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RECENT DEVELOPMENTS IN INDIAN AGRICULTURE AND GLOBAL SCENARIO

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Abstract

Agricultural development is an essential requirement for economic development of any country. It offers support to farmers or crop growers by supplying them with a variety of agricultural support. The provision of protection, assistance in the field of science, the use of advanced techniques, the control of pests and the facilitation of diversity all come into the category of agricultural production. Development in the field of agriculture is indispensable to fulfill the demand of food of world population especially non agriculture workers who solely depend on farmers for their livelihood. It also provides raw material for the industries and earn foreign currency through the trade of agriculture product. In colonial rule, there was neither equity nor development in the agricultural division. The policy and rulers of independent India resolved these problems through land reform and the advancement of the use of 'High Yielding Variety' (HYV) seeds that led to the revolution in Indian agriculture. Participation of Government agencies and private players in the agriculture research and development boost the output of agriculture production.

Key words: : Agriculture, Institution, Productivity, Research and Development, Technology.

ABBREVIATIONS: Full-time equivalent (FTE), State agricultural universities (SAUs), Krishi Vigyan Kendras (KVK), Indian Council for Agricultural Research (ICAR), Intellectual Property Rights (IPR)

Introduction

Agricultural development is crucial for sustained and balanced growth of any country. Especially in a country like India where the major population relies on agricultural for their sustenance and livelihoods. At the time of Indian Independence, the agricultural productivity was extremely low per hectare/worker. However, since 1950-51, the economic planning completely changed the previous trend of low agriculture yield and resulted in special development in agriculture, particularly after year 1962. According to the 2011 census, almost 60 per cent of Indian labour force is engaged in agriculture. Much of the land holdings are tiny. Around 82% were classified as small scale land holdings in year 2006 and farm size was limited to less than 2% for more than 40% of agriculture land which affects agriculture production and hampered its growth because of its scattered nature. Many development efforts have been made since Indian Independence to resolve the agriculture related issues[1]. As a result of Green Revolution, India improved in the field of agriculture remarkably, especially in sense of productivity, availability, food security which helped in poverty reduction [2]. However, the agriculture industry also faces critical hurdles. The agricultural growth output tends to lie below 4%, in the present time also, the hunger induced malnutrition remained at many places. Strong empirical evidence shows that Indian agricultural sector has been benefited substantially from the government plans, spending in research [3]. Other evidences shows the promising growth in agriculture based research and development than other public investments [2].

In high-income countries like United States, France, the policymakers have continued to invest a comparatively high proportion of overall public research and development budget in agriculture. This may be because of technical advancement, such as availability of new plants variety which may be often costly, complex to produce but relatively easier to distribute. Thus it is difficult for innovator to reap benefits of its efforts. Another explanation is that lands are usually too small to perform own study. And today's big farms are still local enterprises. Further, agricultural growing environments are extremely complex, so agricultural technology must respond to various local needs[4].

The latest indicator reveals that countries like India, China, Brazil have comparable amounts of research and development (R&D) comparable with United States. The research and development strength deficit estimated by a survey shows that many developed countries will be in need to spend $7.1 billion more than the $21.4 billion, spent on an average during 2008–2011, thus need an expansion of 33% of overall real investment[5].

Byerlee and Pal [6] has pointed out, that the emphasis of research in India has broadened with more distinctive trait in agriculture. The Indian agriculture research has also integrated topics such as proper utilization of natural resources, nutritional welfare, sustainable development and poverty reduction.

