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Impact of infrastructure and technology on agricultural productivity in Jammu and Kashmir

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Abstract
Infrastructure and Technology has come to play a very significant role even in marketing these days. They are absolutely critical to the agro-industry be it at the primary (production), secondary (processing) or tertiary (marketing and packaging) stage. Experts have always suggested that agricultural technology could play a vital role in addressing the issues and concerns relating to the conservation and management of rural resources. Technological innovations and Government policies have brought out changes in cropping pattern, productivity, but the change is not uniform in all regions due to different agro-climatic, socio-economic and non-economic factors. Therefore, the aim of the present paper is to analyze the Impact of Infrastructure and Technology on Agricultural Productivity in Jammu and Kashmir.

Keywords: Infrastructure, Technology, Marketing, Innovations, Agricultural Productivity

Introduction

Jammu and Kashmir State is predominantly an agrarian economy. Agriculture remains the backbone of the economy more than 60 percent of its population depends on agriculture and allied sectors. This sector contributes around 27 percent to the State's income. In Jammu and Kashmir, agriculture is the key sector for employment and income generation, because large scale industrialization is not desirable ecologically, and due to hilly regions the infrastructure is too poor to attract industries. Therefore, agricultural sector continues to remain the important sector for socio-economic development of the people. Jammu and Kashmir needs to focus on its weakest contributor **"**Agriculture**"** which ironically supports more than 60 percent of employment.

The goal before the Agriculture Production Department is to enhance the income of farmers and to generate employment in agriculture and allied sectors. These are: (a) achieve 4% growth in agriculture and raise incomes by increasing productivity (land, labor), diversification to high value agriculture and rural non-farm by maintaining food security; (b) sharing growth (equity) by focusing on small and marginal farmers, lagging regions, women etc.; (c) third is to maintain sustainability of agriculture by focusing on environmental concerns.

The strategy adopted for this purpose is to increase production and productivity of the crops and to enable farmers to diversify their crop production so as to take advantage of market opportunities. The main role of the department is to help farmers to adopt better technology and to facilitate establishment of infrastructure for farm production and marketing. New avenues are being explored for investment. The department is also promoting diversification of agricultural crops to motivate farmers to move towards low volume-high value crops like vegetables, medicinal plants and niche products like saffron, Rajmash, Zeera, Mushrooms etc. Agriculture has, after a very long time, occupied centre stage in the economic and administrative discourse in the State at a time when all seemed lost due to the dwindling interest of the younger generation in agriculture activities. The concerted efforts of the Agriculture Production Department have triggered a new hope among the people, which promises profitability and dignity in the agriculture as an occupation.

In Jammu and Kashmir State, agriculture has received sufficient impetus for its improvement since the inception of Five Year Plans. The Projects have increased considerable area under irrigation. The farmers know the needs of inputs for increasing the yield i.e. improved seeds, fertilizers, insecticides, pesticides, iron plough, tractors and other farm machinery. Co-operative Banks give them credit facilities and government agencies purchase their surplus produce at the revised rates. The main agricultural crops of Jammu and Kashmir are rice, wheat, maize, pulses, coarse grains, oil seeds, fodder etc.

Infrastructure and Technology in Agricultural Productivity

Infrastructure plays a strategic role in producing large multiplier effects in the economy with growth in agriculture (Mellor, 1976). It is estimated that, across the world, 15 per cent of crop produce is lost between farm gate and consumer because of poor roads and inappropriate storage facilities (World Bank, 1997). Parikh (1999) in India Development Report has also placed UP in the deficient category in terms of electricity, roads, storage, credit facilities, etc. According to CMIE (2000) the value of Composite Development Index (CDI) for UP is 112.04, which is though above the national value of 100, lags behind several agriculturally-developed states like Punjab and Haryana.

For analyzing the impact of infrastructure on agricultural development, Thorat and Sirohi (2002) [8] have used ten explanatory variables, viz. transport, power, irrigation, tractors, research, extension, access to agricultural credit societies, regulated and wholesale markets, access to fertilizer sale points and commercial banks, covering physical, financial and research infrastructures. They have reported that transport, power, irrigation and research were the four critical components affecting agricultural productivity significantly. With improved access to power, irrigation rises along with productivity. Development of transport facilitates access to

fertilizer sale points, markets, credit facilities and extension services.

