We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,300

Open access books available

172,000

International authors and editors

190M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities

WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com

Effects of Different Tillage Methods, Nitrogen Fertilizer and Stubble Mulching on Soil Carbon, Emission of CO₂, N₂O and Future Strategies

Sikander Khan Tanveer, Xiaoxia Wen,
Muhammad Asif and Yuncheg Liao

Additional information is available at the end of the chapter

<http://dx.doi.org/10.5772/56294>

1. Introduction

The basic reasons of greenhouse effect are the greenhouse gases which emits and absorbs the radiations. The main greenhouse gases include CO₂, Methane and Nitrous oxide which are playing a major role in global warming.

CO₂ is mainly emitted by the burning of coal, natural gas and wood etc. Before the Industrial revolution its concentration in the atmosphere was about 280 ppm but due to the burning of fossil fuels now its concentration is about 397 ppm. The concentration of CO₂ in the atmosphere is about 0.039 percent by volume and it is used by the plants for the process of photosynthesis.

Nitrous Oxide is also a major greenhouse gas. In the atmosphere from N₂O, Nitric oxide (NO) is produced, which after combination with O₂, reacts with Ozone. Global warming potential of this gas is 298 times more than the global warming potential of CO₂. In agriculture the main source of N₂O is the use N fertilizers, which is used for the production of crops. It is also produced from the animal wastes. In the atmosphere annually about 5.7 Tg N₂O-N yr⁻¹, N₂O is produced and agricultural soils provide about 3.5 Tg N₂O-N yr⁻¹, which is produced from the soils by the process of Nitrification and Dinitrification. Its emission from the soil is affected by many factors including temperature, moisture, PH, soil organic matter and soil kind etc.

The soil contains carbon in the organic and as well as in the inorganic form. Soil organic carbon is mainly present in the soil organic matter in the form of "C". and its availability in any soil mainly depends upon the soil kind, its texture, vegetation and management processes. Management of SOC is very important for the maintenance of healthy soils because its loss

leads to soil infertility. SOC can be helpful in mitigating the effects of elevated CO_2 in the atmosphere, because change in land management practices can be helpful in sequestering the C from the atmosphere.

Tillage is a group of field operations and it is defined as the mechanical manipulation of the soil for improving its physical condition suitable for plant growth. The main aims of the tillage are production of a suitable tilth or soil structure, control of weeds; manage soil moisture, incorporation of organic matter, managing water and air in the soil and establishment of a surface layer which prevents the soil from wind and water erosion. A wide range of implements are used for tillage operations which vary from country to country. Different tillage implements have been designed and are used for various operations depending on the soil, type of operations, agro climatic conditions and soil conditions. Primary tillage implements include Moldboard plough, Disc plough, Chisel plough, Sub Soiler and Rotavator and secondary tillage implements include Harrows, Field cultivators and Rollers while due to recent technological developments along with economic pressures, Minimum and Zero tillage is also being practiced on large scale in the world.

Soil is the medium in which crops grow and it is one of the most precious natural resources of earth. Its maintenance for the coming generations is the responsibility of all human beings. However the urge for the production of more food, feed, fiber and fuel, especially in the form of emission of Greenhouse gases is causing irreparable damages to our environment.

2. Background

Long term records indicate increasing trends in the growth of anthropogenic greenhouse gas emissions, particularly in the last decades (IPCC, 2001). The greenhouse gases mainly include CO_2 , CH_4 and N_2O having the contributions of about 60%, 20% and 6% while the potential of N_2O in warming the atmosphere is greater than 290–310 times than CO_2 and 10 times than CH_4 . The concentrations of CO_2 and N_2O currently in the atmosphere are about 397 ppmv and 314 ppbv, respectively.

The emission of greenhouse gases from the soils is not clear (Le Mer J., and Roger, 2001). It has also been reported that the addition of anthropogenic greenhouse gases in to the atmosphere has been previously underestimated (Mosier A.R., et al 1998) because these gases may diffuse directly from the soil or indirectly in the atmosphere through subsurface drainage after leaching (Sawamoto T. et al. 2003).

Agricultural productivity lead to the emission of several greenhouse gases (CO_2 , CH_4 and N_2O), that differ with regards on their ability to absorb the long wave radiation, and depending on their specific radiation forcing and residence time in the atmosphere. The relative ability of gases, also called global warming potential (GWP), is computed relative to carbon dioxide. The GWP is 1 for Carbon dioxide, 21 for Methane, 310 for Nitrous Oxide, 1800 for O_3 and 4000 – 6000 for CFCs (IPCC, 1995) The rate of increase in CO_2 was 1.6 ppmv per year from 1990 to 1999 ([http:// www. CO2 Science.Org/](http://www.CO2Science.Org/)) and N_2O was 0.8 ppbv per year in the 1990s, respectively

(IPCC, 2001). According to OECD (2000), the total emission of CO₂, CH₄ and N₂O (As CO₂ equivalent) was 14142 million tons for the period from 1995 to 1997. OECD (2000) also reported that agriculture is responsible for about 1% of CO₂ emissions, about 40% of CH₄ and 60% of N₂O, so it is clear that agriculture is also playing an important role in the emission of green house gases.

Watson et al., (1995) reported that emissions of carbon dioxide (CO₂) and nitrous oxide (N₂O) are major sources of atmospheric green house gases generated from the upland agro-ecosystems. It was estimated that 90% of N₂O and 20% of CO₂ in the atmosphere come from agricultural production (Bouwman, 1990).

