A Study of Crop Intensity Parameters in Jammu Province of Union Territory of Jammu and Kashmir

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A B S T R A C T

The study focuses on the analysis of various agricultural parameters in Jammu Province of Union Territory of Jammu & Kashmir. Along with this it also focuses on measuring the magnitude of the performance of these agricultural parameters and based on their performances categorization of different districts are done. The various agricultural parameters such as Cropping Intensity, Irrigation Intensity, Crop Diversification, Agricultural Efficiency etc. are measured with the help of data collected from Digest of Statistics 2016-2017, Directorate of Economics and Statistics Government of J & K. For measuring these agricultural parameters various statistical techniques are used. For instance, in Crop Diversification Simpson Index is used, for Agricultural efficiency Bhatia's method is used and to find the overall magnitude of performance of these parameters Composite index formula is used. Result of the study reveals that Districts of Jammu and Kathua in the whole province have the highest index value; whereas 50% of the districts fall under category of low composite index value. The districts which have low composite index value can improve their performance by focusing on the improvement of low performing agricultural parameters like crop diversification, irrigation intensity etc. As all these low performing districts have hilly terrain the irrigation system of these districts can be improved by storing water in farm ponds which are constructed by low density polythene film. Sprinkler system and gravity drip irrigation system can also help in improvement of irrigation system in these high-altitude areas. Off season fruits and vegetables are also given more importance in other hilly states of India and the same can be done in these districts. Analysis of different agricultural parameters not only helps in increasing crop production but it also helps in the growth of socio-economic status of the farmers and amelioration of the environment.

Key words: Crop diversification, Agricultural efficiency, Irrigation intensity, Cropping intensity

Agriculture is the fulcrum around which whole economic activities of the man revolves. It is the vital source of food and employment for the major population of our country. Due to the diverse agroclimatic conditions in our country, the farming community has the privilege to cultivate different type of crops [1]. Similarly, the area of Jammu province is heterogeneous in nature in terms of climate, topography, irrigation facilities, etc. There are some districts which have plain as well as mountainous terrain and some districts which wholly lie in the mountainous area. Due to this farmer of the whole region can grow different types of crops [2]. Agriculture system in India supports 18 percent of the human population and 15% of the livestock population of the world and has the area around 2.3% of total world's land area [3]. For the last two decades the increase in the production of agricultural products have been entirely due to increase in productivity rather than increase in land area under agriculture [4]. Like in other parts of the country agricultural system of the Jammu province is predominately occupied by the small

and marginal farmers. All these farmers cultivate low value or subsistence crops. Because of this majority of the farmers are living in the poor economic condition [5].

The main objective of the study is to measure the performance of various agricultural parameters in the Jammu Province and along with this to study the magnitude of various agricultural parameters over different districts of Jammu province in UT of Jammu and Kashmir. The whole Jammu province has the population of 5350811 and the main languages of the Jammu division are Dogri, Hindi, Pahari, Kashmiri, Gojri and Punjabi [6]. It becomes very crucial in agriculture sector to study the various parameters of agriculture, as all these parameters helps in framing a strong foundation for agriculture regionalization [7].

Cropping intensity and irrigation intensity are among the most important parameters for the agricultural development of any region. High cropping intensity results in high crop production as high index value shows that the factors affecting the agriculture production are favorable in the region [8]. The repeated cultivation of one or two crops in an area has resulted in soil degradation, nutrient deficiency and resource depletion. Crop diversification is one of the solutions which can solve the problem of environment degradation along with providing capital security to the farmers. Agricultural efficiency is another parameter which helps to

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understand the agricultural development of any region. Fertilizer's usage and area under HYV seeds are also some of the factors which highlights the performance of agriculture in particular area. The study of all these parameters will give us the spatial variations of agriculture performance in UT of J & K and it will also help in differentiating various districts that are performing poorly and we can find number of tactics to improve production in those areas. Both food and non-food crops have been considered in our study for measuring various parameters of agriculture.

