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Impact On Agricultural Mechanism And Agricultural Growth

Renju. R .K
MBA, Department of Management Studies
Bharath Institute of Science and Technology,
Selaiyur, Chennai, Tamil Nadu 600 073
Bharath Institute of Higher Education and Research

Abstract
The country have made remarkable progress in the adoption of modern methods of cultivation and creating infrastructure for effectively and sustainably utilizing the national resources available at its command. It had transformed its image from that of a **'begging bowl' to bread basket** due to the efforts of various agencies combined with scientific and engineering inputs in agriculture. Indian agriculture is evolving into a mature and modern enterprise over the last five decades. Farm mechanization had reached a level of maturity pushing the net sales of machinery to over Rs 50,000 crores, almost entirely through indigenous efforts. Farm mechanization programmes have pursued in the country after attaining independence was directed towards optimal utilization of available farm power sources. The impact of tractorization are against oxidization is evident from the fact that India is the largest producer of tractors in the world. Increase the percent of cropping intensity, timeliness of operations and reduction in drudgery have been shown to be the essential incentives for farmers and farm workers to adopt modern methods of cultivation. An increase of 15 per cent in productivity had a reduction of 20 per cent in the cost of cultivation could be achieved by engineering interventions. These interventions are been limited to a few field crops, farm operations and post-harvest activities. The Country with extensive research and development system for an farm machinery design and development for production agriculture, post-harvest, and utilization of renewable sources with energy covering various zones and agro-climatic regions. Extensive facilities are the testing of farm equipment and machinery including different kinds of prime movers are also a part of the agricultural equipment development network in the country which meets not only the national requirements but is also available for neighboring countries.

Indian Agriculture – An Introduction

Agriculture is been the backbone of the Indian economy and will be continue to remain for a long time. It supports almost 17 per cent of the world population from 2.3 per cent of the world geographical area and 4.2 per cent of the world's water resources. The economic reforms, which have been initiated in the country in the early 1990s, had brought the economy on a higher growth trajectory. Annual growth rate of GDP has accelerated from below 6 percent the initial periods of the of reforms regime to more than 8 percent in recent years. This has emerged mainly due to rapid growth in non-agriculture sector. The workforce engaged in agrarian productivity during 1980-81 and 2006-07 witnessed a very small decline; from 60.5 percent to 52 percent. The existing cropping intensity of 137 per cent had registered an increase of only 26 per cent since 1950-51.

The net sown area is about 142 Mha. The net irrigated area was about 58.87 Mha in 2004-05. Now, the total net irrigated area covers about 45.5 per cent of the net sown area, the remaining 54.5 per cent is rain fed land. The degradation of the land and as well as the ground water resources results in the fast deterioration of soil fertility. Losses aroused by the biotic (insect-pests, diseases, weeds) and abiotic (drought, salinity, heat, cold, etc.) stresses account for about an one-fourth of the value

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of the agricultural productivity. The storage, transportation, processing, value addition and marketing of farm produce have to be improved to enhance household food, nutrition and livelihood security. Indian pattern of agriculture is characterized by agro-ecological similarity and diversities in soil, rainfall, temperature, and cropping system. Simultaneously favorable solar energy, what the country receives is about 3 trillion m3 of rainwater, 14 major, 44 medium and 55 minor rivers share about 83 per cent of the drainage basin. Irrigation water is turning up as a scarce commodity. Thus proper harvesting and efficient utilization of water is of greater importance. Intensive cultivation has a result of by introducing of high yielding varieties in the mid 1960's required higher energy inputs and better managerial practices.

Land preparation, land harvesting, land threshing and irrigation are the operations, which utilize most of the energy in agricultural productivity. The share of animate power in agriculture sector has decreased from 92 per cent in 1950-51 to 20 per cent in 2000-01. The desired cropping intensity with timeliness in field operations, animate energy sources alone were no longer adequate in cultivation. Farmers have opted for technical sources to supplement animate power. Average size of a farm holding gradually reduces from 2.58 ha to 1.57 ha (Table 1). Small and marginal farmers have a limited resource and especially in the rain-fed regions where only animate power is used causing with low productivity. Though agricultural production is high, per hectare productivity is much lower than world average. There is an urge to increase the agricultural productivity.