The global soil carbon (C) pool of 2300 Pg includes about 1550 Pg of soil Organic Carbon (SOC) and 750 Pg of soil inorganic carbon (SIC) both to 1- m depth (Batjes,1996). The soil carbon pool is three times the size of the atmospheric pool (770 Pg) and 3.8 times the size of the biotic pool (610 Pg). The SOC pool to 1-m depth ranges from 30 tons/ha in arid climates to 800 tons /ha in organic soils in cold regions and a predominant range of 50 to 150 tons/ha. The SOC pool represents a dynamic equilibrium of gains and losses. Conversion of natural to agricultural systems causes depletion of the SOC pool by as much as 60% in soils of temperate regions and 75% or more in cultivated soils of the tropics. The depletion is exacerbated when the out put of C exceeds the input and when soil degradation is severe. Some soils have lost as much as 20 to 80 tons C/ha. Severe depletion of the SOC pool degrades soil quality, reduces biomass productivity and adversely impacts water quality and the depletion may be exacerbated by projected global warming. Terrestrial ecosystems contributed to the atmospheric C enrichment during both the preindustrial and industrial areas. During the preindustrial era, the total carbon emission from terrestrial ecosystem was supposedly about twice (320 Gt or 0.04 Gt C/year for 7800 years) that of the industrial era (160 Gt or 0.8 Gt C/year for 200 years). Between 1850 and 1998, the emission from fossil fuel combustion was 270 (+ or -) 30 Gt from soil of which about one-third is attributed to soil degradation and accelerated erosion and two thirds to mineralization. The estimates of historic SOC loss range widely, from 44 to 537 Gt, with a common range of 55 to 78 Gt. The soil C can be sequestered through judicious land use and recommended management practices, which are cost effective and environmental friendly. SOC sequestration in agricultural soils and restored ecosystems depend on soil texture, profile characteristics and climate. It ranges from 0 to 150 kg C/ha per year in dry and warm regions and 100 to 1000 kg C/ha per year in humid and cool climates. Soil management techniques and land use patterns play an important role in the removal as well as store of carbon from the ecosystem and the soil management techniques are the suitable ways to reduce the CO₂ emission from the soil (IPCC, 2000; Lal, 2004). The conclusion by the intergovernmental panel on climate change (IPCC) "that there has been a discernible human influence on global climate (IPCC, 2001) is one more call for action on the reduction of green house gas (GHG) emissions. Worldwide about one fifth of the annual anthropogenic (GHG) emission comes from the agricultural sector (excluding forest conversion), producing about 5%, 70% and 50% of anthropogenic emissions of carbon dioxide (CO₂), nitrous oxide (N₂O), and 50% methane (CH₄) (Cole et al., 1996).

Nitrous Oxide (N₂O) is a natural trace gas occurring in the atmosphere that causes global warming and stratospheric ozone depletion. The concentration of atmospheric N₂O has

increased up to 16% over the last 250 years at a rate of 0.25% per year (IPCC, 2007) and agricultural soils account for approximately 42% of anthropogenic N_2O emissions (IPCC, 2007) and nitrogen fertilization is considered as a primary source of N_2O emissions from agricultural soils (Mosier et al., 1998; Mosier and Kroeze, 2000). The annual global emission of N_2O from soils is estimated to be 10.2 Tg N or about 58% of all emissions (Mosier A.R., et al 1998).

Use of nitrogen fertilizers increased at the rate of 6-7% per year during the 1990s (Mosier, 2004). According to FAO (2008) during 2008 to 2012 on world level the demand for nitrogen fertilizers on annual basis will increase at the rate of 1.4% and about 69% of this growth will take place in Asia. It has been reported by many researchers (e.g. Hatano R., and Sawamoto T, (1991), Kaiser E, A., and Ruser R, (2000), and Mosier A.R., and Delgado J.A., (1997) that N_2O emission increases with increasing nitrogen fertilization. Nitrogen fertilizer is one most important mineral fertilizer, both in the amount of plant nutrient used in agriculture and in energy requirements. Its principal products include Ammonia, Urea, Ammonium Nitrate, Urea/Ammonium nitrate solution, Di-Ammonium Phosphate and Ammonium Sulphate. Nitrogen fertilizers are energy-intensive. For example one kilogram of nutrient-N requires about 77.5 MJ for its manufacture, packing, transportation, distribution, and application (Stout, 1990). For its production manufacturer requires pure gaseous nitrogen and hydrogen. AS compared to hydrogen, pure gaseous nitrogen is simple and inexpensive. Natural gas and coal are the main sources of hydrogen for fertilizer production (Helsel, 1992). In addition to this, in some developing countries transportation routes can be very energy demanding.

N_2O emission is affected by many factors but the most important of these are tillage and fertilization. Increased N_2O emission from No-tilled soils as compared to the tilled soils have been reported by many researchers (Aulakh M.S. et al, 1984, Jacinthe P.A., and Dick W.A., 1997, Lal R. et al. 1995, Mackenzie A.F., and Fan M.X., Cadrin F., 1997 and Mummey D.L., et al, 1997). However Grandy et al. (2006) reported that N_2O emissions were similar between NT and CT systems. Lemake et al. (1999) observed lower N_2O emissions from NT compared to CT in some north-central Alberta soils. Similarly Hao et al. (2001) observed decline in N_2O emissions when crop residue was retained, especially in plots tilled in autumn after crop harvest. Mc Swiney and Robertson (2005) and Wanger Riddle et al. (2007) have reported that fertilizer application rates influence the N_2O fluxes. They also reported that the best management practices can be helpful in reducing the emission of N_2O .

Nitrous oxide (N_2O) is a major green house gas (GHG), although its emission is numerically smaller as compared with the other greenhouse gases (Isermann, 1994), but global warming potential (GWP) of it is about 296 times higher than that from Carbon dioxide (CO_2). It is reported that arable soils are responsible for about 57% of the annual N_2O emissions in the world (Mosier et al., 1998). Effects of seasons (Van Kessel et al. 1993; Nyborg et al. 1997 and Aulakh et al. 1982), nitrogen fertilizers (Mc Kenney et al. 1980; Eichner 1990), manure or legumes (Aulakh et al. 1991; Laidlaw 1993) on emission of N_2O have also been reported.

Low fertilizer use efficiency is mainly due to the inexpert use of fertilizer and it is associated with the water and air pollution. These kinds of symptoms are common in many countries, where due to leaching and volatilization important fertilizer losses are taking place (FAO, 2000). In such regions the extra use of fertilizers can be reduced by adopting the more efficient

methods of fertilizers applications, use of fertilizers at the proper timings to meet the nutrient demand of the crop, nitrification inhibitors, controlled release fertilizers, optimization of tillage, irrigation and drainage and ultimately the use of precision farming can be helpful in saving the extra use of fertilizers (Viek and Fillery, 1984; IPCC, 1996). Higher productivity can be achieved at a given level of fertilizer use with improved crop and fertilizers management. However, there are many constraints including economic, educational and social in improving the fertilizer productivity.

Conventional tillage increases the CO₂ in the atmosphere by promoting the loss of soil organic matter, while instead of conventional tillage, conservation tillage increases soil organic matter (SOM) with the passage of time (Dao, 1998) and available water content and soil aggregation (Pare et al., 1999). A lot number of researchers (La Scala Jr et al (2001), Lipiec J., and Hatano R., (2004), Reicosky D.C et al (1997), and Sanchez M.L et al (2002)) have reported that emission of CO₂ is lower in no-till or reduced tillage as compared to the conventional tillage. On the other side more carbon sequestration is in the soil which is under no-till or reduced tillage as compared to the soil under conventional tillage (Ball B.C et al (1999) and McConkey Liang B.C et al (2002)). Wilson H.M and M.M. Al-Kaisi (2010) reported 23% less emission of CO₂ from the soil fertilized with 270 kg N/ha as compared to the soils fertilized with 0 and 135 kg N/ha in a continuous corn and a corn-soybean rotation. Similarly Burton et al. (2004) found that N fertilized plots averaged 15% less soil CO₂ emissions than unfertilized plots.

