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ROLE OF AGRICULTURAL INNOVATION TOWARDS RURAL DEVELOPMENT IN INDIA

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ABSTRACT

Agriculture is the backbone of the Indian economy which plays the most decisive role in the socioeconomic development of the country. It focus on innovation in agriculture is essential to achieve self-reliance in this sector and also ensure food security. In 1999-2000 it was 28.4 per cent; in 2011-12 it further declined to 13.8 per cent. The Innovations in agriculture need to focus on the vast untapped growth potential in agriculture including strengthening of rural infrastructure, promotion of agri-business and subsidiary farm enterprises and creation of more employment to avoid migration from rural areas to urban areas. Agricultural innovation is need for interventions in rainfed horticulture, disease diagnostics, seed and planting material, mechanisation, labour shortage, climate resilient technologies and strengthening of market linkages; new initiatives such as interaction with farmers through video conferencing involving subject matter specialists, community radio station, use of DVDs for disseminating of information on various technologies to be adopted throughout the country, so that it would help bring down the transaction costs in many of the Government programmes. This paper discusses various innovations and technological breakthroughs that took place in Indian agriculture during the British period and afterwards. Further, the paper focuses on the role of agriculture in India, effects of agricultural innovation toward rural development and to study the problem Associated in agricultural innovation.

INTRODUCTION

Agriculture is a way of life for majority of farmers in India and has influenced significantly socio-economic development of the people of this country. Continued focus and innovation in agriculture is essential to achieve self-reliance in this sector and also ensure food security. In recent decades, one of the key concerns is falling share of agriculture and allied activities in India Gross domestic product (GDP). When the five year plans were launched in 1951, its share was as much as 56 percent but declined steadily over the decades. In 1999-2000 it was 28.4 per cent; in 2011-12 it further declined to 13.8 per cent. If agriculture and allied sectors can grow at least at the rate of 4 percent per annum, then the overall GDP growth of over 8 percent can become a reality. In India contribute 4 per cent GDP growth per annum then it will help to achieve the overall 9 percent GDP growth. In order to reach this goal, India needs to have a viable and innovative agricultural policy. The innovations in agricultural policies or programmes are required at the National level as well as at the regional level for enhancing the agricultural production and productivity on the one hand and overcoming the pitiable plight of the farmers. The Innovations in agriculture need to focus on the vast untapped growth potential in agriculture including strengthening of rural infrastructure, promotion of agri-business and subsidiary farm enterprises and creation of more employment to avoid migration from rural areas to urban areas. The climate change and rise in temperature is an inevitable process in India. We need to focus on development of drought-resistant, less water intensive and short-duration crops in drought prone distinct of the country. India can adopt many of the cost-effective innovative irrigation techniques developed by Israel. It is essential to popularise and adopt innovative practices in enhancing soil moisture conservation techniques developed by various institutions within and outside the country. The need of the hour is to build confidence of small and marginal farmers in India through right policies by ensuring easy credit availability, remunerative prices for agricultural products, supply of drought resistant varieties

and short-duration high yielding varieties, establishment of self-help groups and encouraging direct marketing and selling of agriculture products by the farmers. Indian agriculture is a diverse and extensive sector involving a large number of actors. It has been one of the remarkable success stories of the post independence era through the association of Green Revolution technologies. The Green Revolution contributed to the Indian economy by providing food self-sufficiency and improved rural welfare.

How Agricultural Innovation Occurs:

Agricultural innovation typically arises through dynamic interaction among the multitude of actors involved in growing, processing, packaging, distributing, and consuming or otherwise using agricultural products. These actors represent quite disparate perspectives and skills, such as metrology, safety standards, molecular genetics, intellectual property, food chemistry, resource economics, logistics, slash-and-burn farming, land rights—the list is far too long to complete here. For innovation to occur, interactions among these diverse stakeholders need to be open and to draw upon the most appropriate available knowledge. Aside from a strong capacity in R&D, the ability to innovate is often related to collective action, coordination, the exchange of knowledge among diverse actors, the incentives and resources available to form partnerships and develop businesses and conditions that make it possible for farmers or entrepreneurs to use the innovations. Examples of how innovation has occurred in agriculture.

The instances of agricultural innovation listed here came about in different ways. In some cases, markets heightened the pressure to innovate, and the private sector played a decisive role in driving the subsequent innovation. In others, public sector interventions, such as policy, R&D, and other incentives, drove the innovation process.