Table-1
Number and Area of Operational Holdings by type of Holdings

	Number, '000			**Area,'000ha**		
Major size classes	**1981**	**1990-91**	**2000-01**	**1981**	**1990-91**	**2000-01**
marginal <1ha	50,122 (56.4)	63.389 (59.4)	76,122 (63.0)	19,735 (12.0)	24,894 (15.0)	30,088 (18.82)
small 1-2ha	16,072 (18.1)	20,092 (18.8)	22,814 (18.9)	23,169 (14.2)	28,827 (17.4)	32,260 (20.18)
semi medium 2-4ha	12,455 (14.0)	13,923 (13.1)	14,087 (11.7)	34,645 (21.2)	38,375 (23.2)	38,305 (23.96)
medium 4-10ha	8,068 (9.1)	7,580 (7.1)	6,658 (5.4)	48,470 (29.6)	44,752 (27.1)	38,125 (23.84)
large >10ha	2,166 (2.4)	1,654 (1.6)	1,230 (1.02)	37,705 (23.0)	28,659 (17.3)	21,124 (13.21)
all size classes	88,883 (100)	1,06,637 (100)	1,20,822 (100)	1,63,724 (100)	1,65,507 (100)	1,59,903 (100)

Note: Figure within parentheses indicate per cent contribution
Source: Agricultural survey of India report 2010

Smaller the size of farm, greater is the need and importance of marketable surplus, so that small farmers can have a reasonable income in their pockets. Achieving this goal for a farmer will be possible only if the country develops and disseminate eco-technologies rooted in the principles of ecology, economics, and gender equity and employment generation. The pathway towards the "ever-green revolution" in agriculture is estimated food requirement in India and total production of major crops will indicate that to keep pace with the present population growth and consumption pattern, food grain requirement has been estimated to be 240 MT by 2020 and 300 MT by 2025.

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Annual agricultural growth should be maintained at least not below 6.7 per cent to meet these demand projections. Non-availability of manpower during peak crop season have a multiple times and kinds of problems. The overall achievement in the utilization of the irrigation facilities has been relatively found better in India with 63 per cent growth rate as compared to the world average. It is an essential act to increase the utilization of rainwater to enhance the gross cropped area by 30 Mha as the yield of food grain in irrigated areas as almost with twice that in found in rain-fed agriculture. Per capita availability of food grains had found to decline from 510 g per day in 1990 to 436 g in 2003 and this trend must be arrested. The infrastructure for agricultural diversification and the reduction of the post harvest losses of perishables, value addition to agro-produce and the branding system must be strengthened.

Agricultural Production and Productivity

The country starves to find way and means to keep its burgeoning population adequately fed. In the one end the problem of declining productivity is found and on the other end, the challenges posed by liberalization. In such a scenario, leveraging the available natural resources and existing infrastructure is the only way to make the ends meet to reach the saturation level. Management of the already built infrastructure in harmony with natural systems is the calorie on the call. Knowledge of the use of existing infrastructural and natural resources is one of the most primary pre-requisites to utilize them in an effective and sustainable manner.

The discipline of agricultural engineering endeavours must develop technologies for enhancing agricultural productivity and curbing the cost of cultivation. Traditionally animate power was used in for field operations and in processing activities. As a impact of introducing of mechanical power, agricultural engineering activities have expanded considerably. To sustain the project population of 1.363 billion by 2025 the productivity has to be drastically increased by 100 per cent from the present level by intensification of agriculture. It is estimated that the energy input to agriculture would have to be increased form the present level of 1.3 to 2.4kW/ha.