Campbell et al. (2001), reported that without adequate fertility from Conservation to No-tillage may not always result in an increase in soil N or C. The contribution of CO₂ in the total atmospheric greenhouse effect is about 60% (Rastogi M., et al 2002). Conversions of native soils for agricultural use have contributed a large to the emission of CO₂ in to the atmosphere (Paustian K., et al, 1998).

Agriculture seems to have potential to make an important contribution to the mitigation of global climate change. Lal et al. (1998) estimated that changes in global agricultural practices can be able to sequester over about 200 million metric tons of carbon (Mt C) per year. Changes in agronomic practices in United States are thought to have the potential to offset nearly 10% of its total carbon emissions (FAO, 2001). The International Panel on Climate Change (IPCC, 2000) quotes figures showing that alone conservation tillage can be able to store more than a ton of carbon per hectare per year, while other researchers have provided the figures that range from a low of 3 to a high of 500 kg C per hectare per year (Uri, 2001; Follet, 2001).

Uri, (2001) and West and Marland, (2002), reported that No-till cultivation that appears to bring about carbon benefits as compared to the different kinds of tillage systems, but it increases cost of production (because more chemical inputs are required) and often reduces yields (Lerohl and Van Kooten, 1995).

It is generally acknowledged that soil carbon will be increased by the adapting of No (Zero) tillage as compared to the Conventional (Intensive) tillage practices (Kern and Johnson, 1993; IPCC, 2000; Uri, 2001). The relationship between NT and carbon storage is complex one. A lot number of researchers have examined the effects of crop type, fertilizers and rota-

tion (Campbell et al., 2001), climate and soil texture (Tobert et al., 1998; Six et al., 1999) and time (Ding et al., 2002) on carbon storage potential.

The way by which Conventional Tillage (CT) might store more carbon than No Tillage (NT) is not clear (Angers et al., 1997). Conventional tillage increases CO₂ respiration as the soil is plowed (Lupwayi et al., 1999), but it appears that due to plowing organic matter is pushed more deeply in to the soil, which in future facilitates the adsorption and stabilization of more organic material into the soil, as compared to the way in which straw and residue remain concentrated on top of the ground (Paustian et al., 1997).

Tillage often decreases soil organic matter (Gebhart et al., 1994) and it increases the flux of CO₂ from the soils (Reicosky and Lindstrom, 1993) through enhanced biological oxidation of soil carbon by increasing subsequent microbial activity as a result of residue incorporation (Reicosky et al., 1995).

In the tropics the conversion of native ecosystems to agricultural use is believed to be the largest non-fossil fuel source of CO₂ input to the atmosphere. The production of more fertilizers increases the CO₂ emission, but its use reduces the need of further expansion into forested areas and may allow land to set aside for revegetation or reforestation. In addition to it modern cultivation practices and injudicious use of mineral fertilizers are further deteriorating our soil fertility. The intensive management of agricultural soils has resulted in the depletion of soil carbon (C) stocks and has increased atmospheric carbon dioxide (CO₂) levels. Lal and Bruce (1999) and Lal, 2003, 2004 reported that conservation tillage can increase the amount of C sequestered in agricultural soils. A review of soil organic carbon (SOC) studies from West and Post (2002) concluded that on an average conservation tillage could sequester 0.60+ 0.14 t C per ha per year. It has also been reported by several recent published studies that conventional or reduced tillage systems have little to no difference in soil organic carbon (SOC), (Dolan et al., 2006; Venterea et al., 2006; Baker et al., 2007; Blanco-Canqui and Lal, 2008).

A number of studies have reported that conservation tillage systems have higher N₂O emissions when compared to the conventional tilled systems (Robertson et al., 2000; Mummey et al., 1998; Ball et al., 1999).

The use of organic waste can be helpful in improving the crop productivity, improving the soil health, reduce the waste disposal problem and the betterment of environment. In some areas of the world wheat and maize straw are produced in such a huge quantity that their disposal is a big problem. Though a large portion of them is used as animal feed or for making compost but a large portion of it is being burnt which is a big threat to the environment. Therefore possible use of crop residues into the farm soil must be explored.

Researchers have also debated about the burning of crop residues as compared to their burning on the carbon flux. Clapp et al. (2000) and Duiker and Lal (2000) favor the leaving the straw, where as Sanford et al. (1982) found that straw limits the yields. Dalal (1989) reported that burning of residues contribute to carbon sequestration at depths as low as 0.9- 1.2 m.

Javed et al. (2009), reported that N addition with straw increases the CO₂ flux and sequesters the soil C by mitigating the global carbon budget. Since SOC storage is highly dynamic in gain and loss of soil organic matter (SOM), manure abandonment and straw removal led to loss of

soil organic carbon (SOC) (Qiu et al., 2004; Tang et al., 2006). Field practices with low carbon inputs to arable soils, removal of crop straw and manure abandonment have depleted SOC contents (Wang et al., 2008). The loss of SOC has bad affects on biological, physical and chemical properties (Kumar and Goh 2003). Returning crop straw to the soil can enhance the crop yield by affecting the microbial processes and nutrient availability (Olivier et al., 2000). Increase of SOC storage in crop land improves soil productivity and is good for healthy environment (Lal, 2004). Sequestration of atmospheric CO₂ will be significantly improved, if large quantities of crop residues and organic manures are returned to the soil (Lal, 2004 & Lal, 2002). Increase in SOC storage in crop land improves soil productivity and improves the environmental health. Thus can be recognized as win-win strategy (Lal, 2004).

Increase in soil organic matter works as a sink for atmospheric CO₂ and thus reduces the adverse effects of global warming (Lal, 2004). Addition of straw evolutes CO₂, affects microbial activity for decomposition, recycles available nutrients and restores soil organic carbon (SOC) (Henriksen and Breland, 1999; Hadas et al., 2004).

Wu et al. (2003). reported that 57% of cultivated soils in China have experienced losses in soil organic carbon (SOC) due to the injudicious use chemical fertilizers and intensive cultivation along with less use of organic manures and crop straw since the introduction of synthetic fertilizers in 1950s.

