Statistical Analysis of Agricultural Sector in an Indian Economy

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ABSTRACT

Agriculture, along with its related sectors, which employs about 58 percent of India's workforce, accounted for a sizable 18.8% of the country's Gross Value Added (GVA) in 2021-22, with a growth rate of 3.6 percent in 2020-21, indicating that COVID-19 didn't have as much of an impact on this sector as it did on the manufacturing sector. In 2021-22, the industry is predicted to grow by 3.9 percent. The key drivers of overall development in the industry have been linked industries such as livestock, dairying, and fisheries. In this research paper, we will look at the performance of the agriculture sector in terms of output and its percentage of total GVA in the pre-covid and post-covid periods of the Indian economy. We used ANOVA single factor to look at crop output and descriptive statistics to look at the contribution of agriculture and associated industries in an economy's overall GVA and t-statistics to know the number of workers by gender in an agriculture sector.

KEYWORDS: agriculture, allied sector, COVID-19, pre-covid and covid periods, agricultural production, employment, total GVA, ANOVA Single Factor, Descriptive statistics, T-Statistics.

INTRODUCTION

To put it another way, a strong agricultural sector benefits almost every area of the Indian economy. The new Coronavirus epidemic has quickly spread over the world, wreaking havoc on millions of people's lives and livelihoods. The economic consequences of the new Coronavirus pandemic have focused attention on the agriculture sector, stressing its obligation to feed and employ thousands who may have lost their jobs. The agriculture sector continues to be promising and cushioning the economy at a time when most sectors of the economy are believed to be under substantial stress, it is critical to assess the impact on the agricultural and allied industries, which employ the vast majority of India's people. Because the agriculture sector is one of the few bright spots in the middle of the epidemic, it must be prioritised at this period to assure the country's rapid economic recovery.

Major schemes by the Ministry Agriculture and Farmers' Welfare are as:

- **PM-KISAN**

The government announced the PM-KISAN initiative in February 2019 to offer farming households with an annual income supplement of Rs 6,000. Previously, the plan was only open to small and marginal landholder farmer families, i.e., those with a total cultivable landholding of less than two hectares. The budget allocation for the plan was increased from Rs 75,000 crore to Rs 87,218 crore in 2019-20 as a result of the increased coverage.

- **PRADHAN MANTRI FASAL BIMA YOJANA (PMFBY)**

The Pradhan Mantri Fasal Bima Yojana was formed by the Ministry of Agriculture and Farmers Welfare in 2016-17. (PMFBY), intends to promote agricultural output in a sustainable manner by the use of

- Financial assistance to farmers who have lost or damaged crops due to unforeseen circumstances.
- Farmers' incomes must be stabilized so that they can continue to farm.
- Farmers are encouraged to use creative and advanced farming methods.
- Ensure a steady supply of financing to the agricultural sector, which will help to improve food security, crop diversity, and the agriculture industry's development and competitiveness while also safeguarding farmers from production risks.

The initiative is open to all ranchers, including tenant farmers and sharecroppers, who are growing informed crops in specified areas. The allotment of Pradhan Mantri Fasal Bima Yojana (PMFBY) has been kept at Rs 15,500 crore for monetary year 2022-23, which is lower than the Budget plan Evaluations of Rs 16,000 crore for 2021-22 and revised appraisals of Rs 15989.39 crore for the current monetary year.

- **RASHTRIYA KRISHI VIKAAS YOJANA (RKVY)**

The programme boosts states to increment public investment in agriculture and related industries. The Cabinet has agreed to continue the Centrally Sponsored Scheme (as of November 1, 2017) (State Plans) - Rashtriya Krishi Vikas Yojana (RKVY) as Rashtriya Krishi Vikas Yojana Remuneration Approaches for Agriculture and Allied Sector Rejuvenation (RKVYRAFTAAR) for pretty a short time 2017-18 to 2019-20 with an economic distribution of Rs. 15,722 crores with expansive goals of making cultivating a gainful economic movement via reinforcing the rancher's work, risk moderation and advancing Agri business venture.

OBJECTIVES

The primary goal of this research paper is to look at the agricultural sector's performance during the pre-covid and covid periods. The objectives are as follows:

1. Investigate the output of a few important crops in an agriculture sector.
2. Examine how agriculture and related industries contribute to a country's overall GVA.

3. Investigate employment in an agriculture sector by gender.

HYPOTHESIS

H_0: During the covid era, no crops were produced in an agricultural enterprise.

H_0: In an agricultural sector, participation rate of women is more than that of men.

