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Private Investment and Agricultural Output: A Case Study of Meghalaya

Dahun Shisha Dkhar
Ph.D. Research Scholar
Department of Economics
North Eastern Hill University Shillong- 793022, Meghalaya

Biswambhara Mishra
Professor
Department of Economics
North Eastern Hill University Shillong, Meghalaya

Utpal Kumar De
Professor
Department of Economics
North Eastern Hill University Shillong, Meghalaya

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Abstract

This paper is an attempt to investigate the relationship between private investment in agriculture and its output in Meghalaya by using primary data collected through multi-stage sampling technique. Primary data were collected with the help of a pre-tested interview schedule. Information on agricultural inputs, outputs, land holding size, family size, educational level and occupation etc were collected. Correlation analysis and log-linear regression model are the analytical tools that were used in the study. The variables that have a direct contribution to crop output have been incorporated in the regression models. The study reveals that ginger (65 %) and paddy (52.50 %) are the main crops cultivated by the farmers in the study area. The other crops cultivated by the farmers are tomato, potato, pineapple, chili, soybean, maize, cabbage, carrot and turmeric. To avoid multicollinearity in the regression model, correlation analysis of the independent variables (seed, manure, fertilizer, labour, plant protection chemicals and machinery) has been employed. Variables like plant protection and fertilizers; manual labour and manure have high correlation with each other and therefore have been placed in different models. Two models have been constructed to examine the relationship between private investment in agriculture and agriculture output from the farming households. The results from both the regression models reveal that there is a direct relationship between investment in inputs use for agriculture and the resulting output. Therefore, government should not only increase subsidies on inputs but to also provide training on the recommended use of fertilizers and plant protection chemicals by the farmers to avoid their side effects on the health of man and his environment.

Keywords: Agriculture inputs, Agriculture output, Meghalaya, Private investment, Relationship.

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Introduction:

Agriculture is the largest sector in many developing countries. A majority of the world's poor people live in the rural areas and are primarily engaged in agriculture for their livelihood (Fan & Rao, 2003). An evidence from the International Food Policy Research Institute (IFPRI) also showed that promoting higher agricultural growth will be the key in reducing poverty, promoting overall economic growth and achieving the first Millennium Development Goal of reducing the number of poor people to half (Diao, Hazell, Resnick & Thurlow, 2007). In many parts of the world, increased agricultural growth plays a key role in addressing the current world food crisis and also in reducing poverty and hunger. (Fan & Rosegrant, 2008). Thus, expenditure in agriculture is important in alleviating poverty and promoting economic growth in rural areas of developing countries. Meghalaya is basically an agrarian economy as it is rural based with agriculture playing a major role in the economy of the state. More than 80 per cent of the state's population depends on agriculture for their livelihood and nearly 10 per cent of the geographical area of the state is under cultivation. However, regardless of the bulk of the population engaged in agriculture, its contribution to the state's GDP is still low with most of the population occupied in agriculture remains poor.

Review of Literature:

When it comes to investment in agriculture, public and private investments corresponds with each other functionally and cannot be seen as separate entities. Private sector investment includes investment by organised corporate bodies like big private companies and unorganised entities like sugar co-operatives and milk co-operatives. The household sector investment comprises of investment on farm equipment, machinery, irrigation, land improvement and land reclamation. With about 90 per cent share, households dominate the private investment scene. These investments enable farmers to grow existing crops more productively and intensively and take up non-conventional/high value crops (Golait & Lokare, 2008).

In developing countries, smallholders provide the bulk of domestic private investment, particularly on-farm by investment of their own labour and part of their income to improve land, acquire new equipment, and expand livestock herds. Investing in storage and post-production chain will increase their efficiency to produce food and minimize losses. Mechanization and the use of animal traction to replace human labour have dramatic potential to increase productivity. Land improvements, such as land levelling, terracing and bunding for runoff and erosion control, can contribute significantly to the management of natural resources. Globally, on-farm investments, have increased over time, with the increase concentrated in low and middle-income countries. On-farm investments in high-income countries however have remained relatively stable (Interagency Report, 2012).