MATERIALS AND METHODS

The present research has been carried by using the secondary data collected from Digest of Statistics 2016-2017, Directorate of Economics and Statistics Government of J & K (Regional Digest of Statistics 2016-2017) [9]. In order to measure and understand the performance of different agricultural parameters different statistical formulations have used to obtain the desired results. The statistical methods used in the present study are as follows:

Cropping Intensity Index

$$\frac{\text{Gross sown area}}{\text{Net sown area}} \times 100$$

High cropping intensity gives us the result that, all the factors that are affecting the crop cultivation are favorable for multiple usage of land area.

Irrigation Intensity Index

$$\frac{\text{Net irrigated area}}{\text{Net sown area}} \times 100$$

Crop diversification

For crop diversification Simpson Index is used. This is the modified version of Herfindhal Index. Simpson Index is calculated as follows:

$$\text{Simpson Index} = 1 - \sum P_i^2$$

Here, $P_i = \dfrac{A_i}{\sum A_i}$

A is the area under single crop and $\sum A_i$ is the Total cropped area. P is called as the acreage proportion to each crop. This index will give us the value between 0 and 1. The value approaching 1 will give the more diversified nature of the study region [10].

Agriculture Efficiency

To find out the agriculture efficiency Bhatia's method has been used and the method is as follows:

$$Ly_n = (y_1/y) \times 100$$

Here, y_1 is the yield of individual crop in a single district and y is the yield of individual crop in the whole Jammu division and Ly_n is the percentage yield of the individual crop.

Agriculture Efficiency Index, E_i=
$$(Ly_1c_1 + Ly_2c_2 + Ly_3c_3 + \ldots Ly_nc_n)/(c_1 + c_2 + c_3 + \ldots c_n)$$

Here c_1, c_2, $c_{3,\ldots}c_n$ are the percentages of the cropped area to the total cropped area and $Ly_1c_1 + Ly_2c_2 + Ly_3c_3 + \ldots$ are the indices of different crops [11].

Composite Index

To find the magnitude of various agriculture parameters Composite Index is formulated by using variable index which is developed by following formula:

$$I = \frac{x_1 - \min(x)}{\min(x) - \min(x)}$$

Max(x) and min(x) are the maximum and minimum value of X_i among all districts, X_i is the value of the variable for an ith district at a given time. The value of I lies between 0 and 1 (OECD 2008). Various statistical methods like percentage, average etc. have also been used to accomplish the objectives of the study and result is shown with the help of maps made by using Arc GIS tool and Microsoft office Excel.

RESULTS AND DISCUSSION

Agriculture is the largest economic sector on which the maximum population of the country depends for their survival. As mentioned in the Malthus theory with the increase in population there is more pressure on the agriculture sector to increase its production. If the population keeps on increasing and agriculture sector does not match its speed with population growth problems like famine, war, disease etc. can be seen in the area [12]. Due to already existing very large population in our country, the scope of increase in area under agriculture is very less. To cope up with this problem of increasing pressure on agriculture sector there is great need for keeping a check on the performances of various agriculture parameters.

Table 1 District wise values of various agricultural parameters in Jammu Province (2016-17)

District	Irrigation intensity	Cropping intensity	Crop diversification	Agriculture efficiency	Fertilizers distributed (M tonnes) (%age)	Area under HYV seeds (000 Hect. (%age)
Jammu	61.90	183.74	0.699	118.55	36.27	24.36
Samba	30.83	198.2	0.697	101.38	6.84	8.30
Kathua	36.08	199	0.7007	108.78	13.95	17.02
Udhampur	20.88	189.76	0.679	107.38	6.15	10.59
Reasi	6.87	174.16	0.588	68.8	3.18	5.77
Ramban	6.87	127.22	0.577	80.75	7.93	2.86
Doda	8.35	166.9	0.635	81.81	1.85	5.91
Kishtwar	17.54	124.82	0.62	81.45	2.12	2.72
Rajouri	8.89	189.33	0.577	78.49	15.77	15.02
Poonch	12.80	163.62	0.589	82.52	5.95	7.45

