

# An empirical analysis of changing trends of area under rice cultivation, production, productivity and marketing in India with special reference to Karnataka.

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## **Abstract**

India is the world's second-largest producer of rice, and the largest exporter of rice in the world. Production has increased from 53.6 million tons in FY 1980 to 120 million tons in FY2020-21. Rice has been considered as one of the principal food crops and it is a tropical crop. Fortunately in the Countries of China, India the crop required enormous water, hot climate. In the regions that receive heavy rains rice will be grown. In kharif and rabi seasons the very crop rice will be grown. It demands a temperature of around 25 degrees Celsius and above, and rainfall of more than 100 cm. Being the staple food of eastern and southern parts of India the crop has gained very much importance when compared to other crops. Major objectives of the study are To examine the Changing trends of area under rice cultivation, Production, productivity in India and Karnataka. Major objectives of the study are to examine the price behavior of rice in different districts in Karnataka, To examine the price behavior of rice in different districts in Karnataka. India is the leading exporter of the Basmati Rice to the global market. In the financial year 2018-19, India exported around 4.4 million metric tons (drdpat.bih.nic.in. Retrieved 2020). of Basmati rice worth USD 4.7 billion (oec.world, 2020). The Union government hiked the minimum support price for kharif crops by 4-9 per cent for the 2022-23 crop year. For paddy, the MSP is being increased by Rs.100 to Rs. 2,040 per quintal. In addition, the State Government is also providing incentives upto Rs.500 per quintal to encourage farmers to bring more area under rice cultivation (Times of India, 2022 and Na Panta, agri, commodity prices, 2023).

**Key words:** Kharif and rabi seasons, Adoption of resource conservation technologies, Rice wholesalers, rice retailers and consumers, Basmati rice, , High-yielding and stress tolerant rice varieties.

## **I.Introduction:**

Rice production in India

India is the world's second-largest producer of rice, and the largest exporter of rice in the world. Production has increased from 53.6 million tons in FY 1980 to 120 million tons in FY2020-21.

Rice has considered as one of the principal food crops and it is a tropical crop. Fortunately in the Countries of China, India the crop required enormous water, hot climate. In the regions that receive heavy rains rice will be grown. In kharif and rabi seasons the very crop rice will be grown. It demands a temperature of around 25 degrees Celsius and above, and rainfall of more than 100 cm. Being the staple food of eastern and southern parts of India the crop has gained very much importance when compared to other crops.

In different regions, the agronomic issues ie., cultivation of rice cultivated differently . . But in India, particularly in rural areas traditional methods are still in use for cultivation as well as harvesting the rice. Winter rice crop is a long duration crop and summer rice crop is a short duration crop. The methods adopted for cultivation of rice is very curious. The fields are initially plowed and fertilizer is applied which typically consists of cow dung, and then the field is smoothed. The seeds are transplanted by hand and then through proper irrigation, the seeds are cultivated. Rice grows on a variety of soils like silts, loams and gravels. It can tolerate alkaline as well as acid soils. However, clayey loam is well suited to the raising of this crop. Actually, the clayey soil can be easily converted into the mud in which rice seedlings can be transplanted easily. Proper care has to be taken as this crop thrives if the soil remains wet and is underwater during its growing years. Rice fields should be level and should have low mud walls for retaining water. In the plain areas, excess rainwater is allowed to inundate the rice fields and flow slowly. Rice raised in the well-watered lowland areas is known as lowland or wet rice. In the hilly areas, slopes are cut into terraces for the cultivation of rice. Thus, the rice grown in the hilly areas is known as dry or upland rice. The yield of upland rice per hectare is comparatively less than that of wet rice.

The regions cultivating this crop in India are, covering all the primary deltas, Assam plains and surrounding low hills, foothills and Terai region- along the Himalayas and states like West Bengal, Bihar, eastern Uttar Pradesh, eastern Madhya Pradesh, northern Andhra Pradesh and Odisha. India, being a land of the eternal growing season, and the deltas of the Ganges-Brahmaputra (in West Bengal), Kaveri River, Krishna River, Godavari River, Indravati River and Mahanadi River with a thick set-up of canal irrigation like Hirakud Dam and Indravati Dam, permits farmers to raise two, and in some pockets, even three crops a year. Irrigation has made even three crops a year possible. Irrigation has made it feasible even for Punjab and Haryana, known for their baked climate, to grow rice. They even export their excess to other states. Punjab and Haryana grow prized rice for export purposes. The hilly terraced fields from Kashmir to Assam are ideally suited for rice farming, with age-old hill irrigational conveniences.