RESEARCH METHODOLOGY

We used 11 years of data, from 2011-12 to 2021-22, to examine the performance of the agriculture industry during the pre-covid and covid periods.

Secondary sources include the Economic Survey, the Monthly Bulletin of the Directorate of Economics and Statistics (Ministry of Agriculture and Farmers' Welfare) 2022, and data from the Second Advance Estimate page of the Directorate of Economics and Statistics' website (Ministry of Agriculture and Farmer Welfare). To ascertain if crops were grown throughout the Covid era, a single-factor ANOVA is utilised.

REVIEW OF LITERATURE

Balamurugan. P (2021)[1] conducted a study on the "Impact of Covid-19 on Agriculture and Allied sectors in India", discussed the influence of Covid-19 on agriculture, dairy sector, poultry industry, and fisheries. The researcher also spoke briefly about the policy package for agriculture and related industries. The researcher concluded that the government's actions are insufficient, and that the government should raise its expenditure for pandemic relief to fulfil the demands of the agriculture sector in order to secure the industry's higher growth rate in the future.

Gohain, Lekharani (2019)[2] conducted a study entitled "Trend and performance of Indian Agriculture in post-independence era: an analysis of determinants" focuses on the pattern of agricultural output development since independence and elaborates on the influence of some of the main drivers implicit in the sector's rise. The current analysis is based on secondary data and aims to highlight the trend and pattern of several significant drivers of Indian agriculture from 1950 to 2013. The researcher concluded that production and yield per hectare of chosen crops have increased at a declining pace since independence. Agriculture's growth rate is not as good as it was during the country's independence.

Priscilla, Laishram, Arsha Balakrishnan, Lalrinsangpuii and A.K. Chauhan[3] (2017) carried out a study entitled "A Study on the performance of agricultural sector in India" studied the performance of the agriculture sector, by employing time series data on area, production, and productivity of food grains, production and per capita availability of milk and eggs, and production of meat were compiled at the national level, and a decade-by-decade analysis of growth rate, instability index, and decomposition analysis was performed. The inference drawn by the researcher is that, during the entire period, the area under food grains exhibited negative increase although production and productivity growth was positive. Both vegetables and fruits had positive growth in terms of area, output, and productivity. The yield impact was larger than the area effect in general for food grains, which might be attributable to increasing usage of high yielding cultivars.
The area impact contributed more to vegetable and fruit production than yield and the interaction effect, indicating that steps to boost productivity should be done.

Cariappa, Adeeth AG, Kamlesh Kumar Acharya, et al. (2021)[4] carried out a study entitled "**Impact of COVID-19 on the Indian agricultural system: A 10-point strategy for post-pandemic recovery"** goal is to compile early evidence of COVID-19's influence on the Indian agricultural sector, including production, marketing, and consumption, as well as a set of prospective post-pandemic recovery and prosperity plans. According to the study, the pandemic hampered production and marketing due to labour and logistical restrictions, while the negative income shock limited access to markets and raised food commodity costs, impacting consumption patterns.

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Arumugam. U, G. Kanagavalli, M. Manida (2020)[5] carried out a study on "COVID-19: Impact of Agriculture in India" with the goal of researching agricultural difficulties in COVID 19, identifying the Indian government's response, and determining how to use social safety nets as a buffer between health and financial distress. The majority of the research is descriptive in nature. For this, secondary data sources were employed, gathered from a variety of published sources, including books, journals, newspapers, magazines, and online sites. The corona virus's dispersing impact, i.e., lockdown across the kingdom, has twisted out to be a black opening for the farming community, but not directly. The transportation of agricultural goods has been impeded, labour scarcity caused by the fear of viral transmission, which leads to the wasting of gathered commodities, mostly perishable fruits and vegetables, on the farmer's field. The growth of agricultural items from their point of origin to a decisive shopper has been impeded in general due to shut down.

PRODUCTION OF SOME MAJOR CROPS

According to the Ministry of Agriculture and Farmers Welfare's Directorate of Economics and Statistics' Second advance projections for 2021-22.

- ***Rice output*** climbed from 105.3 million tonnes to 127.93 million tonnes from 2011-12 to 2021-22, the highest in the past 11 years.
- ***Wheat output*** increased from 97.88 million tonnes to 111.32 million tonnes, the highest level in the next 11 years.
- ***Production of Nutri/Coarse Cereals*** in 2011-12 was 42.01 million tonnes which increased to 51.32 million tonnes in 2020-21 and then decreased to 49.86 million tonnes in 2021-22.
- ***Total Pulses*** output increased from 2011-12 to 2021-22, rising from 17.09 million tonnes to 26.96 million tonnes, the most in the past 11 years.
- In 2011-12, ***total nine oilseeds*** output was 29.8 million tonnes, rising to 37.15 million tonnes in 2021-22, the finest production in 11 years.
- ***Cotton output*** climbed from 35.2 million tonnes in 2011-12 to 36.07 million tonnes in 2019-20, the greatest in comparison to previous years. It was 35.25 million tonnes in 2020-21 and 34.06 million tonnes in 2021-22, respectively.

