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## **Development of Conservation Agriculture in Vietnam**

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By

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## **Abstract**

Conservation agriculture aims to achieve sustainable and profitable agriculture and subsequently aims at improved livelihoods of farmers through the application of the three conservation agriculture principles: minimal soil disturbance, permanent soil cover and crop rotations. Conservation agriculture holds tremendous potential for all sizes of farms and agro-ecological systems, but its adoption is perhaps most urgently required by smallholder farmers, especially those facing acute labour shortages. It is a way to combine profitable agricultural production with environmental concerns and sustainability and it has been proven to work in a variety of agro ecological zones and farming systems

Conservation agriculture has been successfully implemented in North and South America, Africa, Australia for many years and brings benefit on economy and environment.

Vietnam is known as an agricultural country, with 75.8% of its manpower involved in agriculture, forestry, and fisheries. Agricultural production is mainly manual with small scale and low capacity, the yields of crops and animals are only 60 – 70% of other countries in the region.

Convention agriculture still is mainly accepted in production with intensive crop and increasing crops. Development of conservation agriculture is slow and unremarkable.

**Key words:** conservation agriculture , no-soil systems, soil erosion, crop residue, permanent soil cover, environment pollution

## **1. Introduction**

### **1.1 Background of Vietnam**

Vietnam is situated in South East Asia in the Indochinese Peninsula

The natural area is 330,990 square kilometers, in which arable area is 7,348.5 thousand hectares, equals 22.2% of natural area.

Vietnam lies in the region of monsoon, tropical weather with a high temperature of 7500°C/year, rainfall volume of 1800-2000mm/year and is not evenly distributed among the months of the year. Versatile and various climates of the regions create a variety of vegetation and domestic animals (originated in the temperate area, sub-tropical and tropical

areas). The bad thing of climate is drought in the dry-season and floods and storms in the rainy season.

In 33,099,093 ha of natural land, there are 7,348,449 ha of agricultural land (annual arable land of 5,523,899 ha, long term plan: 1,247,161 ha, meadowland for husbandry: 304,274 ha and water surface for agriculture: 273,115 ha). Land used for forestry is 9,641,142 ha (29.13% of natural land) of which planted forest of 779,438 ha and natural forest of 8,841,704 ha. Specialized land of 1,117,697 ha, equals to 3.3% of natural land area. Inhabitant land: 773,960 ha, equals to 23% of natural land area, virgin land: 14,217,845 ha, or 42.95% of natural land area.

Vietnam is known as an agricultural country, with 75.8% of its manpower involved in agriculture, forestry, and fisheries. This sector contributed approximately 23.0% of the national GDP in 2002 and 21.8% in 2003. The output value structure of agriculture, forestry, and fisheries in 2002 was 76.90%, 4.33%, and 18.77%, respectively.

However, so far Vietnam economy is still classified as one of the under developed countries in the World. Gross Domestic Product (GDP) average in 2005 was only USD 654 /person. Production infrastructure, social understructure is still poor and backward. Agricultural production is mainly manual with small scale and low capacity, the yields of crops and animals are only 60 – 70% of other countries in the region. Market for exporting agricultural products is not stable. Price of export agricultural products only equals to 60 – 70% of average export price of other countries in the same region. Deforestation speed is fast, covering rated of the whole nation is 29%. At present, there is still 10 million hectare of bare hill and empty land, which is eroded, washed, affecting badly to ecological environment

The rate of population development is still high, average of 2.2% per year in the country. In rural areas this ratio is higher and this is a big difficulty in economic development. Population density is 214 person/km<sup>2</sup>.