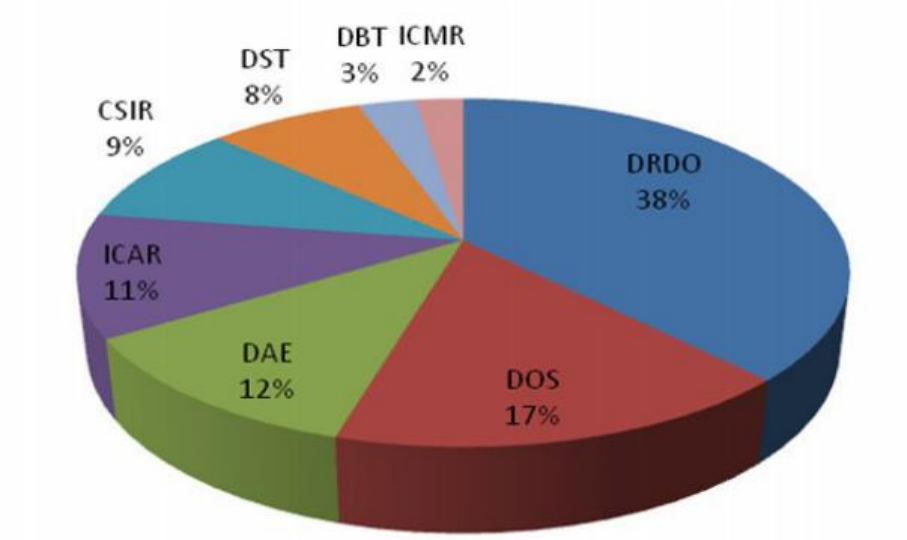

Figure 1: Illustrates the R&D expenditure through the selection of multiple scientific agencies (In the year of 2014-2015) [Department of Science and Technology, Government of India, Jan 2018].

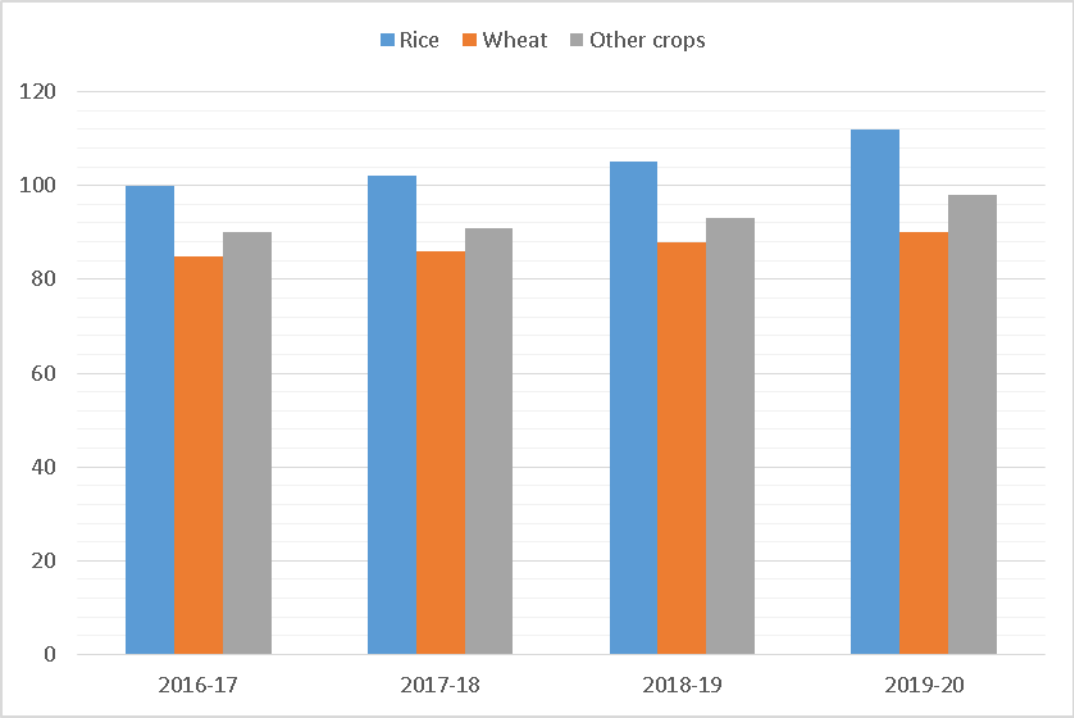

Figure 2: Illustrates the production of multiple crops in India.

