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THE ROLE OF EDUCATION IN AGRICULTURAL OUTPUT AND LABOR ALLOCATION: A CASE STUDY OF RURAL PAKISTAN

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Abstract

The purpose of this study is to highlight the impact of education on farm activity (Productivity) given the movement of labor (Labor allocation) from off-farm to on-farm. Therefore, this study aims to assess the labor allocation across the farm and off-farm activity by considering human capital (level of education attained). This sector contributes 20.71% to the GDP of Pakistan. However, the contribution of the agriculture sector in GDP has shrunk from 27% in 2000-01 to 19% in 2018-19. Mostly the skilled or individuals with some human capital investment allocate their labor to nonfarm activity instead of in farm activity. Hence allocation of labor specifically skills labor in agriculture/ farm activity matters. In this study, only rural areas are focused on analyzing the objectives of this research. For estimation purposes, OLS, Heckman Selection Technique (two-stage method) is used. Furthermore, Probit is employed for evaluating the marginal effects of the coefficients for understanding the true meaning. Results indicate that wage differential, dependency ratio, educational level, and unemployment in educational level are showing a mixed trend toward farm activity. The wage differential is positive and significantly related to farm activity, which indicates that when off-farm wages increase, individuals move toward the off-farm activity. Unemployment at the educational level is negatively related to farm activity. Physical input and cultivated land show a negative impact on farm wages. Whereas human capital, land tenure, access to water, and livestock are positively related to it. The study suggested that it is necessary to increase the enrolment rate at all education levels so education-based policies should be introducing. Policies should be introduced that provide technical training related to farm equipment and skills. It helps those farmers that are uneducated and having less knowledge. Livestock is an asset for the farmworkers. The policies should be introduced to the farmers to have healthy and better upbringing facilities.

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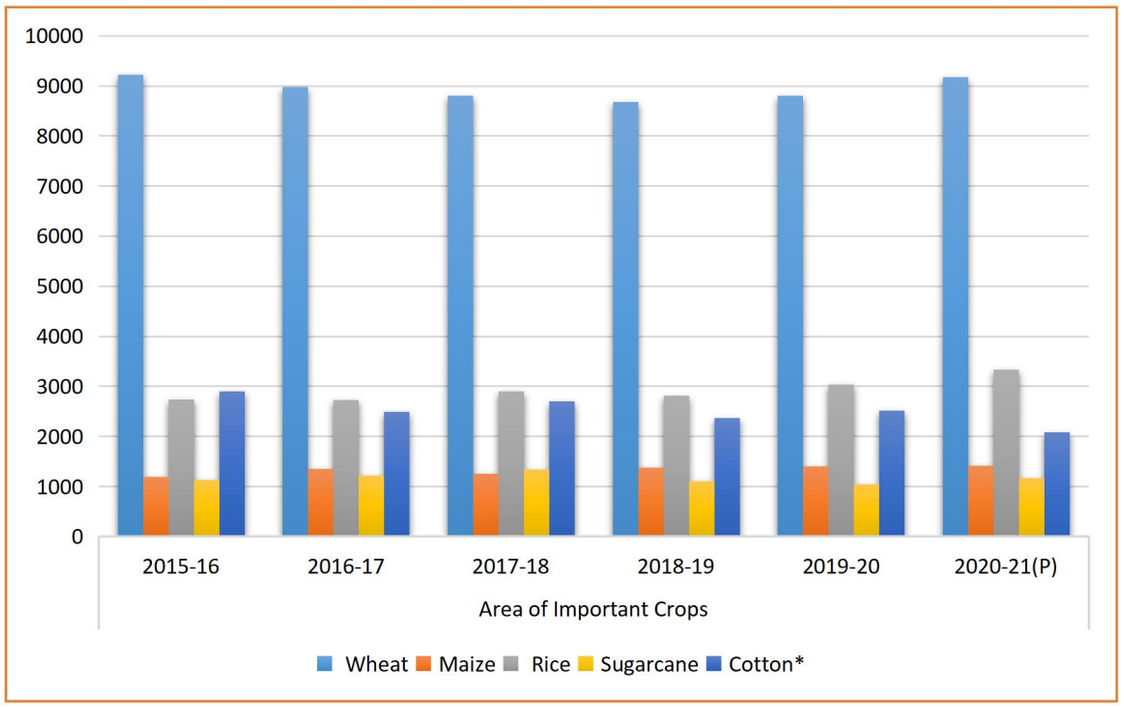
Introduction