Studies of investment in Indian agriculture (Chand, 2000; Chand & Kumar, 2004) revealed a highly significant positive relationship between private investment and both agricultural output and productivity growth nationally and in most states. Overall, the evidence suggests that since the early 1980s, public investment in agriculture has been less important to overall investment in the sector and to growth in output and productivity than the environment for private investment, defined as profitability and credit availability compared to other sectors.

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Baba, Saini, Sharma and Thakur (2010) confirmed the long term complementarity between public and private investment which indicated that the improvement of public investment would not only augment the level of capital but also attract more private investment in agricultural sector. They also pointed that agricultural productivity, state income; grants from union government and literacy level in the state were positive and significant determinants of public investment. However, allocation in the form of fertilizer subsidies and population growth has negatively affected public investment. They also found that public investments, agricultural productivity, literacy level, terms of trade and per capita income have significantly contributed in the improvement of private investment.

Mani, Bhalachandran and Pandit (2011) depicted that an increased levels of public and private investment in agriculture leads to an increase in the overall agricultural capital stock. With regards to the relationship between public and private sector investments, the results indicated a significant crowding-in impact of public investment on private investment in both agricultural as well as industrial sectors.

Private investment needs to be encouraged in specific areas of agriculture to reduce the burden on public investment. The government needs to concentrate on rectifying the inefficiencies which may induce more private investments (Nath, 1999). Although most investments may be primarily mobilized by the farmers themselves, the public sector — general government units and public (financial and nonfinancial) corporations have a critical role. The efficiency of these expenditures, whether measured in relation to agricultural GDP, to total government outlays, or the agricultural labour force, remains a key element of the overall policy (Anonymous, 2012).

Public investment in agriculture is important and cannot be replaced by the private sector. Governments must give priority to investments in key public goods, such as capacity building, infrastructure, and research systems, to help small-scale producers ensure their food security and livelihoods. Private investment should complement public sector investment. Unfortunately, not all private investments in agriculture are positive; current policy environments and business practices often encourage investment that exacerbates poverty. However, when coupled with the right policy environment, private investment can be catalytic to inclusive economic growth, environmental sustainability, and long-term poverty reduction. Such achievements require innovation, a long-term focus and a more inclusive approach by the private sector. Thus, these general principles outlined have the potential to propel private investment towards positive outcomes (Sahan and Mikhail, 2012).

Objective of the study:

This study is an attempt to investigate the relationship between private investment in agriculture and its output in Meghalaya.

Methodology:

Data Source

Primary data has been used for the purpose of analysis due to the non-availability of secondary data regarding the private investment in agriculture for Meghalaya.

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Collection of Primary Data

The primary survey was conducted in Meghalaya through a multi-stage sampling technique. For the primary data, two districts in Meghalaya have been identified, *viz.,* East Khasi Hills District and Ri-Bhoi District on the basis of their topography as Ri-Bhoi has a comparably more flat topography than East Khasi Hills. Three blocks have been selected from East Khasi Hills District and two blocks have been selected from Ri-Bhoi District on the basis of the highest number of cultivators in each district. East Khasi Hills District has more number of blocks than Ri-Bhoi District therefore more blocks have been selected from East Khasi Hills. From East Khasi Hills District, Mawphlang, Mylliem and Mawryngkneng Blocks have been selected since they have the first, second and third highest number of cultivators respectively. Umsning and Umling blocks have been selected from Ri-Bhoi District on the basis of first and second highest number of cultivators in the district respectively. In the next stage, from each block of East Khasi Hills District one village is selected on the basis of highest number of cultivators in the respective blocks. Three villages viz., Marpna, Nongpathaw and Diengpasoh have been selected from Mawphlang, Mylliem and Mawryngkneng Block respectively. However in Ri-Bhoi District, since Umsning Block has more number of cultivators than Umling Block, two villages viz., Umtasor Mawdkhar and Umlaper have been selected from Umsning Block and Mawphrew village have been selected from Umling Block. In the last stage, sixty farmers from each village have been selected on the basis of land holdings size i.e., small (0.05 - 1 acre), medium (1.01 to 2 acres) and large (> 2 acres). From these 60 farmers 20 farmers have been selected from each of the land holding category. Thus the total number of farmers that have been considered is 360.