In some states like West Bengal, Assam, and Orissa two crops of rice are raised in a year. Rice is considered as the master crop of coastal India and in some regions of eastern India, where during the summer and monsoon seasons, both high temperature and heavy rainfall provide ideal conditions for the cultivation of rice.

**II.Review of literature:**

- 1) Neeraj Kumar, R. S. Chhokar, R. P. Meena, A. S. Kharub, S. C. Gill, S. C. Tripathi, O. P. Gupta, S. K. Mangrauthia, R. M. Sundaram, C. P. Sawant, Ajita Gupta, Anandkumar Naorem, ManojKumar & G.P.Singh(*Cereal Research Communications* volume 50, pages573–601 (2022) studied on Challenges and opportunities in productivity and sustainability of rice cultivation system: a critical review in Indian perspective.

The study focused on Rice–wheat cropping system, intensively followed in Indo-Gangetic plains (IGP), played a prominent role in fulfilling the food grains demand of the increasing population of South Asia. In northern Indian plains, some practices such as intensive rice cultivation with traditional method for long-term have been associated with severe deterioration of natural resources, declining factor productivity, multiple nutrients deficiencies, depleting groundwater, labour scarcity and higher cost of cultivation, putting the agricultural sustainability in question. Varietal development, soil and water management, and adoption of resource conservation technologies in rice cultivation are the key interventions areas to address these challenges. The cultivation of lesser water requiring crops, replacing rice in light-textured soil and rainfed condition, should be encouraged through policy interventions. Direct seeding of short duration, high-yielding and stress tolerant rice varieties with water conservation technologies can be a successful approach to improve the input use efficiency in rice cultivation under medium–heavy-textured soils. Moreover, integrated approach of suitable cultivars for conservation agriculture, mechanized transplanting on zero-tilled/unpuddled field and need-based application of water, fertilizer and chemicals might be a successful approach for sustainable rice production system in the current scenario. In this review study, various challenges in productivity and sustainability of rice cultivation system and possible alternatives and solutions to overcome such challenges are discussed in details.

- 2) Pavithra Shivalingaiah, K. M. Singh, Nasim Ahmad, D.K.Sinha Sinha (January 2017, SSRN Electronic Journal, DOI:10.2139/ssrn.3058145) conducted study on, Analysis of Rice Value Chains - A Study of Bihar and Karnataka States in India.

The present investigation was aimed for analyzing comparative value chain addition of rice production and marketing in Bihar and Karnataka States, based on primary data having 300 stakeholders selected using random sampling method from two purposively selected districts East Champaran and Davangere of Bihar and Karnataka, respectively, duly categorized into paddy growers, paddy wholesalers, millers, rice wholesalers, rice retailers and consumers. Farmers were the first value adding actors, and earned on an average of the gross return Rs 44,641.8/ha (East Champaran) and Rs 1, 32,117.26/ha (Davangere) by cultivating paddy. They added value of Rs 115.71 per quintal by drying, Rs 86.77 per quintal by selling in markets and Rs 127.27 per quintal by storing (speculation) of produce to sell in future in case of East Champaran district and in case of Davangere district. Paddy wholesalers, the second important key players,

and added value of average Rs 65.8 per quintal and Rs 75.67 per quintal in case of both districts under study, respectively. Rice millers were important value adder in rice value chain and added value in three stages purchasing and milling of paddy and selling of rice. The value addition by rice millers estimated about 81.21 per cent and 26.55 per cent, and 60.63 per cent and 32.95 per cent by marketing and milling in East Champaran and Davangere district, respectively. Rice wholesalers were the fourth actor in value chain, value addition by them was about 10.69 per cent and 11.05 per cent in both districts, respectively. The profit earned from rice was Rs 2.38 per kg (East Champaran) and Rs 3.11 per kg (Davangere). Rice retailers, the final value chain actor received less value addition and the profit earned was estimated to be Rs 2.57 per kg and Rs 3.62 per kg in both the districts under study.

### III. Research Methodology:

#### Statement of the problem:

Because of drought and other natural calamities rice production has not increased to the expectations of the farmers and with the fluctuations in prices of rice rice mill owners as well as farmers have faced problems. At this juncture the present study taken up to safeguard the interests of farmers of paddy as well as rice mill owners.

#### Major objectives of the study:

- 1) To examine the Changing trends of area under rice cultivation, Production, productivity in India and Karnataka.
- 2) To examine the price behavior of rice in different districts in Karnataka.