## **1.2 Situation of conservation agriculture in the World and Vietnam**

Conventional agriculture is generally harmful to the environment. It includes practices such as crop residue burning or deep soil inversion by tilling to control weeds and to prepare the seed bed. These techniques considerably increase soil deformation by compaction, erosion and river contamination with sediments, fertilizers and pesticides. In addition, conventional agriculture techniques increase the emission of CO<sub>2</sub> into the atmosphere, contributing to global warming and reduce the sustainability of agriculture by lowering soil organic matter and fertility, along with further negative environmental effects (e.g. a decrease

in biodiversity). In conventional agriculture, tillage operations require considerably higher inputs in machinery investment and maintenance, fossil combustibles and labour

Conservation agriculture refers to several practices which permit the management of the soil for agrarian uses, altering its composition, structure and natural biodiversity as little as possible and defending it from degradation processes (e.g. soil erosion and compaction). Generally, conservation agriculture includes any practice which reduces, changes or eliminates soil tillage and avoids residues burning to maintain enough surface residues throughout the year. The soil is protected from rainfall erosion and water runoff; soil aggregates are stabilized, organic matter and the fertility level naturally increase, and less surface soil compaction occurs. Furthermore, the contamination of surface water and the emissions of CO<sub>2</sub> to the atmosphere are reduced, and biodiversity increases.

Conservation Agriculture is gaining acceptance in many parts of the world as an alternative to both conventional agriculture and to organic agriculture. Although the practice of conservation agriculture on a large scale emerged out of Brazil and Argentina, similar developments were occurring in many other areas of the world, notably North America in zero tillage, Africa and Asia with technologies such as agro forestry. Conservation Agriculture techniques can be adapted to very different climatic and soil conditions, as well as agrarian systems.

No-tillage is now being adopted on more than 95 million ha world wide and the technology is showing increasing interest by farmers. The countries with the biggest area under no-tillage are the USA, followed by Brazil, Argentina, Canada, Australia and Paraguay. These are the 6 countries where adoption is above 1 million ha. Adoption rates are increasing much faster in South America than in other parts of the world and also the quality of no-tillage is better in terms of permanently not tilling the soil and permanent soil cover. Adoption rates continue to be very low in Europe, Africa and most parts of Asia. Approximately 47% of the no-tillage technology is practiced in South America, 39% is practiced in the United States and Canada, 9% in Australia and about 3.9% in the rest of the world, including Europe, Africa and Asia. Despite good and long lasting research in this part of the world, the development of conservation agriculture brings a great benefit to production and environment protection.

In Vietnam, development of conservation agriculture is slow and unremarkable. Convention agriculture still is mainly accepted in production with intensive crop and increasing crops.

## **2. Opportunities and challenges of development conservation agriculture in Vietnam**

### **2.1 Opportunities**

Sustainable development has become viewpoints of the Party and directions and policies of the Government and was affirmed in the Resolution of the 9th National Communist Party Congress as: "Fast, effective and sustainable development, economic growth in parallel with the implementation of social progress and equality and environment protection" and "Socio-economic development along with environmental improvement, ensuring harmony between artificial and natural environment, and preserving bio-diversity".

The overall and long-term objective of the agricultural and rural sector is to build up a agriculture and forestry production that has a large scale of production, organic, modern, efficient, sustainable, and that have a high productivity, high quality and clear environment based on the application of advanced science and technology achievements so that they are able to meet the domestic and export demand. Government concentrates to develop organic, sustainable agriculture industry. Therefore, development of sustainable agriculture has to closely link to conservation agriculture techniques.

Conservation agriculture has successfully been developed in many countries in the World , so we can learn experience lessons from them.

Investment and cooperation. The great numbers of qualified technicians, engineers, research institutions, institutes have experienced in successful development of agricultural techniques in Vietnam for many years.

Many advanced techniques and technologies are extensively applying in the conservation agriculture.

Supports from international Organizations and Governments for development of conservation agriculture techniques

The advanced achievements and experiences in promotion on conservation agriculture in the world provide enormous information, research materials and facilities to the research and application in Vietnam

### **2.2Challenges**

Vietnamese agricultural production is still poor and backward, mainly manual with small scale and low capacity, the yields of crops and animals are only 60 – 70% of other countries in the region. Convention agriculture has closely attached to farmers for very long time. Convention agriculture is mainly accepted in production with intensive crop and increasing crops. Development of conservation agriculture is slow and unremarkable.

The most important limitation in all areas where conservation agriculture is practiced is the initial lack of knowledge. To be widely adopted, farmers have to clearly understand all benefits on economic, agronomic, environment of conservation agriculture (1) Lack of transfer of technology. Research has demonstrated that these techniques can be applied and well as their benefits, but these results have not been showed to farmers and technicians. (2) Lack of technology. It is needed an adaptation of the machinery or techniques used in one country to the other country. (3) Lack of institutional support. Institutions have not concentrated to assistance farmers to practice conservation agriculture.