- Cassava-processing innovation system, Ghana. Research-led development and promotion of new cassava products with a private sector coalition.
- Cut flower innovation system, Colombia. Continuous innovation in response to changing markets, using licensed foreign technology and coordinated by an industry association.
- Medicinal plants innovation system, India. Mobilization of traditional and scientific knowledge for rural communities, coordinated by a foundation.
- Small-scale irrigation innovation system, Bangladesh. Promotion by a civil society organization of a low-cost pump to create markets; innovation by small-scale manufacturers with the design of pumps in response to local needs.
- Golden rice innovation system, global. Complex partnership of multinational companies, international agricultural research organizations, universities, and development foundations; complex but creative institutional arrangements over ownership; innovation targeted to poor (nutrient-deficient) users.
- Potato, Peru. Facilitation by an international research center of the development of new indigenous potato products with a coalition of researchers, smallholders, and multiple private actors (including supermarkets, traders, and restaurants).

In each case, the drivers of innovation and growth were different and the role of research and extension varied, but in all cases the actors used similar approaches to address their challenges and innovate. The challenges included meeting stringent quality standards, remaining competitive, responding to changing consumer tastes, and addressing technological problems. The actors' ability to improve their interactions and strengthen their links to one another proved crucial to their success. All of the cases illustrate the importance of taking collective action, having the benefit of facilitation and coordination by intermediaries, building a strong skill base, and creating an enabling environment for innovation to take place. Here we mention only recent work being done on the topic. **Sarvana Kumar (1996)** found that majority (70.00%) of the Mango growers of Dharmapuri district were in the medium scientific orientation category followed by low (15.83%) and high (14.77%) category. **Balasubramani (1997)** conducted a study on Rubber growers in Dakshina Kannada district in Karnataka and reported that 37.00 per cent were found in medium innovative proneness category followed by 35.00 and 28.00 per cent in high and low innovative proneness category respectively. **Keshavamurthy (2005)** in his study reported that the medium innovation proneness was noticed by 70.00 per cent of farmers followed by 15.84 per cent of them having high innovation proneness. The remaining 14.16 per cent of the farmers found to exhibit low innovation proneness.**Neetravathi (2007)** conducted a study on comparative analysis of the preference and performance of the marketing organizations of fruits and vegetables in Bangalore rural and urban districts and indicated that majority of the farmers (47.50%) had medium level of innovation proneness followed by low (27.50%) and high (25.00%) level of innovation proneness. **Pottappa (2008)** conducted a study on knowledge and adoption of Potato growers in Chikkaballapur district and indicated that more than half (61.67%) of the Potato growers belonged to medium level of innovativeness category followed by high (25.84%) level of innovativeness. Only 12.50 per cent of the respondents were under low level of innovativeness category.

OBJECTIVES OF THE STUDY

The main objectives of the present study are as follows:

1. To analyse the role of Agricultural in Indian context.
2. To examine the Effects of agricultural innovation toward rural development.
3. To study the problem associated in Agricultural innovation.

RESEARCH METHODOLOGY

The present study based on secondary data were collected from various Government of India Report (Census data), News papers, Articles, Journals, Indian Agricultural Reports, websites data, etc. The study used simple average, percentage, growth rates as analytical tool for analysis and comparison.

THE ROLE OF AGRICULTURAL IN INDIAN CONTEXT

Agriculture plays a vital role in the Indian economy. Over 70 per cent of the rural households depend on agriculture. Agriculture is an important sector of Indian economy as it contributes about 13.8 (17%) to the total GDP and provides employment to over 60% of the population. Indian agriculture has registered impressive growth over last few decades. The

food grain production has increased from 51 million tonnes (MT) in 1950-51 to 250MT during 2011-12 highest ever since independence. Agriculture plays a critical role in the entire life of a global economy. Agriculture is the backbone of the economic system of a any country. In addition to providing food and raw material, agriculture also provides employment opportunities to very large percentage of the population. The economic importance of agriculture can be given as follows:1. Share In National Income: 2. Largest Employment Providing Sector: 3.Contribution to Capital Formation: 4. Providing Raw Material to Industries 5. Market for Industrial Products, Source of Livelihood, Food Security.