#### Research Gap:

Majority of the studies have focused the rice production, price behavior of the paddy. But none of the study focused towards comprehensively on agronomic issues of rice crop, change in area under rice, productivity, production constraints, varied price of rice in different districts of Karnataka. The present study focused those areas hitherto not been examined.

#### Nature and Source of data:

The study conducted with the help of primary as well as secondary data. Secondary data obtained through journals, reports, periodicals and internet.

The primary data collected with the help of personal interview to farmers as well as rice mill owners of Tumkur district.

**Scheme of presentation:**

The study presented in five sections.

Section 1 deals with Introduction.

Section 2 deals with Review of literature.

Section 3 deals with The Reserarch Methodology

Section 4 deals with Results and Discussion.

Section 5 deals with Suggestions, Recommendation, Area of Further Research.

**Implications of the study:**

With the help of this study it is possible to know the changing trends of area under rice, production, productivity, price behavior , marketing and export potentiality of rice etc issues. Policy makers can formulate and implement the same to bring stability in the production and marketing issues of rice in different districts of Karnataka and in different states in India.

**Limitation of the study:**

The study focused only towards the food crop .rice that too in selected districts of Karnataka. Hence the results are applicable to those areas where similar conditions prevail.

**IV. Results and Discussion.**

**Table 1**

**Rice production in different years:**

Sl.No	Year	Area (Million Hectares)	Production (Million Tonnes)	Yield (Kg/Hectare)
1	1950-51	30.81	20.58	668
2	1951-52	29.83	21.30	714
3	1952-53	29.97	22.90	764
4	1953-54	31.29	28.21	902

5	1954-55	30.77	25.22	820
6	1955-56	31.52	27.56	874
7.	1956-57	32.28	29.04	900
8.	1957-58	32.30	25.53	790
9	1958-59	33.17	30.85	930
10	1959-60	33.82	31.68	937
11	1960-61	34.13	34.58	1,013
12	1961-62	34.69	35.66	1,028
13	1962-63	35.69	33.21	931
14	1963-64	35.81	37.00	1,033
15	1964-65	36.46	39.31	1,078
16	1965-66	35.47	30.59	862
17	1966-67	35.25	30.44	863
18	1967-68	36.44	37.61	1,032
19	1968-69	36.97	39.76	1,076
20	1969-70	37.68	40.43	1,073
21	1970-71	37.59	42.22	1,123
22	1971-72	37.76	43.07	1,141
23	1972-73	36.69	39.24	1,070

24	1973-74	38.29	44.05	1,151
25	1974-75	37.89	39.58	1,045
26	1975-76	39.48	48.74	1,235
27	1976-77	38.51	41.92	1,088
28	1977-78	40.28	52.67	1,308
29	1978-79	40.48	53.77	1,328
30	1979-80	39.42	42.33	1,074
31	1980-81	40.15	53.63	1,336
32	1981-82	40.71	53.25	1,308
33	1982-83	38.26	47.12	1,231
34	1983-84	41.24	60.10	1,457
35	1984-85	41.16	58.34	1,417
36.	1985-86	41.14	63.83	1,552
37.	1986-87	41.17	60.56	1,471
38.	1987-88	38.81	56.86	1,465
39.	1988-89	41.73	70.49	1,689
40.	1989-90	42.17	73.57	1,745
41	19990-91	42.69	74.29	1,740

42	1991-92	42.65	74.68	1,751
43	1993-94	41.78	72.86	1,744
44	1994-95	42.81	81.81	1,911
45	1995-96	42.84	76.98	1,797
46	1995-96	42.84	76.98	1,797
47	1996-97	43.34	81.74	1,882
48	1997-98	43.45	82.53	1,900
49	1998-99	44.80	86.03	1,920
50	1999-2000	44.97	89.48	1,990

Source: <http://drdpat.bih.nic.in/HS-B-Table-01.htm>.

The above table indicate the changing trends in the area under rice, production, yield in different years.

