(IJRSSH) 2017, Vol. No. 7, Issue No. II, Apr-Jun **e-ISSN: 2249-4642, p-ISSN: 2454-4671**

THE STUDY OF CROP COMBINATION REGIONS IN GOA

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ABSTRACT

Crop combination technique provides a base for agricultural regionalization.It is a statistical method by which share of area under different crops and its proportion to the total area sown under different crops are ranked in an ascending order to understand and analyse the cropping pattern and diversification of crops in a given area unit at agiven point of time. It is beneficial for planning and development of agriculture.Although little encouragement is given to agricultural sectorin Goa due to other predominant economic activities such as mining and tourism but, the existing potentiality of the region can make the economy of Goa stronger by advancement in agriculture.Therefore government should take a keen interest to develop agriculture by agricultural land use planning. In the present paper crop combinationregions are identified for years 2006-07 and 2010-11 for comprehensive and clear understanding of the changing cropping pattern inGoa.The delineation of agricultural regions of Goa is carried out by using Weaver's method.The crop combination of Goa varies from 3 to 6 crops for its all areal units.

Keywords- crop combination,cropping pattern

INTRODUCTION

Agriculture geography is the vital branch of geography deals with study of spatial variations in agricultural activities,production,physical and cultural factors controlling its spatial distribution. Agriculture is the most important human activity.Knowledge of agriculture is useful to improve structure and management of agriculture.

Crop combination is an important aspect of agricultural geography helps in understanding the cropping pattern in a region. This technique delineates the agricultural regions based on the acreage statistics.The percentage of total harvested cropland occupied by each crop is taken into consideration. The concept of monoculture that is producing or growing single crop in a field at a time, which will occupy 100% share hardly exist in any geographical region, as growing multiple crops enables to cultivate crops throughout the year irrespective of season.The spatial distribution of crops in a region is useful to adopt the policies toincrease the production, to introduce irrigation schemes, to develop transport system forbetter accessibility. Crop combination is of great significance in understanding and analysing the cropping pattern and crop concentration in any particular area for the developmentof agricultural sector. There are different methods applied in the

delineation of crop combination regions. Weaver (1954) statistical technique is used to establish the crop combination and assessing the changing cropping pattern.

STUDY AREA

Goa forms apart of Konkan, Geographically located between the latitudes $14^0$53'54'' to $15^0$40'00''north and longitudes $73^0$40'33'' to $74^0$20'13''east.It encompasses an area of 3702 km^2.The state is separated from Maharashtra by Terekhol river in north, Karnataka in the south, Western ghats in the east and Arabian sea in the west.

Goa as a region canbe divided into four physical divisions-1) the eastern hill region comprising areas in the western ghat like Sattari, Ponda, Cancona and Sanguem 2) The Central valley land comprising Pernem, Bicholim, Ponda, Eastern Sanguemand Quepem3) The flood plains comprising the coastal plains and uplands 4) Coastal plains with the areas of Tiswadi, Murmugao, Bardez and Salcete.Most of the Goa's soil cover is made up of laterite.Alluvial type of soil is found along the banks of river.Temperature in Goa is moderate with not much variation. The summer is at its hottest in May while the winter months of January and February are the coldest. Otherwise, the state experiences tropical weather for rest of the year. Goa receives rainfall from the Southwest monsoon between the months of June and September. July receives the highest rainfall while February is the driest month.The major rivers of Goa are Mandovi, Terekhol, Zuari, Chapora, Betul, Sal,Talpona,Galgibag.

The state is divided into 2 districts-North Goa and South Goa.Further it is divided into 12 talukas.It involves Tiswadi, Bardez, Pernem, Bicholim, Sattari, Ponda, Sanguem, Cancona, Quepem, Salcete, Murmugao. Dharbandora has been carved out recently.

According to 2011 census, Goa has population of1458545, an increase from 1347668 in 2011 census (Primary Census Abstract, 2011). The density of population in Goa is 394 persons per km^2.

Even after having all the potential natural resources, Goa faces problem of shortage of agricultural produce.Agricultural production in Goa is not sufficient enough to feed its population.Therefore Goa depends on Maharashtra and Karnataka for agricultural imports.The contribution to agriculture to the Net State Domestic Product of Goa continues to be around16%, whereas at the national level it contributes around 45%of the national product.The net sown area of Goa was 159916in 2010-11 and 172108 in 2006-07,which has decreased by 12192 hectare (Angle, 1983), is a matter of concern.

