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Optimizing resource use efficiency and environmental pollution in vegetable crops of vindhyan region of Eastern Uttar Pradesh

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Abstract
Agriculture is the backbone of the India faces occasional upheavals in the production and productivity due to climatic aberrations resulting widespread floods, droughts and other natural calamities. Given the finite supply of natural resources, agriculture that is inefficient may eventually exhaust the available resources or the ability to afford and acquire them. It may also generate negative externality, such as pollution as well as financial and production costs, which has cascading effect on the human life. Agriculture that relies mainly on inputs that are extracted from the earth's crust or produced by society, contributes to the depletion and degradation of the environment. Despite this continuing practice, unsustainable agriculture continues because it is financially more cost-effective than sustainable agriculture in the short term. In the present study, I have tried to show the natural and human resource use pattern in agriculture using different crops grown in the region and resource use efficiency of the inputs used in different crops. Efficiency of the input use has been worked out with the help of Cobb Douglas production function in which the existing input use, recommended input use in the different crops and the optimal input use have been worked out to compare the trade-offs between the level of input use. Further the carbon emission on the farms has been studied by fertilizer and diesel use.

Keywords: agriculture, input use, natural resource, efficiency, vegetable crops, cobb-douglas production function

Introduction

In term of economy the extent to which farm revenue can be generated depends on market orientation and government subsidy. The sold value of crops must be accounted in the sustainability equation. Fresh agricultural produce sold from a farm requires little additional energy, in addition to energy required for cultivation, harvest, and transportation (including consumers). Food sold at a remote location, whether at a farmers' market or the supermarket, incurs a different set of energy cost for materials, labour, and transport. To be sold at a remote location requires a complex economic system in which the farm producers form the first link in a chain of processors and handlers to the consumers. Such practice provide greater revenue due to efficient transport of a large number of items, but it involves externalities and relies on the use of non-renewable resources, shipping, processing, and handling, making it least sustainable. Moreover, such a system is considered vulnerable to fluctuations, such as strikes, oil prices, and global economic conditions including labour, interest rates, futures markets, and farm product prices.

In Third World agriculture anthropologist Robert Netting's work play significant role in as social components of sustainability.. In Smallholders, Householders: Farm Families and the Ecology of Intensive, Sustainable Agriculture, he defines an important cross-cultural pattern of high-labor, high-production cultivation exemplified East Asian paddy rice cultivators, African cultivators such as the Kofyar, alpine peasants, and Mesoamerican farmers of raised fields. One key to socio-economic sustainability in such systems is that these farmers systems provide for much of their own subsistence and also participate in the market. From a system's view, the gain and loss factors for sustainability can be listed. The most important factors for an individual site are sun, air, soil and water as rainfall. These are naturally present in the system as part of the larger planetary processes and incur no costs. Of the four, soil quality and quantity are most amenable to human intervention through time and labour. (The economic input depends solely on the price of labour and cost of machinery used). Natural growth and outputs are also subject to human intervention. What grows and how and where it is grown is a matter of choice. Two of the many possible practices of sustainable agriculture are crop rotation and soil amendment, both designed to ensure that crops is cultivated can obtain the necessary nutrients for healthy growth.

Keeping in view, the population of India, where more than 55 per cent of the populations are employed in agriculture and allied sectors, agriculture is the back bone of this country, the scenario of agriculture in Uttar Pradesh, which is the most populous state of the country, is not very different than in other regions in the country. There are variations in the availability of natural resources and socioeconomic conditions in the rural areas.

According to Pretty and Ball, 2001, Agriculture as an economic sector contributes to carbon emissions through the consumption of direct and indirect fossil fuel. With the increased use of nitrogen fertilizers, pumped irrigation and mechanical power, industrialized agriculture has become progressively less energy efficient. These three sources account for more than 90% of the total energy inputs to farming. Under the Framework Convention on Climate Change, a source is any "process or activity which releases a greenhouse gas, or aerosol or a precursor of a greenhouse gas into the atmosphere".

Research Methodology

Sampling Design

The study has been conducted in Eastern part of the state of Uttar Pradesh which is purposively selected, with the reason that there are hardly few studies of this kind have taken place. Study has been conducted in the districts of Sonbhadra and Mirzapur purposively with the reason that the district is having the maximum farming land used for cultivation of different crops in the state. The district Sonbhadra comprises of 8 community development blocks out of which 1 block has been selected randomly, further 6 villages from selected block has been selected arbitrarily making total 6 selected village. District Mirzapur comprises of 12 community development blocks out of which 2 blocks has been selected, further 6 villages from each selected block has been selected making a total of 12 selected village, making a total of 18 villages in the study.