Adoption of modern agricultural technology has been another crucial factor for raising agricultural productivity in India, especially in the northern states like Punjab and Haryana. Bhalla and Singh (2001) have observed that the annual compound growth rate of agricultural productivity for UP during 1962-65 to 1992-95 was 2.30 per cent, which was though at par with the national level, was lower than that of agriculturally-developed states like Punjab (3.13%) and Haryana (3.21%). The green revolution introduced the high-yielding varieties (HYVs) of wheat and rice during 1960s and early-1970s in Punjab, Haryana and western UP. Along with the HYVs, the increased consumption of fertilizer also contributed towards raising yield and output. Desai and Namboodiri (1997) [2] have found that factors like HYVs and fertilizer have greater influence on the growth of agricultural productivity in India.

The study was carried out with the following objectives in the state of Jammu and Kashmir:

- To analyze the impact of Infrastructure on Agriculture.
- To analyze the impact of Technology on Agriculture.
- To suggest Policy implications for the improvement of Agricultural Productivity and Development.

Methodology

Keeping in view the objectives of study, the data collection has been carried out at secondary levels. The secondary data has been collected from various secondary sources such as Journals, Magazines, Economic Surveys, Agricultural Production Department Kashmir, SKUAST, Ministry of Agriculture, Directorate of Economics and Statistics, Planning and Development Department. The equation mentioned below was used to find out the trend value of production of fresh and dry fruits in Jammu and Kashmir.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + Ut$$

Where,

Y- Dependent variable
X- Independent variable
β_0 - Intercept, β_1 - coefficient (Slope),
U_t - Error term

$$\text{Growth Rate} = (Y_c - Y_b / Y_b) * 100$$

Where,

Y_c - Quantity in current year
Y_b - Quantity in Base year.

Results and Discussion

It has been found that agricultural productivity in Jammu and Kashmir increased with marginal fluctuations, which could be due to adoption of HYVs and fertilizer during the green revolution period in the state.

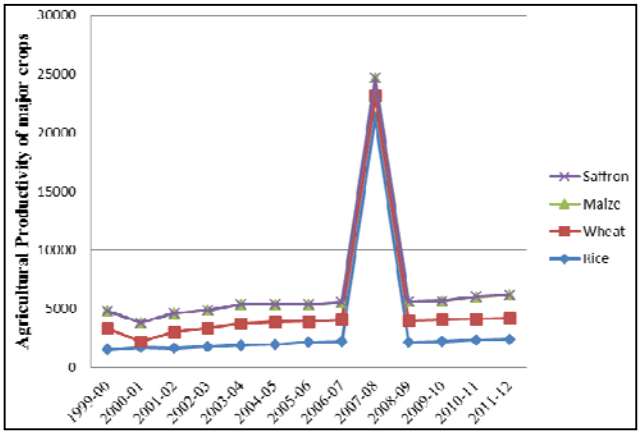

Fig 1: Regression analysis for fertilizer and HYVs on agricultural productivity in Jammu and Kashmir during 1999-00 to 2011-12

Dependent Variable	Independent Variable	Intercept	Coeffients	R^2	F	Sig.
Agricultural	Fertilizer	18692.37	12.81531	0.80561	20.72152*	0.000278
Productivity	HYVs Area		-17.4626			

* Significant at 0.05 level

Analyzing the impact of infrastructure and technology (fertilizer and HYV), it is found that both fertilizer and area under HYVs have positive and significant impact on agricultural productivity. It is shown that R^2 is 0.80 (i.e 80%), it means that dependent variable (Agricultural Productivity) is 80% explained by Independent variables (Fertilizers and HYV). Thus, it can be said that the independent variables altogether have explained 80.5% variation in agricultural productivity.

Technological change has been the basis for increasing agricultural productivity and promoting agricultural development. Research impacts the productivity of farming systems by generating new technologies which, if appropriate to farmer's circumstances, will be rapidly adopted. Development of agricultural sector driven by innovation at all levels. The type of innovations that ultimately makes the difference is what farmers decide to do.

Agricultural Innovation System (AIS) is key to improve the economic, environmental and social performance of the agri-food sector. The long-term positive impact of agricultural research and development (R&D) on productivity growth is well established, and technologies and practices can help to improve the sustainability of natural resource use. In recognition of their potential contribution to challenges facing agri-food sector. Agricultural Innovation System is the key subject of renewed attention from policy makers.