Despite the increasing trend of government support for agricultural research and development, more money would be required to satisfy needs of overgrowing population. The Indian agriculture sector is growing very

rapidly due to the technological advancements and multiple government schemes launched in last decade. There is a great scope in agriculture sector now a days in order to explore pragmatic opportunities in comparison to the old times. Many young entrepreneurs are working in agriculture sector in order to resolve the existing issues that have been encountered by numerous researchers during last decade. There has been done ample enhancements that were required in order to improve various things such as the production of the crops and to minimize the crops diseases and certain other critical factors that affects the growth and overall production of the crops. Figure 1 shows the research and development (R&D) expenditure through the selection of multiple scientific agencies (In the year of 2014-2015). Figure 2 shows the production of multiple crops in India.

Methodology

2.1. Method:

This work involves the careful examination of several policies and strategies involved to boost up the agriculture sector in many of the world countries. This study has mainly focused on Indian players and the condition in agriculture sector. There has been done pragmatic enhancements in the agriculture sector during last decade in India, but there is a huge demand in order to investigate the current issues and challenges to resolve existing problems related to the production of the food products and to reduce the chances of the disease that affects multifarious crops in various Indian states. This investigation was conducted on the basis of facts and the collection of the information form the government official websites as well as from various database. This investigation clearly provides the ample amount of information about the India agriculture management in order to increase the overall production of the crops and to aware the people for the latest trends in this sector.

2.2. Analysis:

2.2.1. Investment, Capacity and Institutional Involvement:

India has a well-developed and interlinked research objective like many other countries. Indian agriculture has its traces since centuries though the major extension in agriculture program happened after achieving the independence in 1947. In the liberal atmosphere, the Indian government focused towards the poverty and misery of their people and created excellent funding mechanism for the development of Science and Technology (S & T). It generated research centers throughout the country as focused learning institutions with highly qualified people. Indian government generated two tier research scheme in agriculture.

First level is Federal, which controls a large number of research institutions under Indian Council for Agricultural Research (ICAR). ICAR has played the leading role in fostering the agriculture. It was established before Indian independence in 1929, but renamed after 1947 and all the federal agricultural based research institutes had been kept in its scrutiny. ICAR manages all its related institutions, agencies, their research focus planning and imparts the related education. ICAR covers a wide variety of work in field of natural resources, livestock, horticulture and many other. In the decade of 1990, ICAR spent the double equivalent of its annual growth which was around 7%. Moreover, in 2009 this inflow increased upto 17.9 billion INR.

Present Indian agriculture faces many problems which is not only limited to financing but also incorporates other challenges like climate change, pests, greenhouse effect and others. To address these issues, ICAR devises the model to promote innovations, combat with pests/weeds, strengthen intuitional capacity, to deal with climate change and other collaborative work across the world. To some degree, required research links have already been developed and presently they are in existence. India has emerged as a host for organizing projects to unite many public institutions with private enterprises and foreign organisations. ICAR oversees all these coordinated research projects around India.

Apart from the scientific, collaborative and educational functions, ICAR also funds a network of institutions such as Krishi Vigyan Kendras (KVK) founded at Puducherry in 1974. In 2009, ICAR dedicated its 10% budget to KVKs which has risen considerably in recent years. Krishi Kalyan Abhiyan focuses on boosting agriculture and related practices in these aspiring districts. Krishi Kalyan Abhiyaan was undertaken for all those districts where number of villages were less than 25 and the population was more than 1000, in the consultation with Ministry of Rural Development as per directions of NITI Aayog. This work is being implemented with proper

co-ordination among 25 villages of a district and supervised by Krishi Vigyan Kendra. Various programs to encourage best practices and increase agricultural profits have been pursued such as: distribution of Soil Health Cards to the farmers; 100 % combat with Foot and Mouth Disease (FMD), bovine vaccination in each village, 100 % look afetr of Sheep and Goat plague, distribution of horticulture/agroforestry/bamboo plant at the rate of Rs. 5 per family (location appropriate), artificial insemination saturation, micro-irrigation demonstration programmes, integrated Cropping practice demonstrations.

