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A Geographical Analysis on Sustainable Agricultural Development in Purba Bardhaman District, West Bengal

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Abstract:
Sustainable agricultural development has emerged as a significant area of geographical research due to the growing concerns related to food security, environmental sustainability, resource depletion, climate change and rural livelihood transformation. A geographical approach helps identify regional disparities and the factors responsible for differences in agricultural sustainability. The importance of integrated planning, local resource management, participatory approaches and policy interventions for achieving long-term agricultural development. It also highlights the challenges faced by farming communities such as land degradation, changing climatic conditions, market uncertainties, and socio-economic inequalities affecting sustainable agricultural transformation. In this article, a geographical analysis on sustainable agricultural development in Purba Bardhaman district, West Bengal was discussed.

Keywords: *Sustainable, Agricultural, Development, Purba Bardhaman.*

I. INTRODUCTION:

Agriculture has been one of the most significant human activities shaping economic development, social well-being, and environmental sustainability across the world (Arus, P., 2020). In the contemporary era, increasing population pressure, climate change, land degradation, water scarcity, and declining agricultural productivity have created serious challenges for the long-term sustainability of agricultural systems (Behera, D.K., 2015). Sustainable agricultural development has emerged as a comprehensive approach that seeks to balance agricultural productivity, environmental conservation, and socio-economic equity to ensure food security for present and future generations (Kapoor, O.V. et al., 2019). A geographical analysis of sustainable agricultural development focuses on the spatial variations, regional disparities, and environmental factors influencing agricultural practices and outcomes (Livsey, J., 2021). Geography provides an integrated framework for understanding the relationship between human activities and natural resources by examining the interaction between climate, soil, land use, water availability, technology, demographic characteristics, and socio-economic conditions (Narayan, B.S., 2012). Such an analysis helps identify how different regions adopt sustainable practices according to their ecological and socio-economic contexts. Sustainable agriculture emphasizes efficient resource utilization, conservation of biodiversity, reduction of environmental impacts, and improvement of farmers' livelihoods. Practices such as organic farming, integrated pest management, crop diversification, agroforestry, conservation agriculture, and efficient irrigation systems contribute to maintaining ecological balance while enhancing agricultural resilience (Roy, C., 2011). However, the adoption and effectiveness of these practices vary significantly across geographical regions due to differences in physical landscapes, institutional support, market accessibility, and technological advancement (Sarkar, S., Ghosh, T.K., 2017). The objective of the study is to geographical analysis on sustainable agricultural development in Purba Bardhaman district, West Bengal.

II. RESEARCH METHODOLOGY:

Research is a systematic approach to inquiry. Research methodology denotes the systematic and theoretical analysis of the methods utilized within a specific domain.

Study Area: Purba Bardhaman District, West Bengal.

Variables:

Dependent Variables: Age, Gender.

Independent Variables: Sustainable Agricultural Development, Agricultural Productivity, Agricultural Sustainability.

Research Design:

The research design serves as a method for answering the research questions. The comprehensive strategy or framework that guides the trajectory of research is referred to as research design. The objective of qualitative research is to understand how individuals see the world. The objective of quantitative research design is to

ascertain the quantity of individuals who believe, act, or feel in a particular manner. In this research, qualitative and quantitative research design has been used.

Primary Data and Secondary Data:

Primary data denotes information derived from first-hand accounts or empirical facts, especially within the framework of research. It may also be termed as primary knowledge or unprocessed data. An external entity or agency conducts the analysis, necessitating investment and human resources, hence rendering the information compilation process costly. Researchers refer to secondary data as previously collected and documented material that does not directly relate to the current research problem. It is accessible as data collected from diverse sources, including governmental publications, censuses, internal organizational records, books, journal articles, websites, reports, and electronic resources. In this research, primary and secondary data has been used.

Sampling Plan:

Sampling methodology pertains to the analysis of a population via data examination and information collection. Each element in the population possesses an equal and probable chance of selection for the sample when employing the simple random sampling method. In this research, simple random sampling plan has been used.

Sample Size: 600.