Agriculture and farming sector depends on technology heavily. Before the evolution of technology, farmers were dependent on small agriculture tools and animals for planting and harvest crops. However today, there are big tractors, combines and other machines to do this job in hours which used to take number of days before.

There is a lot of innovation in the mobile/ IT and energy spaces that have the potential to make a huge impact on the farm. For Example, smart power systems, precision agriculture tools, farm management software, and affordable sensors are all within reach of even the smallest farmers today. Fortunately, advances in technology can have significant impact, as did irrigation systems, tractors, and other mechanical innovations in the 19th and 20th centuries.

We are keeping our eyes open for opportunities in the agri-tech space. We are looking for start-ups offering technologies that can:

- Increase farmer's profitability, productivity, and efficiency.
- Improve farmer, animal and consumer livelihood with better work environments, food safety, and food security.
- Protect the planet and its finite resources.

Technology has played a big role in developing the agricultural industry. Today it is possible to grow crops in a desert by use of agricultural biotechnology. With this technology, plants have been engineered to survive in drought conditions. Through genetic engineering scientists have managed to introduce traits into existing genes with a goal of making crops resistant to drought and pests. Let's take a good example, a bacterium known as "Bacillus Thuringiensis" acts like a reservoir, it enables crops to be insect-resistant, so these genetically modified crops will grow without any interference from pests. The invention of this technology is being used in developing countries to grow cash crops like cotton, since this genetically engineered cotton plants are pest resistant, they grow better than the normal cotton plants hence yielding good results.

Use of Machine on Farms

Now a farmer can cultivate on more than 2 acres of land with less labor. The use of Planters and harvesters makes the process so easy. In agriculture, time and production are so important; you have to plant in time, harvest in time and deliver to stores in time. Modern agricultural technology allows a small number of people to grow vast quantities of food and fibre in a shortest period of time.

Modern Transportation

This helps in making products available on markets in time from the farm. With modern transportation, consumers in Dubai will consume a fresh carrots from Africa with in the same day that carrot lives the garden in Africa. Modern transportation technology facilities help farmers easily transport fertilizers or other farm products to their farms, and it also speeds the supply of agricultural products from farms to the markets where consumers get them on a daily basis.

Cooling Facilities

These are used by farmers to deliver tomatoes and other perishable crops to keep them fresh as they transport them to the market. These cooling facilities are installed in food transportation trucks, so crops like tomatoes will stay fresh upon delivery. This is a win-win situation for both the consumers of these agricultural products and the farmers.

Genetically Produced Plants

Genetically produced plants like potatoes, can resist diseases and pests, which rewards the farmers with good yields and saves them time. These crops grow very fast they produce healthy yields. Since, they are resistant to most diseases and pests, the farmers will spend less money on pesticides, which in return increases on their (RIO) return on investment.

Development of animals feeds

This has solved the problem of hunting for grass to feed animals, now these feeds can be manufactured and consumed by animals. The price of these feed can is fair so that a low income farmer can afford them. Most of these manufactured animal feeds have extra nutrition which improves the animal's health and output of these animals will also increase. In agriculture, the health of an animal will determine its output. Poorly feed animals are always unhealthy and they produce very little results in form of milk, meat, or fur.

Breeding of animals which are resistant to diseases

Most of these genetically produced animals will produce more milk or fur compared to normal animals. This benefits the farmers because their production will be high. Cross breeding is very good in animal grazing, cross breed animals are more strong and productive.

Irrigation of Plants

In dry areas like deserts, farmers have embraced technology to irrigate their crops. A good example is in Egypt, were farmers use water pumps to collect water from river Nile to their crops. Most of these farmers grow rice which needs a lot of water, so they manage to grow this rice using irrigation methods enhanced by advanced technology. Advanced water sprinklers are being used to irrigate big farms and this helps the crops get enough water which is essential in their growth. Some farmers mix nutrients in this water, so also improves on the growth of these crops.

