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Pattern of agricultural growth in Haryana

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Abstract
This paper has analysed the recent trends in growth of agriculture in Haryana. Although agricultural growth recorded was approx. 3 per cent per annum during 2010-21, few states like Kerala continue to witness low growth. Although small farmers have benefitted from this growth, their income levels are still very low. However, in the state of Haryana this has resulted in continuous environmental degradation, particularly of soil, vegetation and water resources. Soil organic matter levels are declining and the use of chemical inputs is intensifying. Newly introduced crop varieties have been responsive to inputs but this has necessitated both increased fertiliser application and use of irrigation resulting in water contamination by nitrate and phosphate and changes in the ground water table. With 82% of the geographic area already under cultivation, the scope for increased productivity lies in further intensification which is crucially dependent on more energy-intensive inputs. Declining nutrient-use efficiency, physical and chemical degradation of soil, and inefficient water use have been limiting crop productivity, whilst the use of monocultures, mechanisation and an excessive reliance on chemical plant protection have reduced crop, plant and animal diversity in recent years. About 60% of the geographical area faces soil degradation (waterlogging, salinity and alkalinity) which threatens the region's food security in the future.

Keywords: Agriculture growth, agriculture pattern, irrigation trends, agriculture production

Introduction
Haryana state was emerged as a separate administrative entity on 01 Nov 1966 on the political map of India. Haryana is one of the smallest States in India with 4.4 million hectares of land, forming 1.34 percent of the total geographical area of the country. Nearly 80 percent of the total geographical area of the State is under cultivation of which about 84 percent is irrigated with cropping intensity of 184 percent Based on ecology and
cropping pattern, the State can be divided into 3 agro-eco regions. Zone-I: consists of 8 districts, namely Panchkula, Ambala, Kurukshetra, Yamunanagar, Karnal, Kaithal, Panipat and Sonipat. This Zone forms nearly 32 percent of the total area of the State. Zone-II: it consists of 7 districts, namely Sirsa, Fatehabad, Hisar, Jind, Rohtak, Faridabad and Palwal. This Zone accounts for nearly 39 percent of the total area of the State. Zone- III: it consists of 6 districts, namely Bhiwani, Mahendergarh, Rewari, Jhajjar, Gurgaon and Mewat. It covers nearly 29 percent of the total area of the State. The area falling under Zone I and II are ideal for crop diversification with wheat, rice, pulses, cotton and sugarcane as well as for raising dairy cows, buffaloes and poultry. These Zones have better irrigation facilities and good overall infrastructure. However, kandi area in these zones have serious problem of soil and water erosion and hence they are suitable for agro- forestry and agro-horticulture systems. Zone III is having major area under pearl millet and rapeseed & mustard and is also suitable for arid-horticulture. Mewat area is more suitable for agro-forestry, sheep and goat rearing.
Haryana has an area covering just 1.3 per cent of the country. Haryana contributes nearly 3.5 per cent to India's GSDP. During 2004-15, the GSDP grew at a compound annual growth rate (CAGR) of 12.93 per cent. Haryana have the third highest per capita income in the Country at constant prices Rs. 71493. Haryana is considered as the current growth engine of India. About 70% of residents are engaged in agriculture. Haryana is at second position in food grain production in the country. Wheat and rice are the major crops. Haryana is self-sufficient in food production and the second largest contributor to India's central pool of food grains. The main crops of Haryana are Wheat, Rice, Sugarcane, Cotton, Oilseeds, Gram Gram Barley, Corn Millet etc.

The major Kharif crops of Haryana are rice, Jowar, bajra, maize, cotton, jute, sugarcane, sesame and groundnut. The major Rabi crops are Wheat, tobacco, gram, linseed, rapeseed and mustard. About 86% of the area is arable, and of that 96% is cultivated. About 94.4% of the area is irrigated through tube- wells and an extensive system of canals. Haryana contributed significantly to the Green Revolution that made the country self-sufficient in food production. Haryana has a tremendous irrigation infrastructure. Irrigation in Haryana uses water either from underground or from surface through canals. Currently in Haryana, the most important technology for groundwater irrigation is the use of tube-wells with pump. Besides farming, dairy farming is also essential part of the rural economy. Haryana has a livestock population of 98.97 lakh. Haryana, with 660 grams of availability of milk per capita per day, ranks at number two in the country as against the national average of 232 grams. There is a vast network of milk societies that support the dairy industry. The National Dairy Research Institute at Karnal, and the Central Institute for Research on Buffaloes at Hisar are instrumental in development of new breeds of cattle and propagation of these breeds through embryo transfer technology. The Murrah breed of buffalo from Haryana is world-famous for its milk production. There has been diversification of agriculture activities in the form of horticulture, fisheries etc. 95 percent in GDP of Agriculture and Allied Sector. The contribution of Forestry and Fishing Sub-Sectors in GDP of Agriculture and Allied activities is merely around 4 and 1 percent respectively resulting in very low impact of these two Sub-Sectors on the overall growth of Agriculture and Allied Sectors.

