IFOAM INTERNATIONAL FEDERATION OF ORGANIC AGRICULTURE MOVEMENTS

HIGH SEQUESTRATION
LOW EMISSION
FOOD SECURE FARMING

Submission to ADP Chairs on Workstream 2 (Pre 2020 Ambition)

IFOAM is the global umbrella organization for organic food and farming. It's mission is to lead, unite and assist the organic movement in its full diversity. It's goal is the worldwide adoption of ecologically, socially and economically sound systems that are based on the principles of Organic Agriculture.

Background to Submission

Extract from Provisional agenda and annotations of the Second Session of the Ad Hoc Working Group on the Durban Platform for Enhanced Action in Bonn 29 April to 3 May 2013 (http://unfccc.int/resource/docs/2013/adp2/eng/01.pdf)

20. Background: The COP, by decision 1/CP.17, noted with grave concern the significant gap between the aggregate effect of Parties' mitigation pledges in terms of global annual emissions of greenhouse gases by 2020 and aggregate emission pathways consistent with having a likely chance of holding the increase in global average temperature below 2 °C or 1.5 °C above pre-industrial levels. The COP decided to launch a workplan on enhancing mitigation ambition to identify and explore options for a range of actions that can close the ambition gap, with a view to ensuring the highest possible mitigation efforts by all Parties.

21. At its eighteenth session, the COP decided to identify and explore in 2013 options for a range of actions that can close the pre-2020 ambition gap, with a view to identifying further activities for its plan of work in 2014, ensuring the highest possible mitigation efforts under the Convention.

22. At the second part of its first session, the ADP decided to hold in-session roundtable discussions and workshops under workstream 2, addressing matters related to paragraphs 7 and 8 of decision 1/CP.17 (pre-2020 ambition). The ADP invited its Co-Chairs to set out, in early 2013, focused questions for those round-table discussions and workshops, taking into account the submissions referred to in paragraph 24 below.

23. The ADP also expressed its intention to hold a series of workshops beginning in 2013 that may, inter alia, identify and catalyze the implementation of initiatives and actions to rapidly, cost-effectively, urgently and equitably reduce greenhouse gas emissions.

24. The ADP invited Parties and accredited observer organizations to submit to the secretariat, by 1 March 2013, information, views and proposals on actions, initiatives and options to enhance ambition, including through the workplan on enhancing mitigation ambition, with a particular focus on 2013. In their submissions on actions, initiatives and options to enhance ambition, Parties may wish to give consideration to the following

aspects:

(a) Mitigation and adaptation benefits, including resilience to the impacts of climate change;

(b) Barriers and ways to overcome them, and incentives for actions;

(c) Finance, technology and capacity-building to support implementation.

25. Action: The ADP will be invited to initiate discussions in order to identify and explore options for a range of actions that can close the pre-2020 ambition gap, with a view to identifying further activities for its plan of work in 2014.

26. The ADP will also be invited to advance its substantive discussions on this item, taking into account the round-table discussions and workshops held during the session.

(a) Mitigation and adaptation benefits, including resilience to the impacts of climate change;

Currently agriculture is a significant contributor to greenhouse gas (GHG) emissions and therefore to climate change. Organic agriculture has the potential to help agriculture to become a net sequester of GHGs and to assist in building resilience and adaptation in farming systems. Organic farming has a range of practices that are regarded as essential to allowing the system to be certified or classed as organic. Most of these practices are easily transferable to other farming systems and many of them are now being adopted under the emerging title of Climate Smart Agriculture (FAO, 2012). The international organic agriculture movement has already set out in its submission to SBSTA in March 2012, the potential of existing organic based practices and systems (technologies) to help Parties identify practical and low-cost ways to raise mitigation ambition while building resilience and adaption in farming systems especially suitable for the worlds smallholders farmers. This submission re-iterates this adaptation and mitigation potential.

Mitigation: Soils as a carbon sink

Soils are the greatest carbon sink after the oceans. According to Professor Rattan Lal of Ohio State University there are over 2,700 Gt of carbon is stored in soils worldwide. This is considerably more than the combined total of 780 Gt in the atmosphere and the 575 Gt in biomass (Lal, 2008).