Table 1: Production of major crops and their share in total food crops sown in Jammu and Kashmir. (000 Qtl)

S. No	Year	Rice	Wheat	Maize	Pulses	Other cereals & mallets	Total food crops
1	1999-00	3915 (29.44)	4343 (32.66)	4712 (35.48)	145 (1.09)	177 (1.33)	13297
2	2000-01	4153 (37.09)	1487 (13.20)	5258 (46.96)	128 (1.14)	170 (1.51)	11196
3	2001-02	4223 (31.62)	3430 (25.67)	5381(40.28)	125 (0.93)	198 (1.48)	13357
4	2002-03	4214 (31.76)	4055 (30.56)	4651 (35.06)	142 (1.09)	203 (1.53)	13265
5	2003-04	5048 (32.94)	4595 (29.98)	5326 (34.75)	132 (0.86)	225 (0.14)	15323
6	2004-05	4928 (32.79)	4782 (31.82)	4922 (32.75)	152 (1.01)	243 (1.61)	15027
7	2005-06	5574 (37.11)	4575 (30.45)	4535 (30.19)	135 (0.89)	201 (1.33)	15020
8	2006-07	5546 (35.15)	4983 (31.58)	4869 (30.89)	141 (0.89)	238 (1.50)	15777
9	2007-08	5620 (34.67)	4959 (30.59)	4745 (29.27)	153 (0.94)	230 (1.41)	16208
10	2008-09	5712 (33.18)	5101 (29.63)	5025 (29.19)	182 (1.10)	230 (1.32)	16250
11	2009-10	6615 (35.60)	4822 (29.95)	4780 (29.45)	218 (1.34)	232 (1.42)	16267
12	2010-11	8146 (46.89)	3000 (17.27)	5898 (33.95)	325 (1.87)	241 (1.38)	17371
13	2011-12	8476 (47.34)	3000 (16.75)	6098 (34.05)	328 (1.83)	269 (1.54)	17904

Source: Digest of Statistics, Jammu and Kashmir 2011-12

Table 2: Production of other food/non-food crops of Jammu and Kashmir. (000 Qtls)

S. No	Year	Sugarcane	Potatoes	Chills	Oilseeds	Saffron (Qt)	Fruits (000mtonn)
1	1999-00	4.1	293	5	535	77.88	1092.18
2	2000-01	4.5	172	10	282	35.91	1180.20
3	2001-02	4.6	201	19	422	30.3	1222.41
4	2002-03	5.2	185	10	266	65.25	1252.11
5	2003-04	6.9	184	10	421	51.54	1301.62
6	2004-05	6.3	148	11	407	48.34	1331.86
7	2005-06	8.1	152	10	366	88.52	1403.23
8	2006-07	8.1	189	6	413	48.50	1504.01
9	2007-08	2.9	183	7	535	91.31	1636.20
10	2008-09	4.5	179	8	701	50.60	1691.00
11	2009-10	5.6	180	7	855	48.22	1728.01
12	2010-11	7.2	201	9	971	46.00	2222.11
13	2011-12	7.8	222	11	976	49.55	2161.52

Source: Digest of Statistics, Jammu and Kashmir 2011-12

Table 3: Growth rate of major agriculture crops of Jammu and Kashmir (% over previous year).

S. No	Year	Rice	Maize	Wheat	Pulses	Other cereals and mallets	Fruits	Oilseeds	Total food crops
1	1999-00	-	-	-	-	-	-	-	-
2	2000-01	6.07	11.58	-65.76	-11.72	-3.95	8.05	-47.28	-15.76
3	2001-02	1.68	2.33	130.6	-2.34	16.47	3.55	49.64	19.30
4	2002-03	-0.21	-13.56	18.22	13.60	2.52	2.45	-36.96	-0.60
5	2003-04	19.79	14.51	13.31	-7.04	10.83	3.91	58.27	15.52
6	2004-05	-2.37	-7.58	4.06	12.87	8.00	2.30	-3.32	-1.94
7	2005-06	13.10	-7.86	-4.32	-11.18	-17.28	5.40	-10.07	-0.04
8	2006-07	-0.50	7.36	8.91	4.44	18.40	7.19	12.84	5.03
9	2007-08	1.00	-2.56	-0.48	8.51	-3.36	8.77	29.5	-0.44
10	2008-09	1.63	5.90	2.86	18.95	0	3.36	2.05	0.25
11	2009-10	15.80	-4.87	-5.46	19.78	0.86	2.18	1.64	0.10
12	2010-11	23.14	23.38	-37.78	49.08	3.87	28.59	13.56	6.78
13	2011-12	4.05	3.39	0	0.92	11.61	-2.74	0.51	3.06