Performance of agriculture in Haryana

Agriculture experienced negative growth rate for three years in a span of 9 years while forestry, fishing has positive growth rates in general. Area under principal crops like wheat, paddy, sugarcane, cotton and oilseeds has increased manifold. The area under wheat rose by 233.3 percent, 516.14 percent for paddy, 248.63 percent for cotton, 159.4 percent for oilseeds while area reduced by 24.71 percent for sugarcane, (reasons can be price support policies etc.) and rose by 24.71 percent only for all food grains in a span of 50 years. The gross area sown rose only by 35.74 percent for the same period. The production of major crops has been on the rise since 1966-67(the inception year of Haryana and green revolution period). The production of wheat rose by 976 percent, rice by 1582 percent, total food grains by 526 percent, oilseeds by 989 percent, cotton by 551 percent, sugarcane by 65 percent only in a span of 50 years. In the pre-reforms decade, the CAGR of wheat (6.31%) and of total food grains (4.70%) was highest. After reforms, the CAGR of wheat and all food grains reduced to 4.51% and 3.35% respectively in the decade 1990-2000 and it fell further to 0.82% (wheat) and 1.45% (total food grains) during the decade 2000-2010. However, during 11th plan the CAGR of wheat was 5.10% and of all food grains was 3.73%. The average yield of wheat rose by 227 percent and of rice by 173 percent during 50 years. It has remained much higher than the national average yield. Examining the process of technological development in agriculture in Haryana, it is observed that the parameters like density of tractors, intensity of cropping, intensity of irrigation and use of fertilizers show a positive sign of development. These are the determinants of possible diversification of crops and allied activities in Haryana agriculture. The density of tractors rose from 1.04 in 1966-67 to 43.40 in the year 2013-14. The cropping intensity rose from 123.9 percent to 184.20 percent during 1966-67 to 2013-14. While the net irrigated area rose from 1293 thousand hectares in 1966-67 to 3102 thousands hectares and intensity of irrigation rose from 37.08 percent in 1966-67 to 88.43 percent in the year 2013-14. The consumption of fertilizers rose from 42 kg per hectares in 1966-67 to 225 kg per hectares in 2013-14, an increase of 435 percent in 50 years.

Table 1: State Per Capita Income (constant prices)

Year	Rupees
1966-67	608
2007-08	47046
2008-09	49780
2009-10	55044
2010-11	57797
2011-12	61716
2012-13 (P)	64052
2013-14 (Q)	67260
2014-15 (A)	71493

***Source*:** Economic Survey, Haryana 2014-15

Land use change

An emerging scenario After the Green Revolution there has been some extensification in Haryana state. The net sown area was recorded as approximately 78% in 1966–1967 and in excess of 81% in 1990-1991. Intensification has increased with a significant expansion in the area with more than one crop sown per year, during 30 years between 1950-1951 to 1980-1981, this increased from 11 to 42% and again to 53.6% in 1990–1991, this is mainly due to the improvements in irrigation and agricultural technology. As land use intensity has increased, the area of land under irrigation has also increased, from approximately 61% in 1984–1985 to 73% in 1990-1991. The total area under irrigation has increased from 1.29 × 106 ha in 1965–1966 to 2.66 × 106 ha in 1994-1995.

Impact of the Green Revolution on cropping systems

There has been a remarkable shift in India in the cropping patterns for both wet season and winter crops since the Green Revolution (Table 1). Rice (Oryza sativa) and wheat (Triticum) have replaced pulses, bajra (Pearl millet), jowar/sorghum (Syricum), as dominant food crops, while cotton (Gossypium spp.) is the key cash crop. The main wet season crops in 1965-1966 comprised bajra (46%), rice (13%) and sorghum (12%); however, in 1995-1996 rice (34%) was the major crop followed by bajra (27%) and cotton (24%). For winter crops wheat has increased in production as major crop from 43% in 1965–1966 to 64% in 1995-1996. In Haryana, the yields of rice and wheat have increased considerably (Table 2). Gurgaon district recorded highest compound growth rate of 5.22% for wheat crops during 1986-1995.