OBJECTIVES

1. To understand the cropping pattern of various region in Goa state
2. To analyse the spatio-temporal changes of crop combination during the period 2006-07 to 2010-11.

DATABASE AND METHODOLOGY

The present study is based on secondary data acquired from Directorateof Agriculture,Tonca, Caranzalem Goa and Statistical Handbook of Goa for the year 2006-07 and 2010-11.For the delineation of crop combination region in Goa Weaver's method (1954) has been used.The percentage of total harvested cropland occupied by each crop that held as much as 1% of the total cultivated land in each tehsil is computed. Deviation of the real percentages of crops (occupying over 1% of the cropped area) for all the possible combinations in the component areal units against the theoretical standard is calculated.Choropleth map for different crop combination regions is generated by using ArcGis software.

LIMITATION

The study is focused on 11 tehsils of Goa and Dharbandora is not included in the study area as a different areal unit because it is carved out recently from Sanguem tehsil. Hence, study is carried out in entire Sanguem tehsil.

DISCUSSION AND RESULT

Percentage of cropped area to total area of the region (2006-07)

Table No. 1

SR. NO.	TEHSIL	CROPS										
		Rc	Cpo	Ca	Bt	Pp	Ts	Sg	Gc	Vg	Co	Op
1	Tiswadi	43.02	2.29	30.54	0.01	0.00	0.007	0.00	4.02	7.16	12.87	0.03
2	Bardez	29.95	21.46	25.87	0.06	0.05	0.01	0.00	2.25	12.23	12.01	0.06
3	Pernem	18.44	23.16	42.96	0.02	0.08	0.02	0.20	2.25	4.37	8.42	0.04
4	Bicholim	23.41	10.37	48.29	0.45	0.54	0.08	0.09	4.13	2.93	9.51	0.15
5	Sattari	21.35	3.04	58.17	2.05	0.59	0.08	1.01	6.06	0.89	5.08	1.59
6	Ponda	38.65	2.40	22.43	6.45	0.97	0.03	0.05	8.72	3.77	16.36	0.01
7	Sanguem	24.48	1.46	40.02	0.73	1.04	0.21	3.50	8.32	1.03	17.33	1.79
8	Cancona	31.92	0.73	30.43	0.46	0.42	0.009	0.83	14.89	4.21	16.05	0.00

9	Quepem	50.32	1.53	19.16	0.37	0.33	0.08	1.35	8.15	0.81	16.54	1.27
10	Salcete	40.98	6.70	8.87	0.00	0.02	0.009	0.00	8.78	6.42	28.18	0.00
11	Murmugao	26.90	10.37	12.29	0.00	0.06	0.00	0.00	6.12	1.43	42.79	0.00

Sources: Calculated and compiled by the author using data from Statistical Hand Book, 2006-07
**Rc =Rice, Cpo= Cereals/pulses &oil seeds, Ca =Cashew nut ,Bt =Beetle nut, Pp= Pepper , Ts =Trees spices, Sg= Sugarcane, Gc= Garden crops, Vg= Vegetables ,Co= Coconut ,Op= Oil palm*

Percentage of cropped area to total area of the region (2010-11)

Table No. 2

SR. NO.	TEHSIL	CROPS										
		Rc	Cpo	Ca	Bt	Pp	Ts	Sg	Gc	Vg	Co	Op
1	Tiswadi	41.40	2.48	31.59	0.01	0.00	0.007	0.00	3.66	7.45	13.36	0.00
2	Bardez	33.20	16.96	30.70	0.07	0.07	0.01	0.004	2.68	1.85	1.34	0.07
3	Pernem	20.37	21.07	42.80	0.03	0.09	0.01	0.20	2.32	4.64	8.42	0.00
4	Bicholim	22.78	3.93	52.89	0.51	0.66	0.09	0.08	4.89	3.51	10.43	0.17
5	Sattari	7.64	0.43	71010	2.48	0.78	0.12	0.58	7.90	0.69	6.29	1.95
6	Ponda	34.82	0.83	23.86	6.89	1.14	0.06	0.01	11.03	4.00	17.30	0.00
7	Sanguem	19.23	0.80	42.98	0.82	1.21	0.44	3.14	9.43	1.20	18.71	1.98
8	Cancona	32.97	0.51	30.75	0.61	0.51	0.07	0.68	12.52	4.97	16.37	0.00
9	Quepem	44.69	0.60	21.12	0.46	0.48	0.15	1.58	9.77	1.18	18.45	1.46
10	Salcete	39.48	4.06	9.57	0.00	0.03	0.009	0.01	9.13	7.37	30.29	0.00
11	Murmugao	24.94	21.05	10.58	0.00	0.05	0.00	0.00	5.39	1.73	36.22	0.00