The constraints of lower productivity in agricultural produce were realized and thus, central and state governments were emphasized the need for accelerated development in agriculture. Adoption of high yielding varieties by cultivators coupled with the use of higher doses of fertilizer and assured irrigation through tube wells accelerated the pace of progress in agriculture. As a result in the adoption of improved inputs and management practices, the total food grain production increases from a mere 50.8 million tonnes in 1950-51, to 212 million tonnes in 2006-07 and productivity increases from 522 kg/ha to more than 1707 kg/ha (Table 2).

Table-2

Production and Productivity in Agriculture

Crop		2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
All food grains	Area	121.05	122.78	113.86	123.45	120.00	121.60	124.07
	production	196.81	212.85	174.77	213.19	198.36	208.60	211.78
	yield	1626	1734	1535	1727	1652	1715	1707
Rice	Production	84.98	93.34	71.82	88.53	83.13	91.79	91.05
	yield	1901	2079	1744	2077	1984	2102	2084
Wheat	Production	69.68	72.77	65.76	72.16	68.64	69.35	73.70
	yield	2708	2762	2610	2713	2602	2619	2617
Oilseeds	Production	18.44	20.66	14.84	25.29	26.10	27.98	23.26
	yield	810	913	691	1067	967	1004	895
Sugarcane	Production	295.96	297.21	287.38	237.31	232.32	281.17	322.94
	yield	68577	67370	63576	58986	63806	66828	66833
Pulses	Production	11.08	13.37	11.13	14.91	13.13	13.39	14.11
	yield	544	607	543	635	577	598	594

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Course cereals	Production yield	31.08 1027	33.38 1131	26.07 966	37.06 1221	33.47 1153	34.07 1172	32.92 1158
Milk MT	Production yield	80.60	84.40	86.20	88.1	92.6	97.1	100.9
Fish	Production yield	5.66	5.96	6.20	6.40	6.30	6.57	6.87
Irrigated area, Mha		75.95	78.81	75.87	77.94	78.00	80.00	82.63
Fertilizer consumption MT		13.88	17.36	16.09	16.80	18.34	20.34	21.65
Per capita availability of food grains (gms/day)		495.50	416.20	494.10	437.6	462.7	422.4	445.3

Source: Agricultural survey of India report 2010

The production of wheat, rice and oilseeds had increased to an greater extent than with other crops. The increase in the production of food grain was possible due to the result of adopting quality seeds, higher dose of fertilizer and plant protection chemicals, coupled with assured irrigation. The growth in the production of fruits (46 million tonnes), vegetables (91 million tonnes), milk (81 million tonnes), and fish (57 million tonnes) have also increased. As a result, not only the country has achieved self-sufficiency in foods but have adequate agro-produce for export. Our agriculture is now at the crossroads (Table 3).

Table-3

Global Ranking of India in Farm Production and Productivity

Crop	Production rank	Productivity rank
Paddy	2nd	30th
Wheat	2nd	22nd
Maize	7th	35th
Total cereals	3rd	36th
Groundnuts	2nd	40th
Rapeseeds	3rd	28th
Pulses	1st	44th
Potato	4th	26th
Fruits	2nd	---
Vegetables	2nd	---

Source: Agricultural survey of India report 2010

The uses of certified and quality seeds by the cultivators have increased to 700,000 tonnes. The consumption of fertilizers have increased to 21.65 million tonnes (more than 112.69 kg/ha) in 2006-07 from 0.29 million tonnes in 1960-61. It increased at an annual growth of 11.7 per cent. The use of technical graded plant protective chemicals has also increased to 56.11 thousand tonnes (0.4 kg/ha) from a meager of 8.62 thousand tonnes in 1960-61. Crop and site specific agricultural mechanization and agro-based small and medium enterprises in the rural sector using a fine blend of conventional and renewable energy sources will facilitate in enhancing agricultural productivity and profitability resulting in the higher income for farmers and the better quality of life