Primary data were collected with the help of a pre-tested interview schedule by face to face contact with the respondents. The farmers were interviewed personally to collect information on private investment regarding cultivation of agriculture crops. The information given by the respondents was based on their memory. From these farmers, information on agricultural inputs, outputs, land holding size, family size, educational level and occupation etc were collected for the year 2016-17.

Analytical tools and techniques

Description of Variables

To estimate the relationship between private investment and agricultural output the following primary data variables were used in the regression analysis. These variables have been selected since they are important in direct contribution to crop output.

Seed - The actual cost incurred in seeds was computed by taking the actual price of seeds prevailing in the area during planting.

Plant Protection chemicals – The actual expense incurred on pesticides was considered.

Manure – The value of manure used was calculated by considering the average rates prevailing in the area during sowing.

Fertilizers – The actual cost incurred on chemical fertilizers viz., Urea, SSP, MOP, DAP was taken for calculation.

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Machinery – The cost of hiring a tractor or power tiller considering the average rates prevailing in the area during planting.

Labour – The cost of hired human labour was computed by taking the wage rate paid by the sample farmers towards hired human labour. The same wage rate was used for computing the imputed value of family labour.

Production – It is the quantity of crop produce or harvested from the farmer's field. It is computed by multiplying the quantity of the produce with the price received by the sample farmers after selling the produce

Econometric Model

The log-linear regression model was employed to test the nature of relationship between output and other variables of interest. To avoid multicollinearity problems, two models (Eq. (1) & Eq. (2)) have been constructed after correlation analysis between the independent variables. Therefore, variables with high correlation were placed in separate models. OLS method of estimation was rendered to determine the following econometric models:-

$$lnprod = \alpha + \beta_1\, lnseed + \beta_2\, lnfert + \beta_3\, lnmanure + \beta_4\, lnmachine + \mu_i \quad \text{.....Eq. (1)}$$

$$lnprod = \alpha + \beta_1\, lnseed + \beta_2\, lnpltpro + \beta_3\, lnlabor + \beta_4\, lnmachine + \mu_i \quad \text{.....Eq. (2)}$$

Where,
lnprod = logarithm of production of crops from farming households (in Rupees)
lnseed = logarithm of the quantity of seed use for sowing (in Rupees)
lnpltpro= logarithm of the quantity of pesticides use for plant protection (in Rupees)
lnmanure = logarithm of the quantity of manure (mainly cowdung) applied to crops (in Rupees)
lnmachine = logarithm of the use of power tiller for ploughing (in Rupees)
lnfert = logarithm of the quantity of fertilizer (Urea, SSP, MOP, DAP) applied to crops (in Rupees)
lnlabor = logarithm of hired labour and family labour involved in raising of crops (in Rupees)

Results and Discussion:

Socio-economic Characteristics of the Sample Farmers

It is important to know the socio-economic characteristics of the sample farmers. Knowledge about the age and literacy of the farmers is helpful in determining the managerial skills, availability and contribution of family labour to total human labour consumption in cultivation. General information of farmers is discussed in the following sub-heads:

Age and Educational Qualification of Farmers

The age of farmers is an important parameter that determines the production of crops directly or indirectly. The distribution of respondent farmers according to their age and educational qualification is shown in table 6.1. Age is an important factor in adoption rate of technologies and performance of the farmer. Younger people tend to adjust faster and well to new technologies as

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compared to older ones. It is seen that majority of the farmers are in age group of 40 – 60 years (46.94 %) followed by those in the age group of less than 40 years (40 %). Hence, it shows that young people participation in cultivation is lower as compared to middle aged.

Farmer's educational level is another important parameter that determines the productivity of crop grown and the managerial skills of the farmer. Farmers' educational qualification helps in the uptake of advice and training, perception of the need for change, willingness and ability to make adjustments in cultivation (Gasson, 1998). It also helps the farmer in communicating with other people involving in the production and marketing of their produce and for better negotiation with market intermediaries. It is observe in table 6.1 that majority (41.70 %) of the respondent farmers were educated upto Lower Primary followed by 16.90 % which were educated upto Upper Primary while 28.30 % of the farmers are still Illiterates. The total farmers' literacy level was found to be about 75.65 % which indicates that there is potential to make a change in the farming business.