This KVK scheme funded by Government of India, ICAR institutes, also by other agricultural universities, agriculture based non-governmental organizations (NGOs). KVK scheme is an important part under National Agricultural Research System (NARS) which aims to evaluate the modules in agriculture, technology evaluation with help of allied enterprises, refining and presentation by location based specific technology. KVKs is operating as Knowledge and Resource Center for Agricultural based technology, promoting public participation, private and voluntary projects to improve the district's agricultural economy, also connects NARS to the extension system and farmers.

KVK performs on farm testing and access the new agricultural technology *in situ*, capacity development to the farmers, demonstration of production potential of new varieties, update their knowledge, skill development for modern agriculture technologies, works as a frontline helper to support as knowledge and resource center, motivate public/private/voluntary sector to improve agriculture economy in the district, works as agriculture managers, provides advisories and handles media based knowledge spread on various subjects in farmer's interest.

KVK produces quality products such as seeds, bio agents, starters, planting materials, livestock and made it available to the public. KVK organizes frontline activities in extension of technologies, identifies and incorporate the farm innovations and implements the beneficial schemes [7].

The second level is the provincial level which consists of State Agricultural Universities (SAUs) which mandates the research in the state. According to a survey, India spends 0.40 per cent of agricultural Gross Domestic Product (GDP) on agricultural research related development, while Brazil spends a lot more. There is not much private investment in agriculture based research and development. However China get much financial capital for research through private investment [8]. In comparison to the steady positive trend in agricultural research and development spending, the number shows that full-time equivalent (FTE) researchers reflected a marginally negative shift in the years of 1996 to 2009 .While the number of FTE researchers increased in late 1990s, which further decreased up to 17 percent, in 2009 [9]. In 2009, only 11,216 Full time equivalent researchers FTE researchers were involved in research work in India, compared with 13,575 in 2000. There are 63 SAUs, 3 Central Agriculture University and 4 Deemed University recognized by IARI in India, in 2021 [10]. The SAUs are obligated to conduct state-specific study and education.

Other Indian government agencies and educational institutions are engaged in agricultural research development, although their overall contribution is limited yet. These departments account 9% of overall agricultural research and development capacity in year 2009. Fourteen institutes of Indian Council for Forestry Research and Education are the most critical of these departments. These institutions conduct forestry studies related to climate change, ecology, desertification and environmental maintenance. The non SAU higher education institutions accounted for 2% of agricultural research and development capacity in 2009. There are many non-agricultural colleges with amateur agricultural faculties. Private sector has also shown interest in agricultural research and development which is basically dominated by companies engaged in farm related machinery, plant conservation, genetics, animal husbandry, microbiology and biotechnology. Their position in Indian agricultural research and development has begun to grow as small and medium enterprises which gradually diversify into science. This development has been further stimulated with participation of major international and national corporations. Start from the middle of the 1990s, private sector agricultural research and development investment has risen five-fold [11].

Poor investment in agricultural science is one of the key causes for low productivity in India. Indian Economic Survey mentioned that agricultural research and development is the key factor for any innovation and required

to support long-term growth in agricultural productivity. The survey mention that real budget of the Department of Agricultural Research and Education/Indian Council for Agricultural Research (ICAR) rose from 5.393 crore to 6800 crore INR during year 2010-2018. Over the years, the compound annual growth rate of spending has been 4.2% with the higher expenditure in recent years. Rs 4,599 crore is allotted to ICAR for the year 2018-19. This is 0.6% higher than the initial forecast of 2017-18. In 2017-18, the allocation under ICAR rose from the real spending under Rs 319 crore in 2016-17. This is attributable to the consolidation of wages, allowances and office expenses of all ICAR schemes. In the last decade, India's Gross Domestic Expenditure on research and development (GERD) has tripled to Rs 85,326 crores (2014-15) from Rs 24,117 crores (2004-2005). India could also increase its research and development spending to meet its goal of doubling of farm incomes by 2022, increase research and development spending and encourage private investment. [12].