Source: Computed by Author

Table 4: Index of agriculture production of Jammu and Kashmir (Base year 1999-00 =100)

S. No	Year	Rice	Wheat	Maize	Pulses	Other cereals & mallets	Non-Food crops	Food crops
1	1999-00	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2	2000-01	106.7	35.3	111.5	89.3	96.1	82.1	84.3
3	2001-02	107.8	79.0	114.1	87.7	111.8	122.6	100.4
4	2002-03	107.6	93.4	98.8	98.0	114.6	117.3	99.8
5	2003-04	129.8	105.8	113.0	97.1	127.1	118.7	115.2
6	2004-05	125.8	110.1	104.4	104.8	137.2	111.0	113.0
7	2005-06	142.3	105.3	96.2	94.1	113.5	134.1	113.0
8	2006-07	147.6	114.7	103.3	98.3	134.5	131.9	118.6
9	2007-08	143.5	114.1	100.7	105.1	129.9	125.8	121.9
10	2008-09	145.9	117.4	106.6	125.5	129.9	148.2	122.2
11	2009-10	168.9	111.0	101.4	150.3	131.0	154.6	122.3
12	2010-11	208.7	69.9	124.3	224.1	136.1	181.3	130.6
13	2011-12	216.5	69.9	129.4	226.2	151.9	199.2	134.6

Source: Directorate of Economics & Statistics, J&K

Table 5: Productivity of some major crops of Jammu and Kashmir (Kg/hect)

S. No	Year	Rice	Wheat	Maize	Saffron
1	1999-00	1562	1769	1485	3.13
2	2000-01	1702	529	1592	1.92
3	2001-02	1690	1321	1648	1.27
4	2002-03	1784	1633	1451	0.11
5	2003-04	1943	1804	1659	2.27
6	2004-05	1971	1892	1525	1.88
7	2005-06	2152	1810	1413	1.57
8	2006-07	2196	1872	1505	2.96
9	2007-08	2154	1782	1569	1.64
10	2008-09	2180	1835	1592	3.75
11	2009-10	2212	1882	1601	4.21
12	2010-11	2349	1800	1877	3.01
13	2011-12	2396	1800	2000	2.68

Source: Economic Survey, Jammu and Kashmir 2011-12.

Table 6: Area under High yield variety of seeds of different crops in Jammu and Kashmir. (000/hect)

S. No.	Year	Rice	Wheat	Maize	Total area under HYV	Gross cropped area	% in GCA of HYV
1	1999-00	250	245	317	812	1078	75.32
2	2000-01	244	280	330	854	1114	75.85
3	2001-02	249	259	326	835	1106	75.49
4	2002-03	236	248	329	814	1077	75.57
5	2003-04	259	254	321	835	1102	75.55
6	2004-05	250	252	322	825	1101	75.82
7	2005-06	259	252	320	832	1100	74.94
8	2006-07	252	266	323	842	1126	75.64
9	2007-08	263	278	302	844	1133	74.77
10	2008-09	264	272	300	839	1177	72.51
11	2009-10	266	289	301	861	1192	72.84
12	2010-11	282	292	318	856	1207	70.91
13	2011-12	270	292	303	829	1223	67.78

Source: Digest of Statistics, Jammu and Kashmir 2011-12

Table 7: Total irrigated area under different crops of Jammu and Kashmir. (000 hect.)

S. No	Year	Rice	Wheat	Maize	Pulses, Cereal & millets	Other food crops	Total non-food crops	Total irrigated area
1	1999-00	225	62	28	12	27	84	438
2	2000-01	220	74	32	4	34	85	449
3	2001-02	223	69	29	18	24	85	448
4	2002-03	220	67	27	16	25	79	434
5	2003-04	223	69	23	10	26	80	446
6	2004-05	227	71	26	20	28	81	453
7	2005-06	234	73	27	12	32	80	458
8	2006-07	231	74	22	12	39	82	459
9	2007-08	229	77	22	11	37	84	463
10	2008-09	232	80	24	10	39	86	472
11	2009-10	260	82	23	10	43	84	502
12	2010-11	282	86	16	11	44	81	520
13	2011-12	270	87	16	14	67	79	527