Table 1: Distribution of Respondent Farmers according to Age and Educational Qualification

Category	No. of respondent farmers	% of total
< 40 years (Young)	144	40.00
40-60 years (Middle)	169	46.94
above 60 years (Old)	47	13.06
Total	360	100.00
Educational Qualification		
Illiterate	102	28.30
Upto 5 (Lower primary)	150	41.70
6 to 8 (Upper primary)	61	16.90
9 to 10 (Secondary)	30	8.33
11 to 12 (Higher secondary)	14	3.89
Graduate	3	0.83
Total	360	100.00

Source: Authors calculation from Primary Survey

Family Size of Sample Farming Households

The size of the farming households is also another important parameter since it can influence agriculture directly or indirectly. Farms with higher family labour tend to show higher productivity due to proper management practices for their own farms and they also have larger farm size due to the availability of labour since labour accumulates the highest cost in raising crops. The distribution of farming households according to their family size is shown in table 2. It is seen that about 60 % of the households belong to medium category of family size (5 -8 persons) followed by 31.94 % which belong to small family size (upto 4 persons). The average family size of the sample respondents was found to be 6 persons per family with highest of 10 persons and lowest of 2 persons per family.

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Table 2: Distribution of Farming Households according to their Family Size

Category	No. of respondent farmers	% of total
Upto 4 (Small)	115	31.94
5 – 8 (Medium)	216	60.00
Above 8 (Large)	29	8.06
Total	360	100.00

Source: Authors calculation from Primary Survey

Source of Income

Although the main source of income of the farming households is production of crops, however there are other sources of income for the farmers' households. This is because the farmers cannot depend entirely on agriculture since it is characterized by a number of risks and uncertainties like production risk, technical risk, price and market risk, financial risk, legal risk and personal risk. The source of income for the farmers' households other than cultivation is depicted in table 3. It was found that about 68.61 % of the households depend on poultry farming with an average annual income of Rs. 3,996. It is followed by piggery farming accounting 62.78 % of the total sample households with an average annual income of Rs. 12,692. Daily wage labourers also contributes about 37.78 % of the total households as a source of income with an average annual income of Rs. 19,958 followed by business and trading activities which accounts for about 37.22 % (with an average annual income of Rs. 53,064). About 25.83 % of the total households depend on forest produce for their secondary source of income of which the main product is broom grass (average annual income of Rs. 26,782). The other sources of income are livestock rearing (7.78%) with an average annual income of Rs. 20,414 and services (5.56 %) rendered in government offices and teaching in private schools with an average annual income of Rs. 2,74,235.

Table 3: Source of Income for Sample Farming Households

Category	Average Annual Income (Rs.)	No. of households (% of total)
Crops	116610	360 (100)
Poultry	3996	247 (68.61)
Piggery	12692	226 (62.78)
Livestock	20414	28 (7.78)
Forest Produce	26782	93 (25.83)
Labourer	19958	136 (37.78)
Business & Trading	53064	134 (37.22)
Service	274235	20 (5.56)

Source: Authors calculation from Primary Survey

Annual Family Income

The annual income of the farming households is shown in table 4. From the table it is seen that majority of the families were earning less than 1 lakh rupees annually from crop (55.28%) as well as non crop sources (73.33 %). However when all the sources of income for the households were added it was found that majority of the families (46.11 %) were earning about 1 to 2 lakh rupees annually.