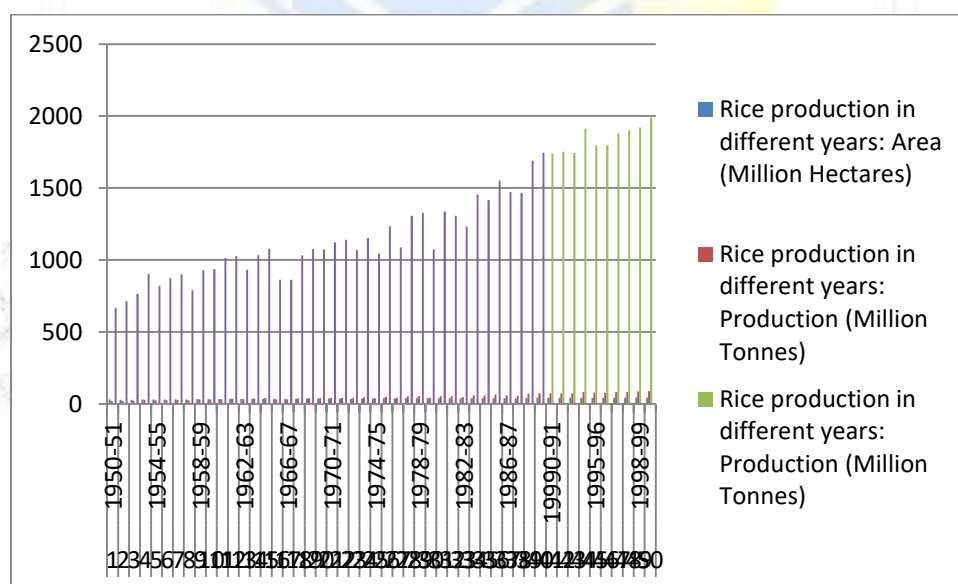


Table 2

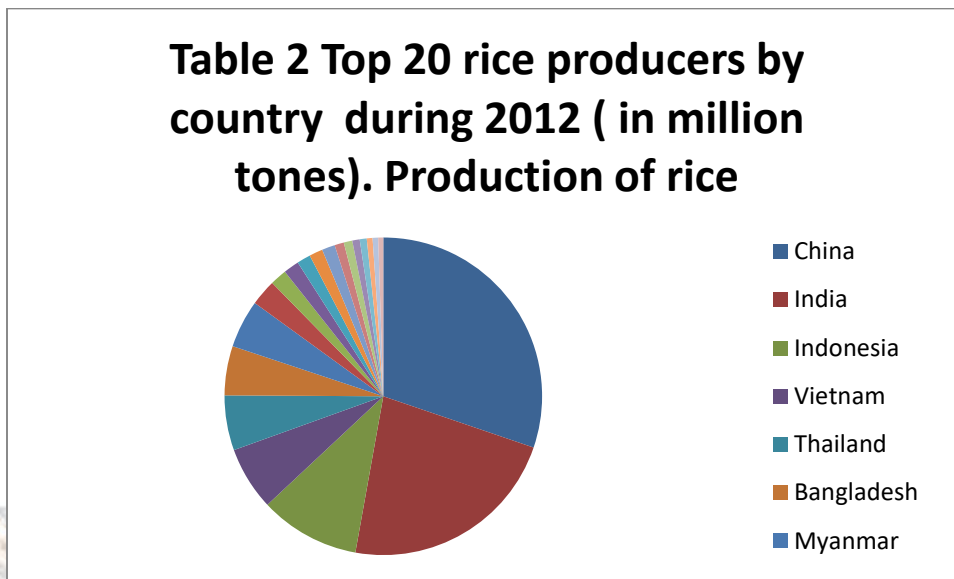


**Top 20 rice producers by country during 2012 ( in million tones).**

Country	Production of rice
China	204.3
India	152.6
Indonesia	69.0
Vietnam	43.7
Thailand	37.8
Bangladesh	33.9
Myanmar	33.0
Philippines	18.0
Brazil	11.5
Japan	10.7
Pakistan	9.4
Cambodia	9.3
United States	9.0
Korea	6.4
Egypt	5.9
Nepal	5.1
Nigeria	4.8
Madagascar	4.0
Sri Lanka	3.8
Laos	3.5

Source: Food and Agriculture Organization.

The above table indicate the Top 20 rice producers by country during 2012, Rice production has recorded highest in China followed by other countries.