The amount of CO in the oceans is already causing a range of problems, particularly for species with calcium exoskeletons such as coral. Scientists are concerned that the increase in acidity caused by higher levels of CO is damaging these species and threatens the future of marine ecosystems such as the Great Barrier Reef and its fish-stocks. The world's oceans, like the atmosphere, cannot absorb any more CO_2 without causing potentially serious environmental damage to many aquatic ecosystems (Hoegh-Guldberg et al., 2007).

Despite the fact that soil is the largest repository of carbon after the oceans and has the potential to sequester more CO_2 than biomass, neither soil nor agriculture is incorporated in any formal agreement of the United Nations Framework Convention on Climate Change (UNFCCC).

This needs to be changed because according to the United Nations Food and Agriculture Organization 'Agri-culture not only suffers the impacts of climate change, it is also responsible for 14 percent of global greenhouse gas emissions. But agriculture has the potential to be an important part of the solution, through mitigation - reducing and/or removing - a significant amount of global emissions. Some 70 percent of this mitigation potential could be realized in developing countries.' (FAO, 2012)

Mitigation: Soil carbon sequestration through agricultural practices
Two independent global meta reviews have looked at the average amount of CO sequestered by organic farming systems compared to conventional systems.

A preliminary study by FiBL, published by FAO, collated 45 peer reviewed comparison trials between organic and conventional systems that used 280 data sets (FAO, 2011). These studies included data from grasslands, arable crops and permanent crops in several continents. A simple analysis of the data shows that on average that the organic systems had higher levels of soil carbon sequestration (Gattinger et al, 2011).

Dr. Andreas Gattinger and colleagues wrote (2011:16): 'In soils under organic management, the soil organic carbon (SOC) stocks averaged 37.4 tonnes C ha-1, in comparison to 26.7 tonnes C ha-1 under non-organic management.' This means that the average difference between the two management systems (organic and conventional) was 10.7 tonnes of C.

Using the accepted formula that SOC x 3.67= CO_2 39.269 tonnes of CO was sequestered in the organic systems per hectare each year than in the conventional systems.

The average duration of management of all included studies was 16.7 years (Gattinger et al, 2011). This means that an average of 2,351 kgs of CO_2 was sequestered per hectare every year in the organic system compared to the conventional system.

Another study by the United Kingdom based Soil Association found that average organic farming practices removed about 2,200 kg of CO_2 per hectare per year. This is critical information as it clearly shows that organic farmers are currently sequestering significant amounts of carbon. Most importantly, this is not based on untested concepts like "carbon capture and storage" and "clean coal"; it is based on cur- rent practices that can be readily adopted by other farmers per hectare per year (Azeez, 2009).

Mitigation: Closing the mitigation gap – the potential of organic practices
Based on these figures, the widespread adoption of current organic practices globally has the potential to sequester 10 Gt of CO_2 per year which is around 20 per cent of the world's current annual GHG emissions.

Farm system	**Hectares**
Grassland	3,356,940,000 hecatres
Arable crops	1,380,515,000 hecatres
Permanent crops	146,242,000 hecatres
Total	4,883,697,000 hecatres
Source: (FAO, 2010)	

Organic @ 2.2 tons per hectare: 10.7 Gt of CO_2 (Azeez, 2009)

Annual GHG emissions: 49 Gt of CO_2e (IPCC Fourth Assessment Report (AR4), 2007)

Mitigation: Potential exists for higher levels of CO2 sequestration
All data sets that use averaging have outlying data. These are examples that are significantly higher or significantly lower than the average. They are always worth examining to find out why. Research into them will allow an understanding on what practices significantly increase soil carbon and those that decrease or do not increase it.

There are several examples of significantly higher levels of carbon sequestration than the averages quoted in the studies above. The Rodale Institute in Pennsylvania, USA, has been conducting long-running comparisons of organic and conventional cropping systems for over 30 years that confirm that organic methods are effective at removing CO_2 from the atmosphere and fixing it as organic matter in the soil. La Salle and Hepperly (2008:5) wrote:

'In the FST [Rodale Institute farm systems trial] organic plots, carbon was sequestered into the soil at the rate of 875lbs/ac/year in a crop rotation utilizing raw manure, and at a rate of about 500lbs/ac/year in a rotation using legume cover crops.