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Table 4: Distribution of Farming Households according to their Annual Family Income

Category	No. of households	% of total
Annual Crop Income (Rs.)		
<1,00,000	199	55.28
1,00,000 – 2,00,000	115	31.94
2,00,001 – 3,00,000	26	7.22
> 3,00,000	20	5.56
Annual Non Crop Income (Rs.)		
<1,00,000	264	73.33
1,00,000 – 2,00,000	59	16.39
2,00,001 – 3,00,000	15	4.17
> 3,00,000	3	0.83
Total Annual Income (Rs.)		
<1,00,000	87	24.17
1,00,000 – 2,00,000	166	46.11
2,00,001 – 3,00,000	46	12.78
> 3,00,000	61	16.94

Source: Authors calculation from Primary Survey

Crops Cultivated by Sample Farmers

There are a variety of crops that have been cultivated by the farmers. A single farming household cultivates more than one type of crop. The distribution of farming households according to the crops that have been cultivated by them is shown in table 5. It was found that majority of the families (65 %) cultivated ginger which was followed by paddy (52.50 %). The other crops cultivated by the farmers were tomato, potato, pineapple, chili and soybean which accounts for 33.89 %, 27.22 %, 17.22 %, 16.39 % and 15 % respectively. A few of the sample households cultivated maize, cabbage, carrot and turmeric for their source of income.

Table 5: Distribution of Farming Households according to Crops Cultivated

Category	No. of households	% of total
Ginger	234	65.00
Paddy	189	52.50
Tomato	122	33.89
Potato	98	27.22
Pineapple	62	17.22
Chilli	59	16.39
Soybean	54	15.00
Maize	49	13.61
Cabbage	35	9.72
Carrot	30	8.33
Turmeric	3	0.83

Source: Authors calculation from Primary Survey

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Results on the Relationship between Private Investment and Agricultural Output

Correlation analysis

There are a number of variables that have been obtained from the farmers' field that directly contribute to crop production. These are seed, manure, fertilizer, labour, plant protection chemicals and machinery. However to examine the relationship between private investment and agriculture output all the variables cannot be placed together in the same model as this will result in multicollinearity. Therefore the following table (table 6) shows the correlation analysis between the independent variables. Variables like plant protection and fertilizers; manual labour and manure have high correlation with each other and therefore cannot be placed in the same model.

Table 6: Bivariate Correlation among various Categories of Expenditure in Total Crop Cultivation

Independent variables (Rs.)	lnfert	lnlabor	lnmachine	lnmanure	lnpltpro	lnseed
lnfert	1.000	0.161	-0.583	0.128	0.986	0.408
lnlabor	0.161	1.000	0.361	0.847	0.152	0.491
lnmachine	-0.583	0.361	1.000	0.258	-0.578	-0.306
lnmanure	0.128	0.847	0.258	1.000	0.125	0.289
lnpltpro	0.986	0.152	-0.578	0.125	1.000	0.414
lnseed	0.408	0.491	-0.306	0.289	0.414	1.000

Source: Authors calculation from Primary Survey

Regression Analysis of Private Investment and Output by Farming Households

Two models have been constructed to examine the relationship between private investment in agriculture and agriculture output from the farming households. The variables which are correlated have been placed in different models. The result from the two models is shown in table 7.

Table 7: Regression Results of Farm Inputs and Output

Dependent Variable: lnProduction; Method: Least Squares; Included observations: 360

Model 1				Model 2			
Variable	Coefficient	t-stat	Prob.	Variable	Coefficient	t-stat	Prob.
lnseed	0.520	25.759	0.000*	lnseed	0.336	17.014	0.000*
lnfert	0.062	9.953	0.000*	lnpltpro	0.038	7.403	0.000*
lnmanure	0.198	11.757	0.000*	lnlabor	0.587	20.826	0.000*
lnmachine	0.063	11.406	0.000*	lnmachine	0.014	2.702	0.007*
C	4.713	26.476	0.000*	C	2.567	13.196	0.000*
R-squared		0.828		R-squared		0.908	
Adjusted R-squared		0.826		Adjusted R-squared		0.907	
F-statistic		427.391*		F-statistic		878.65*	
Prob(F-statistic)		0.000		Prob(F-statistic)		0.000	

Source: Authors calculation from Primary Survey

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Note: * indicate that the level of significance is at 1% level

Where ;
lnprod = logarithm of production of crops from farming households (in Rupees)
lnseed = logarithm of the quantity of seed use for sowing (in Rupees)
lnpltpro= logarithm of the quantity of pesticides use for plant protection (in Rupees)
lnmanure = logarithm of the quantity of manure (mainly cowdung) applied to crops (in Rupees)
lnmachine = logarithm of the use of power tiller for ploughing (in Rupees)
lnfert = logarithm of the quantity of fertilizer (Urea, SSP, MOP, DAP) applied to crops (Rupees)
lnlabor = logarithm of hired labour and family labour involved in raising of crops (in Rupees)