Methodology:

The farmers were selected from the Purba Bardhaman District, West Bengal. The questionnaire sheets were distributed in favor of the respondents after clearing the research objectives. The age of the respondents were 30 to 60 years. Sufficient time was given in favor of the respondents. After completion of their sheet, the sheet was collected for data analysis and interpretation.

Research Tools:

Structured Questionnaries & 5 Point Likert Scale Sheet:

A questionnaire is a series of questions or extra prompts that are meant to get information from a group of people. In this research, structured questionnaires (5 Point Likert Scale sheet) were used.

Tools Used:

- Existing Agricultural Practices and Evaluate Their Sustainability in terms of Environmental, Economic and Social Dimensions Scale
- Key Determinants Influencing Agricultural Sustainability, Including Soil Health, Water Availability, Cropping Patterns, Input Usage and Technological Adoption Scale

Data Analysis and Interpretation:

Data analysis entails examining raw data to discern patterns, formulate conclusions, and inform decision-making. Data interpretation entails understanding, organizing, and extracting meaningful insights from data. In this research, pie charts were used.

III. DATA ANALYSIS, INTERPRETATION, RESULTS AND DISCUSSION:

Personal Profile:

Table. 1. Age (in years):

Options	Respondents	%
30-40 years	287	47.83
41-50 years	188	31.34
51-60 years	125	20.83
Total	**600**	**100**

(Source: Primary Data, Survey)

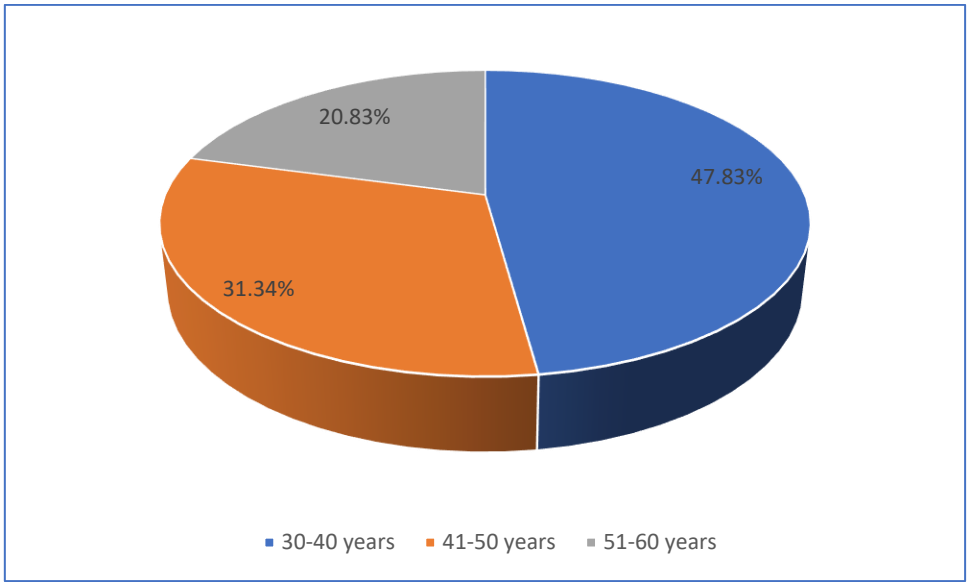

Figure. 1. Age (in years) (%)

From the above table & figure, it was found that the percentage of 30-40 years: 47.83%, 41-50 years: 31.34% & 51-60 years: 20.83%.

Table 2. Gender:

Options	Respondents	%
Male	300	50
Female	300	50
Total	**600**	**100**

(Source: Primary Data, Survey)