During the 1990s, results from the Compost Utilization Trial (CUT) at Rodale Institute – a 10-year study comparing the use of composts, manures and synthetic chemical fertilizer – show that the use of compos- ted manure with crop rotations in organic systems can result in carbon sequestration of up to 2,000lbs/ ac/year. By contrast, fields under standard tillage relying on chemical fertilizers lost almost 300 pounds of carbon per acre per year.' (La Salle and Hepperly 2008:5).

Converting these figures into kilograms of CO_2 sequestered per hectare using the accepted conversion rate of 1 pound per acre = 1.12085116 kg/ha and soil organic carbon x 3.67= CO_2, gives the following results:

- The FST based on conventional plots using standard tillage and chemical fertilizers lost almost 300 pounds of carbon per acre per year. This is equivalent to a negative sequestration rate or emissions of 1,234.1kg of CO_2 /ha/yr.

- The FST legume based organic plots showed that carbon was sequestered into the soil at the rate of about 500 lbs/ac/year. This is equivalent to a positive sequestration rate or captures of 2,055.2kg of CO_2 /ha/yr.
- The FST manured organic plots showed that carbon was sequestered into the soil at the rate of 875lbs/ ac/year. This is equivalent to a positive sequestration rate or captures of 3,596.6 kg of CO_2 /ha/yr.
- The Compost Utilization Trial; showed that carbon was sequestered into the soil at the2rate of 2,000lbs/ac/year. This is equivalent to a positive sequestration rate or captures of 8,220.8 kg of CO_2/ha/yr.

Thus there are significant benefits and adverse effects depending on the type of farming systems adopted. Chemical based inputs resulted in loss of soil carbon whereas organic inputs, which in many cases can be sourced on farm, not only avoided emissions caused by the chemicals inputs but also significantly increased net sequestration with composting being the most effective. The legume based organic plots showed sequestration rates consistent with those expected for organic systems and could be much higher if combined with either manure or compost inputs.

Mitigation: The Potential in desert climates

Sekem is the oldest biodynamic farm in Egypt. It was founded in 1977 by Dr. Ibrahim Abouleish. The Louis Bolk Institute and Soil & More, two organizations based in the Netherlands, have made a study to calculate soil carbon sequestration at Sekem. Their results show that on average Sekem's management practices have resulted in 900 kgs of Carbon being stored in the soil per hectare per year in the fields that were 30 years old. Using the accepted formula of Soil Organic Carbon x 3.67 = CO_2, this means that Sekem has sequestered 3,303 kgs of CO_2 per hectare per year for 30 years. (Luske and van der Kamp, 2009; Koop mans et al, 2011).

Based on these figures, the widespread adoption of Sekem's practices globally has the potential to sequester 16 Gt of CO_2, which is around 30% of the world's current annual greenhouse gas emissions into soils. (4,883,697,0002ha x 3,303 kgs = 16.1 gt CO_2/ha/yr)

Researchers at the Royal Thai Organic Project near Chiang Mai in Thailand have managed to increase their soil organic matter levels from 1 per cent to 5 per cent over a period of eight years (personal communication). This means that 187.2 tons of CO_2 /ha has been sequestered through this project, which equates to 2 23.4 tons of CO_2 /ha/yr. If this was applied globally, it would sequester 114 Gt CO_2/ha/yr – more than double the world's current annual GHG emissions. (4,883,697,000 ha x 23.4 tons of CO_2 /ha/yr = 114 Gt CO_2 /ha/yr).

Mitigation: The potential in tropical climates

There is an emerging body of science showing that the most stable fractions of soil carbon are stored deeper in the soil than most of the current soil carbon measurements used on farms. Most soil tests tend to work at a depth of around 15 to 20 cm as this is the usual root zone for many crops. Research is finding that a significant amount of carbon is stored at lowered depths and this tends to be very stable.

Mitigation: The potential of deeper carbon systems

Research by Rethemeyer and colleagues using radiocarbon techniques to analyze various soil carbon fractions indicated a progressive enrichment of stable organic compounds with increasing soil depth to 65 cm. (Rethemeyer et al, 2005).

Research by Professor Rattan Lal and colleagues from Ohio State University compared carbon levels between no-till and conventional tillage fields and found that, in some cases, carbon storage was greater in conventional tillage fields. The key is soil depth.

They compared the carbon storage between no-till and plowed fields with the plow depth - the first 8 inch-es (20cm) of the soil the carbon storage was generally much greater in no-till fields than in plowed fields. When they examined 12 inches (30cm) and deeper, they found more carbon stored in plowed fields than in no-till.