In the first model, results reveal that an increase in investment of seeds for sowing by 1 % increases agricultural output by 0.52 %. Similarly, an increase in investment of inputs like fertilizer, manure and machinery by 1% increases agricultural output by 0.06 %, 0.20 % and 0.06 % respectively. All the variables in the model are statistically significant at 1% level of significance and 83% of the variation in agricultural output is explained by the various investments in agricultural inputs.

In the second model, similarly the results reveal that an increase in the investment of seeds for sowing by 1 % increases agricultural output by 0.34 %. An increase in the investment of plant protection by 1% increases agricultural output by 0.04 %. The results also show that an increase in the investment in human labour and machinery by 1 % increases agricultural output by 0.59 % and 0.01 % respectively. All the variables in the model are significant at 1% level of significance and 91% of the variation in agricultural output is explained by the various investments in agricultural inputs. Therefore, from the two models we can say that there is a direct relationship between investment in inputs use for agriculture and the resulting output in Meghalaya.

Seed - The investment in seed for sowing is mainly for purchasing improved seeds especially for planting of tomatoes, chilli, cabbage, cauliflower, carrot and soybean. Farmers invest lesser in sowing of paddy, ginger, turmeric, potato and pineapple as they usually use their own seeds for sowing and purchase when needed in case of deficit at the time of sowing. But even when they purchase seeds, they usually buy the local varieties of the region for sowing of paddy, ginger, turmeric, potato, maize and pineapple. There is a higher investment in the purchase of seeds for sowing of tomato, chilli, cabbage, carrot and soybean because the farmers usually purchase hybrid seeds for sowing such crops. Hybrid seeds are known to give better yield as compared to the local ones. Therefore farmers will get higher returns from sowing hybrid seeds. However the disadvantage of hybrid seeds is that the production drops when the seeds are recycled for the following year (Smale, Cohen & Nagarajan, 2009). This implies that when the seeds are sown in the second or following years their production decreases than when the seeds are new. Therefore farmers have to buy new seeds for each sowing period to get higher production. However, purchasing of new seeds means additional costs for farmers, but with the advantage of higher production which in turn increases the output from the farm.

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Manure - Manure mainly in the form of cow dung is a common input for nutrients use by the farmers. This is because it is easily available and farmers can purchase the cow manure at a lower cost as compared to fertilizers. Moreover, farmers who do not know how to use fertilizers and who are not aware of it can easily apply cow manure to their fields. It was found that manure is invested mainly for crops like tomato, chilli, paddy, potato, carrot, soybean, maize, turmeric, cabbage and ginger except for pineapple. The use of manure is advantageous because the nutrients present in the manure are being released consecutively and therefore increases the organic content in the soil (Morris, Kelly, Kopicki & Byerlee, 2007). Inspite of that, the disadvantage of using manure is that it contains lower levels of nutrients which may not be able to supply the recommended amount that the crops need as compared to fertilizer.

Fertilizers - Chemical fertilizers like Urea, Single superphosphate (SSP), Muriate of Potash (MOP) and Diammonium Phosphate (DAP) are invested by the farmers mainly for production of tomato, chilli, potato, cabbage and soybean and some farmers who are cultivating ginger are also using chemical fertilizer to raise their ginger crop. According to farmers the above crops cannot do away without chemical fertilizer since fertilizers increase the production of the crops. This is in accordance with Morris, Kelly, Kopicki and Byerlee, 2007 who mentioned that adding nutrition is essential for good growth and development of plants and also to obtain high quality produce. Moreover growing crops on the same plot in consecutive years deplete the soil from its nutrients; therefore it is imperative to add extra nutrients in order to restore the soil fertility. Fertilizers usually include nutrients like nitrogen, phosphorus and potassium that help to restore nutrients in the soil. However, application of chemical fertilizers is not always advantageous as it involves a higher cost for investment and moreover, if it is not handled in a proper way and lack of knowledge will have a negative impact on the environment and is also harmful for human's health if not applied in proper dose and can also harm animals as well (Emana, Gebremedhin & Regassa, 2010).