Source: Regional Digest of statistics J&K, 2016-2017

The various agricultural parameters used in the study are Cropping Intensity, Irrigation Intensity, Crop Diversification, Agricultural efficiency, Percentage of area under high yielding varieties (HYV) seeds and all are calculated with the help of using various statistical formulas. All these parameters help in increasing the crop production of an area by proper use of agricultural land available, irrigation facilities, balance use of fertilizers etc. Analysis of different agricultural parameters not only help in increasing crop production but it also helps in the growth of socioeconomic status of the farmers, ensuring food security, reducing environmental degradation and adaption of changing climate. Therefore, all these parameters are essential to find the overall situation of agriculture in Jammu Division. The (Table 1) presents the different index values of the various agricultural parameters in the study region which are calculated by using various mathematical formulas.
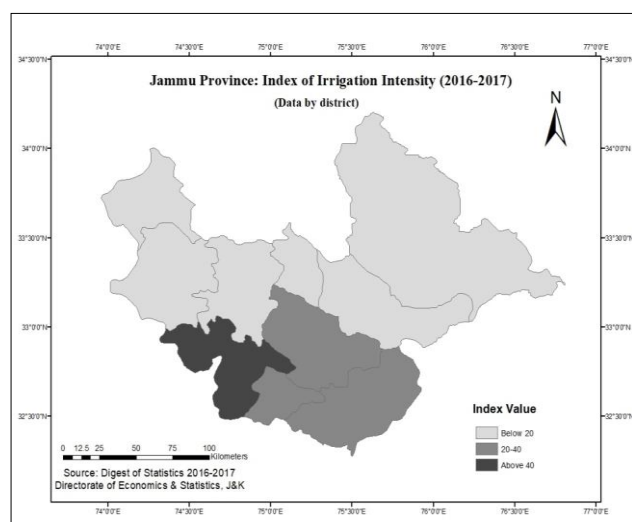
Irrigation intensity

Irrigation is one of the important requirements for the efficient production of agriculture. With the expansion of technology in the agriculture sector, different ways of irrigation have been adopted by the farmers. Irrigation intensity is measured as proportion of the cultural commanded area, proposed to be irrigated annually. If the area is having high irrigation intensity value, this determines that area is irrigated properly in both the seasons (Kharif and Rabi) of cultivation. After studying irrigational intensity of Jammu Province from (Table 2), this can be revealed that there is only one district in the whole study region that is Jammu district which falls under high irrigational intensity with the index value of 61.90. Out of the total ten districts, three districts namely Kathua, Samba and Udhampur falls under moderate range of irrigational intensity. The districts such as Kishtwar, Poonch, Rajouri, Doda, Reasi and Ramban have low irrigational intensity index value. The main reason of low irrigation intensity value of these districts may be attributed to high altitude or mountainous terrain of these area because of which it becomes very difficult for the farmers to provide the better irrigation facilities in these difficult terrain areas.

Table 2 Classification of districts having different levels of irrigation intensity

Classification of districts	Index of irrigation intensity	Districts	Total No. of districts	Percentage of districts
High Irrigation Intensity	Above 40	Jammu	1	10%
Moderate Irrigation Intensity	20-40	Samba,Kathua, Udhampur	3	30%
Low irrigation Intensity	Below 20	Kishtwar, Poonch, Rajouri, Doda, Reasi, Ramban	6	60%

Source: Regional Digest of Statistics J&K (2016-17)