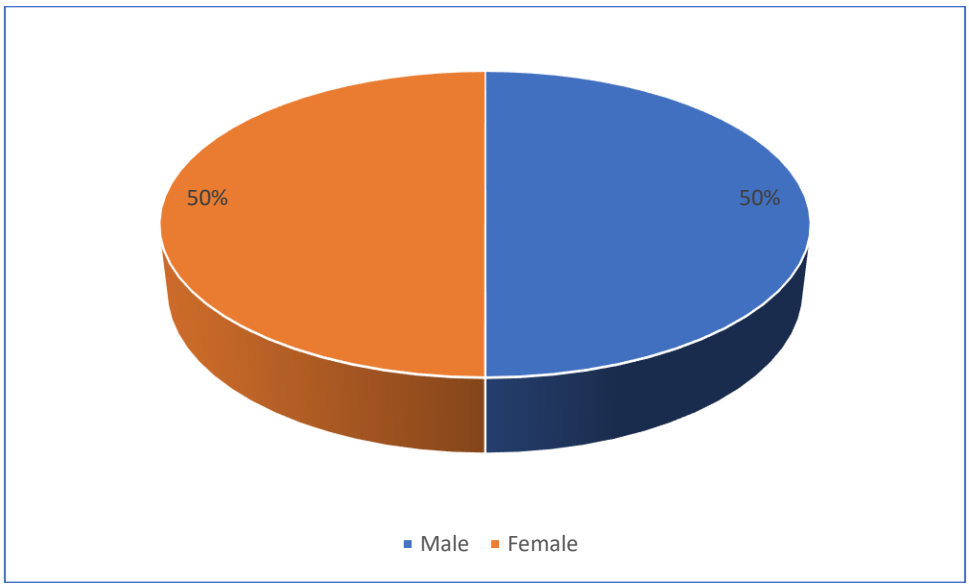

Figure 2. Gender (%)

From the above table & figure, it was found that the percentage of male: 50% & female: 50%.

Existing Agricultural Practices and Evaluate Their Sustainability in Terms of Environmental, Economic and Social Dimensions:

Environmental Sustainability:

Table 3. The current agricultural practices help in conserving soil fertility:

Options	Respondents	%
SA	86	14.33
A	126	21
N	104	17.33
D	169	28.16
SD	115	19.18
Total	**600**	**100**

(Source: Primary Data, Survey)

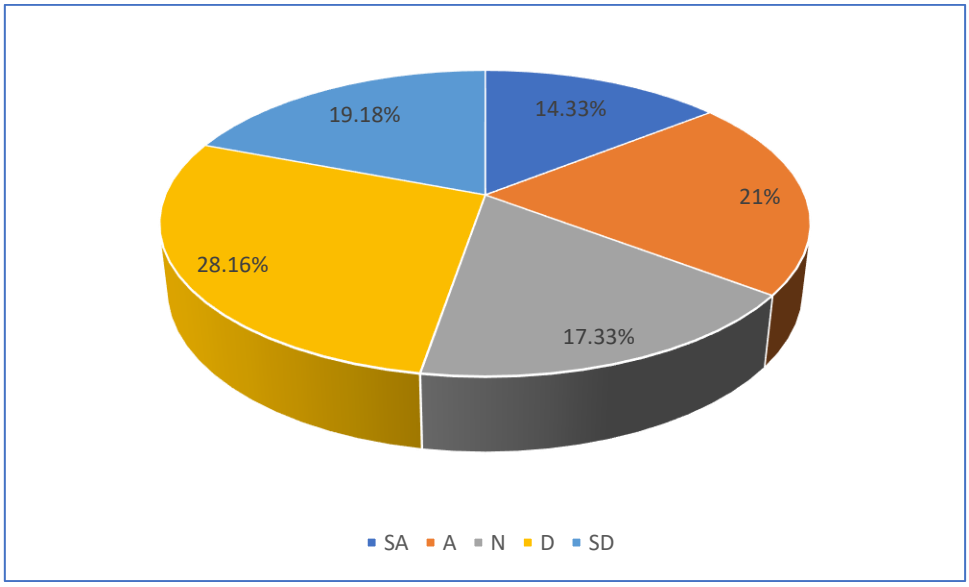

Figure 3. The current agricultural practices help in conserving soil fertility (%)

From the above table & figure, it was found that the percentage of SA: 14.33%, A: 21%, N: 17.33%, D: 28.16% & SD: 19.18%.