The output of certain key crops is indicated in table 1, and production patterns are discussed using figures 1 and 2.

SECOND ADVANCE ESTIMATES OF PRODUCTION OF FOOD GRAINS, OILSEEDS AND COMMERCIAL CROPS FOR 2021-22.

TABLE-1. AS ON 16.02.2022.

(MILLION TONNES).

CROP	RICE	WHEAT	NUTRI/COARSE CEREALS	TOTAL PULSES	TOTAL NINE OILSEEDS	COTTON
2011-12	105.3	94.88	42.01	17.09	29.8	35.2
2012-13	105.23	93.51	40.04	18.34	30.94	34.22
2013-14	106.65	95.85	43.3	19.26	32.75	35.9
2014-15	105.48	86.53	42.86	17.15	27.51	34.81
2015-16	104.41	92.29	38.52	16.32	25.25	30.01
2016-17	109.7	98.51	43.77	23.13	31.28	32.58
2017-18	112.76	99.87	46.97	25.42	31.46	32.81
2018-19	116.48	103.6	43.06	22.08	31.52	28.04
2019-20	118.87	107.86	47.75	23.03	33.22	36.07
2020-21	124.37	109.59	51.32	25.46	35.95	35.25
2021-22 (SAE)*	127.93	111.32	49.86	26.96	37.15	34.06

SOURCE: DIRECTORATE OF ECONOMICS AND STATISTICS, MINISTRY OF AGRICULTURE AND FARMERS WELFARE.

***SAE:** SECOND ADVANCED ESTIMATES.

FIGURE: 1

TRENDS IN AGRICULTURAL PRODUCTION (MILLION TONNES)

