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Trade-Off Between Fertilizer Subsidy And Investment In Indian Agriculture: Special Reference To Assam

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ABSTRACT

Public Subsidy is governmental financial support paid to the farmers and agribusinesses to reduce their input expenditure and supplement their income. It helps farmers from any unusual price shocks and crucial for improving agricultural production and productivity. Indian Government has been implementing various schemes and programs under which subsidies are provided for the benefit of small and marginal farmers to reduce their cost of cultivation. Assam Government has also provided various forms of subsidies in fertilizers in agriculture to boost the food security in Assam. Given the limited resources, there arises a trade-off between subsidy in fertilizers and investment in inputs in Agriculture. Therefore, it is important to examine the outcomes of input subsidy in components as fertilizers and compare with government expenditure in the form of investment in technology in order to put public resources in an efficient use. An important issue is with the use of nitrogen fertilizers as it contributes to the greenhouse effect. Nitrogen, an important component in fertilizers has been dubbed as the 'other greenhouse gas,' and is as bad as carbon dioxide in global warming, but is not as famous. This paper is an attempt to study the issues related to subsidies in various inputs in the agriculture of Assam. This paper have tried to highlight the risk involved with excessive use of fertilizers to human health and the alternate methods to increase productivity in agriculture in a sustainable way among general public, farming community, health practitioners and agricultural scientists to maximise our social, environmental, economic gains and hope in the years to come.

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INTRODUCTION

Agriculture, with its allied activities, is the largest livelihood provider in India. It is the backbone of Indian Economy. About 58% of the Indian population is directly or indirectly dependent on agriculture and contributed 17.8% to country's GDP. India has the highest net cropped area in the world followed by US and China. Farmers in India have been facing numerous challenges such as input cost, absence of insurance and credit, poor supply chain management, lack of storage facilities etc. The consistent high growth of agricultural sector is a prerequisite for India to become a global economic superpower as well as to feed the growing population. The new agricultural strategy or Green Revolution was adopted in India during the Third Plan i.e. during 1960s. Thus the traditional agricultural practices followed in India are gradually being replaced by modern technology and intensive effort was made for rising agricultural production and productivity in selected regions of the country through the introduction of modern inputs like fertilizers, credit, marketing facilities etc. (Ladejinsk, 1973). During the period from 1961 to 1972-73, Fertilizer consumption increased from 300,000 tons to 2.8 million tons, electric and diesel pump sets from 420,000 to 2.1 million, the number of tube wells from 19,000 to 718,000, tractors from 31,000 to 173,000, and the area under improved varieties had risen from 2 to 23 million hectares. Agricultural sector of India has been getting the financial support from the central and state governments in the form of subsidy. The main forms of agricultural subsidy are in the inputs like seed, fertilizer, electricity, irrigation, credit subsidy etc. The volume of electricity subsidy increased considerably from 6,033 crore in 1999-2000 to 27,489 crore in 2008-09 and that of irrigation subsidies also increased from 11,196 crore in 1999-2000 to 23,665 crore in 2008-09.

Data reveals that the volume of subsidy provided to fertilizer is the highest among all components of agricultural subsidies which increased considerably from 13,244 crore (at current prices) in 1999-2000 to 76,603 crore in 2008-09 and then slightly declined to 67,972 crore (revised estimate) in 2013-14. While the ratio recommended for use of the N (Nitrogen), P(phosphorous), and K(potassium) fertilizers is 4:2:1, the ratio was 6.3:2.5:1 in 2019-20. (P.R.Sindia, 2022)

The need for fertilizers has been felt by farmers to add nitrogen to their farms and gardens to make available just the precise nutrients for their plants' growth. Over the years there has been an increase in use of inorganic nitrogen fertilizers for various agricultural practices and have been on an increase since the few decades worldwide. It is without doubt that fertilizers such as nitrogen contributes substantially increases yield, but excessive use of this fertilizer has given rise to serious threats to environment and human health. Rate of nitrogen fertilizers application is closely related with accumulation of nitrate around the environment, nearby groundwater, as well as in leafy and root vegetables. Consumption of diets having high

nitrate has contributed to imbalances in thyroid condition, various types of human cancers, defects in foetus developments diabetes etc. (Ahmed M. et al. 2017)

Fertilizers are mainly of two types; Organic and chemical. Organic fertilizers come from organic sources such animal residue and plants. Organic manures are not easily obtainable in large quantities for cultivation of large areas and hence they tend to be expensive. Chemical fertilizers come from inorganic materials, which have chemical treatments. The chemical formulations are precise and deliberate for particular plant use and they are relatively more readily available and cost-effective also.