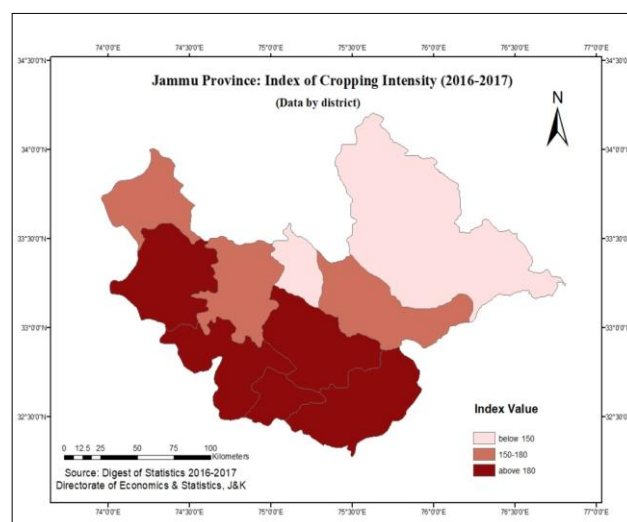Fig 1 Index of Irrigation intensity in Jammu Province (2016-17)   Fig 2 Index of Cropping intensity in Jammu Province (2016-17)

Table 3 Classification of districts having different levels of cropping intensity

Classification of districts	Index of cropping intensity	Districts	Total No. of districts	Percentage of districts
High cropping intensity	Above 180	Jammu, Kathua, Samba, Udhampur, Rajouri	5	50%
Moderate cropping intensity	150-180	Poonch, Doda, Reasi	3	30%
Low cropping intensity	Below 150	Kishtwar, Ramban	2	20%

Cropping intensity

Further an attempt has also been made to examine the cropping intensity in Jammu province. Cropping intensity means the cultivation of number of crops in the same field in a year. It is one of the factors which highlight the agricultural growth of any region. Higher the cropping intensity means that there is proper use of land for agricultural purpose. With help of statistical formulation, the cropping intensity indices have been obtained and are grouped in the (Table 3). The information reflected in the (Table 3) about the cropping intensity reveals that, out of ten districts in Jammu Province, five are falling under the category of high Index value (above 180) which are namely as Jammu, Samba, Kathua, Udhampur and Rajouri. The districts which fall under moderate cropping intensity category are named as Poonch, Doda and Reasi. There are only two districts which have recorded low level of

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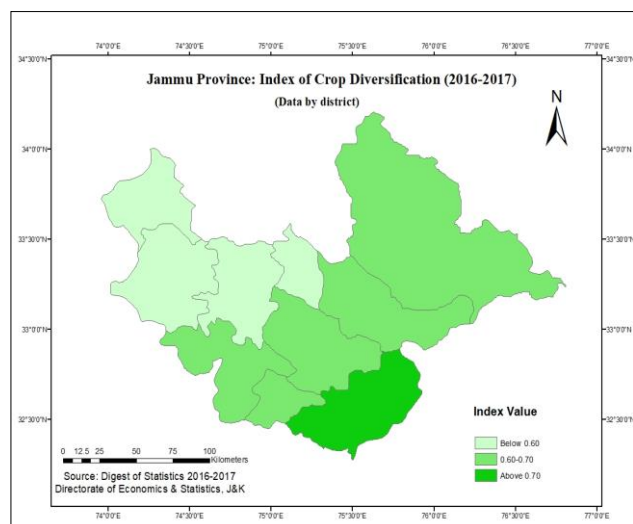cropping intensity and these districts are Kishtwar and Ramban.

Crop diversification

The next agricultural parameter which has been studied in the Jammu Province is Crop diversification. Crop diversification is the addition of the new crop in a particular area with the main focus on the increasing the capital of the farmers. It also helps in improving the soil fertility, controlling weeds and pests, and beneficial in controlling soil erosion. By using the Simpson index method of measuring the crop diversification, different index values has been obtained and these are further categorized into high, moderate and low classes in the (Table 4).