Pakistan's agriculture industry is an important source of GDP. This study examines the influence of Human Capital investment on on-farm activity (productivity) in light of labour mobility (labour allocation) from off-farm to on-farm. Aside from that, the study concentrated on the connections between human capital development and agricultural output. The agriculture industry is the backbone of Pakistan's economy, as it provides the majority of the country's food. This industry accounts for 20.71 percent of Pakistan's GDP. When a farmer reaches a particular degree of experience, his or her productivity rises. However, the quality of workers determines how much experience influences productivity (human capital).The economic value of a worker's experience and skills is referred to as human capital. Education, training, Level of intelligence, skills, health, and other characteristics are included. The notion of Human Capital, first and foremost, may improve their productivity and effectiveness. Human capital is also important since it is thought to boost productivity and lead to profitability.This research looks at how human capital and labour allocation impact the productivity of Pakistani rural families. Human capital is studied not just in terms of its direct impacts on output and earnings, but also in terms of its indirect implications on labour allocation.



Throughout the years, the area of wheat has demonstrated a declining trend. Throughout the years, the maize area has shown an upward trend. In the selected years, the rice area showed a variety of trends. In the selected years, the sugarcane area likewise exhibits a little mixed pattern.

Objectives of the Study

After discussing the theoretical foundation, and problem statement the following objectives are determinates.

- This study aims to Assess the labor allocation across the farm and off-farm activity by considering human capital (level of education attained).
- This study aims to evaluate the impact of education on farm activity (wage allocation) given the movement of labor (labor allocation) from off-farm to on-farm.
- More specifically study aims to focused on linkages between human capital development and agriculture productivity.
- The impact of human capital on agriculture productivity conditioned upon the allocation of labor will be assessed.
- The comparative role of physical and human capital will also be evaluated.

Contribution / Significant of the study

This thesis is contributing to economic literature in the following ways:

- A relatively large number of studies conducted in Pakistan on productivity are at a macro level. This study provides micro-based evidence by incorporating education into the model.
- The role of Household-level farm enterprises is not adequately assessed to evaluate the impact of human and physical capital on-farm productivity. This study adequately the role of household-level and provides empirical evidence of them.
- Further incorporating human capital in the model has not addressedthe role ofallocation of labor so this study fulfilled these gaps.

The theoretical background of the Study

This section isdiscussed the theoretical foundation of this study because the theoretical foundation provides a backbone to economic research. The theoretical background is based on (Marcel and Agnes 1999). This study simply presenting the effect of human capital and labor allocation on agriculture productivity. Consider rural households that derive their livelihood from several competing income-generating activities, indexed by a. Production function, ga, is associated with each of these activities.

Ya = ga (LAa, Xa, Ta, Za)

Where Yadenotes agriculture productivity, LAadenotes labor allocation, Xais a vector of variable inputs, and Tastandsfor tools, equipment, and other semi-fixed factors. Zais a vector of human capital. Characteristics of the household. In a variety of ways, human capital can impact Y: better nutrition increases physical strength and increases labor efficiency; better education improves management and thus increases technical and allocative efficiency; leadership improves skills in labor supervision. We expect a significant positive relationship between Y and Z to the degree that human capital increases productivity. The productivity effects of human capital can also be investigated by observing how it affects household labor and input decisions. Let household choices be represented as an optimization problem whereby available manpoweris allocated between leisure and production to maximize joint utility. A Household's utility function is defined over income and leisure. Whereas unearned income, price of inputs, market wage rate, and manpower allocated to activity is also included in the model. Based on this Frameworkthe study is interestedin labor allocation to on-farm and off-farm activity.

Research Gaps

The examination of worldwide and national literature that preceded it gives a more comprehensive picture of education, production, and labour allocation. It has been noted that there are many aspects of this issue that are overlooked, necessitating the necessity for this research. A few points are made in the context of Pakistan to emphasise the gaps:

- While numerous studies on productivity have been undertaken in Pakistan, they have all been at a macro level, necessitating the necessity for a micro-level research. After that, detailed evidence is available, so the researcher gets a better picture of this topic.
- The role of Household-level farm enterprises is not adequately assessed to evaluate the impact of human and physical capital, so the need is to address this fact. Therefore, this study tries to fill this gap and provide a piece of empirical evidence for the researchers.
- Furtherly, incorporating human capital in the macro model has not addressed the role of allocation of labor so this study attempts to fill this gap.