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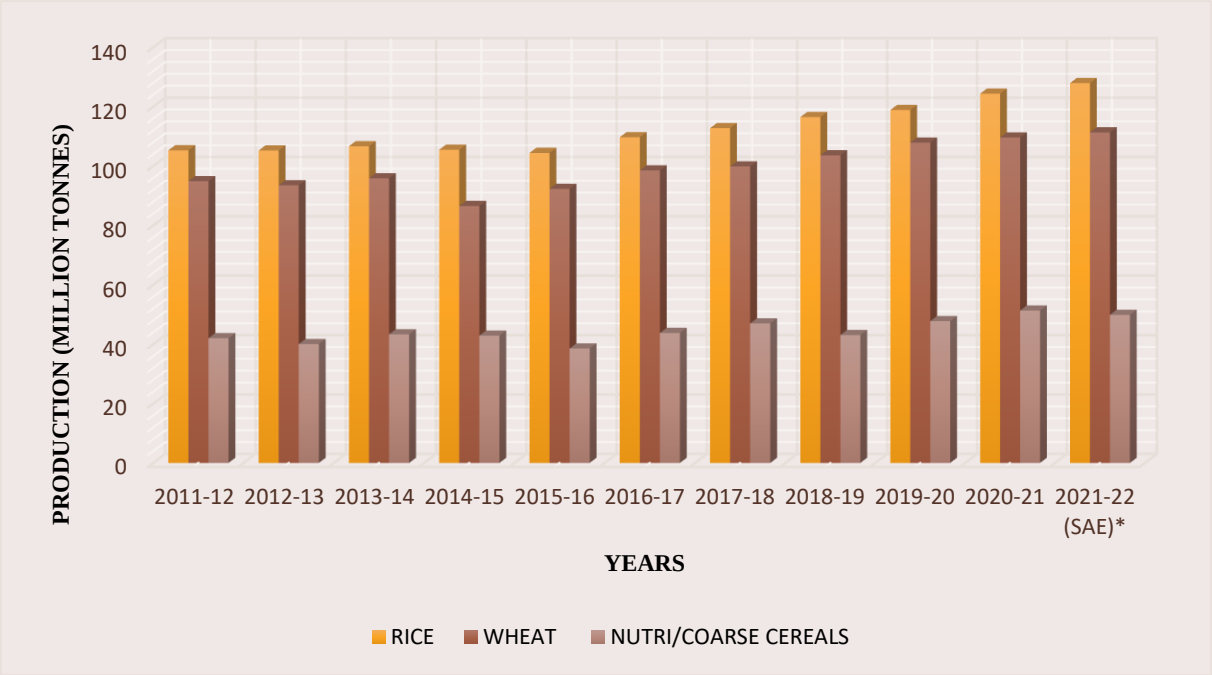
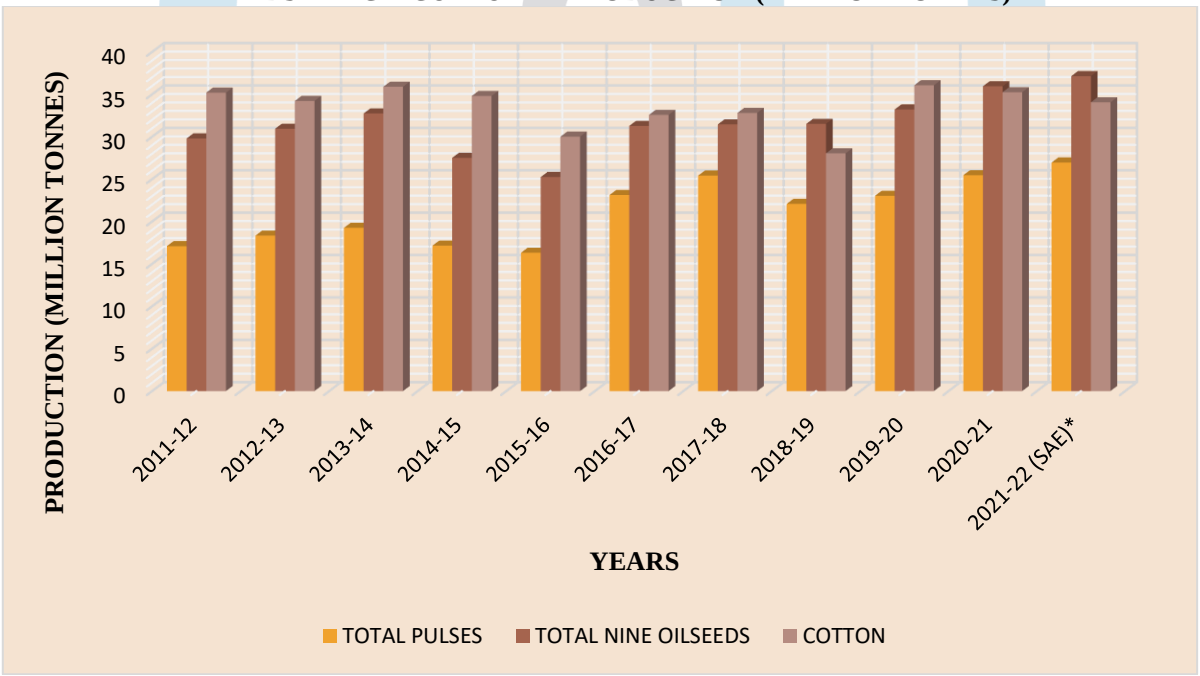


SOURCE: PREPARED ON THE BASIS OF TABLE-1.
***SAE:** SECOND ADVANCED ESTIMATES.

FIGURE: 2
TRENDS IN AGRICULTURAL PRODUCTION (MILLION TONNES)



SOURCE: PREPARED ON THE BASIS OF TABLE-1.
***SAE:** SECOND ADVANCED ESTIMATES.

Anova: Single Factor						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
RICE	11	1237.18	112.4709	69.69413		
WHEAT	11	1093.81	99.43727	62.00458		
NUTRI/COARSE CEREALS	11	489.46	44.49636	16.04935		
TOTAL PULSES	11	234.24	21.29455	14.59357		
TOTAL NINE OILSEEDS	11	346.83	31.53	11.44726		
COTTON	11	368.95	33.54091	6.416129		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	82589.26839	5	16517.85	549.9687	9.75E-49	2.36827
Within Groups	1802.050127	60	30.03417			
Total	84391.31852	65				

SOURCE: CALCULATED BY AUTHOR ON THE BASIS OF SECONDARY DATA COLLECTED.

F-Statistical value* > *F-Critical value i.e., we reject the null hypothesis and accept the alternative hypothesis that there was crop production in the agricultural sector throughout the covid era. As a consequence, the conclusion is statistically significant.

The Null hypothesis is rejected as ***P-value = 9.75E-49 < level of significance (α) = 0.05.***

As a result, COVID-19 has no negative impact on the production of several main crops in the agricultural industry.