Network for Agricultural Machinery Design and Development

In the early Indian farm machinery development was greatly dominated by technological development in England. Horse drawn and steamer form tractors operated equipments were imported during the latter years of the 19th century. In the 1880's, Watts and Kaisar ploughs, corn grinders and chaff cutters were introduced at Cawnpore (now Kanpur) Experimental Farm in Uttar Pradesh. Sardar Joginder Singh (1897- 1946) introduced steamer form tractors in India in 1914. He was Agriculture Minister in the Punjab Government during 1926-37. The horse drawn equipment

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imported from England was not suitable for bullocks and buffaloes being used in India. Those were preferably modified so as to suit the Indian draught animals and as a result mould, board plough, disc-harrow, and cultivator were introduced in India.

The establishments of Allahabad Agricultural Institute, Allahabad, initiated the developmental activities in agricultural machinery acceleration. Meston, Shabash and Wah-Wah ploughs were introduced in Uttar Pradesh, manufactured by the Agricultural Development Society, in the early forties. The development of spike tooth thresher introduced at this Institute in 1960s revolutionized wheat threshing technology in India. Agricultural machines were largely fabricated by the village craftsmen and small scale industries. Tractors, engines, milling, dairying equipment and oil mills were manufactured by organized sectors. Small-scale industries seldom have R&D facilities and they depend upon public institutions for technological support. They found to be required not only drawings but also prototypes and technical guidance in manufacture of the equipment. These industries however, upgraded their technology along with experience.

The Indian Council of Agricultural Research (ICAR) along with the co-operation of Agricultural Universities and industries developed at simple and low cost hand tools and animal drawn region specific improved machinery to suit local cultural practices. The ICAR also established the Central Institute of Agricultural Engineering at Bhopal to address the issues and concerns related to the agricultural engineering. The CIAE provided the leadership and coordinated the researches through a network of research centers established all over the country for developing commodity and location specific technologies**.** The CIAE also created facilities for manufacture of commercial grade prototypes. The ICAR for the first time sponsored and introduced various schemes to conduct a state-wide survey of existing tools and implements used by the farmers in 1954.

The results were published in the form of a book entitled "Indigenous Agricultural Implements of India" in 1960. During the sixties, ICAR made serious efforts in the promotion of research and development on improved farming implements by establishing 17 Research Training and Testing Centers (RTTCs), one in each of the major states, which were operated and controlled by the State Department of Agriculture.

The major concerns of these RTTCs were to test and modify the existing implements and to develop a new improved implement for a suitable at different agro-climatic conditions of the country. During the latter part of the sixties (IV Five Year Plan Period) two Zonal Research and Testing Centers, one at IARI, New Delhi and the other at TNAU, Coimbatore and four research centers at Ludhiana, Pune, Hyderabad and Mandi were established. In 1971-72, ICAR sponsored the All India Coordinated Research Projects (AICRP) on Research & Development of Farm Implements & Machinery, Production of Prototype and their evaluation under different agro-climatic conditions. With the establishment of CIAE, the scheme was shifted to Bhopal in 1977. The research in the area of farm machinery further strengthened with the creation of other AICRPs on Power Tiller (1980), Utilization of Animal Energy (199)Human Engineering and Safety in Agriculture (1994) and a NRC on Reducing Drudgery of Women in Agriculture (1994). The AICRPs undertake research and development keeping regional needs of the farmers and conduct front line demonstration for pilot introduction.

Training and Testing Activities for Tractors and Farm Machinery

The Ministry of Agriculture, Government of India has four Farm Machinery Training and Testing Institutes one each in North, South, North-East and Central India. The Central Farm Machinery Training and Testing Institute, Budni is a premier Institute functioning since 1955. The other sister institutes are located in Hisar (Haryana), Anantpur (Andhra Pradesh) and Biswanath Charially (Assam). The main objectives of the training institutes are to give training in agricultural

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machinery and promotion of farm mechanization and testing of tractors and agricultural machinery. Institutes organize and offer training on working principle, operation, adjustment, service, maintenance, repair, selection and management of tractors and farm machinery for progressive cultivators, technicians, engineers, in-service personnel, defense personnel, foreign nationals and women in cultivators.