Economic Sustainability:

Table 4. The current farming methods provide stable income for farmers:

Options	Respondents	%
SA	75	12.5
A	101	16.83
N	46	7.67
D	272	45.33
SD	106	17.67
Total	**600**	**100**

(Source: Primary Data, Survey)

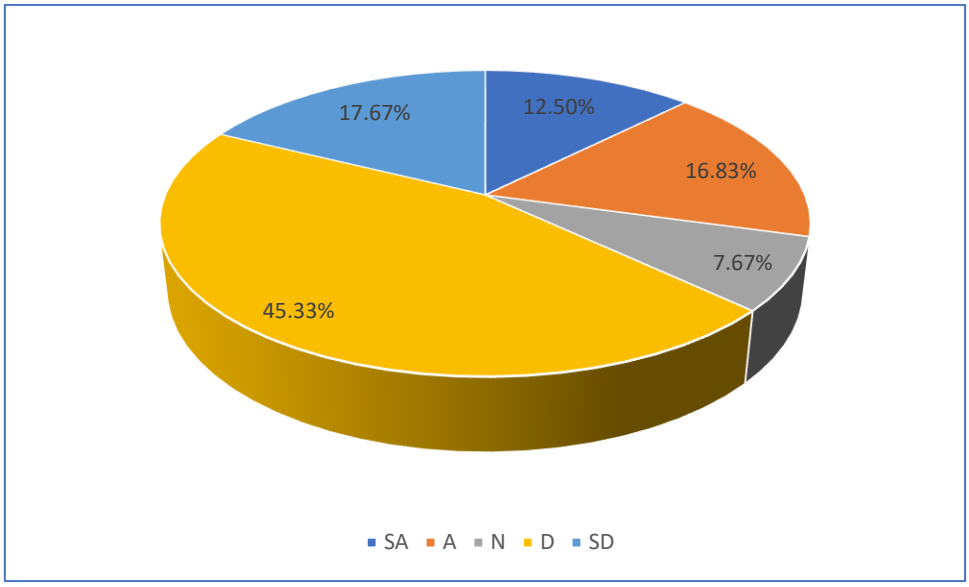

Figure 4. The current farming methods provide stable income for farmers (%)

From the above table & figure, it was found that the percentage of SA: 12.5%, A: 16.83%, N: 7.67%, D: 45.33% & SD: 17.67%.

Social Sustainability:

Table 5. Farming practices ensure safe and healthy working conditions for farmers:

Options	Respondents	%
SA	140	23.33
A	173	28.83
N	29	4.83
D	139	23.17
SD	119	19.84
Total	**600**	**100**

(Source: Primary Data, Survey)

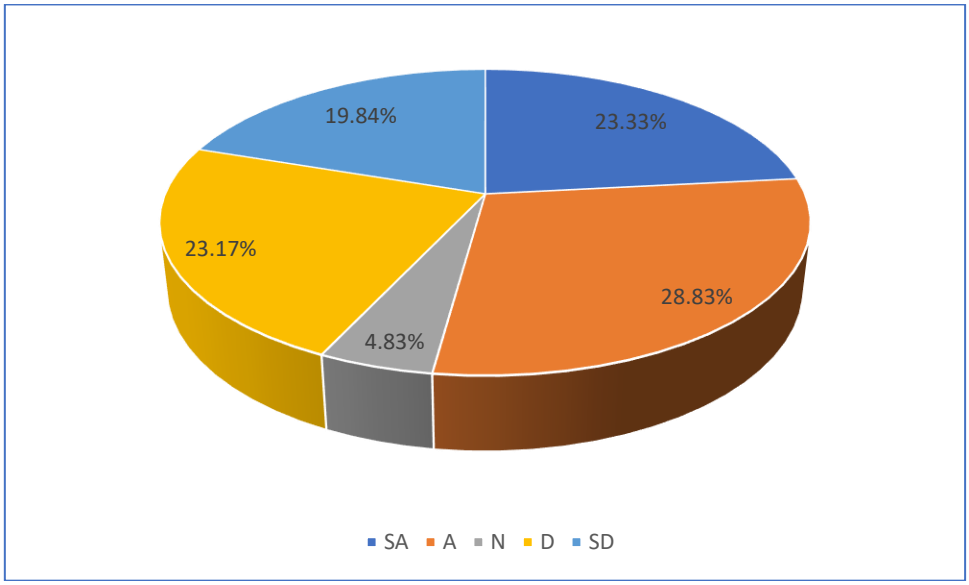

Figure 5. Farming practices ensure safe and healthy working conditions for farmers (%)

From the above table & figure, it was found that the percentage of SA: 23.33%, A: 28.83%, N: 4.83%, D: 23.17% & SD: 19.84%.