Indian Agricultural Developments:

❖ During 1943–1964:

Famines were more frequent during the colonial era in India. From various reports we could see that there were terrible famines between 1760 and 1943. Since 1850, several famines (nearly 20) killed at least 20 million people in India. The nation had to face acute food shortage during this period as the British were interested in growing only the cash crops like cotton, indigo, jute etc in order to supply the raw material for their factories back in England The world's worst food disaster happened during 1942– 1943 in British-ruled India known as the Bengal Famine. During this time Burma was caught by Japan and the rice imports from Burma were hoarded by the British resulting in exorbitant price rise. People could not afford to buy rice as the price of rice increased 3 to 4 fold17. Further, rice crop was badly affected by Helmenthosporium oryzae and the productivity was suppressed considerably. About 2 million people were died due to famine induced hunger in 1943 in the eastern India that included present day Bangladesh. (http://www.annualreviews.org/doi/Pdf/10.1146/annurev.py.11.090173.000303 retrieved on 5.3.13).

It was therefore obvious that food security was a dominant item of independent India's agenda as it has undergone unforgettable agony due to severe famines. In the first five year plan, emphasis was given on the agricultural development as there was acute food shortage, along with irrigation, fisheries, animal husbandry and marketing. Food production increased substantially from 54 MT (1950–51) to 65.8 MT by the end of first five year plan. In the third five year plan emphasis was laid on agriculture to make the country self sufficient in food grain production. Many fertilizer plants were established during this plan period. In the fourth five year plan, despite a worst drought, India could achieve self sufficiency in food grain production due to Green Revolution. Further, agricultural research and education were given considerable attention.

Before independence, the main source of revenue was from the tax on land. But after independence, land taxes have steadily declined as a share of revenues and completely replaced by sales taxes2. During this period, some special programs were implemented by the Government viz., The Grow More Food Campaign (1940s) and the Integrated Production Program (31950s) to focus on supply of food and cash crops respectively.The Bhakra-Nangal multipurpose dam was among the earliest river valley development schemes undertaken by independent India. All Five-year plans were oriented towards agricultural development especially on landreclamation and development, farm mechanization, electrification etc. Various institutions for agricultural research were founded under the Indian Council of Agricultural Research, New Delhi.

❖ During 1964–1990:

Due to widespread drought during 1965–66, India imported food grains from the US under PL-480 scheme. Unexpectedly, the United States has decided not to export wheat to India due to some internal problems. This decision at a critical time opened the ways for green Revolution in India. Under the critical situation of lower level of agricultural production combined with increased population, the country was in dire need to increase its food production remarkably. This was the time when semi-dwarf varieties were developed in wheat in Mexico and rice in China. The introduction of these high yielding semi dwarf varieties of rice and wheat revolutionized the Indian agriculture scenario which was combined with right policies of government to provide essential inputs and market facilities, credit etc. The first high yielding variety in rice was released in 1968 as Jaya. In wheat, Lerma Rojo 64A and Sonora 64 were introduced directly from Mexico, later two varieties namely Kalyansona and Sonalika were released for cultivation. Because of these Innovative ideas and policies the food grain production in the country increased to 108.46 MT in 1970-71, to 129.6 MT in 1982–81, to 176.4 MT in 1990–91. Therefore, the Green Revolution has changed the face of Indian agriculture and the country became self sufficient in its food grain production.

❖ During 1990–2012:

During the last two decades, a fatigue of the Green Revolution is set in both due to economic and ecological reasons. The regions where the benefits of Green Revolution (North Western India) were harnessed in abundance are now facing the challenges of land degradation, Yield plateauing and thereby deceleration in compound growth rate. In 1991, economic reforms were introduced to liberalize the nation's economy. This has got a tremendous impact on Indian agriculture especially on food grain production. Slowdown in growth began since 1995–96 for livestock, 1996–97 for crop sector, 1998–99 for fruits and horticulture, 1996–97 for crops other than fruits and vegetables. If we divide this period as post reform period (1990–91to 1995–96) and post liberalization period (1996–97 to till date), the deceleration is more spectacular during post liberalization period. Farm growth has stagnated at an annual average of 2.3 % for the last ten years. After mid 1990's even food grain production is not catering to the increase in population. Considering the period 1980–1990, the yield of food grains was increasing at 3.2% per year later in the next decade i.e. 1990–2000, the growth has slowed down to 2.9%. During the last 10 years between 2000 and 2010, the food grain production has increased only by 1.2%. Critical analysis of observed yield data of past years showed that the reduced productivity in rice-wheat hot spot in India is nor far below the yield productivity of other countries like the US, Australia, China, Argentina, Egypt etc. Country like China grows wheat under marginal soils but with intensive management system. Climatic constraints (rainfall and day length) contribute significant yield loss in India particularly in non-traditional rain fed areas. The yield levels can be enhanced provided irrigation during critical stages. Even now agriculture sector remains the principal source of livelihood for more than 52% of the population, although, its contribution to the national GDP has declined to 13.9% due to high growth experienced in industries and service sectors. Many reasons are attributed for the deceleration in agricultural