Table 4 Classification of districts having different levels of crop diversification

Classification of districts	Index of crop diversification	Districts	Total No. of districts	Percentage of districts
High crop diversification	Above 0.70	Kathua	1	10%
Moderate crop diversification	0.60-0.70	Jammu, Samba, Udhampur, Doda, Kishtwar	5	50%
Low crop diversification	Below 0.60	Poonch, Rajouri, Ramban, Reasi	4	40%

Source: Regional Digest of Statistics J&K (2016-17)

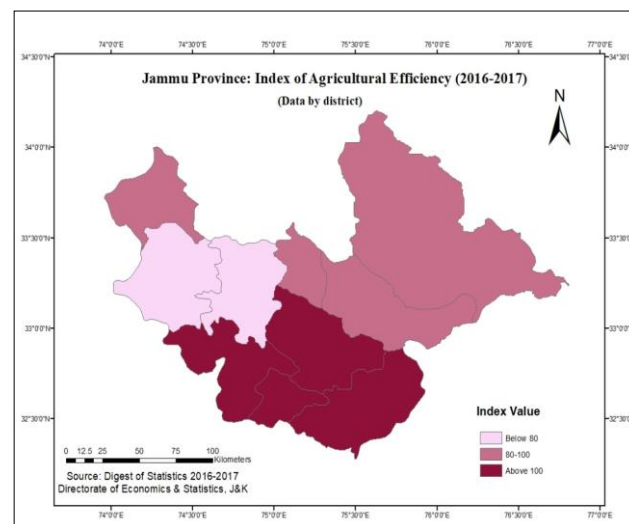Fig 3 Index of crop diversification in Jammu Province (2016-17)

Fig 4 Index of agricultural efficiency in Jammu Province (2016-17)

The information given in (Table 4) is reflecting that out of 10 districts of Jammu Province there is only one district i.e., Kathua with the value of 0.7007 is having highest index value of crop diversification. The main reason for this can be the different agroclimatic conditions in the district. The district has the privilege of both temperate and tropical type of climate, so different types of crop can be seen in the district Kathua. Out of total ten, five districts are falling under moderate crop diversification range (0.60-0.70). These districts are Jammu, Samba, Udhampur, Doda and Kishtwar. Remaining of the four districts namely Poonch, Rajouri, Ramban and Reasi have very low crop diversification index value. The districts of Ramban and Rajouri have least index value of crop diversification (0.577). Difficult terrain which results in less mechanized farming and also proves to be difficult in transportation of products, small and fragmented land holdings and less variations in the agroclimatic conditions of these districts stop the farmers of the area to shift from the old traditional crops to new cash crops.

Agricultural efficiency

The next attempt has been made on the study of agricultural efficiency in the study region. Agricultural efficiency depicts the yield per unit area of land. By agriculture efficiency we can make the best analysis of the fertility, productivity and capability of the land. The main reason for the less agricultural efficiency in an area are like lack of irrigation facilities, modern tools of agriculture, lack of fertilizers and pesticides etc. The (Table 5) is highlighting the classification of agricultural efficiency index which is calculated by using statistical formula given by Bhatia.

Table 5 Classification of districts having different levels of agriculture efficiency

Classification of districts	Index of agricultural efficiency	Districts	Total No. of districts	Percentage of districts
High agriculture efficiency	Above 100	Jammu, Kathua, Samba, Udhampur	4	40%
Moderate agriculture efficiency	80-100	Ramban, Doda, Kishtwar , Poonch	4	40%
Low agriculture efficiency	Below 80	Rajouri, Reasi	2	20%

The information mentioned in (Table 5) about the Agricultural Efficiency in Jammu Province, reveals that out of total districts in the Jammu Province four are falling in the range of high agricultural efficiency index value. The districts which fall under this category are named as Jammu, Kathua, Samba and Udhampur. Jammu with the index value of 188.55, ranks first in the whole province. Again, there are four districts namely Ramban, Doda, Kishtwar and Poonch which

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falls under moderate agricultural efficiency index value category. The remaining two districts named as Rajouri and

Reasi have low agricultural efficiency index value. Reasi with 68.8 index value ranks last in the whole Jammu Province.