Even though chemical fertilizers help farmers to produce more and high-quality crops in the short-run, but it leads to fewer or poor quality crops in the long term. This is because of the complexities of soil health. As like humans, the soil too needs a balance of nutrients to remain healthy. While NPK (Nitrogen, phosphorous and potassium) can definitely help plants and crops grow better, but just adding them to the soil without keeping the balance can lead to unintended outcomes or hidden endangerment. (Buckler L. 2018)

This paper presents certain solutions within agriculture and allied activities that respond to technological change and can impact food security. It explores proven, frontier and horizon technologies ranging from indigenous and advanced techniques to urban farming, sustainable agriculture, precision agriculture and high-tech digital solutions. This paper takes a look at technologies for healthy soils, increase in productivity, and protection of human health. Because the right information at the right time can be vital, the paper also looks at early warning systems for future generations, solutions for food security and forecasting productivity change in the coming years.

Objectives of the study

1. To study the Public Subsidies in Indian Agriculture.
2. To focus the trade-off between subsidy and investment for sustainable agriculture.

Methodology

This study is based on secondary data and descriptive in nature. The secondary data has been collected from published journal articles, PRS India, Assam Budget Documents, books related to Agricultural subsidy and related research papers.

Literature Review

Many researchers have presented their views on the impact and crucial issues related to subsidies on Indian agriculture sector. (Chand & Pandey, 2008) revealed that amount of fertilizer subsidies going to different states depend upon size of the state, area under cultivation, amount of fertilizer used per hectare and composition of fertilizer used. Ghosh, (2004) stated that discriminatory and non-uniform subsidies must be removed at once for

effective and undistorted incentive to firms. (Singh & Kohli, 2005) also revealed that in the years 1980-81 and 1985-86, the Punjab government advanced the most credit subsidy per operational holding. Ghosh, 2004 stated subsidy could be routed through the Ministry of Environment since the main aim of the policy is to encourage environmentally improved practices. Bathla, Thorat, & Yu, (2017) revealed that credit subsidies have low return to increasing agricultural productivity but it shows high marginal returns in poverty reduction. They found useful to retain credit subsidies for poor. Although farmer's savings rates have been increasing, they are not typically sufficient for major innovations. Due to differences in availing the subsidies by farmers, they are not a leading priority for resource allocation and utilization. Bathla, Joshi, & Kumar, (2017) found that Governments in relatively developed and high-income states have continued to spend more relative to lower-income states on investments and subsidies.

“Adoption of technologies for sustainable farming systems Wageningen Workshop (2001)” focused on the adoption of technologies that have the potential to increase production through sustainable farming systems. Adoption of technology, is however a broad concept. It is influenced by the development, propagation and application at the farm level with the existing techniques and new biological, chemical and mechanical techniques, all of which are enclosed with farm capital and other inputs; it is also affected by education, training, advice and information which form the basis of farmers' knowledge.

In report prepared by Megha Sud, (2020) who was formerly with the OECD, in her paper mentions that improper or excess-use of pesticides and fertilisers however, have the potential to carry significant costs to the environment and to human health, depending on factors such as toxicity, mobility and persistence in the environment.

Mulla (2013) states precision agriculture has been a new concept that has been adopted by many countries in recent times to increase production, optimise labour, and to ensure judicious management of fertilizers. Precision agriculture (PA) is the science of improving crop yields and assisting management decisions using high technology sensor and tools for analysis. PA uses large amount of data and information to improve the use of agricultural resources, yields, and the quality of crops.

Sahoo et al. (2015) describes remote sensing system is a rapidly expanding technology implemented by various advanced countries in agricultural applications. It has been useful to identify the changes in various physical processes in cultivation, which can be better identified using multispectral remote sensing.