Sources: Calculated and compiled by the author using data from Statistical Hand Book, 2010-11
**Rc =Rice, Cpo= Cereals/pulses &oil seeds, Ca =Cashew nut ,Bt =Beetle nut, Pp= Pepper , Ts =Trees spices, Sg= Sugarcane, Gc= Garden crops, Vg= Vegetables ,Co= Coconut ,Op= Oil palm*

Delineation of crop combination regions of Goa for the year2006-07and 2010-11

Table No. 3

		YEAR 2006-07			YEAR 2010-11		
SR. NO.	**TEHSIL**	**VALUES**	**CROP COMBINATION**	**TYPES OF CROPS**	**VALUES**	**CROP COMBINATION**	**TYPES OF CROPS**
1	Tiswadi	173.21	3 crop	Rc+Ca+Co	155.64	3 crop	Rc+Ca+Co
2	Bardez	39.23	5 crop	Rc+Ca+Co+Vg+Gc	69.5	4 crop	Rc+Ca+Cpo+Co
3	Pernem	139.28	3 crop	Ca+Cpo+Rc	135.98	3 crop	Ca+Cpo+Rc
4	Bicholim	189.38	5 crop	Ca+Rc+Cpo+Co+Gc	310.39	6 crop	Ca+Rc+Co+Gc+Cpo+Vg
5	Sattari	262.60	3 crop	Ca+Rc+ Gc	607.79	6 crop	Ca+Gc+Rc+Co+Bt+Op
6	Ponda	105.63	3 crop	Rc+Ca+Co	88.04	4 crop	Rc+Ca+Op+Gc
7	Sanguem	140.72	4 crop	Ca+Rc+Co+Gc	159.63	4 crop	Ca+Rc+Co+Gc
8	Canacona	64.91	4 crop	Rc+Ca+Co+Gc	81.7	4 crop	Rc+Ca+Co+Gc
9	Quepem	250.08	4 crop	Rc+Ca+Co+Gc	166.51	3 crop	Rc+Ca+Co
10	Salcete	175.16	6 crop	Rc+Co+Ca+Gc+Cpo+Vg	159.75	6 crop	Rc+Co+Ca+Gc+Vg+Cpo
11	Marmugao	17391	4 crop	Co+Rc+Ca+Cpo	76.51	3 crop	Co+Rc+Cpo

Sources: Calculated and compiled by the author based on Weaver's Crop Combination Method by using data from District Statistical Hand Book, 2006-07 and 2010-11

**Rc =Rice, Cpo= Cereals/pulses &oil seeds, Ca =Cashew nut ,Bt =Beetle nut, Pp= Pepper , Ts =Trees spices, Sg= Sugarcane, Gc= Garden crops, Vg= Vegetables ,Co= Coconut ,Op= Oil palm*

Crop Combination Pattern in Goa For The Year 2006-07 And 2010-11

Table No. 4

		YEAR 2006-07		YEAR 2010-11	
SR.NO	NO.OF CROPS	NO.OF TEHSILS	NAMES OF TEHSIL	NO.OF TEHSILS	NAMES OF TEHSIL
1	Monoculture	0	-	0	-
2	2 crop	0	-	0	-
3	3 crop	4	Tiswadi, Pernem, Sattari, Ponda	4	Tiswadi, Pernem, Quepem, Murmugao
4	4 crop	4	Sanguem, Canacona, Quepem, Murmugao	4	Bardez,Ponda, Sanguem, Canacona,
5	5 crop	2	Bardez, Bicholim	0	
6	6 crop	1	Salcete	3	Bicholim,Sattari, Salcete

Source: Compiled by the author

The study is being carried out in different tehsils of Goa for the year 2006-07 and 2010-11. Significant changes have been noticed in the cropping pattern of the region. Crop diversification is a cropping system where more than one or several crops are grown in an agricultural year. The level of crop diversification largely depends on the physical, social, economic conditions and technological development in the region. Higher the level of agricultural technology shows lesser the degree of crop diversification. It is observed from the study that rice, cashew nut and coconut are the major crops in Goa. It is observed from the analysis that not even a single tehsil has monoculture. The crop combination varies from 3 to 6 crops.