The above-mentioned points are important and provide a significant base for this study. After that this study, the picture of this area is clearer for researchers.

Economic Model and Estimation Technique

The model of the study is divided into three parts. The first part provides a detailed discussion on construction of variable. The second section explains econometric model that examines the objectives of this research. Later on, in the last step, the estimation technique is presented through which the econometric model is analyzed. Furthermore, this section also discusses data, source, and data limitation

The Wage Differential, Dependency Ratio, Educational Groups, and Unemployment Rate by Educational Level are all included. Farm activity equation variables are generated at the PSU level due to the necessity for this investigation. The Primary Sampling Unit (PSU) level is made up of 200 to 250 families in one enumeration block (enumeration block is another name of primary sampling units). The Pakistan Bureau of Statistics (PBS) has a sampling farmework for the whole nation, which includes both urban and rural regions. Every town or city, whether urban or rural, is split into enumeration blocks, with a total of 200 to 250 homes surveyed from each enumeration block. In addition, the homes included in PSU are referred to as Secondary Sampling Units (SSUs).PSUs and SSUs are fixed for every province, PSUs consist of a total of 1,668 blocks whereas 26,688 households (SSUs) in every PSU. Given the description into the construction details of each variable are discussed below:

Farm Activity:The dependent variable constructed in 1 or 0 formations. This variable is constructed from the employment and income section of the survey.

Farm Wage: It is the main dependent variable in the second model. It includes the wages that are drive by farm activity. Farm wage is equal to the actual wage rate if an individual is involved farm activity.

Wage Differential: In a PSU, wage differential is estimated based on discrepancies in on-farm and off-farm wages. To calculate the pay gap, first calculate the farm wage, i.e. how much money is made if a person works on a farm. Then, using the same technique, off-farm earnings are calculated, based on those who engage in an off-farm activity and how much they earn.

Dependency Ratio:In this variable children less than 14 years and elders greater than 65 years is divided by the young population this variables is also aggregated across PSU.

Educational Group: This variable only considers an individual's highest class, which includes Primary, Middle, Matriculation, Intermediate, Graduation, and Master's degree. At the PSU level, each member in an Educational group is aggregated.

Unemployment Rate in Educational Group: The unemployment rate by educational group, consists of the unemployed population by educational level

Human Capital: Education is considered as proxy of Human Capital. It is because education is the key element through which human capability is measured

Empirical Models and Estimation Technique

The study assumes that Human Capital investment decisions (represented here by the level of education of the workers under study), Physical Inputs, Livestock, Land Tenure, Cultivated Land, and Access to Water all have an impact on farm wages. The model is formulated based on a review of the literature. These factors have a significant positive or negative impact on farm wages.

The rural modified equation 1, for Farm wage is as follows,

$$\mathbf{Farm\_wage_i} = f\ (\alpha_0 + \ \alpha_1 \mathbf{EDU} + \ \alpha_2 \mathbf{LS} + \alpha_3 PI + \ \alpha_4 LT + \alpha_5 CL + \alpha_6 AC + \mu_i) \qquad (3.2.2)$$

Hence;

- EDU represent Educational groups.
- LS is Cost of Cattle, buffalos, sheep, goats, horses in rupees.
- PI is Physical Inputs cost (cost of tube well, tractor, plough, thresher, harvest, and trucks) in rupees.
- LT is Land Tenure.
- CL is Cultivated Land in acres.
- AC = Access to Water, dummy variable.

Moving on to the first and most important aspect, education. t is usually observed that education create positive impact on wages. It implies that as one's degree of education rises, so does the wage level. Education has a favourable correlation with agricultural wage.