Table 2: Changing cropping pattern

Crops	1965-1966 (%)	1995-1996 (%)
Rainy season (Kharif)		
Bajra	46	27
Rice	13	34
Sorghum or jowar	12	5
Cotton	11	24
Sugarcane	8	6
Maize (Taino mahiz)	6	1
Pulses	3	3
Winter season (Rabi)		
Wheat	43	64
Chickpea (Cicer arietinum)	42	14
Barley (Hordeum vulgare)	7	2
Oilseeds	6	19
Pulses	2	1

***Source*:** Indian Council of Agricultural Research, 1998.

Table 3: Haryana: Percentage of Area under Different Crops to total Cropped Area in 2011-12.

Districts/Agra climatic zones	Rice	Wheat	Other Cereals	Total Cereals	Gram	Other Pulses	Total Pulses	Sugarcane	Cotton	Rapeseed & Mustard	Other Oilseeds	Total Oil seeds	Fruits & Vegetables	Residual crops
	Percent to Total Cropped Area													
Ambala	39.92	41.3	0.76	82.84	0.03	0.68	0.71	4.73	0.0	0.63	0.08	0.71	1.67	9.34
Panchkula	22.42	39.68	17.34	79.44	0.48	2.02	1.10	1.05	0.0	3.71	0.08	3.79	3.20	10.02
Yamunanagar	34.17	39.83	0.85	74.84	0.05	0.74	0.79	12.34	0.0	1.26	0.19	1.45	1.4	8.41
Kurukshctra	43.31	41.74	0.16	85.21	0.04	0.32	0.36	3.41	0.0	0.55	1.16	1.71	3.43	5.89
Kamal	43.65	44.35	0.34	88.34	0.03	0.25	0.28	2.83	0.0	0.26	0.02	0.28	1.24	7.04
Pani pat	39.95	45.33	0.26	85.54	0.00	0.38	0.38	3.44	0.0	0.47	0.00	0.47	1.78	8.36
Northern	40.24	42.73	0.98	83.95	0.04	0.49	033	4.83	0.0	0.68	0.29	0.97	2.05	7.67
Kaithal	41.75	45.43	1.71	88.89	0.03	0.04	0.07	0.70	2.0	0.21	0.01	0.22	0.40	7.73
Sonipat	30.41	49.21	6.58	86.20	0.00	0.69	0.69	2.49	0.3	0.81	0.00	0.81	2.13	7.34
Rohtak	16.76	44.91	18.35	80.03	0.36	2.20	1.17	3.34	4.1	5.90	0.01	5.92	0.82	3.26
Jhajjar	12.21	42.37	24.13	78.71	0.22	2.01	2.22	1.10	0.6	13.16	0.07	13.23	0.57	153
kid	24.12	45.62	6.78	76.52	0.03	0.10	0.13	0.59	11.1	0.97	0.02	0.99	0.39	8.92
Central	26.72	45.68	9.66	82.06	0.10	0.77	0.86	1.44	4.8	3.20	0.02	3.22	0.80	6.77
Faridabad	16.09	47.36	8.07	71.52	0.00	0.66	0.66	1.07	0.1	1.12	0.15	1.27	4.88	20.50
Pa lwal	16.54	50.73	8.70	75.97	0.00	0.59	0.59	1.19	0.3	1.73	0.03	1.76	0.42	19.79
Gurugram	4.39	44.79	31.42	80.61	0.00	0.55	0.55	0.03	0.1	11.79	0.30	12.09	2.04	4.62
Nuh	3.27	42.97	22.26	68.50	0.22	0.92	114	036	0.0	15.55	0.22	15.77	2.21	12.00
Rewari	139	24.98	32.42	58.80	0.02	0.54	0.56	0.00	0.6	3182	017	3199	0.62	5.44
Mahendragarh	0.00	15.30	37.49	52.79	3.09	0.19	3.27	0.00	0.8	33.51	0.05	33.56	0.19	9.38
Southern	5.49	33.77	25.94	65.20	0.90	0.52	1.43	0.36	0.4	20.06	0.13	20.19	1.16	11.26
Bhiwani	2.44	21.49	22.47	46.40	6.38	1.01	739	0.28	7.1	21.36	0.06	21.42	033	17.04
Hisar	6.79	36.09	7.66	50.54	2.04	1.69	3.73	0.17	22.1	10.03	0.13	10.16	0.83	12.44
Fatehabad	20.75	44.26	2.02	67.03	0.13	0.22	0.35	0.03	20.4	2.43	0.19	1.22	0.59	8.95
Si rsa	8.77	40.78	1.56	51.11	1.04	0.31	1.35	0.00	27.7	5.58	0.37	5.95	1.03	12.88
Western	8.44	34.56	9.28	52.28	2.70	0.85	3.35	0.13	15.2	10.78	0.19	10.96	0.70	17.21