GROSS VALUE ADDED (GVA) IN AGRICULTURE

The trend in the share of Agriculture and allied sectors (shown in table- 2 and figure – 3) to total GVA in an economy has been the highest during 2020-21 i.e., 20.2% which indicates at the time period when COVID-19 was at its peak, the agriculture and allied sector that contributed more total GVA of an economy. In Pre-COVID-19 period, the share of agriculture and allied sector was high during 2013-14 i.e., 18.6%. In 2021-22, the share of agriculture and allied sector declined to 18.8%, which has declined as compared to 2020-21, on the other side, it has improved as compared to 2013-14, i.e., 18.6%.

TABLE-2.

SHARE OF GVA OF AGRICULTURE AND ALLIEED SECTORS IIN TOTAL ECONOMY (AT CURRENT PRICES)

(IN PERCENT)

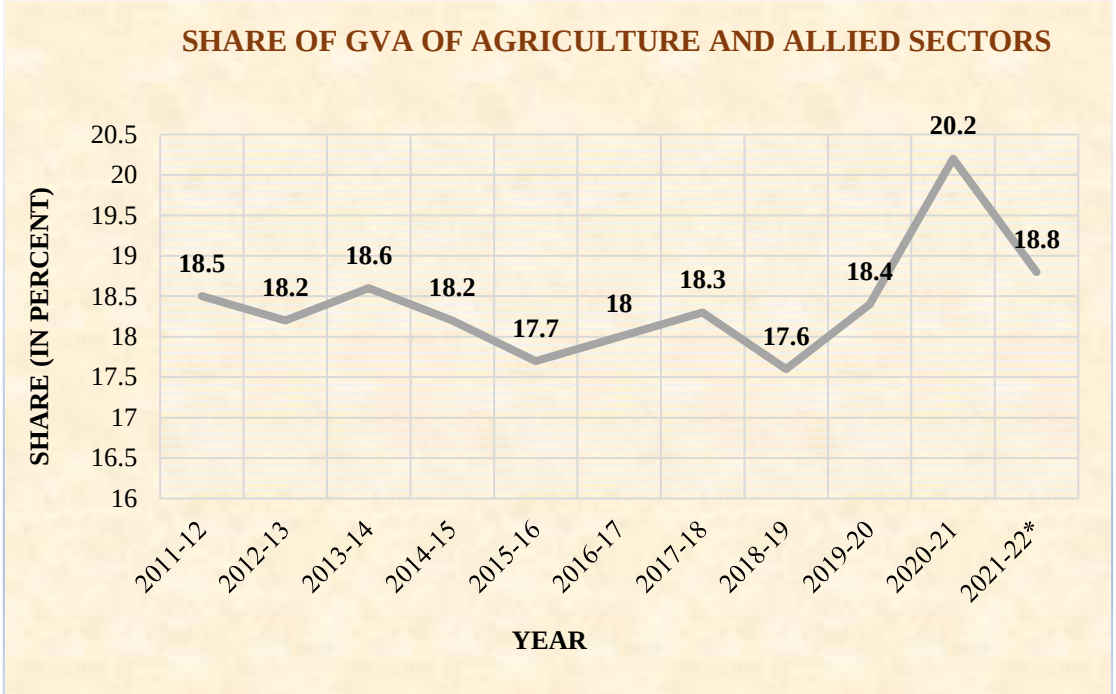
YEAR	SHARE OF GVA OF AGRICULTURE AND ALLIED SECTORS
2011-12	18.5
2012-13	18.2
2013-14	18.6
2014-15	18.2
2015-16	17.7
2016-17	18
2017-18	18.3
2018-19	17.6
2019-20	18.4
2020-21	20.2
2021-22*	18.8

SOURCES:

- MONTHLY BULLETIN JANUARY 2022, DIRECTORATE OF ECONOMICS AND STATISTICS, MINISTRY OF AGRICULTURES AND FAEMERS WELFARE.
- ECONOMIC SURVEY 2021-22.

*As per first advance estimates of national income, 2021-22.

FIGURE- 3



SOURCE: PREPARED ON THE BASIS OF TABLE-2.