OLS revealed the biased outcome. The main reason for the biased results is that in this study, farm salary is only earned if the household person is active in agricultural activity, else 0. Farm pay (the dependent variable) is only noticed if the household is active in farming. As a result, OLS estimate may produce biased findings.

$$\boldsymbol{E(FW_i|FA_i = 1, X_i) = \alpha_i X_i + E(\mu_i|FA_i = 1) = \alpha_i X_i + E(\mu_i|\epsilon_i > - Z_i\beta)} \qquad \mathbf{(3.2.7)}$$

So, the second stage model in Heckman would use the predicted value of first stage model. Further, this will examine the effect of independent variables on the outcome. So, the problem of selection biases is resolved now, after incorporating the predicted farm wage probabilities as the supplementary explanatory variable in the model. The unobservable unknown residuals are observed in every stage of the Heckman model.

Further, at the first stage, the Probit model estimation explain the determinants of Farm activity as follows,

$$\mathbf{Farm\_activity_i} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\mathbf{WGD} + \boldsymbol{\beta_2 DR} + \boldsymbol{\beta_3 EG} + \boldsymbol{\beta_4 UMEG} + \in_i \quad \textbf{(3.2.8)}$$

Heckman Selection Model strictly follows these assumptions; firstly both model's error terms are normally distributed with 0 mean and variance.

$$(\epsilon,\mu) \sim (0,0,\sigma\epsilon 2,\sigma\mu 2) \quad \textbf{(3.2.9)}$$

Secondly, the residuals of both stages are correlated shown by the significant value of coefficient correlation (rho).

$$(\rho_{\epsilon,\mu}) \gtrless 0 \quad \textbf{(3.2.10)}$$

Finally, the residuals of both equations are uncorrelated with the independent variables of other sets.

$$(\epsilon,\mu)\ independent\ of Zi,i \quad \textbf{(3.2.11)}$$

The connection between the residuals of both phases must be checked. Assuming that the error words are connected to one another. If these error factors are associated with one another, the OLS model has selection bias. According to this estimate, farm wage is influenced by the potential of agricultural activities. However, if the error term of model 1 is uncorrelated with the residual of another model (2), it confirms that farm activity has no effect on farm wage. As a result, the second stage model is a random process that is unaffected by many unobservable factors.

$$E[(\varepsilon_i | u_i > -Z_i \gamma)] = \rho_{\varepsilon u}\sigma_\varepsilon \lambda_i(-Z_i \gamma) = \beta\lambda\ \lambda_i(-Z_i \gamma) \quad \textbf{(3.2.12)}$$

So, λi(-Ziγ)it is the inverse Mill's Ratio, and $\boldsymbol{\beta\lambda}$ is the unknown parameter and if $\boldsymbol{\lambda_i(-Z_i\ \gamma)}$is greater than 0 it shows the selection effect, and this justifies the Heckman Selection use in this study.

Empirical Analysis and Discussion

This section of the study covers the discussion on the empirical result based on the data extracted out from the HIES data set 2015-16. This section is divided into two parts, first part provides an empirical analysis based on Ordinary Least Square (OLS). In the second part, Heckman Selection Model (two steps) along with Marginal Effects obtained from the first step of the Heckman Selection Technique is discussed. Marginal effects give a proper understanding of the estimated coefficient obtained from Probit model.

The determinants of Farm Wage using the OLS technique. Results show that Education, Life stock, Land tenure, and access to water are positively related to Farm wage. Whereas Physical inputs and Cultivated land are negatively affecting Farm Wages. It may be because physical inputs and cultivated land needs diversion of large resources toward its provision hence decrease the investment on farm inputs necessary for production. Thus, decreasing the productivity and wages

Farmwage	**Coef.**	**Robust Std. Err.**	**t (P>t)**
Education	11422.24	5981.773	1.91 (0.056)
Lifestock	0.013102	0.0255827	0.51 (0.609)
Physical input	-0.008016	0.038567	-0.21 (0.835)
Land tenure	11646.57	4818.457	2.42 (0.016)
Cultivated land	-328.7621	1411.808	-0.23 (0.816)

Accesswater	0.3549105	0.1881331	1.89 (0.059)
_cons	22321.57	17339.87	1.29 (0.198)
F (6, 2133)	7.24	Prob>F	0.0000

This model above describes the determinants of farm wage based on systematically selected sample of a total of 2,140 households, (selected from rural areas only), which is selected from the random sampling from a population of 24,238 households. In this data set, some specific interests are common among the households, it presents those who belong to rural areas of the country and involve in farm or off-farm activity. But the result that is derived from OLS may be reflect biased results because selection without random sampling enhances the possibility of biases. To eliminate this problem from the model, Heckman Selection Technique is employed.