Plant Protection Chemicals - Plant protection chemicals or pesticides covers a wide range of compounds including insecticides, fungicides, herbicides, rodenticides, molluscicides, nematicides, plant growth regulators and others. The use of chemicals has been the dominant paradigm for pest control in recent decades and has succeeded in greatly reducing crop losses. Pesticides are invested by the farmers mainly for crops like tomato, chilli, potato, cabbage and ginger for protection against plant diseases, insects and as weed control. It was found from the sample farmers' that in tomato, Decis and Anaconda are commonly use against fruit borers, white flies and aphids while Indofil M-45 and Dithane M-45 are use for controlling late blight disease. Indofil M-45 and Dithane M-45 are also use for controlling late blight disease in chilli. Decis is also use against fruit borers, white flies and aphids in chilli. Indofil M-45 is use in soybean crop. Glycel is use in ginger crop as herbicide (for removal of weeds).

Application of pesticides helps to control pests and diseases and thus helps in producing quality products and better yield. In case of tomato, it was found that it helps in increasing the shelf life of the fruit and can be transported for longer distance. Therefore due to the production of quality produce the farmers can fetch better returns for their produce. This is also in line with Cooper and Dobson, 2007 who stated that pesticides aid in improving the quality of the agricultural produce as well in increasing the crop output. They also mentioned the advantages of increasing the shelf life of

the agricultural produce and reducing the drudgery of weeding by using herbicides and in order to enable the labourers to be engaged in other tasks. However, pesticides use has its own danger because if not used judiciously and optimally, it may result in problems like the loss of their effectiveness in the long run and also result in pollution of the environment and health related issues in animals and human beings (Sabur and Molla, 2001).

Machinery - The investment of machinery by the sample farmers is in the form of power tiller used for land preparation mainly for the cultivation of paddy and pineapple. Cultivation of paddy and pineapple requires larger area as compared to the cultivation of the other crops. Paddy is mainly cultivated in fields in which the soil is quite hard to work with; so the use of machinery helps in easier and faster ploughing of the soil. The used of machinery has helped in reducing the cost of labour while ploughing the soil as well as to increase the speed of work and therefore in turn increases the return from the agricultural produce. Stavytskyy and Prokopenko, 2017 stated that investment in agricultural machinery raises agricultural productivity and also improves the quality of agricultural products. Investment in mechanization has resulted to be effective and highly advantageous for agriculture development and economic development in general.

Labour – Human labour is the main form of labour involved in the production of agriculture output in the state. Labour invested varies for different crops. Results from farmers' field reveal that an average of 142 mandays per acre is invested in ginger and an average of 143 mandays per acre in turmeric. An average of 128 mandays per acre is invested in potato and an average of 112 and 100 mandays per acre is invested in the production of chilli and tomato respectively. Pineapple absorbs about an average of 57 mandays per acre in addition to the use of machinery for land preparation. In case of cabbage and carrot an average of 55 and 53 mandays per acre respectively is used for production. Production of paddy requires an average of 49 mandays per acre in addition to the use of machinery for ploughing of land. Results also reveal that an average of 40 and 43 mandays per acre is invested for the cultivation of soybean and maize.

Conclusion:

Results from primary data prove a direct relationship between investment in agricultural inputs viz., seed, manure, fertilizer, machinery and plant protection chemicals and agricultural output and thus have an impact on farm economy. Therefore government should increase subsidies on inputs like improved variety of seeds and technology suitable with the climatic conditions and topography of the state. Research institutes should develop crop varieties and farm implements suitable to the prevailing conditions in the state. However, only improved technology is not sufficient to raise the financial standard of the farming households. Training on the recommended use of fertilizers and plant protection chemicals ought to be made in addition to subsidies on these inputs so that these inputs are used judiciously by the farmers to avoid their side effects on the health of man and his environment.