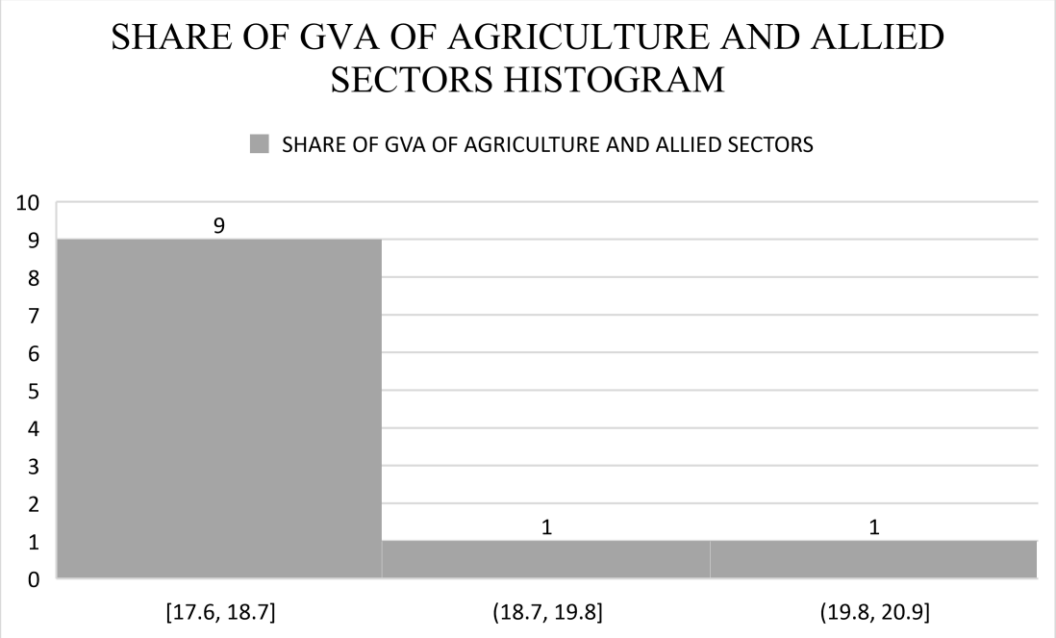
DESCRIPTIVE STATISTICS

SHARE OF GVA OF AGRICULTURE AND ALLIED SECTORS	
Mean	18.40909091
Standard Error	0.209525241
Median	18.3
Mode	18.2
Standard Deviation	0.694916607
Sample Variance	0.482909091
Kurtosis	4.500902235
Skewness	1.761790086
Range	2.6
Minimum	17.6
Maximum	20.2
Sum	202.5
Count	11

SOURCE: CALCULATED BY AUTHOR ON THE BASIS OF SECONDARY DATA COLLECTED.

From the above descriptive statistics, we analysed that the mean of the share of GVA of agriculture and allied sector to total GVA in an economy is 18.41. Mode indicates that the share of agriculture and allied sector to total GVA in an economy mostly is 18.2. The standard deviation of 0.69 suggests that there are little changes in the percentage of agricultural and associated sectors in an economy, indicating a positive share. The maximum share of agriculture and allied sector is 20.2 and minimum is 17.6 which means that the range of the share of agriculture and allied sector is 2.6.

FIGURE- 4



SOURCE: PREPARED ON THE BASIS OF TABLE-2.

The above histogram shows that the share of agriculture and allied activities to total GVA from 2011-12 to 2019-20 (9 years) lies within (17.6%, 18.7%). During 2020-21, it was 20.2% and in 2021-22 it is 18.6%. Hence, mostly the share of agriculture and allied activities remained constantly at 18% since 2011-12.

EMPLOYMENT

Data from PLFS show the participation of women. Women in agriculture are increasing. Female workers accounted for 30% of the agricultural workforce in 2017-2018 and 37% in 2019-2020. However, men continue to dominate the agricultural workforce with 63%.

NUMBER OF AGRICULTURE WORKERS BY GENDER (MILLION)