### **3. Assessment of development on conservation agriculture**

#### **3.1 Soil resources**

Soil is a limited natural resource on which agrarian activities (agriculture, livestock and forestry) are carried out. It is interconnected with other natural resources, which are also essential for human life, such as the air, water, fauna and flora. Soil acts as the most important intermediate and regulating factor most agricultural processes and, by extension, the environmental effects of agriculture. From whence it can be said that if the soil is well managed, the effects of agriculture on the environment will be acceptable and, conversely, if it is badly managed agriculture will deteriorate other resources needed by humans (water, fauna, flora, and atmosphere).

Traditional or conventional agriculture bases most of its operations or practices on soil tillage; i.e., inversion tillage such as mouldboard plough or disk harrow, or vertical tillage such as chisel, "spiked" harrow and other tools. Soil tillage drastically alters its original structure, breaking up its natural aggregates and burying the residues of the previous crop. So that, the bare soil becomes unprotected and exposed to the action of the wind and rain. Under these circumstances water and soil erosion and sediment runoff are likely to occur. Soils are important reservoirs of active carbon (C) and play a major role in the global C cycle. Soil erosion is a major environmental threat to the sustainability and productive capacity of conventional agriculture world-wide. Indeed, during the last 40 years, nearly one-third of the world's arable land has been lost to erosion and continues to be lost at a rate of more than 10 million hectares per year. Crop yields in eroded soils are lower than those in protected soils because erosion reduces soil fertility and water availability. For example, in some locations crop yield on severely eroded soils were 9% to 34% lower than those on slightly eroded soil.

Water resources also decrease due to erosion. For example, in light textured soils, which exhibit high water infiltration rates, following conventional cultivation an almost universal result is very fine and smooth seedbed surfaces, which are very susceptible to crusting by rain impact. Consequently infiltration rates decrease, runoff occurs for long periods and the water is lost to groundwater recharge.

Zero tillage is a ‘cornerstone’ of CA, and can be practiced in both large and small farming systems .With zero till (also termed no-tillage and direct drilling) the only tillage operations are low-disturbance seeding techniques for application of seeds and fertilizers directly into the stubble of the previous crop. Gradually, organic matter of the surface layers of zero tilled land increases, due to reduced erosion, increased yields resulting in more crop residue added to the soil surface, and differences in the assimilation and decomposition of soil organic matter. Gradually, organic mulch is developed on the soil surface, and this is eventually converted to stable soil organic matter because of reduced biological oxidation compared to conventionally tilled soils. Zero tillage is effective in mitigating many of the negative on-farm and off-site effects of tillage, principally erosion, organic matter loss, reduced biodiversity and reduced runoff. The conditions are replaced with permanent soil cover, improvements in soil structure, improved organic matter status, improved water use efficiency, and improved soil biology and nutrient cycling.

Most of zero tillage in the agricultural benefits of zero tillage relate to increased organic matter in the soil. This results from the combination of eliminating soil disturbance in conventional tillage, increased biomass from improved crop yields, greater diversity of types of organic matter from increased rotation and cover crops, reduced erosion and differences in the assimilation and decomposition of soil organic matter from reduced surface soil temperatures and increased biodiversity. With time, the soil gradually becomes physically and chemically stratified with a mulch of accumulated plant litter at the soil surface, rich in organic carbon and nutrients. The mulch layer creates a stable microbial ecology and environment for biological activity, and insulates the soil from temperature extremes and rapid desiccation. The microbial and macro faunal (earthworms) populations become more like those of natural soils. Their activity greatly enhances the assimilation and transfer of surface organic mulches into deeper soil layers and in the process creating physically robust channels to enhance water penetration and dispersion into the soil. In years of average or above average rainfall, the improved soil conditions ensure crop yields comparable to those with conventional tillage, but often with considerably less fertilizer and other inputs. In dry years, the improved soil moisture levels, aggregation and organic matter status of the zero till soils often ensure yield where conventionally tilled soils do not. Profit margins with zero tillage are normally better than under conventional tillage systems, and this enhances the sustainability and future continuity of the CA farming systems.