Source: Economic Survey, Jammu and Kashmir, 2011-12

Table 8: Percentage of irrigated area of various crops as share of total irrigated area.(000 hect)

S. No.	Year	Rrice	Maize	Wheat	Other pulses cereals & millets	Other food crops	Non-food crops	% area Irrigated to gross sown area
1	1999-00	90	8.83	25.30	27.90	11.25	66.14	40.69
2	2000-01	90.16	9.96	26.42	8.5	10.65	67.21	40.30
3	2001-02	89.55	8.69	26.64	39.13	9.75	62.20	40.59
4	2002-03	93.22	8.89	27.01	33.33	10.51	63.11	40.29
5	2003-04	89.55	8.20	27.82	38.46	11.56	65.22	40.41
6	2004-05	90.22	7.16	27.95	47.61	12.81	66.66	41.10
7	2005-06	90.96	8.07	28.96	27.90	16.52	67.76	41.14
8	2006-07	91.80	8.43	27.87	27.56	26.11	62.48	41.63
9	2007-08	97.34	6.81	27.69	27.50	32.60	66.14	41.76
10	2008-09	85.02	7.28	28.36	26.42	28.14	62.08	40.86
11	2009-10	97.07	7.25	29.39	24.96	31.60	51.01	42.47
12	2010-11	100.0	5.03	34.01	22.10	36.21	43.54	43.08
13	2011-12	100.0	3.28	32.03	25.23	39.11	39.50	43.09

Source: Computed by Author

Table 9: Distribution of fertilizers in Jammu and Kashmir with index numbers.

S. No.	Year	Distribution of fertilizers		Fertilizer intensity	
		In 000/tonns	Index no. 1999-00= 100	Kg's per Hectare	Index no. 1999-00= 100
1	1999-00	34.311	100.0	31.82	100.0
2	2000-01	46.585	135.0	41.81	120.4
3	2001-02	40.584	118.2	36.69	93.9
4	2002-03	42.401	123.5	39.36	118.7
5	2003-04	66.520	193.8	60.36	193.9
6	2004-05	60.563	176.4	54.97	174.5
7	2005-06	93.900	273.7	85.29	274.9
8	2006-07	97.279	283.5	86.35	287.4
9	2007-08	129.132	378.1	113.88	364.6

10	2008-09	133.703	391.1	112.29	361.5
11	2009-10	156.860	457.1	131.05	422.5
12	2010-11	163.281	479.4	135.24	435.4
13	2011-12	177.510	520.5	145.14	467.7

Source: Compiled from Registrar Cooperative Socities, Sgr. And Digest of Statistics, J & K 2011-12

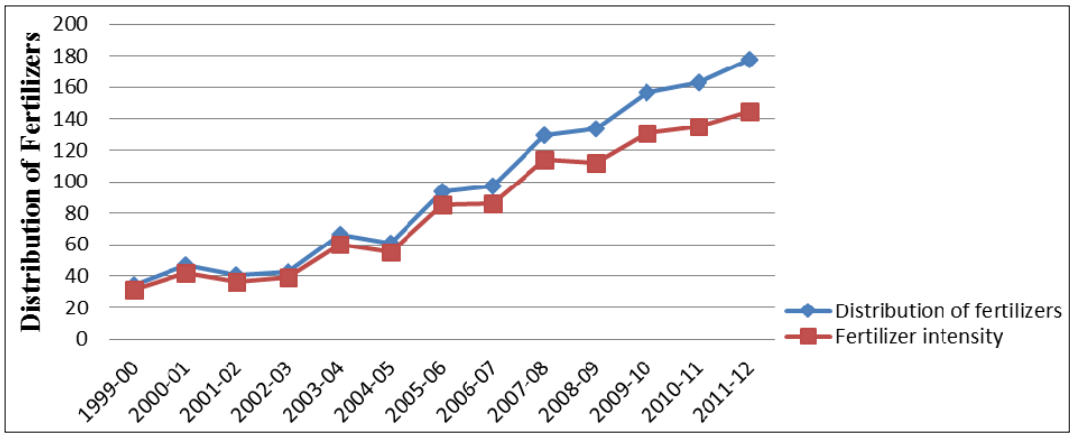

Fig 1: Distribution of fertilizers (In 000/tonns) and Fertilizer intensity (Kg's per Hectare)

Besides infrastructure, other important variables considered in the study were fertilizer consumption and area under HYVs. The consumption of fertilizer in Jammu and Kashmir had increased during 1999-00 to 2011-12, with marginal fluctuations (shown above). It was mainly due to the adoption of green revolution technologies in the state.

