to problems of soil salinity, alkalinity and high ground water table.
- Crop rotations that mitigate weed, disease and insect problems, increase soil productivity and minimize soil erosion.
- Integrated nutrient management that reduces the need for chemical fertilizers improves the soil health and minimize environmental pollution by conjunctive use of organics, in-organics and bio-fertilizers.
- Integrated pest management that reduces the need for agrochemicals by crop rotation, weather monitoring, use of resistant cultivar, planting time and biological pest control.
- Management system to control weed by preventive measures, tillage, timely inter cultivation and crop rotation to improve plant health.

The horizontal expansion of agriculture is not possible without heavy capital investment. Only judicious utilization of land by adopting more remunerative cropping patterns, scientific rotation of crops and multiple cropping may help in overcoming the food and raw material problems of the country. The change in the cropping pattern and introduction of crops which enhance the soil fertility are imperative to make agriculture more remunerative and sustainable.

Conclusion

Area, yield and interaction effect for Paddy, Cotton and Maize crops in Andhra Pradesh state during the study period was found to be positive and for the Sugarcane crop area and interaction effect found to be positive and yield effect found to be negative. Area and yield effect for Groundnut crop found to be positive and interaction effect was found to be negative where as for Blackgram crop area and interaction effect was found to be negative and yield effect alone was found to be positive. Area and interaction effect for other kharif and other rabi crops was found to be negative and yield effect alone was found to be positive.

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