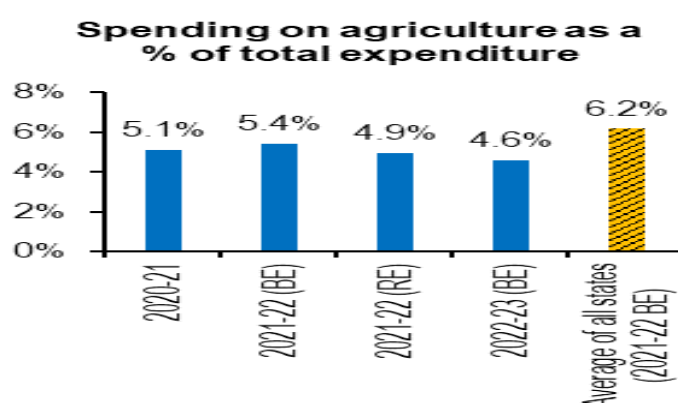
Precision Agriculture is a new advanced method in which farmers provide optimized level of inputs such as water and fertilizer to enhance productivity, quality, and yield. (Gebbers and Adamchuk, 2010)

Discussion:**Contextual information**

Assam, the gateway to the North East India is the largest State in the North East is bordering seven states viz. Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and West Bengal and two countries viz. Bangladesh & Bhutan. The State is endowed with abundant fertile land and water resources with total geographical area of cultivation 78,438sq.km of which 98.4% area is rural. Natural resources have affluently enriched the state. The state is drained by the massive Brahmaputra, the Barak River in the south, and their tributaries provide abundant water resources.

According to land utilization statistics 2014-15, Gross cropped area of Assam is 4082594 in hectare where Net area sown is 2827324 in Hectare. Progress of area coverage under Rabi crops for wheat Assam reported 0.02lakh hectare whereas higher area reported from the states of Madhya Pradesh (6.07lakh ha), Haryana (2.56lakh ha). For Pulses less area is reported from Assam (0.02lakh hectare whereas higher area is reported from states like Gujarat (1.07lakh ha), Rajasthan (0.44lakh ha), Haryana, Punjab (DES 2021). The inhabitants of Assam rely heavily on agriculture and allied activities for their livelihood. As per the budget estimates of 2021-22, Assam has allocated 5.4% of its total expenditure towards agriculture and allied activities, which is lower than the average allocation for agriculture by states (6.2%). National Agriculture Insurance Scheme though is being implemented in the state since 2009-10, has not been able to provide the desired solution due to lack of awareness, slow response of banks etc. The chemical fertilizer consumption in the state is about 53.50 kg per hectare against the national average of 104.5 kg per ha. Due to lack of proper training and education among farmers, the imbalanced and injudicious use of fertilizer and pesticides is a serious issue. (Source: Assam Budget Documents 2022-23)

Figure: 1 spending on agriculture as a % of total expenditure



- 2020-21, 2021-22 (BE), 2021-22 (RE), and 2022-23 (BE) figures are for Assam. BE is Budget Estimates; RE is Revised Estimates.

Source: Assam Budget Documents 2022-23; various state budgets; PRS Legislative Research