***Source*:** Statistical Abstract of Haryana, 2010, 2011, 2012.

Environmental consequences of agricultural development

Increasing pressure of the population on the land dictates the need for potential utilisation of all available land. However, large parts of the land are degraded by desertification, soil salinity, waterlogging, floods, and droughts, due to inefficient agricultural practices, and deforestation has caused excessive soil erosion (Gill, 1992; Randhawa, 1992) [3, 7]. The increasing demand for food, fodder, fibre and fuel can only be met through bringing more of these degraded areas into cultivation and forestry. Sensing the gravity of the problem, the Government of India has set up a National Wastelands Development Board (NWDB) with the objective of bringing all the wastelands under productive use in the country through a massive programme of afforestation.

Based on national classification of the different types and categories of wastelands, two major types have been considered in this study: culturable wasteland, and non-culturable wasteland. Haryana has about 7.54% of land under these categories in total. The largest area comprises sandy stretches in Sirsa, Hissar and Bhiwani which encompasses 3.76% of culturable wasteland. Salt affected areas, mainly alkaline in nature, and waterlogged and marshy areas, comprise approximately 1.6 and 0.6% of culturable wasteland respectively. The main concentration of both the categories is found in Ambala, Karnal, Jind, Sonepat and Hissar. Wastelands related to undulating landforms are mainly found in Faridabad, Gurgaon, Mahendergarh, Bhiwani and Hissar comprise about 0.3% of land. Barren land has spread over Faridabad, Gurgaon and Mahendergarh covers about 1.4% of land.

Ground water use and declining water table

Approximately 95-98% of the area under rice-wheat is irrigated. Irrigation from ground water accounts for 60-65% of the total irrigation requirement and the remaining 35-40% is met through canals. This intensive exploitation has caused the ground water problems. While in many areas the ground water table is rising (as discussed earlier). Many districts in the rice–wheat growing area of Haryana show a water table decline in the range 3-10 m. These districts are Kurukshetra (10 m), Ambala (3 m), Yamunanagar (3 m), Kaithal (3 m), Karnal (5 m), Panipat (5 m). An integrated use of ground water and surface water resources should be the basis for future planned irrigation on which sustainable crop production depends.

Impact on ground water quality

The use of agro-chemicals in Haryana is the highest in India. Fertiliser consumption has increased from 3 to 130 kg ha^{-1} in the last 30 years. Fertiliser use for rice and wheat is 160 and 170 kg ha^{-1}, respectively. There is an imbalance in the N, P and K consumption ratio in rice–wheat crops. The use of K is also low in this region. There is a definite trend in accumulation of nitrates to toxic levels in the ground water.

Need for land and water conservation

The monitoring of land and water detects significant changes in the soil characteristics that directly or indirectly affect the quality of the land and its ability to produce the basic needs of food, fibre and timber. An integrated assessment of the status and risk of soil degradation will produce one of the essential data sets for national understanding (Singh, 1997) [9]. The objectives for producing a soil degradation map are to identify the dangers resulting from inappropriate land and soil management; to improve the capability in regional and national institutions; and to deliver accurate information for agricultural planning purposes. Other states and centre funded work includes reclamation of salt and alkaline affected lands, field channel and water channels (warabandi) construction work (Alexander, 1985) [2].

Soil reclamation and land levelling are prominent in the annual plan for Haryana. The Planning Commission has allocated funds for the development of culturable as well as non-culturable wasteland and various chemical inputs have been allocated for the land. Land Reclamation and Development Boards are engaged in this task and also provide subsidies for agricultural inputs in Haryana.

The districts of Hissar, Rohtak and Gurgaon have been largely reclaimed through different developmental programmes initiated by the Government of Haryana. The committee on Natural Resources, Planning Commission, New Delhi's study on wastelands, including saline, alkaline and waterlogged land and their reclamation measures has estimated that about 6000, 4000 and 2000 ha of land affected by salinity and alkalinity were reclaimed in the Hissar, Rohtak and Gurgaon districts, respectively. As general characteristics the alkali soils of Haryana have a high pH value of average 9.3, with a higher proportion of sodium bicarbonate in the upper 1 m depth and negligible infiltration rates. On an average depth of 1.5 m the soils have a calcic horizon, thus signifying the presence of pedogenic calcium carbonate. The task of desalinisation in such soil is quite formidable. The low percolation also leads to rapid waterlogging.