Analytical Tool

The Cobb-Douglas production function in logarithmic form is linear in the parameters and this brings use of it into the general framework of linear statistical analysis, as is quite familiar (Afriat,1972).The land use pattern, cropping pattern, input use pattern and productivities of the crops were examined.The concept of the technical efficiency of firms has been of fundamental importance for the development and application of econometric models of production functions. The definition of the technical efficiency of a given firm (at a given time period) as the ratio of its mean production (conditional on its levels of factor inputs and firm effects) to the corresponding mean production if the firm utilized its levels of inputs most efficiently (Battese and Coelli, 1991). The resource use efficiency in crop production was estimated with the help of Cobb-douglas production function. The Cobb-Douglas production function as also used by Afriat; 1972; Battese, 1991;Campus, 2014,; Gautam et.al., 2018 for efficiency of production function is described as below:

$$Y = a X_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} X_6^{b6}$$

Where,

Y= Output (Quintals); a = Intercept; X_1= Labour (Mandays); X_2= Capital (Rs): X_3= Seed (Q/Kg): X_4= Pesticide (Rs.); X_5= Diesel (Lit.): X_6= Fertilizer (Kg/Ha)

b_1, b_2, b_3, b_4, b_5 and b_6 are regression coefficients.

For estimation of the above mentioned model, it is converted into linear form by taking log on both the sides. The double log linear form of the model may be written as:

$$\text{Log } Y = a+b_1\log X_1+b_2\log X_2+b_3\log X_3+b_4\log1 X_4+b_5\log X_5+ b_6\log X_6$$

The efficiency of various inputs were estimated by working out their marginal productivities as mentioned below:

$$\frac{d\bar{Y}}{d\bar{X_i}} = \frac{b\bar{Y}}{\bar{X_i}}$$

And then $\frac{b\bar{Y}}{\bar{X_i}}$ was compared with $\frac{Px}{Pyi}$. With following conclusions:

If, $\frac{b\bar{Y}}{\bar{X_i}} > \frac{Pxi}{Py}$, there is under use of the i^{th} input in the production process,

If, $\frac{b\bar{Y}}{\bar{X_i}} < \frac{Pxi}{Py}$, there is over use of the i^{th} input in the production process and

If, $\frac{b\bar{Y}}{\bar{X_i}} = \frac{Pxi}{Py}$, there is optimal use of the i^{th} input in the production process.

The optimal level of the input use can be calculated by following equation

$$Xi = \frac{b\bar{Y}.Py}{Pxi}$$

The recommendations for increasing or decreasing the input use were made (Meeusen, and Broeck, 1977; Gautam et. al., 2018).

Results and Discussion

Table 1: Regression Coefficients for the crops using Cobb Douglas Production Function

S.No.	Crops	Constant	X_1 (Labour)	X_2 (Capital)	X_3 (Seed)	X_4 (Pesticide)	X_5 (Diesel)	X_6 (Fertilizer)	R^2
1.	Brinjal	20.09	0.13* (1.91)	0.007* (1.86)	0.004** (2.56)	0.10* (1.95)	0.125*** (3.82)	0.07*** (4.1)	0.72
2.	Chilli	0.0014	0.57	0.04	1.3	0.09	0.28* (2.31)	0.31* (2.42)	0.63
3.	Okra	16.23	0.10* (2.23)	0.01	0.06	0.01	0.11* (2.12)	0.05* (2.43)	0.65
4.	Onion	10.41	0.22* (2.31)	0.01	0.007	0.003	0.10* (2.41)	0.07* (2.25)	0.71
5.	Potato	5.65	0.14* (2.41)	0.01	0.19* (2.45)	0.03	0.21* (2.37)	0.14* (2.39)	0.77
6.	Tomato	50.90	0.06* (2.10)	0.004	0.01	0.009* (1.95)	0.06* (2.21)	0.09* (2.32)	0.68

Note: *Figures in Parenthesis are' t'- values*

* Significant at 10 per cent Probability level
** Significant at 5 per cent Probability level
*** Significant at 1per cent Probability level

According to table 1 as far as the vegetable crops are concerned Brinjal, Chilli, Okra, Onion, Potato and Tomato are the important crops of the region. In the case of Brinjal, labour, capital and pesticide were found to be significant at 10 per cent level of significance with t values 1.91, 1.86 and 1.95 while seed was found to be significant at 5 per cent level of significance with t value 2.56. variables diesel and fertilizer were found to be significant at 1 per cent level of significance with R^2 value 0.72 which signifies that 72 percent of the dependent variable is explained by the independent variables which were found to be significant at 1, 5 and 10 per cent level of significance.