Every year Assam sees major floods due to its tropical monsoon climate which annually recurring destruction of infrastructure, crops, livelihood and loss of lives. The problem is accentuated due to poor or non-existent drainage system and in some cases due to topography of land which impedes fast drainage from crop lands. According to Assam Budget Analysis 2019-20, Rs. 672 crore has been provided as capital outlay for flood control projects. Similarly in 2020-21 the amount has been increased to Rs 694 crore allocated for Brahmaputra Flood Control Project. Government provides short term subsidies for crops to the farmers but it does not help to prevent the effect of flood. (Fan, Gulati, & Thorat, 2008) discussed in their paper that subsidies have short term and immediate effect. (Guo, Li, Cao, Cao, & Huang, 2021) also found that effect of agriculture subsidy policy was short lived. In Assam heavy amount of subsidies mainly concentrated towards farm management, provision of farm inputs like power tillers, tractors etc. but visible amount of subsidy to flood management, weather risks control are never there till date in bigger scale. A pilot weather based insurance scheme was introduced in Assam since 2013-14 but awareness and media coverage about this scheme among farmers are very low. Amount of subsidies should gear towards development of farm aspects for long term. Prevailing input subsidies should concentrated more on adoption of flood tolerant crops by farmers which are low water requiring and high yielding to manage weather risk. Based on such problems agricultural produce have narrowed down across the state. Although both production and productivity of rice had shown some amount of improvement over the years it was not that this improvement could be expressed as marked one. Assam never approaches near to the Indian average. In the year 1979-80 rice production of Assam was 892 kg against 1074 kg of corresponding average of India. The gap remained widened in 2004-05 when production of rice in Assam was 1475 kg that of India as 1980 kg (Sharma, 2016). It was also stated in his article that the gap has widened due to insufficient irrigation system as well as recurring overwhelming flood in Assam. Comparing the state like Punjab, in financial year 2020, rice production across the northern state of Punjab in India amounted to over 11 million metric tons whereas Rice production of Assam increased from 4.73 million tonnes in 2017 to 5.1 million tonnes in 2020 growing at an average annual rate of 2.73%(Agricultural draft policy). Agricultural Draft policy of Assam reported that Assam badly fails to produce the required amount of wheat, maize and pulses and hence depends heavily on the import from the other parts of the country. It was also stated that regions and states specializing in crops like paddy, wheat, cotton and sugarcane gets larger share in subsidies. The fertilizer subsidies in India are concentrated in seven of its states. Uttar Pradesh (16.70%) and Maharashtra (11.01%), followed by Karnataka (7.16%), Madhya Pradesh (7.03%), Andhra Pradesh (6.80%), Punjab (6.72%) and Gujarat (6.58%). These seven states receive 62 per cent of the total fertilizer subsidy distributed. It is also mentioned that these states are dominated by the fertilizer intensive crops like paddy, wheat, sugarcane and cotton. The states like Assam, Jharkhand, Chhattisgarh, Odisha, Himachal Pradesh and Jammu and Kashmir, Kerala and Tamil Nadu together receives a share of less than 12 per cent. (Praveen et.al 2017)

It has been found that in India, the total agricultural subsidy increased from Rs33, 591 crore in 1999-2000 to Rs1, 60,917 crore in 2008-09, which is quite substantial (Dhār, 2016). Annual central government subsidies to farmers would be of the order of Rs.120,500 crores as the sum of fertilizer subsidies Rs.70,000 crores in 2017-18, credit subsidies Rs.20,000 crores in 2017-18 crop insurance subsidies Rs.6500 crores in 2018-19 and expenditures towards price support Rs.24,000 crores estimated for 2016-17. Further Annual State government subsidies are almost of an equal amount of Rs.115,500 crores to as the sum of power subsidies Rs.90,000 crores in 2015-16, irrigation subsidies Rs.17,500 crores in 2013-14 and crop insurance subsidies Rs.6500 crores in 2018-19. In addition, in the year 2017-18, state governments announced loan waives totalling to Rs.122, 000 crores. Overall farm subsidies amounted to 2-2.25% of GDP (Ramaswami, 2019). To supplement the financial needs of farmers in procuring inputs for appropriate crop health and yields, in 2019, Government of India launched PM-KISHAN scheme. Budgeted expenditure on this scheme was 75,000 crore (2019-20), however actual expenditure was 48,714 crore which was 35% lower than budget allocation. For 2022-23 allocation has been increased to 68,000 crore which is 1% increase over the revised estimate in 2021-22(67,500 crore). ‘Pradhan Mantri Fasal Bima Yojana’ (PMFBY) was launched in 2016-17 to provide crop insurance. In 2022-23 the scheme has been allocated 15,500 crore, a 3% reduction over the 2021-22 revised estimate. In 2022-23, Rs19, 500 crore has been allocated for interest subsidy. In 2016-17 actual interest subsidy was 13,397 crore which has increased to 17,790 crore in 2020-21. In 2022-23, Rs1, 05,262 crore has been allocated for fertilizer subsidy, a decrease of 25% over the revised estimates of 2021-22. In 2021-22, the department has been allocated Rs140, 122 crore as fertilizer subsidy at the revised stage, which is 75% higher than budget estimate. (PRS India, 2022)

Fertilizer Subsidy Vs Input Investment

Health hazards:

Thus a substantial amount of investment in terms of subsidy comes from the Government. But this investment which comes in the form of subsidy for fertilizers has also been found to be dangerous for human consumption and human health. Most importantly, food crops grown using chemical fertilizers may not be as nutritious as they should be because chemical fertilizers leads to fast growth as well as health in plants, and as a result these crops that have less nutritional value. Plants will grow more, but they will be having less of essential nutrients such as calcium, zinc, and iron. This can cause cumulative effect on the health of the consumers.