The burning or discarding of the crops straw has caused a decline in soil organic matter (SOM), reduction in microbial activity and is causing pollution by discharging CO₂ into the atmosphere. Michellon and Parret, (1994) reported that the use of crop residue can be helpful in the reduction of chemical fertilizer use. While Boyer et al., (1996) reported that the use of crop residues can be helpful in the restoration of soil fertility. Lal et al. (1998) recommended the rate of residue for cool and humid areas about 400-800 kg/ha/year, while about 200-400 kg for warm and dry areas.

Kumar and Goh, 2000 reviewed the effects of crop residues and management practices on the soil quality, soil nitrogen dynamics recovery and as well as on crop yields. They reported that residues of cultivated crops are a significant factor for crop production through their effects on soil health as well as on soil and water quality. Unger et al. (1988), reviewed the role of surface residues on water conservation and they reported that surface residues enhance water infiltrations. Dao, (1993) and Hatfield & Pruger, (1996), reported that surface mulch helps in reducing water losses from the soil and promotes biological activity which enhances nitrogen mineralization especially in the surface layers. Leak (2003) reported that rotations increase microbial diversity. Jacinthe P.A et al. (2002) reported that carbon sequestration can be enhanced by the crop residue management.

3. Future strategies

Many crop management and soil management practices in the future can be helpful in the reduction of emission of greenhouse gases along with the maintenance of soil fertility, few of them include

1. Adaptation of tillage systems that are helpful in the reduction of emission of greenhouse gases, and can be helpful in the increasing the soil fertility.
2. Selection of more better cropping systems which are more environmental friendly and give maximum crops productions.
3. Judicious and timely use of nitrogenous fertilizers
4. Use of crop residues and animal manures
5. Use of crop rotations
6. Reduce the soil erosion

In future from the less available land resources, only the better crop production practices will be helpful to feed the burgeoning population. Instead of traditional tillage practices, use of productive but more sustainable environmental friendly management practices will resolve this problem. Crop and soil management practices that maintain soil health and reduce farmers cost are essential in this regard. Minimum soil disturbance, soil cover (mulch) combined with judicious use of fertilizers will be helpful in getting the maximum yields of crops and maintenance of healthy environment.

Author details

Sikander Khan Tanveer¹, Xiaoxia Wen¹, Muhammad Asif² and Yuncheng Liao^{1*}

*Address all correspondence to: yunchengliao@163.com or yunchengliao@nwsuaf.edu.cn

1 College of Agronomy, Northwest A&F University Yangling, Shaanxi, China

2 Agriculture, Food and Nutritional Science, 4-10 Agriculture/Forestry Centre, Univ. of Alberta, Edmonton, Canada

References

- [1] Angers, D. A, Bolinder, M. A, Carter, M. R, Gregorich, E. G, Drury, C. F, Liang, B. C, Wrony, R. P, Simard, R. R, Donald, R. G, Beyaert, R. P, & Martel, J. (1997). Impact of tillage practices on organic carbon and nitrogen storage in cool, humid soils of eastern Canada. *Soil Tillage Res.* , 41, 191-201.
- [2] Arah JRMSmith, K.A, Crichton I.J,LI, HS.: (1991). Nitrous oxide production and denitrification in Scottish arable soils. *European Journal of Soil Science*, , 42, 351-367.

- [3] Aulakh, M. S, Rennie, D. A, & Paul, E. A. (1984). Gaseous nitrogen losses from soils under zero-till as compared with conventional-till management systems J. Environ. Qual. , 13, 130-136.
- [4] Aulakh M.S; Doran, J. W., Walters, D.T., and Power, J.F.(1991). Legume residue and soil water effects on denitrification in soils of different textures. Soil Biol. Biochem. , 23, 1161-1167.
- [5] Aulakh M.S; Rennie D.A.and Paul,E.A.(1982). Gaseous nitrogen losses from cropped and summer-fallowed soils. Can. J. Soil Sci., 62, 187-196.
- [6] Baker, J. M, Ochsner, T. E, Venterea, R. T, & Griffis, T. J. (2007). Tillage and soil carbon sequestration: what do we really know? Agriculture, Ecosystems and Environment., 118, 1-5.
- [7] Ball, B. C, Scott, A, & Parker, J. P. O, CO₂ and CH₄ fluxes in relation to tillage, compaction, and soil quality in Scott land. Soil and Tillage Res. , 53, 29-39.
- [8] Batjes, N. H. and N in soils of the world. European Journal Soil Science. , 47(2), 151-163.
- [9] Bayoumi Hamuda H.E.A.F., Kecskes, M.(2003). Correlation between the efficiencies of CO₂ release, FDA, and dehydrogenase activity in the determination of the biological activity in soil amended with sewage sludge. Nyiregyhaza, Hungary. , 11-16.
- [10] Bhattaacharyya, R, Kundu, S, Prakash, R, & Gupta, H. S. (2008). Sustainability under combined application of minerals and organic fertilizers in a rainfed soybean-wheat system of the Indian Himalayas. European Journal of Agronomy, , 28, 33-46.
- [11] Blanco-canqui, H, & Lal, R. (2008). No tillage and soil profile carbon sequestration: An on- farm assessment. Soil Sci. Soc. Am. J. , 72, 693-701.
- [12] Bouwman, A. F. (1990). Exchange of greenhouse gases between terrestrial ecosystems and the atmosphere, soils and the Greenhouse Effect. John Wiley and Sons, Chichester, England, , 61-127.
- [13] Boyer, J, Michellon, R, & Lavelle, P. (1996). Characterization of soil Pelargonium asperum with different management options. In: Proceedings of the XII th International Colloquium on soil Zoology, Dublin, , 236.
- [14] Burton, A. J, Pregitzer, K. S, Crawford, J. N, Zogg, G. P, & Zak, D. R. (2004). Simulated chronic deposition reduces soil respiration in Northern hardwood forests. Glob. Ch. Biol., 10(3-N), 1080-1091.
- [15] Campbell, C. A, Selles, F, Lafond, G. P, & Zentner, R. P. (2001). Adopting zero tillage management impact on soil C and N under long-term crop rotations in a thin Black Chernozem. Can. J. Soil Sci. , 81, 139-148.