THREE CROP COMBINATIONS

In 2006-07, 3 crop combinationswere seen in 4 tehsils of Goa including Tiswadi, Pernem, Sattari and Ponda.In the same year rice was dominant crop in Tiswadi followed by cashew nut and coconut.These three crops altogether makes around 86% of totalnet sown area under different crops. In Pernem, cashew nut covers more area approximately around 43%.Cereals,pulses and oilseeds are second important crops in the region followed by rice.In Sattariaround 58% of net sown area is utilized for cashew nut,as hilly areas forming parts of Western Ghats covered by laterite soil whichfavours only cashew plantation. It is followed by rice in plain areas along the banks of river Mandovi in the region. Garden crops are third important crop in the region. InPonda rice is dominant crop covering 38% of total cropped area, followed by cashew nut and coconut.In 2010-11, 4 tehsils out of 11 have 3 crop combinations. These are Tiswadi, Pernem, Quepem, and

Murmugao.Tiswadi and Pernem remained with same crop combination with similar crop ranking.In the same year rice is the dominant crop in Quepem covering 50% of total cropped area, followed by cashew nut and coconut. In murmugoa coconut is dominant crop followed by rice and cashew nut.

FOUR CROP COMBINATIONS

In 2006-07, 4 crop combinations were noticed in Sanguem, Cancona, Murmugao and Quepem. In Sanguem 4 most important crops werecashew nut (40%), rice (24%), coconut (17%)and garden crops (8%). In canaconaand Quepem rice was dominant crop with its high share in total cropped area, followed by cashew nut, coconut and garden crops. In Murmugao the most dominant crop was coconut with 42% of its share due to favourable geographical conditions in the region for coconut plantation. It was followed by rice,cashew nut and cereals, pulses and oil seeds.But, in 2010-11, 4 crop combinations were seen in Bardez, Ponda, Sanguemand Canacona.In Bardez rice, cashew nut, cereals, pulses, oil seeds and coconut are the important four crops.In Ponda,Sanguem and Canacona four crop combinations are rice, cashew nut,coconut and garden crops.