The Institutes are being designated at one of the agencies for testing the tractors and allied agricultural machineries and as to their conformity to the Central Motor Vehicle Rules, 1989, as amended from time to time and issuance of the certificates to that effect. Commercial and confidential tests are carried out by the Institutes for the purpose of establishing performance characteristics of machines that are in ready for commercial production and confidential tests are carried out for providing information to the manufacturers on the performance of their machines and any other related data that may be required.

The objective of the Batch Testing by agricultural tractors is to ensure continuous up gradation in the quality of the tractors that are being manufactured in the country. These tests are organized in a regular interval period of three years. The test reports under batch testing programme are published in two parts. The first part contains results of laboratory and field tests by the Institute and the same is released as the Commercial Test Report. The second part, which contains data's based on the user's survey, which is published as the Confidential Report so as to provide feedback to the manufacturers for their betterment.

Concerns for Agricultural Mechanization in India

Agricultural activities remain to be the major occupation of the people of India and it is endowed with varied agro-climatic conditions, which offers immense scope for the cultivation of various kinds of agriculture and horticulture crops. India needs reforms for to reach the growth path in agriculture and horticulture. Indian agrarian society has unparalleled and intellectual potential but timely efforts are needed to evolve a strategy, which supports the dissemination of the technology to needy farmers.

The onus is on the researchers and policy makers to stabilize and maintain a holistic kind of approach to farm mechanization and agriculture productivity and in rather than looking at them being isolated. Diverse farm mechanization scenario in country is due to size of farm holdings and socio-economic population. Hand tools and animal-drawn implements are extensively used which involve drudgery. Presently, the contribution off animate power to total farm power has been reduced to only about 19 per cent and from rest of the sources such as tractors, power tillers, electric motors and diesel engines; it has increased to 81 per cent.

No doubt there have been spectacular and drastic advancements in almost all sectors of agriculture, which have propelled the country from a food deficit to self-sufficient and in some commodities, a surplus nation. India is a large country with diverse agro-ecological differences having predominance of rain fed agriculture, as irrigated agriculture is limited to 40 per cent of the country. Farm holdings are small in possession which is due to higher population density and land fragmentation which will continue in part due to 'Laws of Inheritance' and the 'Hindu Succession Act'. The majority of the farmers have limited surplus money for modernize farms or invest in improved inputs. Draught animals and increased agricultural labnourers may remain as the chief source of farm power for soil tillage and for handling crops. Mechanical power for tillage, irrigation, harvesting and threshing will be preferred including custom hiring by those farmers who cannot afford to own machines.

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Major constraints in modernizing Indian agriculture are low productivity, high cost of production, slow diversification in agricultural exports, export of raw materials and low value added products, difficulties of meeting quality standards; lack of appropriate infrastructural facilities in the production catchments, supply routes and ports, inadequate transport and marketing facilities, inadequacies of market intelligence and trained manpower, technological deficiencies - failure to harness latest technologies at scales compatible to small scale decentralized resource and management constraint situation, poor quality and costly packing materials, weak networking and reluctance of the processors to share profits of value addition with the producers, global trade blocks and their compulsions to meet shortfalls from member states, emergence of strong competitors and global politics etc.

Conclusions

The country have made remarkable progress in the adoption of modern methods of cultivation and creating infrastructure for effectively and sustainably utilizing the national resources available at its command. It had transformed its image from that of a **'begging bowl' to bread basket** due to the efforts of various agencies combined with scientific and engineering inputs in agriculture. Indian agriculture is evolvin into a mature and modern enterprise over the last five decades. Farm mechanization had reached a level of maturity pushing the net sales of machinery to over Rs 50,000 crores, almost entirely through indigenous efforts. Farm mechanization programmes have pursued in the country after attaining independence were directed towards optimal utilization of available farm power sources.

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