**Table 3**

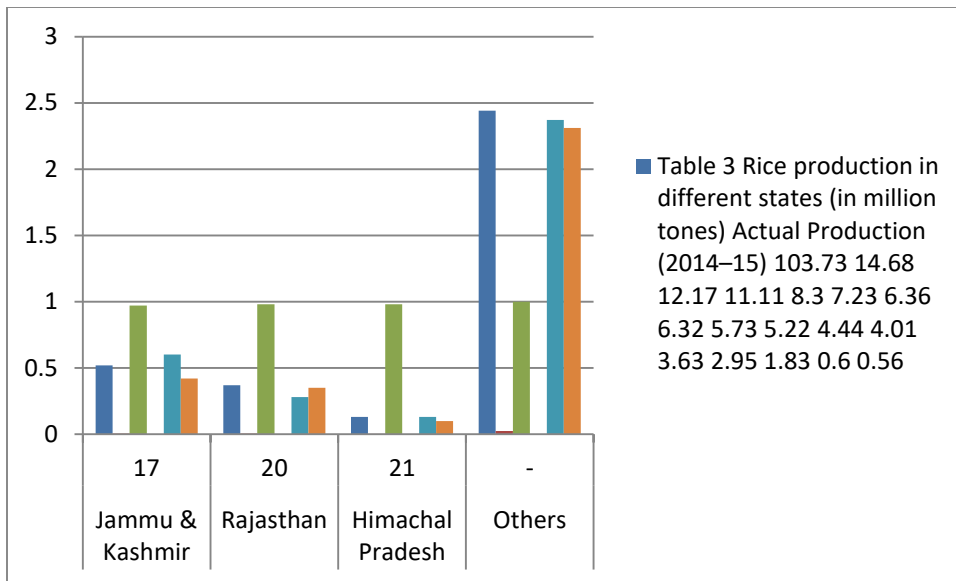
**Rice production in different states (in million tones)**

States	Rank (2014–15)	Actual Production (2014–15)	% of Country Total (2014-15)	Cumulative % of Country Total (2014-15)	Average Production (2010-11 to 2014-15)	Estimate (2015–16)
India	-	103.73	100.0%	100%	105.48	103.61
West Bengal	1	14.68	13.9 %	14 %	14.54	16.10
Uttar Pradesh	2	12.17	11.5 %	25 %	13.45	12.51
Punjab	3	11.11	10.5 %	36 %	11.03	11.64
Odisha	4	8.30	7.9 %	44 %	7.17	5.80
Andhra	5	7.23	6.9 %	51 %	7.34	6.94

Pradesh						
Bihar	6	6.36	6.0 %	57 %	5.93	6.11
Chhattisgarh	7	6.32	6.0 %	63 %	6.37	6.29
Tamil Nadu	8	5.73	5.4 %	68 %	5.68	5.72
Assam	9	5.22	4.9 %	73 %	4.91	5.14
Telangana	10	4.44	4.2 %	77 %	5.31	4.19
Haryana	11	4.01	3.8 %	81 %	3.84	4.18
Madhya Pradesh	12	3.63	3.4 %	85 %	2.65	3.49
Maharashtra	13	2.95	2.8 %	94 %	2.93	2.61
Gujarat	14	1.83	1.7 %	96 %	1.66	1.56
Uttarakhand	15	0.60	0.6 %	96 %	0.58	0.63
Kerala	16	0.56	0.5%	97%	0.53	0.70
Jammu & Kashmir	17	0.52	0.5%	97%	0.60	0.42
Rajasthan	20	0.37	0.4 %	98 %	0.28	0.35
Himachal Pradesh	21	0.13	0.1 %	98 %	0.13	0.10
Others	-	2.44	2.3 %	100 %	2.37	2.31

Source: Federal Research Division, 2023.

It is clear from the above table that Rice production in different states in India. West Bengal has recorded highest rice production in India.



### Rice export from India:

Indian economy is one of the biggest exporters of rice in the world.

#### Basmati rice

India is the leading exporter of the Basmati Rice to the global market. In the financial year 2018-19, India exported around 4.4 million metric tons (*drdpat.bih.nic.in. Retrieved 2020*).of Basmati rice worth USD 4.7 billion (*oec.world, 2020*).

The Indian states with the highest areas of Basmati rice under production are Jammu and Kashmir, Himachal Pradesh, Punjab, Haryana, Delhi, Uttarakhand and Western Uttar Pradesh (*oec.world, 2020*).

#### Non Basmati rice:

According to APEDA, "any rice other than Basmati Rice is named as Non-Basmati rice." In 2018-19, India exported 7.5 million metric tons of Non-Basmati rice worth USD 3 billion. The main export destinations were Nepal, Benin, Senegal, Bangladesh and Guinea (*drdpat.bih.nic.in, 2020*).