In the case of Chilli, variables Diesel and fertilizer were found to be significant at 10 per cent level of significance with t values 2.31 and 2.42 respectively at R^2 0.63. i.e the independent variables explain only 63 per cent variation in the dependent variable. The rest of the variables i.e labour, capital, seed and pesticide were found to be insignificant in explaining the variation caused in the part of dependent variable. In the case of Okra, labour, Diesel and fertilizer were found to be significant at 10 percent level of significance with t values 2.23, 2.12 and 2.43 and R^2 0.65. the rest of the independent variables were found to be insignificant like capital, seed and pesticide. It can be said that the dependent variable labour, diesel and fertilizer use explains only 65 per cent in the part of dependent variable. In the case of onion, labour, diesel and fertilizer were found to be significant at 10 per cent level of significance with t values 2.31, 2.41 and 2.25 respectively at R^2 0.71. This signifies that the significant independent variable explains only 71 per cent in the part of yield of the onion. In the case of potato, labour, seed diesel and fertilizer were found to be significant at 10 per cent level of significance with t values 2.41, 2.45, 2.37 and 2.39 in labour, seed, diesel and fertilizer respectively. The R^2 value comes to 0.77 which shows that independent variable explains only 77 per cent in the part of dependent variable. In the case of tomato, labour, pesticide, diesel and fertilizer were found to be significant at 10 per cent level of significance with t values 2.10, 1.95, 2.21 and 2.32 and R^2 0.68. only 68 per cent part of the dependent variable is explained here in the case of tomato by the independent variables labour, pesticide, diesel and fertilizer.

A. Input use pattern and efficiency in Vegetable crop

Table 2: Level of optimal input use in Brinjal

Particulars	Variability (Min to Max)	Average use	Recommended use	Level of Optimal use
Labour (Mandays)	104--152	128	-	135
Capital (Rs)	10600--17200	13900	-	14500
Seed (kg)	0.4-0.88	0.64	.750	.740
Pesticide (kg)	13-31	22	25	24
Diesel (liter)	288-480	384	-	401
Fertilizer (kg)	240-252	246	240	248

According to the table 2, the existing use of the inputs like labour, capital, seed, pesticide use, diesel use and fertilizer has the following scheme. As for the Labor input, it varies from 104-152 man days, average use is 128 man days, recommended use is unknown/uncertain while the level of optimal use is 135 and it’s a case of underuse as the average use is lower than the level of optimal use. As for capital input it varies from Rs 10600-17200, average input is Rs.13900,recommended input is uncertain and the level of optimal input is Rs145000, the case again is that of underuse. As for the seed used it varies from 0.4-0.88 kg, average use is 0.64kg, recommended use is 0.75 kg and level of optimal use is 0.74 kg and the case again is that of under use. As for the pesticides used it varies from 13-31 kg, average use is 22 kg, recommended use is 25 kg and the level of optimal use is 24 kg the case again is that of underuse. As for diesel used, it varies from 288-480 liters., average use is 384liters.,recommended use is uncertain and the level of optimal use is 401 liters. And the case again is that of under use. Finally talking about fertilizer used, it varies from 240-252 kg, average use is 246 kg, recommended use is 120;60;60 kg, and the level of optimal use is 248kg and the case again is that of slight underuse.

Table 3: Level of optimal input use in Chilli

Particulars	Variability (Min to Max)	Average use	Recommended use	Level of Optimal use
Labour (Mandays)	118-198	158	-	167
Capital (Rs)	19000-29000	24000	-	25400
Seed (kg)	4.5-7	5.75	1.25	5.85
Pesticide (kg)	2-5.5	3.75	10 phorate	3.86
Diesel (liter)	125-375	250	-	286
Fertilizer (kg)	292-312	302	300	315