- [16] Campbell, C. A, Selles, F, Lafond, G. P, & Zentner, R. P. (2001). Adopting zero tillage management: Impact on soil C and N under long-term crop rotation under different stubble and tillage practices. *Australian J. Soil Res.* , 30, 71-83.
- [17] Clapp, C. E, Allmaras, R. R, Layese, M. F, Linden, D. R, & Dowdy, R. H. (2000). Soil organic carbon and ¹³C abundance as related to tillage, crop residue, and nitrogen fertilization under continuous corn management in Minnesota. *Soil Tillage Research*. 53 (3/4), 127-142.
- [18] Cole, C. V, Duxbury, J, Freny, J, Heinemeyer, O, Mianmi, K, Rosenberg, N, Sampson, N, Saurbeck, D, & Zhao, Q. (1997). Global estimates of potential mitigation of greenhouse gas emissions by agriculture. *Nutrient Cycling in Agro ecosystems* , 49, 221-228.
- [19] Cole, V, Cerri, C, Minami, K, Moiser, A, Rosenberg, N, & Sauerbeck, D. (1996). Agricultural options for mitigation of greenhouse gas emissions, in R. Watson, M. Zinyowera and R. Moss (eds.), "Climate Change 1995: Impacts, Adaptations and Mitigation of Climate Change: Scientific-Technical Advances", Contribution of Working Group II to the second Assessment of the IPCC, Cambridge, Cambridge University Press.
- [20] Dalal, R. C, Wang, W. J, Roertson, G. P, & Parton, W. J. (2003). Nitrous oxide emission from Australian agricultural lands and mitigation options: a review. *Australian Journal of Soil Research*, , 41, 165-195.
- [21] Dalal, R. C. (1989). Long-term effects of no-tillage, crop residue, and nitrogen application on properties of vertisol. *Soil Sci. Soc. Amer. J.* , 53, 1511-1515.
- [22] Dao, T. H. (1993). Tillage and winter wheat residue management effects on water infiltration and storage. *Soil Science Society of America Journal.*, 57, 1586-1595.
- [23] Dao, T. H. (1998). Tillage and crop residue effects on carbon dioxide evolution and carbon storage in a Palenstoll. *Soil Sci. Soc. Am. J.*, 62, 250-256.
- [24] Ding, G, Novak, J. M, Amarasiriwardena, D, Hunt, P. G, & Xing, B. (2002). Soil organic matter characteristics as affected by tillage management. *Soil Sci. Soc. Amer. J.*, 66, 421-429.
- [25] Dolan, M. S, Clapp, C. E, Allmaras, R. R, Baker, J. M, & Molina, J. A. E. (2006). Soil organic carbon and nitrogen in a Minnesota soil as related to tillage, residue and nitrogen management. *Soil tillage. Research.* , 89, 221-231.
- [26] Duiker, S. W, & Lal, R. (2000). Carbon budget study using CO₂ flux measurements from a no till system in central Ohio. *Soil Tillage. Research*. 54 (1/2), 21-30.
- [27] Eichner, M. J. (1990). Nitrous oxide emissions from fertilized soils: Summary of available data. *J. Environ. Qual.* , 19, 272-280.

- [28] FAO: "Food and fuel in a warmer World" News & HighlightsFAO Newsletter, December 4, (2001).
- [29] FAO: Current World Fertilizer Trends and Outlook to (2004). Rome.
- [30] Farquhar, G. D, Ehleringer, J. R, & Hubickn, K. T. (1989). Carbon isotope discrimination and photosynthesis. *Annu. Rev. Plant Physiol. Plant Mol. Biol.* , 40, 503-537.
- [31] Follett, R. F. (2001). Soil management concepts and carbon sequestration in cropland soils. *Soil Tillage Research*.61(1/2), 77-92.
- [32] Food and Agricultural Organization of the United Nations(2008). FAOSTAT Database <http://www.Fao.org/faostat/>.
- [33] Gebhart, D. L, Johson, H. B, Mayeux, H. S, & Polley, H. W. (1994). The CRP increases soil organic carbon. *J. Soil water conserv.*, , 49, 488-492.
- [34] Grandy, A. S, Loecke, T. D, Parr, S, & Robertson, G. P. (2006). Long term trends in nitrous oxide emissions, soil nitrogen, and crop yields of till and no-till cropping systems. *J. Environ. Qual.*, 35, 1487-1495.
- [35] Grattan, S. R, Berenguer, M. J, Connell, J. H, Polito, V. S, & Vossen, P. M. (2006). Olive oil production as influenced by different quantities of applied water. *Agric.Water Manage.* , 85, 133-140.
- [36] Hadas, A, Larissa, K, Mustafa, G, & Emine, E K. (2004). Rates of decomposition of plant residues and available nitrogen in soil, related to residue composition through simulation of carbon and nitrogen turnover. *Soil Biology and Biochemistry* , 36, 255-266.
- [37] Hao, X, Chang, C, Carefoot, J. M, & Ellert, H. H. B.H., (2001). Nitrous oxide emissions from an irrigated soil as affected by fertilizer and straw management. *Nutr. Cycl. Agroecosyst.*, 60, 1-8.
- [38] Hata Hatano RSawamoto T.: (1997). Emission of N₂O from a clayey aquic soil cultivated with onion plants. In: Ando, T. et al (Eds), *Plant Nutrition- for sustainable Food Production and Environment*, , 555-556.
- [39] Hatfield, K. L, & Prunger, J. H. (1996). Microclimate effects of crop residues on biological process. *Theor.Appl.Climatol.*, 54, 47-59.
- [40] Helsel, Z. R. (1992). Energy and alternatives for Fertilizer and Pesticide use, in R.C. Fluck (ed.), *Energy in World Agriculture 6*. Amesterdam, Elsevier, , 177-201.
- [41] Henriksen and Breland(2002). Carbon mineralization, fungal and bacterial growth and enzyme activities as affected by contact between crop residues and soil. *Biol Fert Soil.*, 35, 41-48.