Existing Agricultural Practices:

Table 6. The current agricultural practices balance environmental, economic, and social needs:

Options	Respondents	%
SA	164	27.33
A	157	26.17
N	59	9.83
D	142	23.67
SD	78	13
Total	**600**	**100**

(Source: Primary Data, Survey)

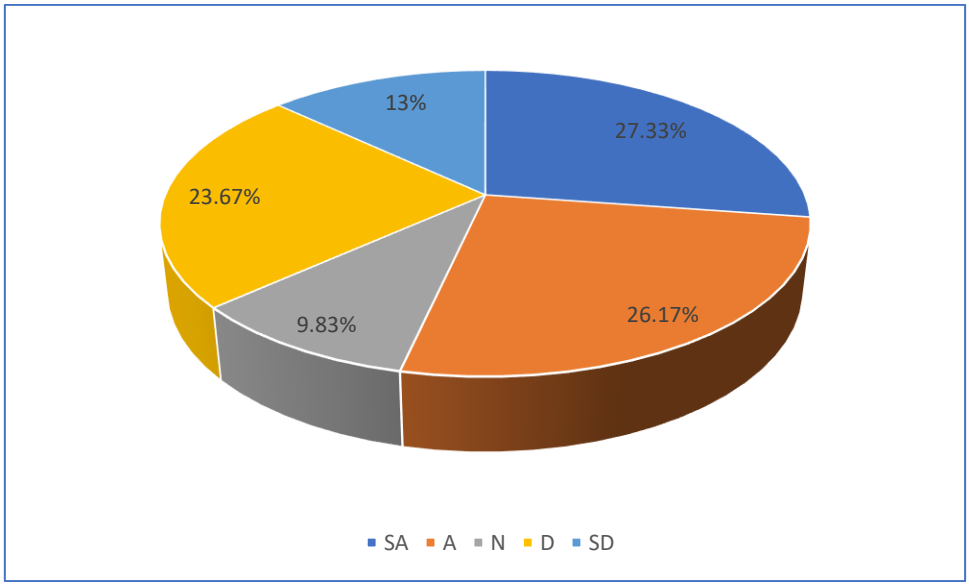

Figure 6. The current agricultural practices balance environmental, economic, and social needs (%)

From the above table & figure, it was found that the percentage of SA: 27.33%, A: 26.17%, N: 9.83%, D: 23.67% & SD: 13%.

Key Determinants Influencing Agricultural Sustainability, Including Soil Health, Water Availability, Cropping Patterns, Input Usage and Technological Adoption:

Soil Health:

Table 7. The fertility of my farmland is adequate for sustaining long-term crop production:

Options	Respondents	%
SA	175	29.17
A	193	32.17
N	68	11.33
D	112	18.66
SD	52	8.67
Total	**600**	**100**

(Source: Primary Data, Survey)