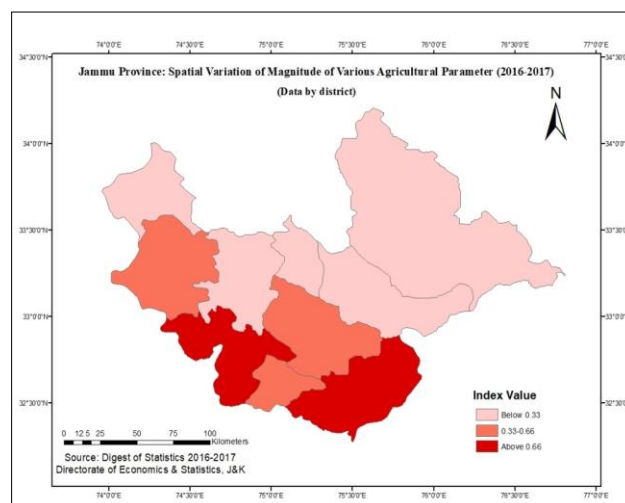Table 6 District wise composite index of various agricultural parameters

District	Irrigation intensity	Cropping intensity	Crop diversification	Agriculture efficiency	Fertilizers distributed (%age)	Area under HYV seeds (%age)	Overall composite index
Jammu	1.000	0.794	0.99	1.000	1.00	1.00	0.963
Samba	0.435	0.989	0.97	0.654	0.15	0.26	0.575
Kathua	0.530	1.000	1.00	0.803	0.35	0.66	0.724
Udhampur	0.254	0.875	0.82	0.775	0.12	0.36	0.536
Reasi	0.000	0.665	0.09	0.000	0.04	0.14	0.156
Ramban	0.000	0.032	0.00	0.240	0.18	0.01	0.076
Doda	0.026	0.567	0.47	0.261	0.00	0.15	0.245
Kishtwar	0.193	0.000	0.35	0.254	0.01	0.00	0.134
Rajouri	0.036	0.869	0.00	0.194	0.40	0.57	0.346
Poonch	0.107	0.523	0.10	0.275	0.12	0.22	0.224

Fertilizers distributed and area under HYV seeds (Percentage)

Further attempt on the study of various agricultural parameters, is made by the study of the percentage of area under HYV seeds and percentage of amount of fertilizers distributed in different districts of Jammu Province. These are also very essential indicators which reflect the agriculture growth of an area. Larger the amount of fertilizer distributed more is the chances of higher crop production and it is also the case with HYV seeds. In the modern world where there is great competition among farmers to increase their crop production both fertilizers and HYV seeds have very crucial part to play in increasing the production. In the study region the districts like Jammu, Kathua and Rajouri have high percentage of Fertilizers distributed in their respective districts whereas the districts like Doda, Kishtwar and Reasi have low percentage of fertilizers distributed in their districts. In case of area under HYV seeds again the districts of Jammu, Kathua and Rajouri have high percentage of area under these seeds and the districts of Kishtwar, Ramban and Reasi have low percentage of area under HYV seeds.

Further the research paper focuses to study the magnitude of various agricultural parameters over different districts in the Jammu Province. For finding the magnitude, composite index formula is used, which is formulated by using index values of above discussed parameters. This index gives us the value between 0 and 1. The value near zero reveals that,

the performance of all the agricultural parameters is not upto the mark in a particular district whereas value near one highlight that various agricultural parameters have performed well in that district. The table number 6 gives us the district wise composite values of various indexes used in the study.

Source: Regional Digest of Statistics J&K (2016-17)

Fig 5 Spatial variation of magnitude of various agricultural parameters in Jammu Province (2016-2017)

Table 7 Classification of districts having different composite index value

Classification of districts	Value of composite index	Districts	Total No. of districts	Percentage of districts
High	Above 0.66	Jammu, Kathua	2	20%
Moderate	0.33-0.66	Samba, Udhampur, Rajouri	3	30%
Low	Below 0.33	Poonch, Kishtwar, Doda, Reasi, Ramban	5	50%