According to the table 3, the existing use of the inputs like labour, capital, seed, pesticide use, diesel use and fertilizer has the following scheme. As for the Labor input, it varies from 118-198 man days, average use is 158 man days, recommended use is unknown/uncertain while the level of optimal use is 165 and it’s a case of underuse as the average use is lower than the level of optimal use. As for capital input it varies from Rs 19000-29000, average input is Rs.24000, recommended input is uncertain and the level of optimal input is Rs25400, the case again is that of underuse. As for the seed used it varies from 4.5-7 kg, average use is 5.75 kg, recommended use is 1.25 kg and level of optimal use is 5.85 kg and the case again is that of slight under use. As for the pesticides used it varies from 2-5.5 kg, average use is 3.75 kg, recommended use is 10phorate and the level of optimal use is 3.86 kg the case again is that of underuse. As for diesel used, it varies from 125-375 liters., average use is 250liters.,recommended use is uncertain and the level of optimal use is 286 liters. Finally, in the case of fertilizer use, it varies from 292-312kg, average use is 302 kg, recommended use is 3000 kg, and the level of optimal use is 315kg and the case again is that of underuse.

Table 4: Level of optimal input use in Okra

Particulars	Variability (Min to Max)	Average use	Recommended use	Level of Optimal use
Labour (Mandays)	90-123	106.5	-	111
Capital (Rs)	18500-23725	21112	-	21865
Seed (kg)	7.25-12.5	10.66	12-15	11.20
Pesticide (liter)	1.2-3.95	2.57	1-2	2.65
Diesel (liter)	289-443	366	-	376
Fertilizer (kg)	170-225	197.86	100	201

According to the table 4, the existing use of the inputs like labour, capital, seed, pesticide use, diesel use and fertilizer has the following scheme. As for the Labor input, it varies from 90-123 man days, average use is 106.5 man days, recommended use is unknown/uncertain while the level of optimal use is 111 and it’s a case of underuse as the average use is lower than the level of optimal use. As for capital input it varies from Rs 185000-23725, average input is Rs.21112, recommended input is uncertain and the level of optimal input is Rs21865, the case again is that of underuse. As for the seed used it varies from 7.25-12.5 kg, average use is 10.66 kg, recommended use is 12-15 kg and level of optimal use is 11.20 kg and the case again is that of under use. As for the pesticides used it varies from 1.2-3.95 kg, average use is 2.57 kg, recommended use is 1-2 kg and the level of optimal use is 2.65 kg the case again is that of underuse. As for diesel used, it varies from 289-443liters., average use is 366 liters, recommended use is uncertain and the level of optimal use is 376 liters. Finally, in the case of fertilizer use, it varies from 170-225 kg, average use is 197.86 kg, recommended use is 100 kg, and the level of optimal use is 201kg and the case again is that of underuse.

Table 5: Level of optimal input use in Onion

Particulars	Variability (Min to Max)	Average use	Recommended use	Level of Optimal use
Labour (Mandays)	210-250	231	-	235
Capital (Rs)	18500-26475	22487	-	23556
Seed (kg)	10.88-14.18	12.53	10-12	12.86
Pesticide (kg)	1.5-3.7	2.6	1-1.5	2.7
Diesel (liter)	224-444	334	-	395
Fertilizer (kg)	215-347	281	100	298

According to the table 5, the existing use of the inputs like labour, capital, seed, pesticide use, diesel use and fertilizer has the following scheme. As for the Labor input, it varies from 210-250 man days, average use is 231 man days, recommended use is unknown/uncertain while the level of optimal use is 235 and it’s a case of underuse as the average use is lower than the level of optimal use. As for capital input it varies from Rs 18500-26475, average input is Rs.22487,recommended input is uncertain and the level of optimal input is Rs23556, the case again is that of underuse. As for the seed used it varies from 10.88-14.18 kg, average use is 12.53kg, recommended use is 10-12 kg and level of optimal use is 12.86 kg and the case again is that of under use. As for the pesticides used it varies from 1.5-3.7 kg, average use is 2.6 kg, recommended use is 1-1.5 kg and the level of optimal use is 2.7 kg the case again is that of underuse. As for diesel used, it varies from 224-444 liters., average use is 334liters.,recommended use is uncertain and the level of optimal use is 395 liters. Finally, in the case of fertilizer use, it varies from 215-347 kg, average use is 281 kg, recommended use is 100 kg, and the level of optimal use is 298kg and the case again is that of underuse.