- [42] Huang, Y, Zou, J, Zheng, X, Wang, Y, & Xu, X. (2004). Nitrous oxide emissions as influenced by amendment of plant residues with different C: N ratios. *Soil Biology and Biochemistry.*, 36, 973-981.
- [43] Intergovernmental panel on Climate Change (IPCC)(2007). Chapter 8: Agriculture. In: Metz, B., Davidson, O., Bosch, P., Dave, R., Meyer, L. (Eds.), *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York.
- [44] Intergovernmental panel on Climate Change (IPCC): Summery for Policymakers A report of working group I of the Intergovernmental Panel on Climate Change, 1-83(<http://WWW.ipcc.ch/pub/pub.htm>), (2001).
- [45] IPCC ((2000). *Special report on emissions scenarios* Cambridge University Press, Cambridge, UK.
- [46] IPCC (2007) *Climate Change (2007). The Physical Science Basis* Cambridge University Press, Cambridge, UK and New York, USA.
- [47] IPCC (Intergovernmental Panel on Climate Change):(2000). *Land use, Land Use Change, and Forestry*. Cambridge University Press, New York. Kern, J. and Johnson, M.: 1993. Conservation tillage impacts on national soil and atmospheric carbon levels. *Soil Sci. Soc. Amer. J.* , 57, 200-210.
- [48] IPCC(2001). *Atmospheric chemistry and greenhouse gases*. *Climate Change 2001: The Scientific Basis*, Houghton et al. Eds., Cambridge University Press, Cambridge, , 248-253.
- [49] IPCC: (1995). *Climate Change 1995. Working group 1*. IPCC, Cambridge University Press, Cambridge, U.K.
- [50] IPCC: (1996). *Technologies, Policies and measures for Mitigation Climate Change*, Cambridge, Cambridge University Press.
- [51] IPCC: 2001 *Climate Change (2001). Impacts, adaptations, and Vulnerability*. Contribution of Working group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), Cambridge. Cambridge University Press, 1000 pp.
- [52] Iqbal, J, Hu, R, Lin, S, Bocar, A, & Feng, M. (2009). Carbon dioxide emission from Ultisol under different land uses in mid- subtropical China. *Geoderma* , 152, 63-73.
- [53] Isermann, K. (1994). Agriculture share in the emission of trace gases affecting the climate and some cause- oriented proposals for sufficiently reducing this share. *Environ. Pollut.*, 83, 95-11.
- [54] Jacinthe, P. A, & Dick, W. A. (1997). Soil management and nitrous oxide emissions from cultivated fields in southern Ohio. *Soil Tillage Research*, , 41, 221-235.

- [55] Jacinthe, P. A, Lal, R, & Kimble, J. M. Carbon budget and seasonal carbon dioxide emission from a central Ohio Luvisol as influenced by wheat residue amendment. *Soil Tillage Research*.(2002). , 67, 147-157.
- [56] Janzen, H. H, Campbell, C. A, Izaurrealde, R. C, Ellert, B. H, Juma, N, McGill, W. B, & Zentener, R. P. (1998 b). Management effects on soil C storage in the Canadian prairies. *Soil Tillage Research*. (In press).
- [57] Janzen, H. H, Campbell, C. A, Izaurrealde, R. C, & Ellert, B. H. (1998a). Soil carbon dynamics in Canadian Argo systems. in R. Lal, J.M. Kimble, R.S. Follett, and B.A. Stewart, eds. *Soil processes and carbon cycle*. CRC Press, Boca Raton, FL., 57-80.
- [58] Kaiser, E, & Ruser, A. R.: (2000). Nitrous oxide emissions from arable soils in Germany- An evaluation of six long-term field experiments. *J. Plant Nutr. Soil Sci.*, , 163, 249-260.
- [59] Kern and Johnson:(1993). Conservation tillage impact on national soil and atmospheric carbon levels. *Soil Sci.Soc. Amer. J.* , 57, 200-210.
- [60] Kumar and Goh: (2003). Nitrogen release from crop residues and organic amendments as affected by biochemical composition. *Soil Sci. plant Anna* , 34, 2441-2460.
- [61] Kumar K & Goh KM(2000). Crop residues and management practices: effects on soil, soil nitrogen dynamics, crop yield and nitrogen recovery. *Advances in Agronomy* 6:
- [62] La Scala JrN., Lopes A., Marques Jr., Pereira G.T.: (2001). Carbon dioxide emissions after application of tillage systems for a dark red latosol in southern Brazil. *Soil Tillage Research*, , 62, 163-166.
- [63] Laidlaw, J. W. (1993). Denitrification and nitrous oxide emission in thawing soil. M.Sc. Thesis, Department of Soil Science, University of Alberta, Admoton, AB.
- [64] Lal, R, Fausey, N. R, & Eckert, D. J. Land use and soil management effects on emissions of radiatively active gases in two Ohio Soils. In: Lal, R., Kimble, J., Levine, E., Stewart, B. (Eds.), *Soil Management and Greenhouse Effect*. Lewis/CRC Publ., Boca Raton, FL, (1995). , 41-59.
- [65] Lal, R. (2003). Global potential of soil carbon sequestration to mitigate the green house effect. *Crit. Rev. Plant Sci.*, 22, 151-184.
- [66] Lal, R. (2004). Soil carbon sequestration to mitigate climate change, *Geoderma* , 123, 1-22.
- [67] Lal, R, & Bruce, J. P. (1999). The potential of world cropland soils to sequester C and mitigate the green house effect. *Environ. Sci. Pollut.*, 2, 177-185.
- [68] Lal, R, Kimble, L. M, Follett, R. F, & Cole, C. V. (1998). The potential of U.S Cropland to Sequester C and Mitigate the Greenhouse Effect, Ann Arbor Press, Chelsea, MI.
- [69] Lal, R. (2004). Is crop residue a waste? *J. Soil water Conservation.* , 59, 136-139.