References:

1. Anonymous. (2012). *Statistics on Private and Public investment in agriculture: government expenditure, capital stocks and other FAOSTAT datasets.* (Agenda Item 10). Retrieved from FAO website: www.fao.org
2. Baba, S. H., Saini, A.S., Sharma, K. D. & Thakur, D. R. (2010). Impact of investment on agricultural growth and rural development in Himachal Pradesh: Dynamics of public and private investment. *Indian Journal of Agricultural Economics, 65*(1), 135-158.
3. Chand, R. (2000). *Emerging trends and regional variations in agricultural investments and their implications for growth and equity*. (Policy paper 11). National Centre for Agricultural Economics and Policy Research, New Delhi. Retrieved from www.cabdirect.org
4. Chand, R. & Kumar, P. (2004). Determinants of capital formation and agricultural growth: Some new explorations. *Economic and Political Weekly, 39*(52), 5611-5616.
5. Cooper, J. & Dobson, H. (2007). The benefits of pesticides to mankind and the environment. *Crop Protection, 26*(9), 1337-1348.
6. Diao, X., Hazell, P., Resnick, D. & Thurlow, J. (2007). *The role of agriculture in development implications for Sub-Saharan Africa.* (International Food Policy Research Institute Research Report 153). Retrieved from pdfs.semanticscholar.org
7. Emana, B., Gebremedhin, H. & Regassa, N. (2010). *Impacts of improved seeds and agrochemicals on food security and environment in the rift valley of Ethiopia: Implications for the application of an African green revolution.* (Report No. 56) Retrieved from Food and Agriculture Organization website: agris.fao.org
8. Fan, S. & Rao, N. (2003*). Public spending in developing countries: Trends, determination, and impact.* (EPTD Discussion Paper No.99). Retrieved from International Food Policy Research Institute, Environment and Production Technology Division website: ageconsearch.umn.edu
9. Fan, S. & Rosegrant, M. W. (2008). *Investing in agriculture to overcome the world food crisis and reduce poverty and hunger.* (IFPRI Policy Brief 3). International Food Policy Research Institute, Washington, D.C., U.S.A. Retrieved from ageconsearch.umn.edu
10. Gasson, R. (1998). Educational attainment levels of UK farmers-A review. *European Journal of Agricultural Education and Extension, 4*(4), 231-243.
11. Golait, R. & Lokare, S. M. (2008). Capital adequacy in Indian agriculture: A riposte. *Reserve Bank of India occasional papers*, 29(1), 79-101.
12. Interagency Report, Sustainable agricultural productivity growth and bridging the gap for small-family farms. (2012). *Interagency Report on Sustainable agricultural productivity growth and bridging the gap for small-family farms.* Retrieved from www.fao.org
13. Mani, H., Bhalachandran, G. & Pandit, V. N. (2011). *Public investment in agricultural and gdp growth: Another look at the inter sectoral linkages and policy implications.* (Working Paper No. 201). Retrieved from Centre for Development Economics, Delhi School of Economics website: www.cdedse.org
14. Morris, M., Kelly, V., Kopicki, R. & Byerlee, D. (2007). *Fertilizer use in African agriculture - lessons learned and good practice guidelines.* Retrieve from openknowledge.worldbank.org
15. Nath, V. (1999). *Trends in public investment in agriculture.* Vikas Nath Policy Analyst Action Aid. Retrieved from vikas-investment.pdf

16. Sabur, S. A. & Molla, A. R. (2001). Pesticide use, its impact on crop production and evaluation of IPM technologies in Bangladesh. *The Bangladesh Journal of Agricultural Economics, XXIV* (1 & 2), 21-38.
17. Sahan, E. & Mikhail, M. (2012). *Private investment in agriculture: Why it's essential, and what's needed.* (Discussion Paper 25). Retrieved from OXFAM, United Kingdom website: www.oxfam.org
18. Smale, M., Cohen, J. & Nagarajan, L. (2009). *Local markets, local varieties – rising food prices and small farmers' access to seed.* (IFPRI Issue Brief 59). Retrieve from reliefweb.int
19. Stavytskyy, A. & Prokopenko, O. (2017). Investments in agricultural machinery and its efficiency in Ukraine. *Ekonomika, 96*(1), 113-130