Worst of all, chemical fertilizers may increase the risks of developing cancer in adults and children and may affect foetal brain development. Scientists are quite aware of this concept. A study by the University of Wisconsin in 1994 shows concentrations of nitrate (a common fertilizer) and a pesticide in the groundwater may compromise the nervous, endocrine, and immune system of young children and developing fetuses. Another study in 1973 correlates

high levels of sodium nitrate in groundwater with the prevalence of gastric cancer, and another one in 1996 with that of testicular cancer.

A recent study, points out that chemical fertilizer may play an important role in causing of 'methemoglobinemia', otherwise known as Blue Baby syndrome. Study reveals, this condition results from feeding the infants with baby formula using well water contaminated with nitrates. The baby turns blue and may even lead to coma or death.

Environmental hazards:

An issue with use of chemical fertilizers is they seep through the soil into the groundwater and runs to other water sources at times of floods, and leads to contamination. Now, NPK in small quantities is non-toxic, but a lot can kill the balance of nature in various ways. One way is by doing exactly what it is supposed to do, which is help plants grow. The problem with use of nitrogen is again tricky and it creates what experts call a 'dead zone'. Nitrogen when it stays in water encourages the growth of plankton and some aquatic plants to excessive amounts. When it dies, its decomposition eats up oxygen that fish and other marine animals require to survive. As such, water bodies closest to the land where agricultural overflow is the heaviest are empty of fish or any sea food. This causes lot of distress in the ecosystem of the area as well as the local fishing industry.

Nitrogen may persist in the water for many years, so it might continue to affect the environment for a long time to come. Another problem with nitrogen is it contributes to the greenhouse effect. It has been dubbed as the 'other greenhouse gas,' nitrogen is just as bad as carbon dioxide in global warming, but is not as famous. The main sources of nitrogen in the atmosphere though are emitted from power plants and cars, but using more nitrogen fertilizers than crop plants can absorb, can be detrimental to health as they stay many years on the soil. Thus, an immediate concern with chemical fertilizers is the effect on the food we eat and its effect on human health.

Though chemical fertilizers have their uses, their usage has caused an imbalance of nutrients in soil fertilization and also has been hazardous. As damage caused by chemical fertilizers is often over a long time use and cumulative, it would be wise to consider alternative and sustainable methods of agriculture.

As the agricultural sector is mostly integrated in the agro-food chain and the global market, several environmental, food safety, and quality are important issues that has to be addressed to in the global market. While animal welfare regulations are also increasingly impacting this sector, it is faced with new challenges to meet growing demands for food, to be internationally competitive and to produce agricultural products of high quality. It has also to meet sustainability goals in the context of agricultural reform policy after trade liberalisation and globalisation.

Sustainable Agriculture

Adoptions of technologies have the potential to contribute to increase production and to sustainable farming systems. Adapting technology is however a broad concept. It is affected by the development, spreading and application at the farm level. It is also affected by education, training, advice and information amongst the people which form the basis for farmer's knowledge. It also includes technologies and practices in the whole agro-food sector that have an impact at the farm level.

Sustainable farming has been looked up to by many developed countries in recent times. Sustainable agriculture refers to the capacity of agriculture over time to contribute to overall welfare by providing sufficient food and other goods and services in ways that are economically efficient and profitable, socially acceptable, and at the same time improving environmental quality. It is a concept that can have different implications in terms of use of appropriate technologies be it in the farm land or at the agro-food sector level or in the context of the overall domestic market or global market.

With the environmental as well as the human concerns, there is an urgent need to consider shift from subsidy to alternate investment in agriculture. With increasing awareness of health hazards of fertilizers among people world-wide, it would be difficult for Indian agricultural products to get a widely accepted market in the international market if Indian agricultural products continue to use fertilizers that pose dangers to human health. Several OECD countries have started adopting alternative and sustainable methods of cultivation. We have responsibility not only to meet the food security, but the added responsibility of health and welfare of its citizens as well as to increase our agricultural exports. Acceptability of Indian agricultural products in the international markets will increase demand for agricultural products and increase the GDP of our country. Need of the hours is to consider a shift from Fertilizer subsidy to Investments in sustainable inputs.