India curbed rice exports by banning shipments of fully broken rice and imposing a 20 per cent duty on white rice exports. In its first advance estimate, the Agriculture Ministry pegged kharif rice production at 104.99 million tonnes (mt) this season against 111.76 mt last season Third, Bangladesh has approached India for 0.5 mt of parboiled rice on a government-to-government basis to build stocks for its public distribution system (Subramani Ramancombu, December,2022).

### Major rice producing districts in Karnataka:

Koppal district stands first in Karnataka in the production of paddy. Rice is grown in Karnataka in 27 districts. Out of which 14 districts are under high productivity group (yield more than 2,500 Kg/ha).

The major paddy growing districts in Karnataka are, Raichur, Ballari, Haveri, Uttar Kannada, Dharwad, Koppal, Mysore, Hassan, and Chitradurga.

Rice market price in Karnataka:

As of May 2023 The market price of rice in Karnataka is Rs.3,625 per quintal. Minimum market price has recorded Rs.2,200 per quintal, Average market price has recorded Rs. 3,625 per quintal, Maximum market price has recorded Rs.5,600 per quintal.

The price of a common variety of paddy which was fetching Rs.1,940/- per quintal in the previous year has at present increased to Rs. 2,4000 to Rs. 2,500 per quintal.

**Table 4:**

**Price of Rice in Karnataka**

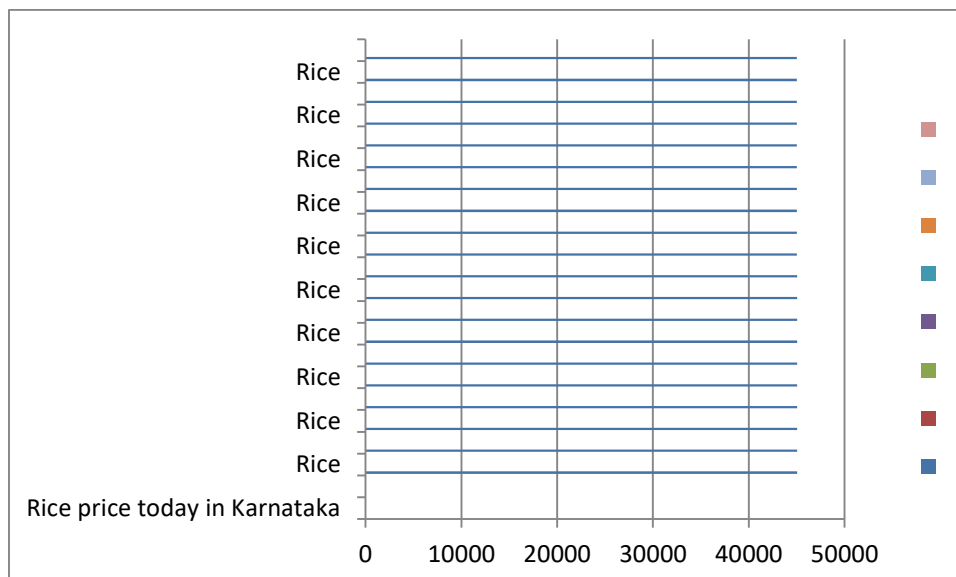
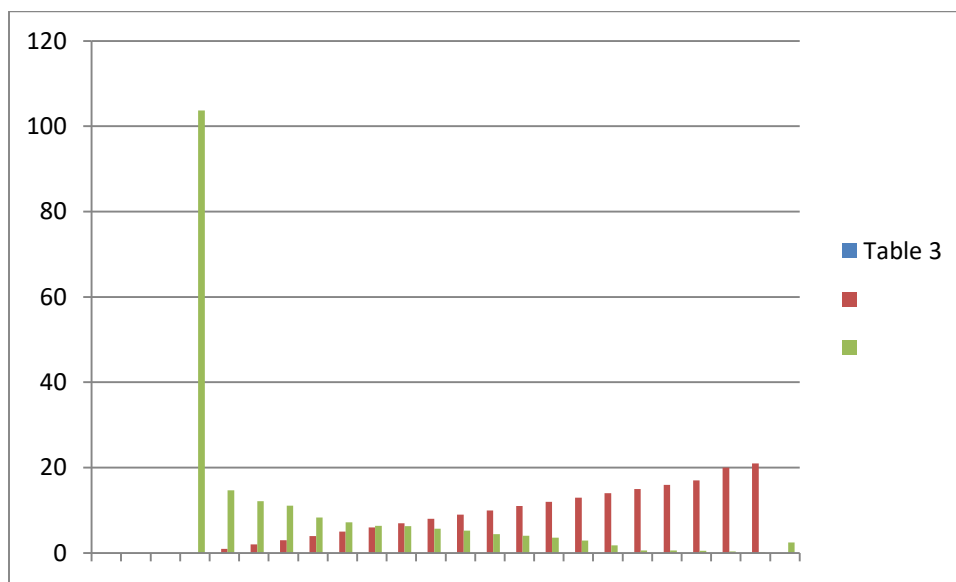
Commodity	Arrival Date	Variety	State	District	Market	Min Price	Max Price	Avg price	Telegram
Rice	05/05/2023	Broken Rice	Karnataka	Gulbarga	Gulbarga	Rs 2100 / Quintal	Rs 2950 / Quintal	/Rs 2550 / Quintal	Get Alert Free
Rice	05/05/2023	Coarse	Karnataka	Gulbarga	Gulbarga	Rs 3100 / Quintal	Rs 3800 / Quintal	/Rs 3500 / Quintal	Get Alert Free
Rice	05/05/2023	Hansa	Karnataka	Kolar	Chintamani	Rs 2200 / Quintal	Rs 2300 / Quintal	/Rs 2250 / Quintal	Get Alert Free
Rice	05/05/2023	Sona	Karnataka	Kolar	Chintamani	Rs 4500 / Quintal	Rs 5600 / Quintal	/Rs 5000 / Quintal	Get Alert Free
Rice	05/05/2023	Medium	Karnataka	Bangalore	Bangalore	Rs 3800 / Quintal	Rs 4400 / Quintal	/Rs 4100 / Quintal	Get Alert Free
Rice	05/05/2023	Fine	Karnataka	Gulbarga	Gulbarga	Rs 4150 / Quintal	Rs 5100 / Quintal	/Rs 4650 / Quintal	Get Alert Free
Rice	05/05/2023	Coarse	Karnataka	Shimoga	Shimoga	Rs 1900 / Quintal	Rs 2700 / Quintal	Rs 2250 / Quintal	Get Alert Free