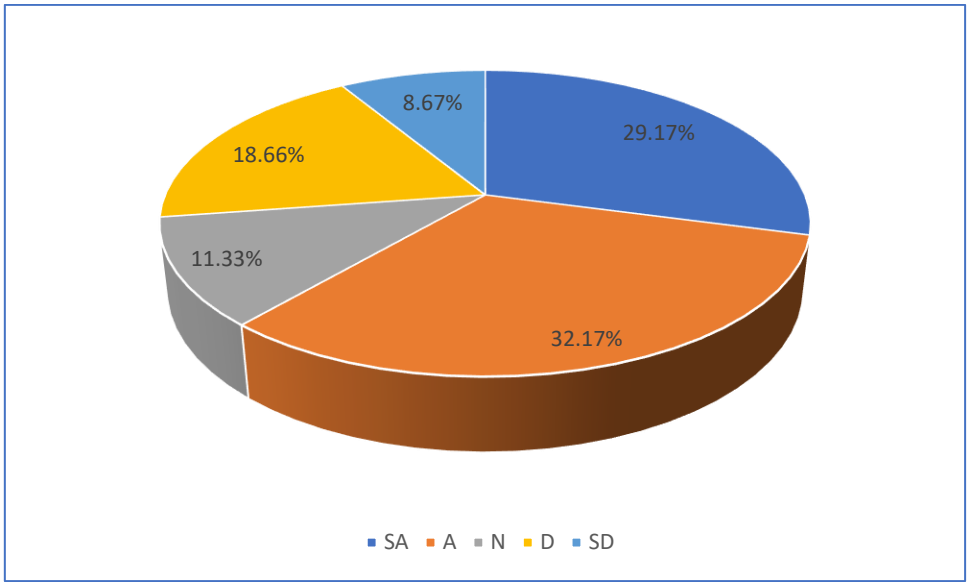

Figure 7. The fertility of my farmland is adequate for sustaining long-term crop production (%)

From the above table & figure, it was found that the percentage of SA: 29.17%, A: 32.17%, N: 11.33%, D: 18.66% & SD: 8.67%.

Water Availability:

Table 8. Water resources available to my farm are sufficient throughout the cropping seasons:

Options	Respondents	%
SA	161	26.83
A	206	34.33
N	39	6.5
D	109	18.17
SD	85	14.17
Total	**600**	**100**

(Source: Primary Data, Survey)

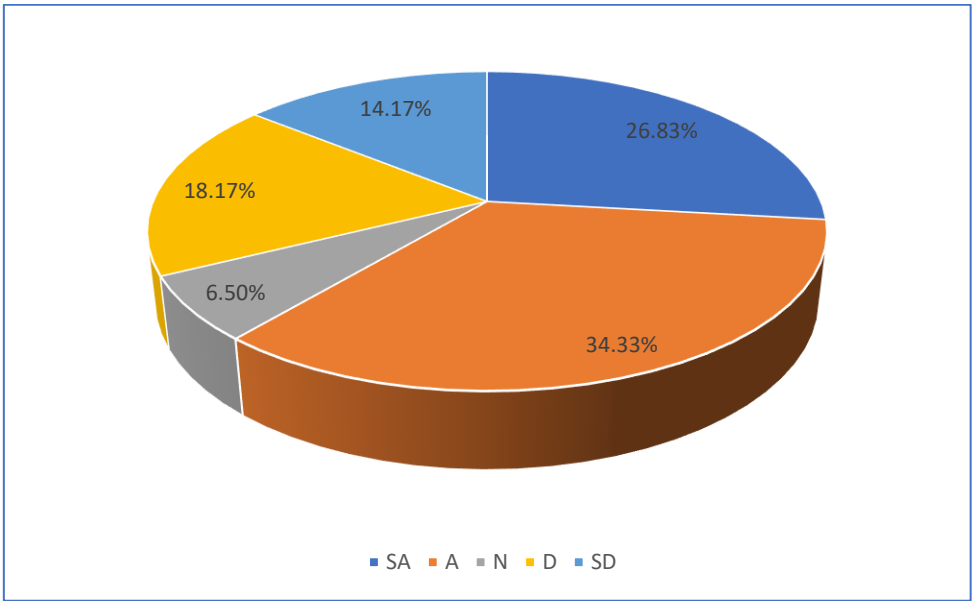

Figure 8. Water resources available to my farm are sufficient throughout the cropping seasons (%)

From the above table & figure, it was found that the percentage of SA: 26.83%, A: 34.33%, N: 6.5%, D: 18.17% & SD: 14.17%.