- [70] Lal, R. (2004). Soil carbon sequestration impacts on global climate change and food security. *Science* , 304, 1634-1627.
- [71] Le Mer J Roger P.: Production, oxidation, emission and consumption of methane by soils: A review. *Eur. J. Soil. Biol*, (2001). , 37, 25-50.
- [72] Leake, A. R. (2003). Integrated pest management for conservation agriculture. In: Garc Benites J, Martinez-Vilela A. (editors). *Conservation Agriculture, Environment, Farmers experiences, Innovations, Socio-economy, Policy*. Kluwer. A publishers. Dordrecht/Boston/London., 271-279.
- [73] Lemke, R. L, Izaurrealde, R. C, Nyborg, M, & Solberg, E. D. (1999). Tillage and N source influence soil-emitted nitrous oxide in the Alberta Parkland region. *Canadian Journal of Soil Science*, , 79, 15-24.
- [74] Lerohl, M. L, & Van Kooten, G. C. (1995). Is soil erosion a problem on the Canadian Prairies? *Prairie Forum* , 20, 107-121.
- [75] Li, C. S, Frohling, S, & Butterbach-bahl, K. (2005). Carbon sequestration in arable soils is likely to increase nitrous oxide emissions, offsetting reductions in climate radiative forcing. *Climate Change*, , 72, 321-338.
- [76] Linn, D. M. And Doran, J.W.(1984). Effect of water- filled pore space on carbon dioxide and nitrous oxide production in tilled and non-tilled soils. *Soil Sci. Soc. Am. J.* , 48, 1267-1272.
- [77] Lipiec, J, & Hatano, R. Effects of soil compaction on greenhouse gas fluxes. In: Glin-ski J., Jozefaciuk G., Stahr K. (Eds.) *Soil-Plant-Atmosphere: Aeration and Environmental problems*, (2004). , 18-29.
- [78] Luwayi, N. Z, Rice, W. A, & Glayton, G. W. (1999). Soil microbial biomass and carbon dioxide flux under wheat as influenced by tillage and crop rotation", *Can.J.Soil Sci*, 19(2)., 273-280.
- [79] Mackenzie, A. F, Fan, M. X, & Cadrin, F. Nitrous oxide emission as affected by tillage, corn-soybean-alfalfa rotations and nitrogen fertilization. *Can. J. Soil Sci.*, (1997). , 77, 145-152.
- [80] Maljanen, M, Martikainen, P. J, Aatlonen, H, & Silova, J. (2002). Short term variation in fluxes of carbon dioxide and methane in cultivated and forested organic boreal soils. *Soil Biology & Biochemistry*, , 34, 577-584.
- [81] McConkey Liang BC., Campbell C.A., Curtin D., Moulin A., Brandt S.A., Lafond G.P.: Crop rotation and tillage impact on carbon sequestration in Canadian prairie soils. *Soil Tillage Research*, (2003). , 74, 81-90.
- [82] Mckenny, D. J, Shuttleworth, K. F, & Findlay, W. I. (1980). Nitrous oxide evolution rates from fertilized soil: Effects of applied nitrogen. *Can. J. Soil Sci.*, 60, 429-438.

- [83] Mcswiney, C. P, & Robertson, G. P. (2005). Non linear response of N₂O flux to incremental fertilizer addition in a continuous maize (*Zea mays* L.) cropping system. *Global Change Biol.* , 11, 1712-1719.
- [84] Michellon, R, & Perret, S. (1994). Conception de systems agricoles durables avec couverture herbacee permanente pour les haunds de la Reunion. Centre de cooperation internationale en recherché agronomique pour le development- reunion, Montpillier, France.
- [85] Moiser, A. R, Delgado, J. A, & Keller, M. (1998). Methane and nitrous oxide fluxes in an acid Oxisol in Western Puerto Rico: Effects of tillage, liming and fertilization. *Soil Biol. Biochem.* , 30, 2087-2098.
- [86] Moiser, A. R, & Kroeze, C. (2000). Potential impact on the global atmospheric N₂O budget of the increased nitrogen input required to meet future global food demands, *Chemposh. Global Change Sci.*, 2, 465-473.
- [87] Moiser, A. R, Kroeze, C, Nevison, C, Oenema, O, Seitzinger, S, & Van Cleemput, O. (1998). Closing the global N₂O budget: Nitrous oxide emissions through the agricultural nitrogen cycle. *Nutr. Cycl. Agroecosyst.*, , 225-248.
- [88] Moiser, A. R. (2004). Agriculture and the Nitrogen Cycle. Assessing the impacts of fertilizer use on feed production and the environment. SCOPE Series Island Press, Washington D C.(65)
- [89] Mosier, A. R, Kroeze, C, Nevison, C, Oenema, O, Seitzinger, S, & Van Cleemput, O. (1998). Closing the global N₂O budget: nitrous oxide emissions through the agricultural nitrogen cycle. *Nutr. Cycling Agroecosyst.*, , 52, 225-248.
- [90] Mummey, D. L, Smith, J. L, & Bluhm, G. (1998). Assessment of alternative soil management practices on N₂O emissions from US agriculture. *Agri. Ecosystem. Environ.* , 70, 79-87.
- [91] National Bureau of StatisticsChina, (2008). China Statistical Yearbook- 2008. China Statistics Press, Beijing (In Chinese)
- [92] Nyborg, M, Laidlaw, J. W, & Solberg, E. D. And Malhi, S.S. (1997). Denitrification and nitrous oxide emissions from soil during spring thaw in a Malmo Loam, Alberta. *Can. J. Soil Sci.* , 77, 153-160.
- [93] OECD(2000). Environmental indicators for agriculture- methods and results. Exactive summery 2000, Paris.
- [94] Oliver, C D, & William, R H. (2000). Decomposition of rice straw and microbial carbon use efficiency under different soil temperature and moistures. *Soil Biology and Biochemistry*, , 32, 1773-1785.

- [95] Pare, T, Dinel, H, Moulin, A. P, & Townley- Smith, L. Organic matter quality and structural stability of a black Chernozemic soil under different manure and tillage practices. *Geoderma* , 91, 311-326.
- [96] Paustian, K, Andren, O, Janzen, H. H, et al. (1997). Agricultural soils as a sink to mitigate CO₂ emissions. *Soil use and Management* , 13, 230-244.
- [97] Paustian, K, Andren, O, Janzen, H. H, Lal, R, Smith, R, Tian, P, Tiessen, G, Van Noordwijk, H, & Woomer, M. P.L.: (1997). Agricultural soils as a sink to mitigate CO₂ emissions. *Soil Use Mgmt.* 134 (4, supp.), , 230-244.
- [98] Paustian, K, Elliott, E. T, & Carter, M. R. Tillage and crop management impacts on soil C storage: Use of long-term experiment data. *Soil Tillage Research*, (1998). , 47, 7-12.
- [99] Powlson, D. S, Witmore, A. P, & Goulding, W. T. (2011). Soil carbon sequestration to mitigate climate change: a critical re-examination to identify the true and the false. *European Journal of Soil Science*, , 62, 42-45.
- [100] Rastogi, M, Singh, S, & Pathak, H. Emission of carbon dioxide from soil. *Current Sci.*, (2002). , 82, 510-517.
- [101] Reicosky, D. C, Dugas, W. A, & Torbert, H. A. (1997). Tillage-induced soil carbon dioxide loss from different cropping systems. *Soil Tillage Research*, , 41, 105-118.
- [102] Reicosky, D. C, Kemper, W. D, & Langdale, G. W. Douglas, Jr., C.L. and Rasmussen, P.E., (1995). Soil organic matter changes resulting from tillage and biomass production. *J. Soil Water Conserv.*, , 50(3), 253-261.
- [103] Reicosky, D. C, & Lindstrom, M. J. (1993). Fall tillage method: Effect on short-term carbon dioxide flux from soil. *Agron. J.*, , 85(6), 1237-1243.
- [104] Robertson, G. P, Paul, E. A, & Harwood, R. R. (2000). Greenhouse gases in intensive agriculture: contributions of individual gases to the radioactive forcing of the atmosphere. *Science* , 289, 1922-1925.
- [105] Sanchez, M. L, Ozores, M. I, Colle, R, Lopez, M. J, De Torre, B, Garcia, M. A, & Perez, I. fluxes in cereal land use of the Spanish plateau: influence of conventional and reduced tillage practices. *Chemosphere*, , 47, 837-844.
- [106] Sanford, J. O, Hariston, J. E, & Reinschmiedt, L. L. (1982). Soybean-Wheat Double Cropping: Tillage and Straw Management Glycine max, Triticum aestivum, Yield, (osl), Returns, Mississippi", Research Report, Mississippi Agricultural and Forestry Experiment station. 7 (14), 4p.
- [107] Sawamoto, T, Kusa, K, Hu, R, & Hatano, R. O, CH₄ and CO₂ emissions from subsurface-drainage in a structured clay soil cultivated with onion in Central Hokkaido, Japan. *Soil Sci. Plant Nutr.*, , 49, 31-38.