Commodity	Arrival Date	Variety	State	District	Market	Min Price	Max Price	Avg price	Telegram	
Rice	05/05/2023	Medium	Karnataka	Shimoga	Shimoga	Rs 2800	Rs /4500	/Rs 3250 / Quintal	Get Alert	Free
Rice	05/05/2023	Other	Karnataka	Koppal	Gangavathi	Rs 2300	Rs /2300	/Rs 2300 / Quintal	Get Alert	Free
Rice	05/05/2023	Fine	Karnataka	Shimoga	Shimoga	Rs 3600	Rs /6500	/Rs 5750 / Quintal	Get Alert	Free
Rice	04/05/2023	Medium	Karnataka	Bangalore	Bangalore	Rs 3800	Rs /4400	/Rs 4100 / Quintal	Get Alert	Free
Rice	04/05/2023	Broken Rice	Karnataka	Gulbarga	Gulbarga	Rs 2100	Rs /2850	/Rs 2550 / Quintal	Get Alert	Free
Rice	04/05/2023	CR 1009 (Coarse) Boiled	Karnataka	Bidar	Bidar	Rs 4500	Rs /6000	/Rs 5000 / Quintal	Get Alert	Free
Rice	04/05/2023	Coarse	Karnataka	Gulbarga	Gulbarga	Rs 3100	Rs /3800	/Rs 3500 / Quintal	Get Alert	Free
Rice	04/05/2023	Fine	Karnataka	Gulbarga	Gulbarga	Rs 4000	Rs /5000	/Rs 4550 / Quintal	Get Alert	Free
Rice	04/05/2023	Medium	Karnataka	Shimoga	Shimoga	Rs 2800	Rs /4800	/Rs 3250 / Quintal	Get Alert	Free
Rice	04/05/2023	Coarse	Karnataka	Shimoga	Shimoga	Rs 1900	Rs /2700	/Rs 2300 / Quintal	Get Alert	Free
Rice	04/05/2023	Other	Karnataka	Koppal	Gangavathi	Rs 4100	Rs /4100	Rs 4100 / Quintal	Get Alert	Free

Commodity	Arrival Date	Variety	State	District	Market	Min Price	Max Price	Avg price	Telegram
Rice	04/05/2023	Hansa	Karnataka	Kolar	Chintamani	2200	2300	Rs 2250 / Quintal	Get Alert
Rice	04/05/2023	Sona	Karnataka	Kolar	Chintamani	4500	5600	Rs 5000 / Quintal	Get Alert

Source: Commodity online,2023.