Cropping Patterns:

Table 9. I follow crop rotation practices that help maintain soil fertility:

Options	Respondents	%
SA	161	26.83
A	188	31.33
N	35	5.84
D	117	19.5
SD	99	16.5
Total	**600**	**100**

(Source: Primary Data, Survey)

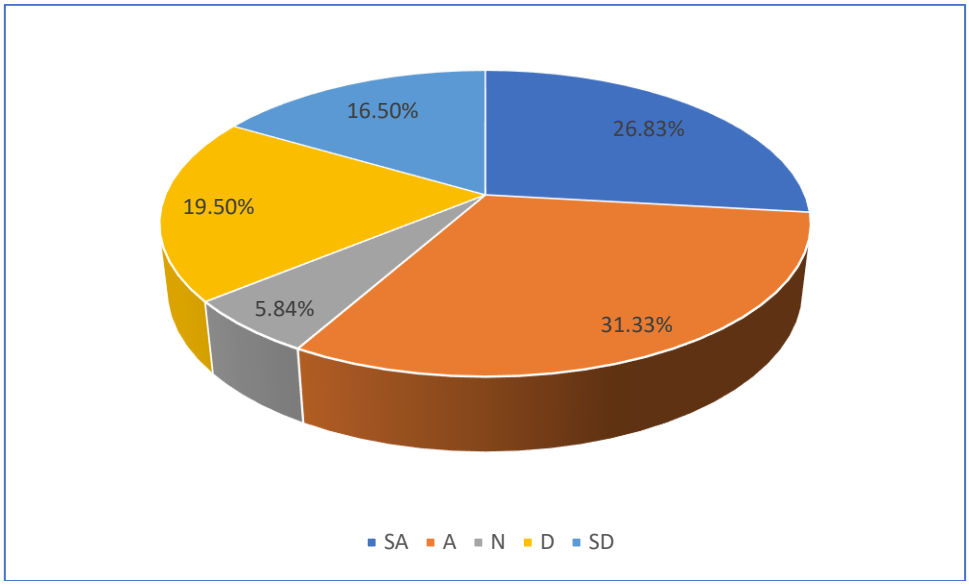

Figure 9. I follow crop rotation practices that help maintain soil fertility (%)

From the above table & figure, it was found that the percentage of SA: 26.83%, A: 31.33%, N: 5.84%, D: 19.5% & SD: 16.5%.

Input Usage:

Table 10. I use chemical fertilizers in a balanced and efficient manner:

Options	Respondents	%
SA	69	11.5
A	128	21.33
N	44	7.33
D	206	34.34
SD	153	25.5
Total	**600**	**100**

(Source: Primary Data, Survey)

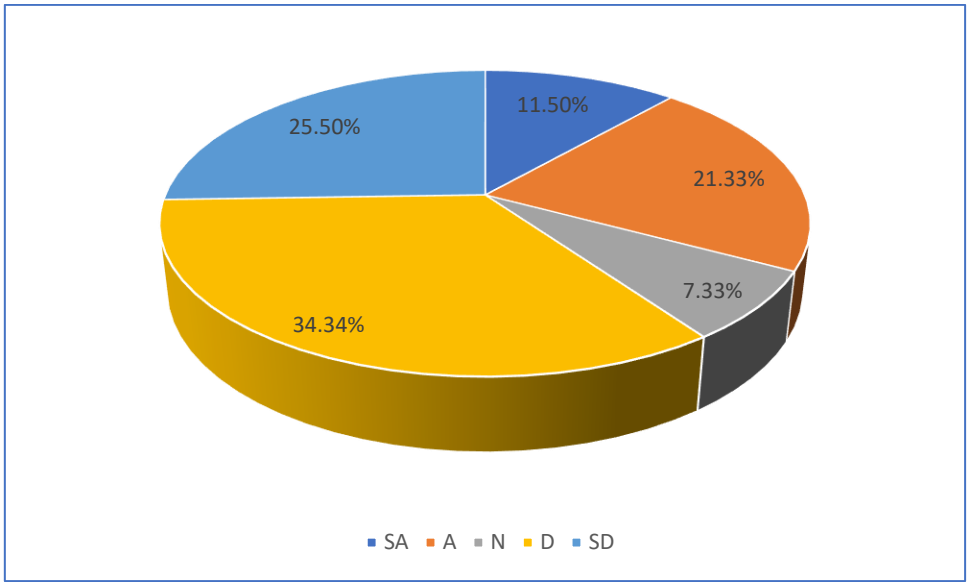

Figure 10. I use chemical fertilizers in a balanced and efficient manner (%)

From the above table & figure, it was found that the percentage of SA: 11.5%, A: 21.33%, N: 7.33%, D: 34.34% & SD: 25.5%.