Table 6: Level of optimal input use in Potato

Particulars	Variability (Min to Max)	Average use	Recommended use	Level of Optimal use
Labour (Mandays)	100-165	132.5	-	138
Capital (Rs)	23750-33500	28625	-	29685
Seed (kg)	1220-2490	1851	800-1000	1965
Pesticide (kg)	21-34	27.5	20-25	28.6
Diesel (liter)	365-885	625	-	712
Fertilizer (kg)	450-476	463	250-300	469

According to the table 6, the existing use of the inputs like labour, capital, seed, pesticide use, diesel use and fertilizer has the following scheme. As for the Labor input, it varies from 100-165 man days, average use is 132.5 man days, recommended use is unknown/uncertain while the level of optimal use is 138 and it’s a case of underuse as the average use is lower than the level of optimal use. As for capital input it varies from Rs 23750-33500, average input is Rs.28625,recommended input is uncertain and the level of optimal input is Rs29685, the case again is that of underuse. As for the seed used it varies from 1220-2490 kg, average use is 1851 kg, recommended use is 800-1000 kg and level of optimal use is 1965 kg and the case again is that of under use. As for the pesticides used it varies from 21-34 kg, average use is 27.5, recommended use is 20-25 kg and the level of optimal use is 28.6 kg the case again is that of underuse. As for diesel used, it varies from 365-885 liters., average use is 625liters.,recommended use is uncertain and the level of optimal use is 712liters. And the case again is that of under use. Finally, in the case of fertilizer use, it varies from 450-476 kg, average use is 463 kg, recommended use is 250-300 kg, and the level of optimal use is 469kg and the case again is that of underuse.

Table 7: Level of optimal input use in Tomato

Particulars	Variability (Min to Max)	Average use	Recommended use	Level of Optimal use
Labour (Mandays)	78-114	96	-	101
Capital (Rs)	9750-16350	13050	-	14124
Seed (kg)	1.2-2.4	1.8	.45-.55	1.9
Pesticide (kg)	1.25-2.45	1.85	1.5	1.95
Diesel (liter)	56-476	266	-	213
Fertilizer (kg)	222-246	266	140-180	296

According to the table 7, the existing use of the inputs like labour, capital, seed, pesticide use, diesel use and fertilizer has the following scheme. As for the Labor input, it varies from 78-114 man days, average use is 96 man days, recommended use is unknown/uncertain while the level of optimal use is 101 and it's a case of underuse as the average use is lower than the level of optimal use. As for capital input it varies from Rs 9750-16350, average input is Rs13050,recommended input is uncertain and the level of optimal input is Rs14124, the case again is that of underuse. As for the seed used it varies from 1.2-2.4 kg, average use is 1.8 kg, recommended use is. 45-.55 kg and level of optimal use is 1.9 kg and the case again is that of under use. As for the pesticides used it varies from 1.25-2.45 kg, average use is 1.85 kg, recommended use is 1.5 kg and the level of optimal use is 1.95 kg the case again is that of underuse. As for diesel used, it varies from 56-476 liters., average use is 266liters.,recommended use is uncertain and the level of optimal use is 213 liters which is over used. Finally, in the case of fertilizer use, it varies from 222-246 kg, average use is 266 kg, recommended use is 140-180 kg, and the level of optimal use is 296kg and the case again is that of underuse.

Environmental Pollution

Agriculture contributes around 10-12 % of total global greenhouse gas (GHG) emissions but is the main source of non-carbon dioxide (CO_2) GHGs, emitting nearly 60 % of nitrous oxide (N_2O) and nearly 50 % of methane (CH_4) (Smith *et al*., 2007). Given their significant contribution to rising atmospheric greenhouse gas concentrations, accounting for emissions of CO2, N2O and CH4 from agricultural practices has become increasingly important. Emissions of these gases may occur either directly during agricultural activities (eg. cultivation and harvesting), or indirectly during the production and transport of required inputs eg. herbicides, pesticides and fertilisers (Wood & Cowie, 2004). Addressing global climate change is a paramount challenge of the 21st Century. Since the beginning of the industrial revolution, atmospheric concentrations of carbon dioxide (CO_2), the chief heat-trapping greenhouse gas, have risen 35 percent, from about 280 to 377 parts per million (ppm). This increase is primarily from the burning of fossil fuels and from deforestation. Atmospheric concentrations of methane (CH_4), the second leading GHG, have more than doubled over the past two centuries. These and other GHG increases have led to a 0.6ºC (1.1ºF) increase in the global average surface temperature since 1900. If current emissions trends are not altered, global temperatures are expected to rise a further 1.4 to 5.8º C (2.5 to 10.4º F) by 2100, according to the Intergovernmental Panel on Climate Change (Baumert *et al*, 2005). Sources of non-CO2 green- house gases are responsible for virtually all the global warming we are going to see for the next half century (Mohr, 2005).