It is clear from the above table that fluctuations in price of rice in different districts in Karnataka.



### **Government support to rice cultivators:**

The Union government hiked the minimum support price for kharif crops by 4-9 per cent for the 2022-23 crop year. For paddy, the MSP is being increased by Rs.100 to Rs. 2,040 per quintal. In addition, the State Government is also providing incentives upto Rs.500 per quintal to encourage farmers to bring more area under rice cultivation(Times of India, 2022 and Na Panta, agri,commodity prices ,2023).

### **V.Suggestions:**

- 1.Farmers of Rice cultivation should be very much familiar about scientific cultivation practices to get higher yield.
- 2.Farmers of Rice cultivation should be very much familiar about disease as well as pest management of the crop, so that they can reduce the lossess.
- 3.Farmers should be aware about the organic farming and technology adoption to get enhanced productivity level, so that they can lead decent standard of living.
4. Farmers should be aware about the institutional sources of agricultural finance especially in rural areas, so that they can get access to get the crop loans, productive, unproductive and consumption loans from co-operative banks as well as commercial banks.

### **Recommendation:**

- 1.. Government should enhance minimum support price to farmers of rice so that food crop farmers can get relief, so that they can plan scientifically for the production, farming and they can participate actively in marketing of rice.

### **Area of Further Research:**

- 1.Cost of production and Returns of rice with other food crops such as Finger millet and jowar can be conducted.
  2. Price behaviour of rice and other food crops such as finger millet and jowar can be compared.
- Technology and non-technology adopters of rice farming areas can be conducted

### **References:**

- 1) Barnes, Gina L. Paddy Soils Now and Then. *World Archaeology* 22(1):1–17, 1990.
- 2) Crawford, Gary W. and Gyoung-Ah Lee. Agricultural Origins in the Korean Peninsula. *Antiquity* 77(295):87–95, 2003
- 3) He, Keyang; Lu, Houyuan; Zhang, Jianping; Wang, Can; Huan, Xiujia (7 June 2017). "Prehistoric evolution of the dualistic structure mixed rice and millet farming in China". *The Holocene*. **27** (12): 1885–1898.



- 4) Heitzman, James; Worden, Robert L., eds. (1996). "Food-Crop Production". India: a country study (5th ed.). Washington, D.C.: Federal Research Division, Library of Congress. pp. 406–407. ISBN 0-8444-0833-6. OCLC 34598209.
- 5) "Increasing rice production in Myanmar". Archived from the original on 25 September 2015. Retrieved 4 May 2015.
- 6) Mishra S. N., Mitra S., Rangan L, Dutta S., and Pooja. (2012). Exploration of 'hot-spots' of methane and nitrous oxide emission from the agriculture fields of Assam, India. *Agriculture and Food Security*. 1/16. doi:10.1186/2048-7010-1-16.
- 7) Molina, J.; Sikora, M.; Garud, N.; Flowers, J. M.; Rubinstein, S.; Reynolds, A.; Huang, P.; Jackson, S.; Schaal, B. A.; Bustamante, C. D.; Boyko, A. R.; Purugganan, M. D. (2011). "Molecular evidence for a single evolutionary origin of domesticated rice". *Proceedings of the National Academy of Sciences*. **108** (20): 8351.
- 8) Sang, Anisia Jati; Tay, Kai Meng; Lim, Chee Peng; Saeid, Nahavandi (2018). "Application of a Genetic-Fuzzy FMEA to Rainfed Lowland Rice Production in Sarawak: Environmental, Health, and Safety Perspectives". *IEEE Access*. **6**: 74628–74647.
- 9) "Top 10 Rice Producing States of India, Indian States with Highest Rice Production". Maps
- 10) UNESCO World Heritage Centre. "Rice Terraces of the Philippine Cordilleras – UNESCO World Heritage Centre". Whc.unesco.org Retrieved 5 May 2015. ofindia.com. 17 January 2012. Retrieved 25 April 2013.
- 12) Zhang, Jianping; Lu, Houyuan; Gu, Wanfa; Wu, Naiqin; Zhou, Kunshu; Hu, Yayi; Xin, Yingjun; Wang, Can; Kashkush, Khalil (17 December 2012). "Early Mixed Farming of Millet and Rice 7800 Years Ago in the Middle Yellow River Region, China". *PLOS ONE*. **7** (12): e52146. Bibcode:2012PLoSO...752146Z. doi:10.1371/journal.one.0052146. PMC 3524165. PMID 23284907.