The researchers found that measuring soil carbon is ineffective in establishing the carbon content of soils. They recommended measuring carbon up to 1 meter below the soil surface to get a more accurate assessment of soil carbon. (Christopher, Lal and Mishra, 2009)

According to Gattinger and colleagues (2011:16) 'Researchers working on the long term comparison trials between organic and convention farming systems in Switzerland (the DOK trials), found that when rotation phases that contained two years of deep-rooting grass-clover leys, that 64 percent of the total SOC stocks are deposited between 20–80 cm soil depths. In many parts of the world, organic farming systems are relying on the soil fertility build-up of deep-rooting grass-legume mixtures and on the incorporation of plant residues by deep-digging earthworms, making it quite likely that the currently available data sets underestimate the SOC stocks in organically managed soils. This is particularly significant considering that in deeper soil horizons, SOC seems to be more stabilized.'

Mitigation: The potential of grazing systems

The majority of the world's agricultural lands (68.7%) are used for grazing (FAO, 2010). There is an emerging body of published evidence showing that pastures and permanent ground cover swards in perennial horticulture build up soil organic carbon faster than any other farming system and with correct management this is stored deeper in the soil. (Fliessbach et al, 1999, Sanderman et al, 2010)

One of the significant reasons for this has been the higher proportion of plants that use the C_4 pathway of photosynthesis as this makes them more efficient at collecting CO_2 from the atmosphere, especially in warmer and drier climates. According to Osborne and Beerling (2006:173) 'Plants with the C_4 photosynthetic pathway dominate today's tropical savannahs and grasslands, and account for some 30% of global terrestrial carbon fixation. Their success stems from a physiological CO_2-concentrating pump, which leads to high photosynthetic efficiency in warm climates and low atmospheric CO_2 concentrations.'

This knowledge is now being applied in innovative ways such as holistic stock management, evergreen farming, agro forestry in pastures and pasture cropping.

Mitigation: The potential of 'pasture cropping'

Pasture cropping works on the principle that annuals grow naturally through perennial pastures in their normal cycles. It is not the purpose of this paper to explain the technical details on how it's being successfully implemented in a wide variety of climates and soil types around the world. The critical issue for this paper, however is to present the preliminary data on soil carbon sequestration so that the potential of this system can be further researched.

Research by Jones at Winona, the property of Colin and Nick Seis in NSW, Australia, that uses a combination of pasture cropping and holistic stock management shows that 168.5 t/ha of CO_2 was sequestered over 10 years. The sequestration rate for last two of the ten years (2009 and 2010) was 33 tons of CO_2 /ha/ yr (Jones, 2011). This system can be and is being successfully used in both arable and pastures systems including horticulture. If this was applied around the world, it could potentially sequester 82 Gt of CO_2/ha/2 yr. (4,883,697,000 ha X 16.85 tonnes = 82 Gt). This is significantly more than the world's GHG emissions of 49 Gt and would help reverse climate change. The increase in soil carbon will also significantly improve the production and adaption capacities of global grazing systems.

Mitigation: The urgent need for more peer reviewed research

It is not the intention of this paper to use the above types of generic exercises of globally extrapolating data as scientific proof of what can be achieved by scaling-up organic systems. These types of very simple analyses are useful for providing a conceptual idea of the considerable potential of organic farming to reduce GHG emissions on a landscape scale. The critical issue here is that urgent peer reviewed research is needed to understand how and why (and for the skeptics – if) these systems sequester significant levels of CO_2 then look at how to apply the findings for scaling-up on a global level in order to achieve a significant level of GHG mitigation.

The potential of these farming methods is enormous, considering that these data are based on current practices.

Mitigation: Permanence

One of the major debates around soil carbon is based on how it can meet permanence requirements. Soil carbon is a complex mix of fractions of various carbon compounds. Two of these, humus and charcoal (char), are very stable: research shows that they can last for thousands of years in the soil. Other fractions are less stable (labile) and can be easily volatilized into CO_2. Soil carbon tends to volatilize into CO_2 in most conventional farming systems. However, correct management systems can continuously increase both the stable and labile fractions through a number of approaches, especially those discussed in this paper.