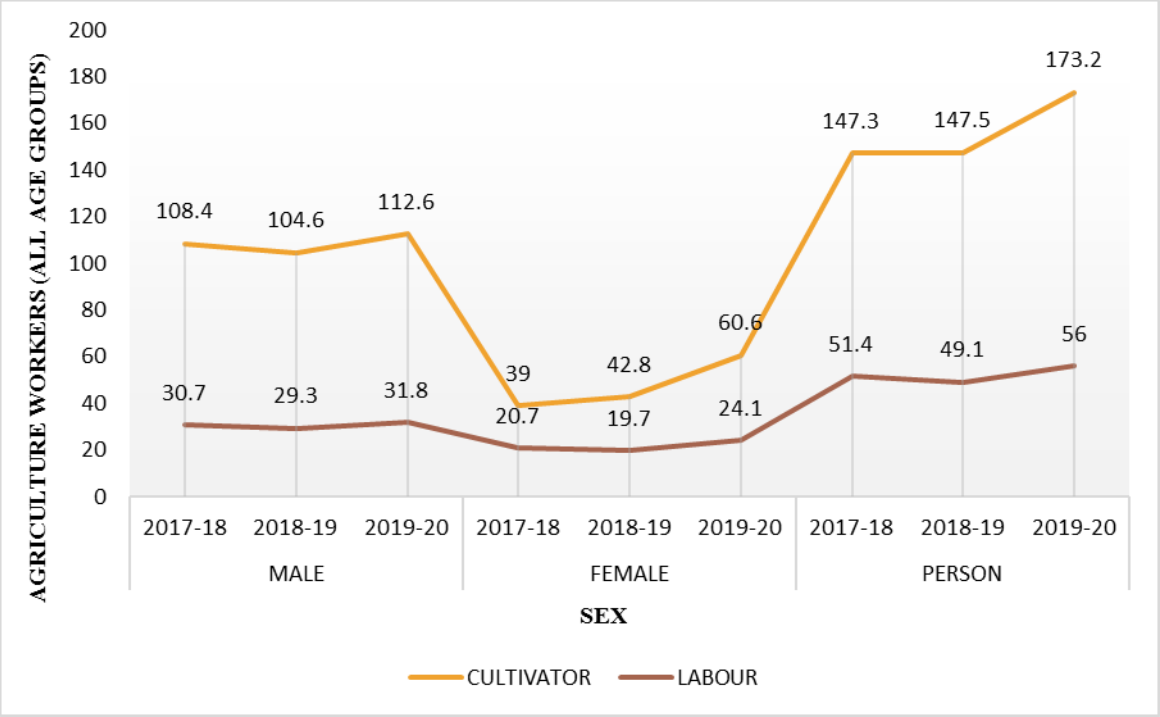
TABLE - 4

Column1	Column2	Column3	Column4	Column5	Column6
SEX	YEAR	ALL AGE GROUPS			ALL
		AGRICULTURAL WORKER			WORKER
		CULTIVATOR	LABOUR	TOTAL	
MALE	2017-18	108.4	30.7	140.8	349.9
	2018-19	104.6	29.3	135.5	353.9
	2019-20	112.6	31.8	147.1	368.2
FEMALE	2017-18	39	20.7	60.4	106
	2018-19	42.8	19.7	63.3	114.4
	2019-20	60.6	24.1	86.2	143.7
PERSON	2017-18	147.3	51.4	201.2	455.8
	2018-19	147.5	49.1	199	468.3
	2019-20	173.2	56	233.3	511.9

SOURCE:

- AUTHORS ESTIMATES BASED ON NSO-PLFS DATA AND POPULATION DATA
- NITI AAYOG DISCUSSION PAPER, "WORKFORCE CHANGES AND EMPLOYMENT", MARCH 2022.

FIGURE - 5



SOURCE: PREPARED BY AUTHOR ON THE BASIS OF TABLE-4.

Estimates from the PLFS 2019-20 show that 86.2 million agricultural workers are women and 147.1 million are men. PLFS data shows that the number of growers in India increased from 147 million in 2017-2018 to 173 million in 2019-2020, while the number of agricultural workers increased by only 4.6 million in two years.

PERCENT DISTRIBUTION OF AGRICULTURAL WORKER AMONG CULTIVATORS AND LABOUR CATEGORIES BY GENDER AND AGE GROUP (YOUTH) 2017-18 TO 2019-20