Various agencies are taking stock of the salinisation and various remedial measures are being planned to regenerate the wastelands. Studies are being carried out by the Ministries of Environment and Forest, Agriculture, the Planning Commission, National Commission on Agriculture, Ministry of Agriculture, Universities and various other agencies on wasteland development. There is an urgent need to create awareness among people for prudent use of land resources by implementing action-oriented projects and to reclaim wastelands. Policies can be formed to shift land use from traditional to modern technical use. An attempt should be made not only to increase production but also to sustain the increased production for wheat and rice without further degradation of our natural resources. The reclamation measures required to be taken up for restoration of physical health of soils and its productivity are outlined below.

Re-enrichment of inherent fertility and agroforestry

The re-enrichment of inherent fertility approach is based upon the regeneration of internal resources to sustain land productivity. This is to be achieved by growing different crops together, mixing or rotating with legumes, planting trees and shrubs, whose roots draw nutrients from deep layers to help translocation of the nutrients and water to the root zone thus increasing operative soil depths. Agroforestry may be evolved along with compatible livestock management both of land and water and integrated land and water development plan for various biomass production, regeneration of land resource base and increase in employment and income. Agroforestry develops on natural principles through crop–tree combination and integrated fertility management (Gordon and Bentley, 1992; Singh, 1999) [11].

Management of water resources

The extensive micro measures for conservation and augmentation of scarce moisture play the most critical role as well as being the best motivation to achieve participation from local people. The systems include in situ moisture conservation and a network of small water harvesting structures that promote recurrent recharge of the soil profile as well as ground water. Many governmental and non-governmental initiatives are being taken in this direction (Gill, 1992) [3]. These include narrowing down the gap between supply and demand for water resources; recharging of ground water reservoirs in areas with declining water table; recharging of excess water through the existing drainage channels by putting bunds at appropriate places; recharging by diverting run-off from adjoining wasteland area; recharging through empty/injection wells; recharging by diverting excess canal water during the rainy season to paddy fields; watershed development and massive reforestation of hilly areas; installation of skimming wells to tap good quality water; installation of deep tube wells along with rivers to enhance the irrigation supply; revision of water allowance, capacity factors and rotational system of irrigation keeping in view the shifting of cropping system; efficient on-farm water management including adoption of optimum irrigation schedule of crops; encouraging low water consumption crops in place of paddy, particularly, in light textured soils (crops such as soybean, cotton, maize,

barley and oats). All these measures have great potentials with regard to conjunctive use of poor quality ground water and canal water.

The soil conservation planning of the area should be on macro-watershed basis rather than micro-watershed basis. Thus, physical planning of watersheds, the socio-economic details would come from target group village/community (Singh, 1998) [10].

Conclusions

The Indian agriculture has shown impressive growth (3% per annum) during the past five years, but this must be accelerated to achieve the target of 4 per cent per annum. The agricultural growth across the states has been diverged. On the positive side, many states have progressed well (compared with the national average), but a few states still in the slow growth stage. The study has revealed that small and marginal farmers are more efficient in getting yield per unit of land compared to medium and large farmers. However, these farmers have not realised adequate income. The pattern of input use and access to input in terms of hired labour, machine and irrigation hours have been found to add more cost and reduce net returns to both marginal and small farmers.

There are variations in the cropping pattern in agro climatic zones of the state. In northern agro climatic zone it is observed that due to irrigation facilities, fertile soil and well developed agricultural infrastructure, the share of area under rice, wheat and sugarcane is more than the other crops of the zone. The share of rice, wheat and sugarcane in total cropped area of northern agro climatic zone is more than the share of area of these crops in other agro climatic zones of the state.

Area under oilseeds and pulses has declined in the state and also in all the agro climatic zones of the state. The share of area under oilseeds has declined because of the increase in the area under wheat due to spread of irrigation facilities. In the same way, the area under pulses has declined. The area under sugarcane in kharif season has declined in all the agro climatic zones of state except the western agro climatic zone, due to development of irrigation facilities in the zone during the period 1991-92 to 2011-12. After the analysis, a major shift is identified in cropping pattern in favour of wheat and rice, which happened due to the development of irrigation, agricultural infrastructure, mechanization of agriculture etc.

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