By connecting the ICAR institutes with SAUs, there is more focused growth with special attention on important national commodities services and organisms. AICRPs have played an active role in mobilizing India's scarce capital through proper channelization with cooperation between institutions with interdisciplinary cooperation through joint assessment of emerging techniques. It has also increased scientific base of SAUs. The Indian Government's in its Twelfth Five-Year plan has targeted an agricultural research and development with 1% intensity ratio of Ag GDP. To achieve this goal requires more attention. India will accomplish this aim if state governments are able to raise their respective contributions and research institutes can increase their funding sources. In short, it demands the need of increased resources for agricultural research and development, especially in the north-eastern countries who cope with lower funding intensity and insufficient research capability. An effective competitive structure for fund generation is currently under discussion that will allow the research system to solve emerging problems while encouraging partnerships between institutions. This will be supported by the allocation of more funds by ICAR to major commissioned programs in priority areas such as genomics, water recycling, diagnostics and vaccinations, field mechanization and post-harvest management. These alliances will include many institutions under and outside the ICAR and SAU.

To achieve the rise in private sector participation and building synergies, there also should be lead efforts. Private-sector mainly focuses on highly paying crops oriented agricultural research and development such as seed, farm equipment, animal wellbeing, plants variety and agro-processing which can generate high revenue. Thus in one sense, private sector is bringing greater flexibility and capability to India's agricultural research and development scheme. In order to promote private-sector investment in the production of agricultural technology, the Intellectual Property (IP) laws regime has been changed in India as per international consensus like Trade related aspects of Intellectual property (TRIPs). ICAR has also developed guidelines for IPR with the aim of stimulating creativity through the sharing of research benefits with innovators. These recommendations would be helpful in promoting collaborations with private sector, in order to commercialize and expand the innovations established in the public sector. Further, to enhance corporate governance, ICAR and SAUs have adopted enhanced target evaluation and reporting processes in recent years.

This also resulted in improved analysis targeting the well being applied at all the stages of framework. Several mechanisms have been adopted for the peer review of research programs which are now set in place and many accreditation programs been created for recognizing the excellent way of education in SAUs. It is accompanied with institution by their staff management systems which use quantitative metrics for the assessment and award for scientific programs, professional development and lateral entrance into the scheme. In the present time SAUs and ICAR have initial links with federal agencies through Farm Crop Boards and ICFRE. The development of a collaboration system between ICAR institutes, SAUs and other agriculture research agencies which involves forestry, plantation could enable a better cross-referencing of technologies.

There has been observed a downfall in staffs but the number of scientists have exponentially raised in the past 25 years. In year 1996, only 67% of the ICAR scientists had a Doctorate degree which rose to 80% in year 2003, 86% in year 2009, more than 95% in 2018. ICAR and SAUs are both engaged in so-called "daily research workers." These staff support scientists in their study and in the management of labs and experimental farms. Thousands of workers are hired by ICAR agencies and SAUs. Their qualifications vary somewhat, but most of them possess MSc degrees. PhD-qualified researchers were significantly older than MSc-qualified researchers.

And the experience of imminent scientist in the field of research, is protected by providing them various suitable positions, emeritus nature of their work, to protect the country loss from their retirement by the ICAR agencies. Considering the fact that more the years pass more they get practical knowledge which is definitely useful for the country.

Results And Discussion

India, Brazil and China have become key players in the global agricultural economy. It is also helpful to equate the developments in Indian agricultural research and development investment with two other countries of rising economies. In the present time, growth in agricultural research in India has noticed a rising trend as the actual expenditure done by the Department of Agricultural Research and Education and ICAR has increased from Rs 5,393 to 6800 crore INR during 2010-18. Although it did not come close to China which spent almost the double amount in the same time. Brazil also has one of the best established and well organized agriculture research with enormous funding among the world countries By a comparative study it has been found that Brazil and other Asian high-income countries spent a much greater share of their agriculture GDP in research, rising from $1.80 for Brazil to $4.75 for Japan which was lesser than the share invested by China (0.62%) [13]. As per the recent report of Organisation for Economic Co-operation and Development (OECD) in 2019, the agricultural research intensity of many world countries have been calculated which recapitulates key indicators which characterize agriculture innovation system and innovation policy approaches which are mentioned as Argentina 0.6, Brazil 1.8, Canada 1.9, China 0.6, Japan 1.8, Netherland 0.9, Sweden 0.9 and Switzerland 2.2. India has a scope of enormous growth with the ARI value of 0.3 in year 2016 [14]. This newly refined index for measuring agriculture research tests country's investment in agricultural research by combining agricultural research budget in form of percentage of agricultural GDP with two other supplementary expenses weighted strength ratios relative to size and income of economy of that region with the help of data envelope analysis. Where the traditional intensity ratio simply calculates the total investment on agricultural research as a share of AgGDP, the agricultural research intensity ratio provides valuable insights into relative investment levels over time for individual countries and supports to decide the investment target for research and development. For example, countries such as China and India have very developed and competitive research programs that are adequate considering the scale of their economies and their income levels. Yet China and India weigh just 0.6 and 0.3 per cent, respectively, on the basis of the traditional scale, which is way below the world average.