The research conducted by Jones at Winona showed that the majority of the newly increased soil carbon was in the stable fractions. She reported that 78 per cent of the newly sequestered carbon was in the non- labile (humic) fraction of the soil and this rendered it into highly stable long chain forms. Her research found that the carbon levels in the 0-10cm increments are from the recent decomposition of organic matter and formed short-chain unstable carbon. The carbon below 30cm was composed of the humic soil fraction and was highly stable (Jones, 2011). Jones's research is consistent with the findings of Christopher, Lal and Mishra, (2009) and Rethemeyer et al, (2005).

Long-term research conducted for more than 100 years at the Rothamsted Research Station in the United Kingdom and the University of Illinois Morrow Plots in the United States of America showed that the total soil carbon levels could steadily increase and then reach a new stable equilibrium in farming systems that use organic matter inputs. This means that good soil organic matter management systems build and maintain stable fractions over long time periods and therefore have a high degree of permanence. (Lal, 2007)

Mitigation: Synthetic nitrogen fertilizers degrade soil carbon

Research shows, there is a direct link between the application of synthetic nitrogenous fertilizers and a decline in soil carbon.

Scientists at the University of Illinois analyzed the results of a 50-year agricultural trial and found that the application of synthetic nitrogen fertilizer had resulted in all the carbon residues from the crop disappearing, as well as an average loss of around 10,000 kg of soil carbon per hectare. This is around 36,700 kg of CO_2 per hectare over and above the many thousands of kilograms of crop residue that is converted into CO_2 every year (Khan et al., 2007; Mulvaney, Khan and Ellsworth, 2009). The researchers found that the higher the application of synthetic nitrogen fertilizer, the greater the amount of soil carbon lost as CO_2. This is one of the major reasons why there is generally a decline in soil carbon in conventional agricultural systems. On the other hand there is a good body of research showing that using legumes and carbon based sources such as compost for increases the levels of soil organic carbon (La Salle and Hepperly 2008).

Researchers from North America and Europe have also shown that organic systems are more efficient in using nitrogen than conventional farming systems. Significantly, because of this efficiency, very little nitrogen leaves the farms as GHGs or as nitrate that pollutes aquatic systems (Drinkwater, Wagoner and Sarrantonio, 1998; Mader et al, 2002).

Mitigation: Avoided emissions

Currently most of the food and other products from farms are exported off the farm and sent to cities. The disposal of these organic residues in landfills is responsible for methane emissions. Methane is a significant greenhouse gas. The correct composting and bio-digester methods are now recognized as effective ways of avoiding methane emissions.

Research by FiBL is showing that more CO_2 e can be avoided by these methods than most other farming practices. (Gattinger et al, 2011)

For example at Sekem in Egypt, since January 2007, they have offset methane emissions through their com-post project. Through using the correct composting methods for organic materials they were able to reduce methane emissions by the equivalent of 303,757 tonnes of CO_2e. (Helmy Abouleish Personal Communication)

Composting the organic wastes in cities and transporting them to the farm brings multiple benefits in closing the nutrient cycle by returning the nutrients that are exported from the farm, avoiding methane emissions and increasing the rate of soil carbon sequestration.

Adaptation and Resilience: Greater resilience in adverse conditions
Organic agriculture has a role in the many strategies that are needed to ensure food security and the viability of farming in the predicted climate extremes that will occur with climate change.

Published studies show that organic farming systems are more resilient to the predicted weather extremes and can produce higher yields than conventional farming systems in such conditions (Drinkwater, Wagoner and Sarrantonio 1998; Welsh, 1999; Pimentel, 2005). For instance, the Wisconsin Integrated Cropping Systems Trials found that organic yields were higher in drought years and the same as conventional in normal weather years (Posner et al., 2008).

Similarly, the Rodale Farm System Trial (FST) showed that the organic systems produced more corn than the conventional system in drought years. The average corn yields during the drought years were from 28% to 34% higher in the two organic systems. The yields were 6,938 and 7,235 kg per ha in the organic animal and the organic legume systems, respectively, compared with 5,333 kg per ha in the conventional system (Pimentel, 2005). The researchers attributed the higher yields in the dry years to the ability of the soils on organic farms to better absorb rainfall. This is due to the higher levels of organic carbon in those soils, which makes them more friable and better able to store and capture rainwater, which can then be used for crops (La Salle and Hepperly, 2008).