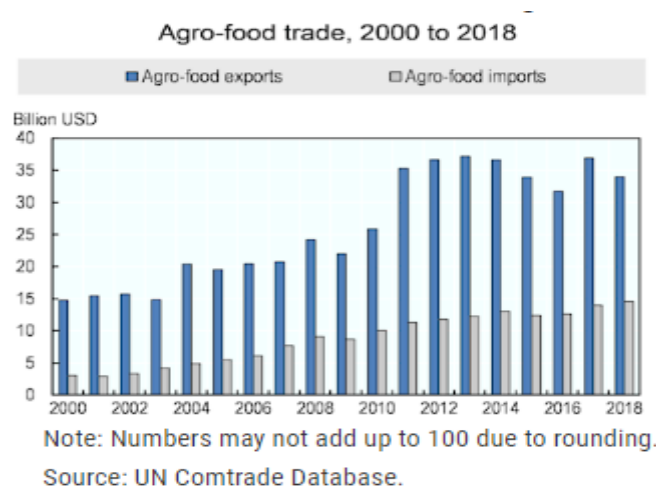
Precision agriculture has been a new concept that has been adopted by many countries in recent times to increase production, optimise labour, and to ensure judicious management of fertilizers. Precision agriculture (PA) is the science of improving crop yields and assisting management decisions using high technology sensor and tools for analysis. Thus PA is a new advanced method in which farmers provide optimized level of inputs such as water and fertilizer to enhance productivity, quality, and yield (Gebbers and Adamchuk, 2010). It requires a huge amount of information about the crop condition or crop health in the growing season. The most crucial objective of PA is to provide support to farmers in managing their business. Modern agricultural production relies on monitoring crop status by observing and measuring variables such as soil condition, plant health, fertilizer and pesticide effect, irrigation, and crop yield. Managing all of these factors is a considerable challenge for crop producers. The rapid enhancement of precise monitoring of agricultural growth and its health assessment is important for sensible use of farming resources and as well as in managing crop yields Nigam et al. (2019). Such challenges can be addressed by implementing remote sensing (RS) systems such as 'hyperspectral imaging'.

The most crucial objective of PA is to provide support to farmers in managing their business. Modern agricultural production relies on monitoring crop status by observing and measuring variables such as soil condition, plant health, fertilizer and pesticide effect, irrigation, and crop yield. Managing all of these factors is a considerable challenge for crop producers.

RS combined with geographic information systems (GISs) and/or global positioning systems (GPSs) are increasingly been used in Precision Agriculture. This has also been beneficial for farmers and other agricultural producers to reduce inputs and optimize cost benefits using modern technologies rather than traditional field approaches. Nowadays, variable rate technology (VRT) is introduced to increase precision farming practices. VRT is a significant component for PA and is becoming more prevalent for large land holders. Use of VRT, collections of field information and other input data are helpful in giving suitable quantities of chemical inputs required for the fields. Hence the importance of precision agricultural techniques, Remote Sensing information as well as VRT has increased tremendously (Brisco et al. (1998).

Countries like Australia which are prime exporters of agricultural products can be cited as a very good example. Australia as an important producer and exporter of agricultural products and it contributes significantly to the economy of the country. Australian agro-food sector is well integrated into the international market; its agricultural exports are substantial and the country is a consistent and significant net exporter of agricultural products, making the country a key supplier to world markets for agricultural products. Agricultural processed goods for final consumption and intermediate goods make up more than half (56%) of the country's agro-food exports. Approximately three-quarters of Australia agro-food imports go to domestic final consumption and the remaining share (24%) is destined for the processing industry