Technological Adoption:

Table 11. I regularly adopt new agricultural technologies to improve productivity:

Options	Respondents	%
SA	171	28.5
A	196	32.67
N	34	5.67
D	126	21
SD	73	12.17
Total	**600**	**100**

(Source: Primary Data, Survey)

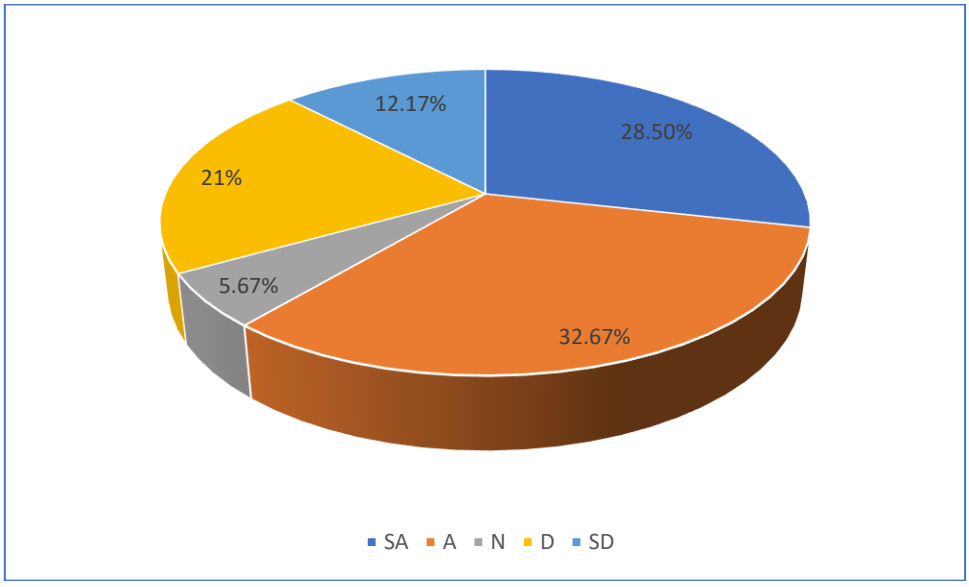

Figure 11. I regularly adopt new agricultural technologies to improve productivity (%)

From the above table & figure, it was found that the percentage of SA: 28.5%, A: 32.67%, N: 5.67%, D: 21% & SD: 12.17%.

IV. CONCLUSION:

This study on sustainable agricultural growth in Purba Bardhaman District emphasizes the complex interplay among natural resources, socio-economic factors, and technology innovations that influence the region's agricultural environment. Purba Bardhaman, a prominent agricultural district in West Bengal, demonstrates a robust production foundation bolstered by fertile alluvial soil, reliable irrigation from the Damodar Valley Command Area, and a longstanding legacy of agricultural techniques. Nevertheless, the data reveal that sustainability continues to be a critical issue owing to escalating land pressure, reliance on groundwater, overutilization of fertilizers and pesticides, and farmers' susceptibility to climate uncertainties. The research indicated that whereas agricultural productivity has enhanced over time, ecological sustainability has not progressed correspondingly. Challenges such as diminishing soil fertility, decreased crop diversity, and difficulties in water management highlight the necessity for a transition from traditional input-intensive agriculture to more environmentally sustainable approaches. The implementation of organic inputs, integrated nutrient management, crop rotation, and water-efficient technologies such as drip and sprinkler irrigation can significantly contribute to the restoration of ecological equilibrium. The study indicates that small and marginal farmers, who represent the predominant group of cultivators in Purba Bardhaman, encounter challenges associated with restricted capital, insufficient access to finance, market volatility, and inadequate extension services. Augmenting institutional support, improving access to contemporary technologies, and promoting farmer cooperatives and self-help organizations can markedly enhance their adaptive capacity and resilience.

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