Figure 3 shows agricultural research intensity in India in between 2002-15. Figure 4 shows the agriculture research intensity of World countries in 2016 (As per OECD report 2019).

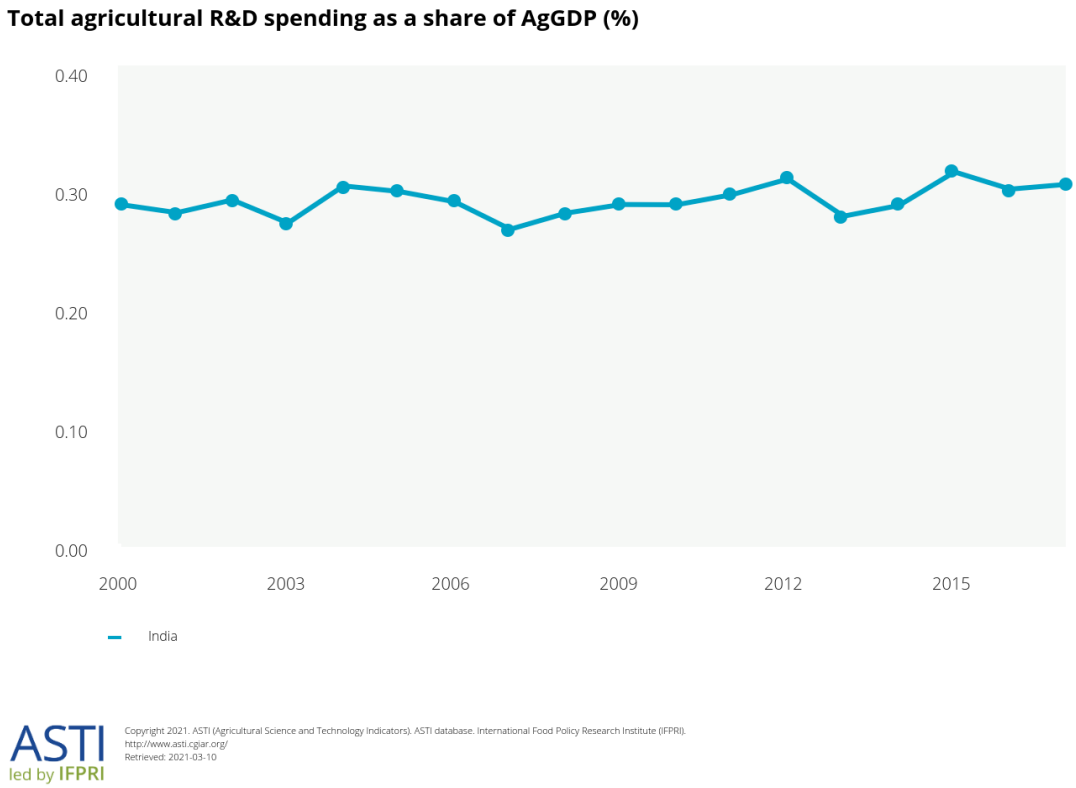

Figure 3: Shows Agricultural Research Intensity in India in between 2002-15[15].