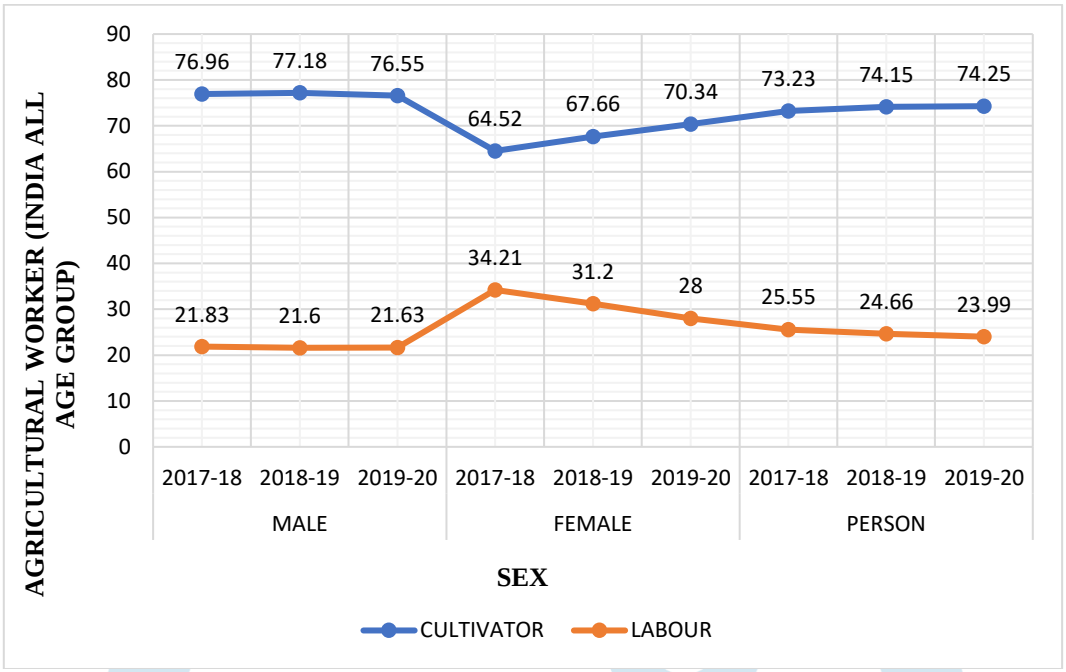
TABLE - 5

Column1	Column2	Column3	Column4	Column5	Column6
SEX	YEAR	INDIA ALL AGE GROUP			
		AGRICULTURAL WORKER			WPR
		CULTIVATOR	LABOUR	AGRICULTURE	
				WORKER	
				% TO TOTAL	
				WORKER	
MALE	2017-18	76.96	21.83	40.24	52.07
	2018-19	77.18	21.6	38.28	52.25
	2019-20	76.55	21.63	39.95	53.89
FEMALE	2017-18	64.52	34.21	56.99	16.51
	2018-19	67.66	31.2	55.29	17.61
	2019-20	70.34	28	59.95	21.85
PERSON	2017-18	73.23	25.55	44.13	34.69
	2018-19	74.15	24.66	42.49	35.29
	2019-20	74.25	23.99	45.57	38.17

SOURCE:

- AUTHORS ESTIMATES BASED ON NSO-PLFS DATA AND POPULATION DATA.
- NITI AAYOG DISCUSSION PAPER, "WORKFORCE CHANGES AND EMPLOYMENT", MARCH 2022.

FIGURE - 6



SOURCE: PREPARED BY AUTHOR ON THE BASIS OF TABLE-5.

Of the 100 working women, 60 are employed in agriculture and related activities. Similarly, out of 100 women working in agriculture, 70% are self-employed, that is, they belong to the farming household. Since the WPR of women is less than half that of men, the total female labour force engaged in agriculture turns out to be much smaller than the male labour force engaged in agriculture.

t-Test: Two-Sample Assuming Equal Variances		
	MALE	*FEMALE*
Mean	52.73666667	18.65666667
Variance	1.005733333	7.950533333
Observations	3	3
Pooled Variance	4.478133333	
Hypothesized Mean Difference	0	
df	4	
t Stat	19.72407774	
P(T<=t) one-tail	1.94863E-05	
t Critical one-tail	2.131846786	
P(T<=t) two-tail	3.89725E-05	
t Critical two-tail	2.776445105	

SOURCE: CALCULATED BY AUTHOR ON THE BASIS OF SECONDARY DATA COLLECTED.

***T-Stat value* > *T-Critical value* (19.72 > 2.77)** it means that our null hypothesis has been rejected, i.e., workforce participation rate of women is more than that of men. As a consequence, the conclusion is statistically significant.

CONCLUSION

Inference that can be drawn from the statistical analysis is that the Covid-19 did not have any adverse effect on agriculture and allied sector as the farmers continued to the production of crops and food grains and this resulted in positive growth rate in agriculture sector 3.6 % in 2020-21 which was less as compared to 2019-20 i.e., 4.3 %.

The country's labour force grew by 10.8% in the two years after 2017-2018, increasing the LFPR from 36.9% to 40.1%. The increase was much higher for the female workforce, increasing their share of the country's total workforce from 23.1% to 27.9% between 2017-2018 and 2019-2020. The latest PLFS data shows that 56.8% of men, 22.8% of women and 40.1% of the total population in India participate in the labour force. The number of workers (workforce) increased by 20% compared to the increase in the labour force between 2017-2018 and 2019-2020. Employment under normal circumstances grew 2.7% in 2018-2019 and 9.4 % in 2019-2020. Between 2017-2018 and 2019-2020, 37.7 million women and 18.3 million men entered the workforce. As a result of these changes, WPR in rural areas increased from 35.0% to 39.2% and in, urban areas from 33.9% to 35.9%. Women's WPR increased from 16.5% to 21.8%. Despite this progress, the labour force participation rate for women in the country remains at 40% of WPR for men.

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