- [108] Shan, L, & Chen, G. L. (1993). *The Theory and Practice of Dryland Agriculture in the Loess Plateau of China*, Science Press, Beijing.
- [109] Six, J, Ogle, S. M, Breidt, F. J, Conant, R. T, Mosier, A. R, & Paustian, K. (2004). The potential to mitigate global warming with no-tillage management is only released when practiced in the long-term, *Global Change Biology*, , 10, 155-160.
- [110] Six, J, & Paustian, K. (1999). Aggregate and soil organic matter dynamics under conventional and no- tillage systems", *Soil Sci. Amer. J.* 63(5), 1350-1358.
- [111] Smith, P, Martino, D, & Cai, Z. (2008). Greenhouse gas mitigation in agriculture. *Philosophical Transactions of the Royal Society, Series B*, , 363, 789-813.
- [112] Stout, B. A. (1990). *Handbook of Energy for World Agriculture*. London & New York, Elsevier
- [113] Tang, H, Qiu, J, Van Ranst, E, & Li, C. (2006). Estimations of soil organic carbon storage in cropland of China based on DNDC model. *Geoderma* , 134, 200-206.
- [114] Tobert, H. A, Potter, K. N, & Morrison, J. E. Jr: (1998). Tillage intensity and crop residue effects on nitrogen and carbon cycling in a vertisol. *Comm. Soil Sci. Plant Analysis.*, 29, 717-727.
- [115] Unger, P. W, Langdale, D. W, & Papendick, R. I. (1988). Role of crop residues- improving, conservation and use. In: Hargrove WL(ED). *Cropping strategies for efficient use of nitrogen*. Special publication 51. American Society of Agronomy, Medison, Wiscar 100.
- [116] Uri, N. D. (2001). The potential impact of conservation practices in US agriculture on global climate change", *J. Sust. Ag.* 18(1), 109-131.
- [117] Van and Kessel, C, Pennock, D. J, & Farrel, R. E. (1993). Seasonal variations in denitrification and nitrous oxide evolution at the land- scape scale. *Soil Sci. Soc. Am.J.* , 57, 988-995.
- [118] Venterea, R. T, Baker, J. M, Dolan, M. S, & Spokas, K. A. (2006). Carbon and nitrogen storage are greater under biennial tillage in a Minnesota corn-soybean rotation. *Soil Sci. Soc. Am.J.*, 70, 1752-1762.
- [119] Viek, P. L. G, & Fillery, I. R. P. Improving nitrogen use efficiency in wetland rice soils", Paper read before The Fertilizer Society of London on the 13th December (1984). *Fertilizers Society Proceedings* (230)
- [120] Wang, L G, Qiu, J J, Tang, H J, Hu, L, Li, C S, & Eric, V R. (2008). Modeling soil carbon dynamics in the major agricultural regions of China. *Geoderma* , 147, 47-55.
- [121] Wang, W. J, Moody, P. W, Reeves, S. H, Salter, B, & Dalal, R. C. (2008). Nitrous oxide emissions from sugarcane soils: effects of urea forms and application rate. *Proceedings of the Australian Society of Sugar Cane Technologists*, , 30, 87-94.

- [122] Wanger- Riddle, C, Furon, A, Mclaughlin, N. L, Lee, I, Barbeau, J, Jayasundara, S, Parkin, G, Von Bertoldi, P, & Warland, J. (2007). Intensive measurement of nitrous oxide emissions from a corn-soybean-wheat rotation under two contrasting management systems over 5 years. *Global change Biol.* , 13, 1722-1736.
- [123] Watson, R. T, Zinyowera, M. C, Moss, R. H, et al. (1996). Impacts adaptations and mitigation of climate change: Scientific- technical analyses. Intergovernmental panel on climate change, climate change 1995. Cambridge University press, USA, 879.
- [124] Weijin Wang Dalal RC, Reeves Steven H., Bahl Klaus Butterbach and Kiese Ralf. (2011). Greenhouse gas fluxes from an Australian subtropical cropland under long-term contrasting management regimes, *Global Change Biology.*, 17, 3089-3101.
- [125] West, T. O, & Marland, G. (2002). A synthesis of carbon sequestration, carbon emissions and net carbon flux in agriculture: Comparing tillage practices in the United States; *Agr. Ecosyst. Env.* , 91, 217-232.
- [126] West, T. O, & Post, W. M. (2002). Soil organic carbon sequestration rates by tillage and crop rotation: global data analysis. *Soil Sci. Soc. Am. J.*, 66, 1930-1946.
- [127] Wilson, H. M, & Al- Kaisi, M. M. Crop rotation and nitrogen fertilization effect on soil CO₂ emissions in central Iowa, *Applied Soil Ecology* (2008). , 39(2008), 264-270.
- [128] Yao, Z. S, Zheng, X. H, Xie, B, et al. (2009). Tillage and residue management significantly affects N-trace gas emissions during the non-rice season of a subtropical rice-wheat rotation. *Soil Biology & Biochemistry*, , 41, 2131-2140.
- [129] Zadoks, J. C, Chang, T. T, & Konzak, C. F. (1974). A decimal code for the growth stages of cereals. *Weed Res.* , 14, 415-421.
- [130] Zhang, Q Z, Yang, Z L, & Wu, W L. (2008). Role of crop residue management in sustainable agricultural development in the North China Plain. *J Sust Agri.* , 32, 137-148.