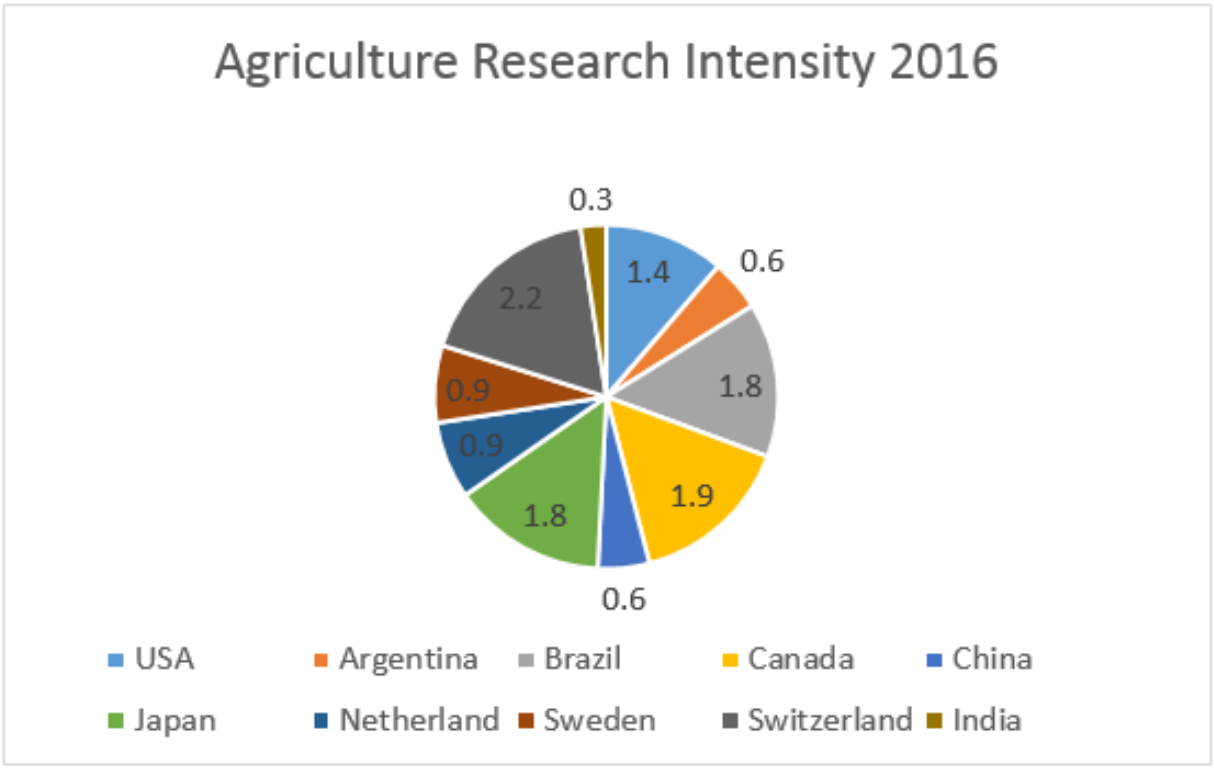

Figure 4: Shows the Agriculture Research Intensity of World Countries in 2016 (As per OECD report 2019).

Conclusion

A rapid growth in population, accompanied by land degradation, has created a condition that urges an improvement in production that can be achieved by focusing on agricultural research and development. Since the late 1990s, India has significantly expanded its public funding of agricultural research. This pattern is expected to persist in the coming years. Indian Government's clear vision and deep contribution to promote agricultural research and development has been come forward as highly rewarded economic and social returns which in turn benefit the research investment. However, the calculated agriculture intensity ratio for public agriculture research and development investment in India is still low, but the condition is very promising yet. Many entrepreneurs have been interested in Indian agriculture and related outcomes. To overcome such hurdles, in twelfth five year plan, Government of India sought to resolve this deficiency by contributing 1% of Ag GDP to agricultural based research. SAU and ICAR are providing the framework with their collaborative effort for enhancing targeted study, integration of services through the different institutions. Other deliberate efforts have also been made to foster partnerships with the farming community for accelerating the low level of technology..

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