growth. Declining investment in agriculture by public sector, insufficient agriculture research and development and inefficiency of institutions providing inputs are some of the factors. Other factors such as land fragmentation, out-dated tenancy laws, lack of modern market and rural infrastructure, inappropriate input pricing policies, etc. were also said to be responsible for agrarian crisis in the country.

For achieving sustainable security in food production we need to give more emphasis on two major cereals, rice and wheat. In addition to this, we also need to make use of the frontier technologies viz., biotechnology, nanotechnology, remote sensing, GIS, genome sequencing, marker assisted technology, weather modelling etc to come out with solutions for ever increasing demands in food production. The food production and security can be achieved through:

EFFECTS OF AGRICULTURAL INNOVATION

Has Indian agriculture performed well in this millennium?

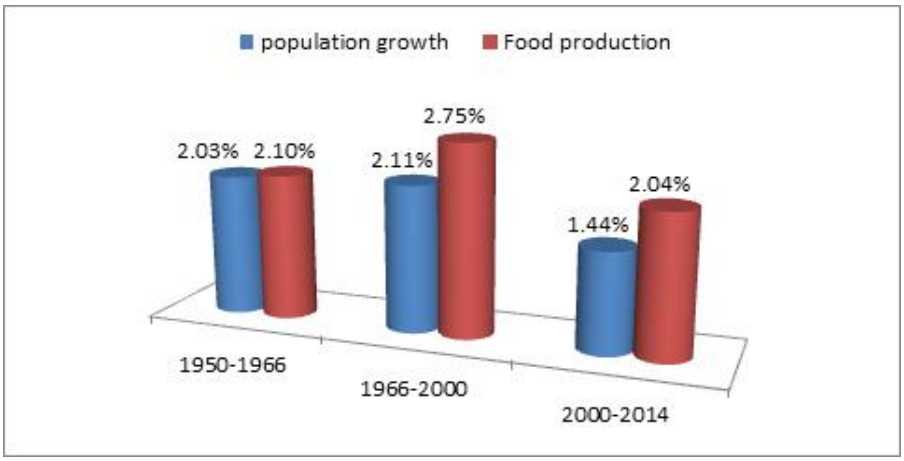
- **India's Green Revolution and innovations ... a great success story**

In 1961, India was on the brink of a mass famine and decided to begin its own Green Revolution. India's green revolution programme encompassed adopting high-yielding varieties of seeds, modern farming methods, irrigation development and financing of agrochemicals. It all began after a high-yielding variety (HYV) of wheat was first introduced in India in 1963by American agronomist Dr Norman Borlaug, who is known as 'the Father of the Green Revolution'. India soon adopted HYV - IR8, a semi-dwarf rice variety, dubbed as the 'Miracle Rice' to further increase production and become self-sufficient. While the introduction of technology was fuelling India's drive towards self-sufficiency, it was the enthusiasm and entrepreneurship of the farmers who adopted it that mobilised the agricultural revolution in India.