The (Table 7) reveals the categorization of overall composite index value into high, medium and low category. It further highlights that the district of Jammu and Kathua have high composite index value. As both of these districts have high index value in maximum agricultural parameters. Out of the six selected agricultural parameters, District Jammu ranks first in four parameters and Kathua ranks first in two parameters. A large proportion of area of both these districts comes under plain area which also encourages farmers in these districts to adopt modern techniques of agriculture. Climatically also, these districts have the privilege of having both temperate and tropical type of climate which also allows the farmers of these districts to grow tropical and temperate

crops. The districts of Samba, Udhampur and Rajouri falls under the category of moderate composite index value. This means that agricultural parameters have performed moderately in these districts. The districts of Samba and Udhampur have good index values in maximum agricultural parameters except in case of areas under HYV seeds and fertilizers distributed. These districts need improvement in increasing area under HYV seeds and amount of fertilizers used. As far as district Rajouri is concerned it is on the boundary of falling in moderate or low composite index value range. In case of crop diversification Rajouri is least diversified and in case of agricultural efficiency it ranks second last. There is great need of improvement of crop diversification in the Rajouri district

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and as far as agricultural efficiency is concerned its magnitude needs to be increased in this district.

Out of the total districts 50% of the districts fall under the category of low composite index value. These districts include Poonch, Kishtwar, Reasi, Doda and Ramban. District Ramban has the least composite index value among all districts. So, there is the great need of improvement in every agricultural parameter. The districts Doda, Kishtwar, Reasi and Poonch also have very less composite index value but these districts have comparatively better result than Ramban. For all these districts topography plays a major role in less indexes value, as all these districts majorly falls in mountainous area. It becomes very difficult for the authorities to provide modern equipment in these districts. Harsh climatic conditions also sometimes hinder the growth of these agricultural parameters.

CONCLUSIONS

From this study about the measurement of various agricultural parameters reveals that different districts have different index values in each agricultural parameter. In case of Irrigation Intensity, District Jammu has the highest irrigation intensity whereas 60% of the districts fall under the category of low irrigation intensity level in the entire Jammu province. The result of cropping intensity reveals that 50% of the districts have high cropping intensity whereas only two districts Kishtwar and Ramban falls under low cropping index range. Crop diversification's result shows that only one district that is Kathua is highly diversified whereas 40% of the districts namely as Poonch, Rajouri, Ramban and Reasi are least diversified. In case of Agricultural efficiency, 40% of the districts fall under the range of high agricultural efficiency level whereas only two districts named as Rajouri and Reasi have low efficiency level. If we talk about the overall performance of the districts, Jammu and Kathua have highest composite index value. This shows that both the districts have better irrigational facilities, both are highly diversified, there is better use of fertilizers and both of these have high percentage of area under HYV seeds. Poonch, Kishtwar, Doda, Reasi and Ramban districts which constitutes 50% of the districts in the whole province have low value of composite index. This reveals that there is a great scope of improvement of agriculture sector in these districts. Extreme climatic conditions and tough terrain also have a great impact in the less performance of different agricultural parameters. If all the agricultural parameters are improved in these less performing districts, all these districts will definitely get more benefits from the agriculture sector. The result also reveals that out of all, the districts which have less composite index value belong to hilly region of the Jammu Province. In hilly area irrigation system can be improved by storing water in farm ponds which are constructed by low density polythene film. Sprinkler system and gravity drip irrigation system can also help in improvement of irrigation system in these high-altitude areas. Government is providing subsidies to the farmers by the schemes like Pradhan Mantri Krishi Sinchai Yojana (PMKSY) to purchase the irrigation equipment's. Off season fruits and vegetables are also given more importance in other hilly states of India and the same can be done in these districts. In these areas farmers can also shift to horticulture, livestock, and tree farming etc. from traditional cereals crops. The schemes like National Livestock Health and Disease Control Programme is launched by the central government to look after the health conditions of livestock in the country. Horticulture Technology Mission (HTM) is also a step taken by the government to improve the horticulture system of the country. Under National Bamboo Mission government is providing financial assistance to the farmers for growing bamboos in their areas. Farmers belonging to these less performing districts can take the benefit from these schemes and can improve the agricultural conditions of their area.

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