Adaptation and Resilience: Improved efficiency of water use
Research shows that organic systems use water more efficiently due to better soil structure and higher levels of humus and other organic matter compounds (Lotter, Seidel and Liebhart, 2003; Pimentel, 2005). Lotter and colleagues collected data for over 10 years during the Rodale FST. Their research showed that the organic manure system and organic legume system (LEG) treatments improve the soils' water-holding capacity; infiltration rate and water capture efficiency. The LEG maize soils averaged 13% higher water content than conventional system (CNV) soils at the same crop stage, and 7% higher than CNV soils in soy- bean plots (Lotter, Seidel and Liebhart, 2003).

The more porous structure of organically treated soil allows rainwater to quickly penetrate the soil, result- ing in less water loss from run-off and higher levels of water capture. This was particularly evident dur- ing the two days of torrential downpours during hurricane Floyd in September 1999, when the organic systems captured approximately double the water than that captured by the conventional systems (Lotter, Seidel and Liebhart, 2003).

Adaptation and Resilience: Composting

The term organic farming is derived from the fact that organic farming systems improve soil health and fertility through the recycling of organic matter. There is a very strong body of evidence, which shows that the addition of organic matter improves soil organic carbon (SOC) levels and this is more effective than synthetic, water-soluble fertilizers. Lal (2007:822) provides an extensive list from the scientific literature that demonstrates this:

> ‘Application of manures and other organic amendments is another important strategy of SOC sequestration. Several long-term experiments in Europe have shown that the rate of SOC sequestration is greater with application of organic manures than with chemical fertilizers (Jenkinson 1990; Witter et al. 1993; Christensen 1996; Korschens & Muller 1996; Smith et al. 1997). Increase in the SOC pool in the 0–30 cm depth by long-term use of manure compared to chemical fertilizers was 10% over 100 years in Denmark (Christensen 1996), 22% over 90 years in Germany (Korschens & Muller 1996), 100% over 144 years at Rothamsted, UK (Jenkinson 1990) and 44% over 31 years in Sweden (Witter et al. 1993). The data from Morrow plots in Illinois indicated that manured plots contained 44.6 Mg/ha more SOC than unmanured control (Anderson et al. 1990). In Hungary, Arends & Casth (1994) observed an increase in SOC concentration by 1.0–1.7% by manuring. Smith et al. (1997) estimated that application of manure at the rate of 10 Mg/ha to cropland in Europe would increase the SOC pool by 5.5% over 100 years. In Norway, Uhlen (1991) and Uhlen & Tveitnes (1995) reported that manure application would increase SOC sequestration at the rate of 70–227 Kg/ha per year over a 37–74-year period.’

Composting was pioneered by the organic farming movement through the work of Sir Albert Howard in the 1930s and 40s and then strongly promoted by Jerome Rodale in his numerous publications, especially in ‘Organic Farming and Gardening’ that was the widely read around the world. (Rodale, 2011)

There is an increasing body of evidence that composts are superior to raw manures in increasing the level of soil organic matter. The Rodale Institute studies have demonstrated that good organic practices using raw manures and cover crops can sequester 3,596.6 kg of CO_2 /ha/yr and that when compost is added this increases to 8,220.8 kg of CO_2 /ha/yr (La Salle and Hepperly 2008).

Adaptation and Resilience: Diverse cropping systems

Another critical aspect of organic production is the use of diverse cropping systems. Certified organic production systems prohibit continuous monocultures in cropping systems. Every certified organic farm needs to have a management plan that outlines their crop (and stock) rotation systems. Lal (2007:822) cites the scientific literature to indicate that this does make a difference:

> ‘Soils under diverse cropping systems generally have a higher SOC pool than those under monoculture (Dick et al. 1986; Buyanoski et al. 1997; Drinkwater et

> al. 1998; Buyanoski & Wagner 1998). Elimination of summer fallow is another option for minimizing losses of the SOC pool (Delgado et al. 1998; Rasmus- sen et al. 1998). Growing a winter cover crop enhances soil quality through SOC sequestration. In the UK, Fullen & Auerswald (1998) reported that grass leys set aside increased SOC concentration by 0.02% per year for 12 years. In Australia, Grace & Oades (1994) observed that the SOC pool in the 0–10 cm layer increased linearly with increase in frequency of pasture in the crop rotation cycle. In comparison with continuous cropping, incorporation of cover crops in the rotation cycle enhanced SOC concentration in the surface layer by 15% in Sweden (Nilsson 1986), 23% in The Netherlands (Van Dijk 1982) and 28% in the UK (Johnston 1973) over [a] 12–28-year period. Similar results were reported by Lal et al. (1998) for the US cropland.'