- **Rural India and agriculture have done well since 2000**

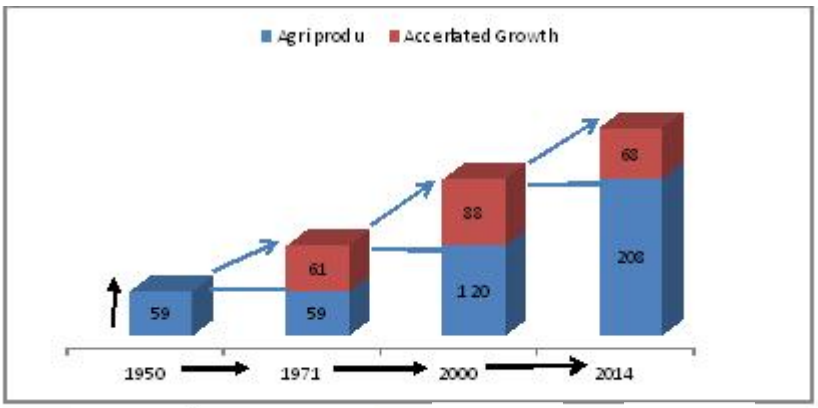
From 1960 till date we have been able to sustain two generations so it is difficult to argue that we have not traded sustainably and sensibly as far as food production goes. India's food production (grains + pulses) growth has been well ahead compared to the population growth. However, production is vulnerable to drought and seasonality.

Fig no. 1. Food production growth is always ahead of population growth



Source: *State of Indian Agriculture 2012-13, Govt of India, Ministry of Agriculture Reports from Ministry of Agriculture- Agriculture Statistics*

In the 16 years of the pre-green revolution, between 1950 and 1966, the annual growth rate of agriculture was about 2%. In the 30 years of green revolution between 1966 and 1996, there was an increase to about 3% per annum. In the 20 years from 1996 till date, the growth rate has decelerated to about 2% per annum, but on a much higher base.



Year → 1950 → 1971 → 2000 → 2014

21 years to add 61 mt 29 years to add 88 mt 14 years to add 68 mt

Source: *State of Indian Agriculture 2012-13, 2016, Govt of India, Ministry of Agriculture Reports from Ministry of Agriculture- Agriculture Statistics.*

Over the years we have seen an accelerated rate of growing an additional 65-80 million tonnes (mt) of food. Since 2000, India has halved the time required to add 75 million tonnes of food — from 25-30 years before 2000 to 14-15 years since 2000. Though in the last few years from 2011-2012 onwards the growth has been muted.

India ranks among the top two producers in several agricultural products:

It is well known that India has become self-sufficient in food grains over the last few decades. Less well known is that India counts among the top two producers in the world of wheat, rice, sugarcane, cotton, milk, fruits, vegetables and spices. Looking at these numbers, one gets the impression that India has done very well with respect to agriculture. Well, other countries have done better.

Table no.1. India's rank in the production of various agricultural products.

China produces 30% more wheat and rice using 25% less land than India.

Agricuture production	India's rank	Next to
Wheat	Second	China
Rice	Second	China
Pulses	First	
Fruits and vegetables	Second	China
Sugarcane	Second	Brazil
Tea	Third	China, Turkey
Cotton (lint)	Second	China
Milk	First	

Source: *State of Indian Agriculture 2012-13, 2016, Govt of India, Ministry of Agriculture Reports from Ministry of Agriculture- Agriculture Statistics.*

With landholding less than India, Japan and S Korea have better yields than India; India's average consumption of fertiliser is less than that in Pakistan and China. India's per hectare agro-chemicals consumption is one of the lowest in the world.The higher growth elsewhere is driven by administrative and technological factors like aggregation of land parcels, improved crop protection / nutrient technologies, adoption of technology-driven seeds and mechanisation, expansion of irrigation.

- **Rural per capita income has grown faster than urban income:**

During the new millennium, rural per capita income has grown a tad higher than urban per capita income. Contrast this with the earlier period till 2000 when urban per capita income always grew faster than rural per capita income, by about four percentage points per annum. The reasons for the reversal are attributed to the high development funds allocated to the rural sector, higher MSPs, burgeoning subsidies and rapid growth of non-farm income in rural areas. On the debit side, the rise in farm input costs is noteworthy. On their part, farmers have acted entrepreneurially to favourably influence cropping intensity and crop diversification. Adoption of better technologies in nutrients, high-quality seeds, pest management and small-farm tractors have been hugely advantageous though some commentators dwell on their downsides.

Table no. 2. Rural v/s urban per capita Income growth (in per cent).

Agriculture production	2000 over 1994	2012 over 2000
Rural per capita income growth	10.79	11.99
Urban per capita income growth	14.34	11.19

Source: *State of Indian Agriculture 2012-13, 2016, Govt of India, Ministry of Agriculture Reports from Ministry of Agriculture- Agriculture Statistics.*

The per capita income in rural India has followed an almost similar growth as urban India — 11.6% in rural per capita income against 12.2% in urban per capita income, over the past 20 years. Still, the disparity between the haves and have-nots exists.