The production, processing, transport and storage of agricultural products, like most human activities, gives rise to emissions of greenhouse gases (GHGs). These GHG emissions include carbon dioxide (CO_2) emitted through the combustion of fossil energy at various stages in the life-cycle of a product: in the production of agri-chemicals and soil amendments; by farm machinery during field preparation, planting, cultivation and harvesting; by vehicles used to transport the intermediate and final products; by the factories that process the products; and in the production of electricity used to keep the products refrigerated, if necessary (Steenblik and Möisé 2010).

Table 8: Carbon Emission coefficients for different fuel sources and the energy conversion units (Boustead and Hancock, 1979; Fluck 1992; Lal, 2003; Gautam et. al. 2018)

S. No	Fuel Source/ Energy Units	Equivalent Carbon emission
A.	**One kg of fuel**	
	Diesel	0.94
	Coal	0.59
	Gasoline	0.85
	Oil	1.01
	LPG	0.63
	Natural Gas	0.85
B.	**Units**	
	Million Calories (mcal)	93.5×10^{-3}
	Gigajoule (GJ)	20.15
	BTU	23.6×10^{-6}
	Kilowatt hour (kW h)	7.25×10^{-2}
	Horsepower	5.41×10^{-2}

Table 9: Environmental Pollution and CO_2 emissions on the Sample Farms

S. No.	Crops	Fertilizer use (Kg. / Ha)	CO_2 Emission (Kg CO_{2-e})	Diesel use (Liter)	CO_2 Emission (Kg CO_{2-e})	Total emission (Kg CO_{2-e}/Ha)
1.	Brinjal	246	393.6	384	360.96	754.56
2.	Chilli	302	483.2	250	235	718.2
3.	Okra	198	316.8	366	344.04	660.84
4.	Onion	281	449.6	334	313.96	763.56
5.	Potato	463	740.8	625	587.5	1328.3
6.	Tomato	468	748.8	266	250.04	998.84

According to the table 9, on an average total NPK fertilizer use in Brinjal is 246 kg /Ha which emits 393.6 Kg CO_{2-e} by the use of fertilizer and on an average 384 liters of diesel use which adds 360.96 Kg CO_{2-e} making a total of 754.56 Kg CO_{2-e}/ Ha. In the case of Chilli, from fertilizer alone 483.2 Kg CO_{2-e} CO_2 emission and 235 Kg CO_{2-e} from diesel use making a total of 718.2 Kg CO_{2-e}/ Ha. Likewise from Okra a total of 660.84 Kg CO_{2-e}/ Ha was emitted. In the production of Onion 763.56, Potato 1328.3 and Tomato 998.84 Kg CO_{2-e}/Ha emission has been found which adds to the annual Green House gas emission. Potato crop shows the maximum emission due to more use of fertilizer and diesel use.

Conclusion

It has been found out that the inputs like labour, capital, seed, fertilizer, pesticide and diesel use in the agriculture is under use in the study which has been undertaken in the study of vegetable crops. Different crops has showed the level of input use with the average use is currently practiced, its recommended and optimal use has been calculated. It has been confirmed by many studies that there is strong evidence that sustainable agricultural and land management can make an important contribution to climate change mitigation through both emissions reduction and carbon sequestration and suggested that the national and international markets for carbon grow, so the sequestered carbon could represent an important new source of income for farmers (Pretty and Ball; 2001). As suggested by Smith *et al*; 2007 trends in GHG emissions in the agricultural sector depend mainly on the level and rate of socio-economic development, human population growth, and diet, application of adequate technologies, climate and non-climate policies, and future climate change. In all the GHG mitigation in agriculture has a significant potential and maintaining a synergy in between climate chance policies, sustainable agricultural development and quality improvement of environment will lead a way forward for the mitigation GHG emissions. According to a report of FAO on Soil Organic Carbon Accumulation and Greenhouse Gas Emission Reductions from Conservation Agriculture, the terrestrial sequestration of carbon can efficiently be achieved by changing the management of agricultural lands from high soil disturbance practices to low disturbance and by adopting effective nitrogen management practices so that the nitrogen balance remains positive.

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