Determinants of Farm Wage using Heckman Selection Technique

	Coef.	**Std. Err.**	**Z**
a) Farm Wage			
Human Capital	12106.24**	4685.961	2.58 (0.010)
Life stock	0.0125348	0.0142412	0.88 (0.379)
Physical input	-0.0097319	0.0412069	-0.24 (0.813)
Land tenure	11581.590*	791.1905	14.64 (0.000)
Cultivated land	-374.9474	744.0117	-0.50 (0.614)
Access water	0.3412812*	0.0698678	4.88 (0.000)
_cons	111287.9	43512.63	2.56 (0.011)
b) Farm Activity			
Wage differential	-6.45E-07*	1.32E-07	-4.90 (0.000)
Dependency Ratio	0.0001939	0.0001513	1.28 (0.200)
Primary	0.0160364*	0.0016672	9.62 (0.000)
Middle	0.0082259**	0.0033994	2.42 (0.016)
Matriculation	0.0087644**	0.0041892	2.09 (0.036)
Intermediate	-0.008274	0.0073007	-1.13 (0.257)
Graduation	-0.0279797**	0.0125967	-2.22 (0.026)
Masters	-0.0286823**	0.0129672	-2.21 (0.027)
Unemployed primary	-0.098000*	0.0365223	-2.68 (0.007)
Unemployed middle	-0.055516	0.0445452	-1.25 (0.213)
Unemployed matric	-0.225971*	0.0402031	-5.62 (0.000)
Unemployed inter	-0.170736*	0.0576189	-2.96 (0.003)
Unemployed graduate	0.120668	0.0968111	1.25 (0.213)
Unemployed masters	-0.137046	0.117827	-1.16 (0.245)
_cons	-1.313348	0.0434036	-30.26 (0.000)
Mills Lambda	-65307.03**	30784.7	-2.12 (0.034)

Rho	-0.26631	Sigma
Wald chi2(6)	481.95	Prob > chi2

The above table presents the result of the Heckman Selection Technique that originated from the two-step method. In the first step, farm activity (measured as 1 if includes in farm activity) otherwise 0 is considered as dependent variable. The result shows that possibility of including in farm activity is significantly affected by all the variables that are included in the study except Dependency ratio, people with Intermediate (education), unemployed middle pass population, unemployed graduate population, and unemployed masters degree population. Other factors that are showing positive and significant impact on farm activity are Primary, Middle, and Matriculation education. While other components such as Wage of Graduate population and Masters degree holders. Unemployed Primary population, Unemployed Matric population, and Unemployed Inter population are negatively but significantly related to farm activity.

Human capital is one of the most important elements and determinants of the wage either for farm or for off-farm. In this study, human capital is measured in terms of education level (that what is the highest class completed by an individual?). The positive and significant effect shows that education is the main and most important component of Farm Wage. When the education level increases, wages for an individual also increases. Same as in for farm activity when an individual is educated then they can understand the new technology through which farm activity become easy and cheap which increases the probability of huge wage return.

Another determinant of farm wage is Land tenure, in which three categoriesare included, land owned, land rented, and land sharecropped. PSLM data set provides detailed information on these three categories of land tenure. And in this study dummies of owned land, rented land and share cropped is used. If land is owed by farmer that is equal to 1 otherwise 0.The result shows a positive and significant result of land tenure on-farm wage. This is because when farmers worked on sharecropped land,they ultimately gaining something in terms of wages for their families. While rented land may create a burden on farm income after detecting the rent from farmer's income very limited amount of money is left for their family. But from all of above farmers who owned a part of the land to do farm activity are the highest beneficiary, among others.