Anecdotal evidence for the prosperity of rural India can be seen through the higher reliance of FMCG companies on rural markets in their sales plans. But all this does not mean that farmers have no issues or that rural India has solved all its problems. Just as with urban life, there are many ills of life in rural India.

The reportage of recent weather adversities and Indian farmer suicides has clouded what could arguably be considered the best 14 years of agriculture. The picture is indeed mixed and there are many perspectives and arguments that are being advanced.

Video conference:

The concept of video conference-based review is close monitoring and review of the program by the head office. This also saves time of field officials who were earlier visiting the head office just for the review meeting of higher frequency. The regular review through video conference is outcome of Bhoochethana program only. Earlier DOA used review by routine meetings either at district, divisional, or state level. In a meeting, it was decided to use the video conference technology for better monitoring and review. In the very first meeting, government realized its usefulness and it was decided to continue for review. Earlier this review was carried out every fortnight and later on it was conducted at weekly intervals. The change in monitoring and review mechanism through video conferencing brought immediate change at field level. Plans were prepared on realistic basis, execution was

more close to plans prepared, and reports were more realistically submitted to head office; other advantages were timely interaction with the field team, timely decision to address the field level issues, and one to one review, and time saved could be used in better execution of the program. Video conference is better use of technology that helps in strict monitoring of inputs at field level and forces officials to work at ground level to bring positive outputs. Field officials are forced to update their reports and follow-up activities closely as per plan. It helped in achieving the targets well in time. Issues are discussed in depth and if needed decisions are taken immediately. Issues are also taken up to higher level depending on the need and demand.

INDIAN AGRICULTURE FACES SOME FUNDAMENTAL PROBLEMS WHICH NEED FAR GREATER FOCUS

One of the biggest successes achieved by India post-independence has been its ability to move from facing food shortages and food imports to that of self-sufficiency and exports of food grains in a rather short period. Indian agriculture has also moved away from subsistence farming to intensive and technology-led cultivation. Still there are some serious issues faced by Indian agriculture:

- ***Larger population dependent on agriculture*** - People are dependent on agriculture in India - ~55% of total employment across India and it contributes only 14% to India's GDP.
- ***Fragmented landholding and inadequate irrigation*** - More than 80% of farmers in India are marginal and small farmers. Inadequate irrigation makes it difficult for them to sustain farming.
- ***Lack of institutional credit5*** - Nearly 40% of all loans come from informal sources. Marginal landholding households suffer the most with only 15% of their credit from institutional sources such as the government, cooperatives and banks — for households with land more than 10 hectares the ratio is 79%.
- ***Output uncertainty*** - This is due to weather and other factors such as lack of market linkages, appropriate application of fertilisers, agrochemicals.
- ***Infrastructure-*** India has very poor rural roads affecting timely supply of inputs and timely transfer of outputs from Indian farms. Irrigation systems are inadequate, leading to crop failures in some parts of the country because of lack of water. In other areas regional floods, poor seed quality and inefficient farming practices, lack of cold storage and harvest spoilage cause over 30% of farmer's produce going to waste, lack of organised retail and competing buyers thereby limiting Indian farmer's ability to sell the surplus and commercial crops. The Indian farmer receives just 10% to 23% of the price the Indian consumer pays for exactly the same produce, the difference going to losses, inefficiencies and middlemen. Farmers in developed economies of Europe and the United States receive 64% to 81%.

The problems of knowledge economy and innovation processes in agriculture, armers did not believe because it was new to them. -They have not yet seen the demonstration fields. -They worried of low yield -Low education -Old age farmers: did not believe new technology and only believe their own experience.

CONCLUSION

Factors affecting in change of technology use include the access to the technical training, meeting, oral transmission, and trust on technician and believe on technology introduced by scientist.

Factors that trigger adoption of new technologies comprise of progressive, young and educated farmers. However, not all farmers adopted technologies introduced because it they are new to them. They were feeling hesitated in application of new technology because they do not believe that the new technology can ensure the high yield. These farmers are usually old age and work based on their own experience.

Though farmers perceived technology as good thing to them, they still faced problems in application of technologies. These comprise of lacking of capital, direction of the government and extension, lack ensure of yield by compensation policy.

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