Table 10: Growth of Agricultural machinery and implements in Jammu and Kashmir.

S. NO	Items	Iron Plough	Chaff Cutters	Pruning scissors	Orchard Leaders	Diesel, spray & electric pumps	Paddy thrashers	Wheat thrashers	Maize thrashers	Tractors	Others
1	1999-2000	1075454	103963	23477	10163	7915	556	987	81	7725	597665
2	2000-2001	760457	109981	26960	18112	11218	664	1001	101	8366	921911
3	2001-2002	825587	112182	32104	22940	17385	682	1061	149	9292	1319800
4	2002-2003	987311	108211	45012	24140	20697	697	1859	295	10149	2117974
5	2003-2004	809773	990255	50501	36149	23591	728	2302	423	10964	3417744
6	2004-2005	652592	985281	59821	40122	28911	735	2891	491	11881	4259110
7	2005-2006	638942	962630	63121	51999	33051	749	3325	518	12818	5651439
8	2006-2007	617191	941113	69920	59010	38692	769	3690	589	14109	6214341
9	2007-2008	601881	932000	72010	62159	39901	791	4128	621	16615	6912333
10	2008-2009	596728	918992	78528	71536	42811	801	4190	628	18919	7353126
11	2009-2010	590411	901215	81891	799538	50512	819	4201	639	22436	7921059
12	2010-2011	574285	892114	86721	88102	59611	822	4278	649	28002	8154211
13	2011-2012	510720	869475	90455	39951	69223	828	4299	651	28732	8604929

Source: Compiled from Live tock Census and Digest of Statistics 2011-12

Summary and Conclusion

The Green Revolution in India initiated as technology mission to increase agricultural productivity in 1960s. The food-grain production no-doubt has increased to comfortable level but there are serious limitations to the seed fertilizer technology. It has also not solved the problems like low yields and crop imbalances.

The ecological dimensions of the new agricultural technology need to be carefully evaluated and thus revolution in agricultural technology in the need of the times. Although agricultural productivity is vital but environmental protection is equally important. Also technology must be both affordable by, and geared to the needs of the poor and under nourished people. As a factor in farm and rural development, infusion of two apparently disparate technologies, i.e. agricultural bio-technology and information technology is expected to catalyze programme changes. Agri bio-tech and Info-tech together are helping to create new tools to attack the problem of rural poverty, generate employment of farm productivity and production, improvement quality and explore marketing and income generating opportunities in newer days.

However, the technological changes in Indian agriculture started in 1960s when access to modern inputs, especially high yielding variety of seeds, fertilizers, mechanization, credit and marketing facilities improved. The Central Government also introduced intensive area development programme in 1960. New yielding varieties of wheat developed in Mexico and the Rice developed in Philippines were brought to India. In addition to HYV seeds, chemicals, fertilizers and pesticides were also introduced and irrigation facilities improved and expanded.

The widespread adaptation of HYV of Wheat, Jawar, and Maize increased their production. The mechanization of farm which introduced during the Green Revolution period is slowly making inroads ever since its inception in 1960s. But the pace

of farm mechanization has been more spectacular in the states like Punjab, Haryana and Western U.P.

The most remarkable achievement of the new technologies in the substantial increase in the production and productivity of food-grains. As a result to improvement in HYV seeds, the Wheat has registered six-fold increase in the production and Rice recorded nearly three-fold increase. Consequently, the country is self-sufficient in food-grains. But there is still need to improve the quality of seeds, irrigation technology, food-grain storage technology etc.

Infrastructure and Technology has come to play a very significant role even in marketing these days. They are absolutely critical to the agro-industry be it at the primary (production), secondary (processing) or tertiary (marketing and packaging) stage. Experts have always suggested that agricultural technology could play a vital role in addressing the issues and concerns relating to the conservation and management of rural resources.

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