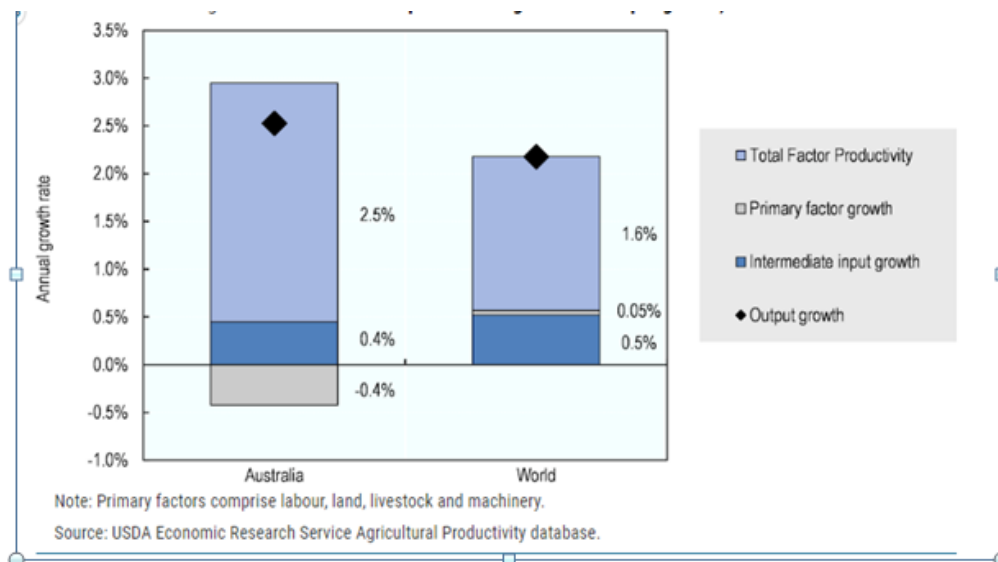
Figure 2 Australia: Agro-food trade



(Agricultural Policy monitoring and evaluation, 2020)

In figure 3 we see during the 2007-16 period total factor productivity (TFP) growth in Australia (2.5% per year) outpaced the world average (1.6%), driven by continued structural adjustment and the uptake of innovative technologies and practices in the sector (Agricultural Policy monitoring and evaluation, 2020)

(Figure 3) **Australia: Composition of agricultural output growth, 2007-16**



With a low level of direct government support to farmers, research and development programmes (R&D) are a major component of Australian support to agriculture, while a smaller portion of public expenditure goes to the development and maintenance of large infrastructures and inspection services, including pest and disease control activities. Industry and governments cost share the eradication of outbreaks, while trade related costs of biosecurity and food safety inspection services are covered by industry. (Agricultural Policy Monitoring and Evaluation, 2020)

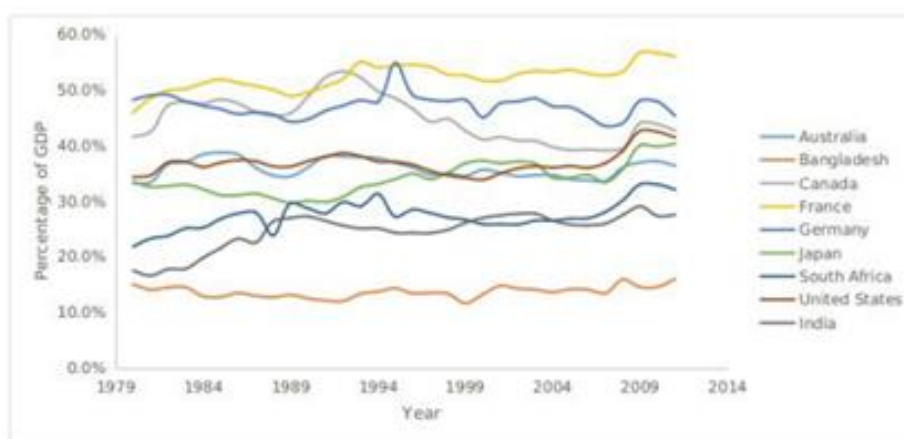
Taking examples from Australia, it's time to pay attention to investment schemes as input investments in the agricultural sector. In India we need to expand our investment in this sector as it can be a driving force to increase India's GDP. India's public expenditure on agriculture as a fraction of total expense fell from 11per cent in 2010-11 to 9.5 percent in 2019-20 showing a sharp fall in the Union government's expenditure on agriculture as a share of gross value added (GVA) by the sector, claimed a study by Foundation of Agrarian Studies (FAS). The share of agricultural in India's total GVA fell in this period to 17.8 per cent from 18.2 per cent, the study found. Public expenditure on agriculture thus has declined faster than agriculture's relative importance in the economy.