Adaptation and Resilience: Sustainable Land Management

The highest percentage of soil carbon is contained in the first 10 cm of soil (Handrek, 1990; Handrek and Black, 2002; Stevenson, 1998). Soil loss and erosion from farming systems is a leading concern around the world (Millennium Ecosystem Assessment, 2005; IAASTD, 2009). It is a major cause of loss of soil carbon due to highest levels of the soil organic matter being in the top layer if the soil.

Comparison studies have shown that organic systems demonstrate less soil loss due to better soil health, and are therefore able to maintain greater soil productivity than conventional farming systems (Reganold, Elliott and Unger, 1987; Reganold et al, 2001; Mader et al., 2002; Pimentel, 2005). Reganold, Elliott and Unger compared the effects of organic and conventional farming on particular properties of the same soil over a long period and found that, '...the organically-farmed soil had significantly higher organic matter content, thicker topsoil depth, higher polysaccharide content, lower modulus of rupture and less soil erosion than the conventionally-farmed soil' (Reganold et al, 1987:370).

Critics of organic systems point to conventional, no-till production systems as superior to organic systems because the latter use tillage. To our knowledge there is only one published study comparing conventional, no-till with organic tillage systems. The researchers found that the organic system had better soil quality. According to Teasdale, Coffman and Mangum (2007:1304) '... the OR [organic] system improved soil productivity significantly as measured by corn yields in the uniformity trial ... [The] higher levels of soil C and N were achieved despite the use of tillage (chisel plow and disk) for incorporating manure and of cultivation (low- residue sweep cultivator) for weed control... the results suggest that systems that incorporate high amounts of organic inputs from manure and cover crops can improve soils more than conventional no-tillage systems despite reliance on a minimum level of tillage.'

The latest improvement in organic low/no-till systems developed by the Rodale Institute shows that these systems can deliver high yields as well as excellent environmental outcomes (Rodale, 2006; Moyer 2011).

(c) Finance, technology and capacity-building to support implementation

The organic practices and systems outlined in this submission are relatively simple to incorporate into farming systems and largely utilize local ecosystem based resources. The biggest challenge to scaling-up these high sequestration, low emission food secure practices is through partnerships between the global organic movement and farmers organizations (e.g. SACAU, AFA etc), local and national governments, NGOs, humanitarian organizations (e.g. Red Cross, Oxfam etc), UN agencies (e.g. UNEP; UNDP, WFP, IFAD, UNCCD etc) and through the private sector via value chain approaches. IFOAM has a global network of over 800 member organizations in 120 plus countries. IFOAM is working hard to engage with organizations such as those listed in order to make the expertise and practices of the organic movement available to many more farmers and communities around the world and thereby simultaneously helping to close the mitigation gap and increase resilience. IFOAM has also established a global organic agriculture research alliance as part of its official suite of Rio+20 Voluntary Commitments. The Innovation Platform of IFOAM (TIPI) aims to aid knowledge sharing and out smallholder farmers at the centre of the research and knowledge dissemination agenda. The IFOAM President outlined the objectives of TIPI at the Agriculture, Landscapes and Livelihoods Day 5 on the margins of CoP18 in Doha in December 2012.

The UNFCCC can assist IFOAM and the global organic movement and the many stakeholders around the world that would like to be able to access affordable organic practices to address climate change mitigation, adaptation and resilience through encouraging such practices in programs such as NAMAs, NAPAs and the Nairobi Work Programme and so on.

In terms of innovate market mechanisms, alternative financing systems to support organic farming and agro-ecological approaches to agriculture that provide a real solution for climate change for vulnerable farmers and communities including a fair compensation to organic farmers for their contribution to mitigation and adaptation strategies must be developed. At the same time no form of agriculture must be included in any speculative carbon market schemes. Such financing systems must strengthen smallholder farmers and help to empower them to improve their farming systems in a way that increases their resilience and performance while significantly contributing to closing the mitigation gap.

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