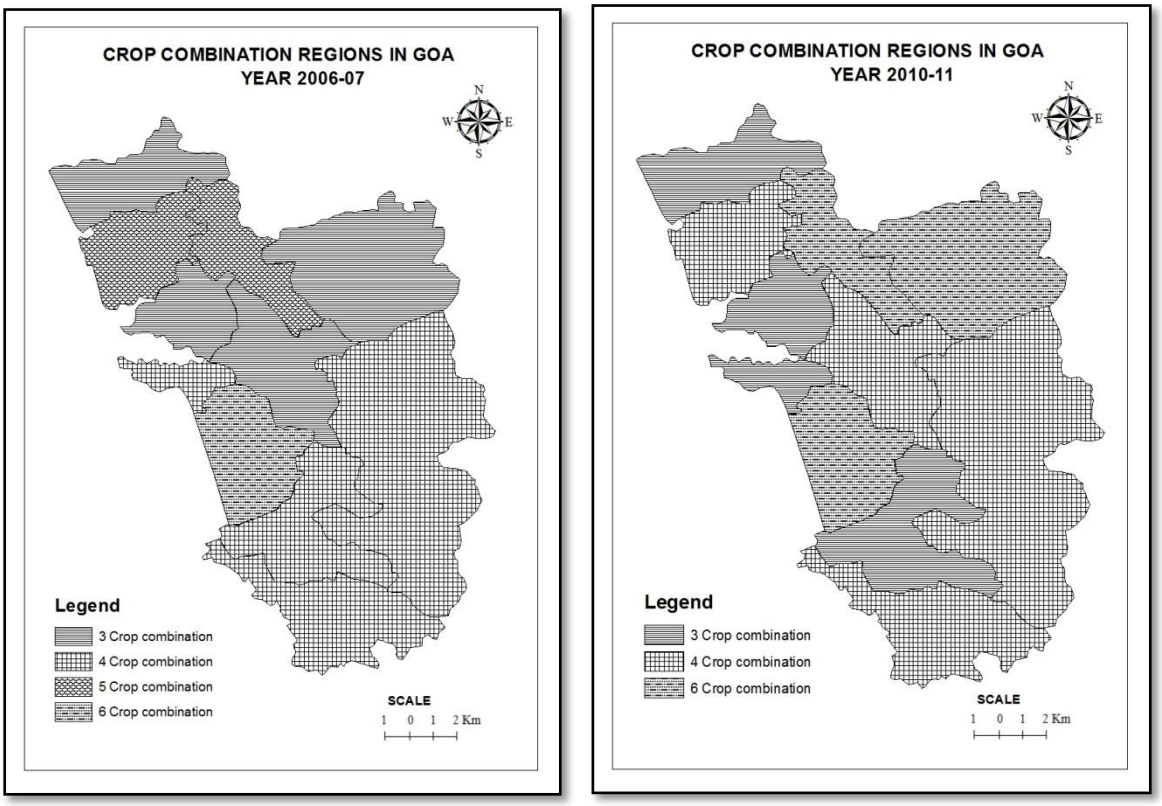
FIVE CROP COMBINATION

Two tehsils have observed 5 crop combinations in 2006-07.These two tehsils are Bardez and Bicholim. In Bardez, the crop ranking is as follow: rice (25.95%), cashew nut (25.87%), cereals, pulses and oil seeds (21.26%), vegetables (12.23%), coconut (12%).In Bicholim,cashew nut is an important crop with its share of 48.29% in total cropped area. It is followed by rice with 23.41%, cereals, pulses and oil seeds with 10.37%, coconut with 9.51%, garden crops with 4.13%.In 2010-11 there is no single tehsil with five crop combination.

SIX CROP COMBINATION

Only Salcete tehsil has 6 crop combinations according to 2006-07 data. But, in 2010-11 two more tehsils were added in this combination, that are, Sattari and Bicholim. The crops grown in these areas are rice, cashewnut, coconut, groundnut, vegetables etc. High crop combination in these regions is because of uneven topography. There are plain areas along river banks as well as mountainous areas which provide wide scope for the mixed farming in a region. Subsistent farming system in the region, where farmers grows several crops to meet the family requirements is also one of the reason of six crop combination in these regions.

Crop Combination Regions in Goa (2000-07 and 2010-11)



CRITICAL ANALYSIS OF CROPPING PATTERN AND CROP COMBINATION REGIONS IN GOA

Cropping pattern refers to the percentage of area under different crops at a specific period of time. It is influenced by physical, social, cultural, economic and technological factors. 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. Areas with lesser physical diversities have lesser diversified cropping pattern. Moreover the land tenancy, ownership of land, size of land holdings imposes restrictions on the cropping pattern of a region.

The cropping pattern in a study area shows a significant variation in every tehsil. Tehsils in the eastern part of Goa including Sattari and Sanguem have similar physical conditions. As the region has high relief with dissected topography the area experience more or less similar cropping pattern. Cashewnut and rice are the main predominant crops in these regions. Coastal areas including Bardez, Murmugao and Salcete have coastal plains with similar type of soil and climate. This results in cultivation of rice and coconut covering more area.

From the study area it is clear that rice, cashewnut and coconut are the dominant cropsall over the region. Most of the region has 3 and 4 crop combinations.

CONCLUSION

The cropping pattern in the region shows diversity of crops. It is observed that the crop combination in the region varies from 3 to 6 crop combinations for the year 2006-07. 3, 4 and 6 crop combination have been noticed in year 2010-11. As rice is the dominant crop all over the region whichmakes part of staple food in Goa, in future there are chances that this crop may occupy more area with its specialization, if proper irrigational facilities are provided to the local people. There are also chances of increase in area under coconut plantation in a region as geographical conditions are favourable for its growth and it also takes lesser hard work and the growing demand in the market as it is one of the main food ingredient in Goa's cuisine.Further there are also chances that cashew nut can become one of the dominant crop due to its huge demand in the domestic as well as international market. But its production restricted to particular season which can affect its proportion in total cropped area.

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