Green Revolution and increases in overall agricultural production and productivity were built on the platform of state support in terms of technology, prices, subsidies, credit and marketing. But over the longer period of reform between 1992-93 and 2010-11, agricultural growth rates slowed down as there was a weakening of public institutional support to

agriculture in the 1990s and 2000s. Agriculture Expenditure Ratio (AER) on crop husbandry, which includes schemes on seeds, soil health, crop management, urea subsidy, etc., fell to 2.8 per cent from 4.2 per cent during 2010-2019.

Figure 4 shows the public expenditure pattern of different countries. The share of public expenditure in agriculture to GDP in India is much lower than in developed countries; barring few years, the figure is lower than South Africa. Between 2010-11 and 2018-19, the public expenditure as a percentage of GDP has also seen a decreasing trend.

Figure 4: Trends of public expenditure as percent GDP in different developed and developing economies 1980-2011



Source: Agrarian Studies; Project report 2010-11 to 2019-20

Public expenditure in India in the agricultural sector as a share of total public expenditure is lower in comparison to all the sectors manufacturing, trade, transport, public administration, etc. In other words, public expenditure on agriculture has declined faster than the decline in the relative importance of agriculture in the economy.

Thus it's time that we pay more attention than it has been receiving till date and we need to expand our investment in the agricultural sectors as it can be a driving force to increase India's GDP.

With increasing awareness of health hazards of fertilizers among people world-wide, it would be difficult for Indian agricultural products to get a widely accepted market in the international market if Indian agricultural products continue to use fertilizers that pose dangers to human health. Several OECD countries have started adopting alternative and sustainable methods of cultivation. We have responsibility not only to meet the food security, but the added responsibility of health and welfare of its citizens as well as to increase our agricultural exports. Acceptability of Indian agricultural products in the international markets will increase demand for agricultural products and increase the GDP of our country. It would be wise if alternate methods of cultivation are adopted.

Suggestions and conclusion:

Many of our issues can be solved by use of technologies. Considering the many faceted problems faced by Indian agriculture, especially in states like Assam, it would be prudent to consider a trade-off between subsidies in fertilizers to investments in inputs as an alternative to improve quality as well as quantity of agricultural produce.

Precision agriculture has been a new concept that has been adopted by many countries in recent times to increase production, optimise labour, and to ensure judicious management of fertilizers. Precision agriculture (PA) is the science of improving crop yields and assisting management decisions using high technology sensor and tools for analysis. PA is an advanced innovation and optimized field level management strategy used in agriculture that aims to improve the productivity of resources on agriculture fields. Thus PA is a new advanced method in which farmers provide optimized level of inputs such as water and fertilizer to enhance productivity, quality, and yield. Precision agriculture aids in improving crop yields by gathering data from multiple sources to and thereby improves the cost-effectiveness of crop management in using fertilizer as inputs, or in irrigation management, or in application of pesticide. Emergence and development of low cost UAVs and associated imaging technology, precision agriculture is already starting to transform agricultural practices in some countries. Options of simple and inexpensive configurations also exists that allows use of low cost digital cameras, to lot more sophisticated and expensive configurations with hyperspectral cameras, thermal sensors, or LiDAR systems.

By providing tools and resources, we can empower farmers and entrepreneurs by implementing these innovative ideas and solutions to be implemented in the field and the market safely and quickly. Multinational company's presence has hardly been felt in the agricultural sector even after economic reforms in 1991. Collaborations with MNC's can prove to be useful. Goal should be to guide the farmers in building sustainable farming with the goal of increasing production through environmental protection and 'Health for all'.

If we can deliver these basic ideas to our network of farmers, investors and industry experts, and turn these ideas into successful projects, Indian agricultural products are going to increase by leaps and bounds not only in production but also in demand across nations. Increased demand for agricultural products in the international market will not only help the farmers to self-sustain themselves but also greatly assist in increasing the GDP of the country.

Because the right information at the right time can be vital, we have to look at early warning systems for future generations, solutions for food security and forecasting productivity change in the coming years.

With such conscious development and use of technologies, we can improve the lives of millions. It can go a long way in creating jobs in agriculture and its allied activities and assist people to move out of poverty, restore our ecosystems and pushing evolution beyond the

barriers and maximise our social, environmental, economic gains and hope in the years to come.

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