Conclusion

After reviewing international and national literature this study distinguished that many studies were conducted in Pakistan on productivity at the macro level. These studies are not adequately assessed to evaluate the impact of human and physical capital role on household-level farm enterprises and incorporating human capital in the macro model has not addressed the role of allocation of labor. Hence this study contributes to the existing literature by assessing the labor allocation across the farm and off-farm activity by considering human capital (level of education attained).The impact of human capital on agriculture productivity conditioned upon the allocation of labor is assessed especially.The comparative role of physical and human capital is also apprised. For this purpose, data is collected from the Agri-sheet of Household Integrated Economic Survey (HIES), and the socio-economic variable is taken from HIES as well, published by the Pakistan Bureau of Statistics, cross-sectional data (2015-16) is used because of the unavailability of data for further years at the time of this thesis. Heckman's two-step selection approach is employed for estimating the results of this study, in which the income model is estimated through the OLS technique, and the Farm Activity model is estimated through Probit.To describes the determinants of farm wage a sample of a total of 2,140 households are chosen (selected from households belonging to rural areas only), it is selected from a random sampling from a population of 24,238 households. This data set has some specific interests that are common among the households. It presents households belonging to rural areas of the country who are involved in a farm or off-farm activity. Furthermore, the result that is obtained from OLS revealed biased results due to the selection problem because Nonrandom sampling increases the possibility of biases. For the solution of this problem, Heckman Selection Technique is employed because it is more appropriate for this research.

The empirical assessment shows that the two models are highly significant and all the independent variables having an impact on the dependent variables.

The result of the study shows in Table 5.1discussed the determinants of Farm Wage using the OLS method. Results show that Education, Life stock, Land tenure, and access to water are positively related to Farm wage. Although Physical inputs and Cultivated land are negatively influencing the Farm Wages. The reason behind that the physical inputs and cultivated land needs diversion of large resources toward its provision hence decrease the investment on-farm inputs necessary for production. Thus, decreasing productivity increasing the wage. Whereas Table 5.2 presents the result of the Heckman Selection Technique that has a two-step method. In the first step, farm activity (measured as 1) otherwise 0 is considered as a dependent variable. The result shows that possibility of including in farm activity is significantly affected by all the variables that are comprised in the study excluding Dependency ratio, people having Intermediate (education), unemployed middle poor population, unemployed graduate population, and unemployed master's

population. Other factors that have a positive and significant impact on farm activity are the population with Primary, Middle, and Matriculation education. Moreover, the Unemployed Primary population, Unemployed Matric population, and Unemployed Inter population are negatively but significantly related to farm activity.

In addition to the above, the Heckman model is pointless for an explanation until marginal effects are not obtained. However, before the estimation of the Heckman model, it is essential to assess the Probit model for predicting the conditional marginal coefficient for analyzing the significant coefficients for the model. Farm activity in the first model of the study is a latent variable equal to 0 and 1. So, Table 5.3 shows the results of marginal effect obtained through the Probit model-selection equation that is explaining determinants of Farm Activity. According to the results, an increase is observed in wage differential shows an increasing trend in investment for farm activity. This variable showing a positive and significant impact on farm activity. This indicates that off-farm wages are increases, individuals move from farm activity to off-farm activity.The dependency ratio is also significant and positively related to farm activity. The association between dependency ratio and farm activity is positive and significant.

Policy Recommendations

After debating the result of this research, few policy recommendations are suggested for the policymakers of Pakistan. These policies help them to understand the impact of education on farm activity/ productivity. The suggested policies are:

- The study suggested that it is necessary to increase the enrolment rate at all education levels so education-based policies should be introducing because:
  - Education contributes to economic development through the production of knowledge and skills.
  - It also increases labor productivity and quality of life.
- Policies should be introduced that provide technical training related to farm equipment and skills.
  - It helps those farmers that are uneducated and having less knowledge.
- Policies should be introduced that provide knowledge regarding new technical equipment to the farmers. It reduced harvesting time and cost.
- Human capital is assessable through education so Agri-based courses should be introduced at institutions levels.
- A better and accurate land tenure system can be introduced that will be monitored by the government regularly.
- Policies should be designed in such a way to provide better incentives and facilities to those who are doing farm activity, this will improve the skills of the farmworker and ultimately their income.
- Access to water is an important element for farm activities so introducing policies to store water should be introduced which can help the farmers to save water.
- Livestock is an asset for the farmworkers. The policies should be introduced to the farmers to have healthy and better upbringing facilities. It furtherly helps the economy because it generated income for farmers and fulfilled the food need of the citizens as well.
- Being an agriculture economy, a research department is essential for the Agri-industry. Policies should be introduced that can promotes Agri-based research. So that, better equipment and fertilizers, and new techniques for harvesting can be introduced to the farmers.
- Policies should be introduced to build infrastructure like roads, bridges, etc., and provides better vehicles. It can provide easy excess towards the markets and save time and cost.

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