Zero tillage, including controlled traffic (where all in-field traffic traverses only specified wheel or foot tracks), is highly compatible to precision treatment of field conditions. Procedures include differential fertilizer applications according to nutrient requirements, spot spraying for weed control, controlled traffic in association with zero till, etc. As a consequence, wetlands, water bodies, habitats, and stream courses in agricultural areas can be better protected. In high input systems, precision treatment is becoming popular because of the improved efficiencies of operation and reduced input costs. At the same time, these principles have been used for many centuries in low input systems to optimize local nutrient, soil moisture, and sunshine conditions, as well as natural plant symbiosis. Zero tillage is conducive to promotion of the environmental integrity of the soil systems, and to maintenance of environmental services. Stability of the soil organic matter under zero tillage, due to enhanced soil aggregation and reduced erosion, enhances sequestration of carbon and contributes to mitigation of climate change. Soil carbon sinks are increased by increased biomass due to increased yields, as well as by reducing organic carbon losses from soil erosion. Fuel use and tractor hours are reduced up to 75%, with further reductions in greenhouse gas emissions. Other environmental benefits include reduced eutrophication and pesticide contamination of rivers and dams. The system is also valuable to mitigate the environmental effects of droughts by ensuring some biological production, surface cover, and erosion control even under severe conditions, due to the greatly improved soil aggregation, biodiversity and organic matter status, and subsequent improved water infiltration and water storage in the soil

In Vietnam: Zero tillage and minimum tillage have initially been accepting for crops on the wet land and dry land at low level.

#### *Zero tillage:*

Zero tillage has been applied for soybean. Soybean is directly seeded by machinery to rice field just after harvesting rice of summer crops and covered by rice straw without tillage. With extra soybean crops in the 2 rice crops at the rice-grew provinces of Red River Delta in recent years, farmers get more income and increase on rice soil fertility. As the effective cultivation mode applied conservation agriculture in the region of greater rice production has been adopted fast and actively, Agricultural Extension General Department positively supports farmers to develop more soybean area and seeding machines. In 2006, in the Hatay province, 40% area of 2 rice crops grew the soybean of winter crops with the rezo tillage.



*Figure 1. Soybeans are sowed directly to the rice field without tillage, just after rice harvested*

Minimum tillage:

Wet soil for rice crops in wet soil is tilled by rotary cultivator / or tilling cages attached with small 2-wheeled tillers with horse-power 12 engine ( BS-12 ), instead of mould board plows mounted to big 4-wheeled tractors with horse-power 50 / or 80 engine ( MTZ-52 / 82 ). Numbers of times of tiller running in the rice field also reduces. So cost for tilling also decreases to 60% and soil quality is improved, trafficability on the wet soil is improved. Soil prepare for sugarcane is tilled by the no-conversion subsoiler instead of moldboard plow attached with 4-wheeled tractor with horse-power 50 / or 80 engine (MTZ-52 / 82). Numbers of times of tractor running in the rice field also reduces. So cost for tilling also decreases to 40% and soil quality is improved,

Soil prepare for crops on the dry land such as soybean, peanut, coffee, tea, vegetable, est. ... by rotary cultivater instead of moldboard plow attached with small 2-wheeled tiller with horse-power 12 engine ( BS-12 ) or 4-wheeled tractor with horse-power 30 / or 50 engine. Numbers of times of tractors running in the field also reduces. So cost for tilling also decreases to 50% and soil quality is improved,

### **3.2 crops residues**

Crop residues are kept on the soil surface to maintain or enhance soil chemical, physical and biological properties and prevent land degradation.

In many areas of the world, crops and livestock compete for the same resources, and require proper management to meet conservation agriculture objectives. Synergistic integration of crops and livestock offers numerous advantages.

In Vietnam, returning crop residue to soil significantly improves soil physic-chemical properties. Crop residues are traditionally removed from the field to serve multiple purposes in the household. Now Crop residue of rice, sugarcane, soybean, peanut, are available on the field for soil protection.

### **3.3 Cover crops**

A permanent soil cover is important to:

(1) Protect the soil against the deleterious effects of exposure to rain and sun; to provide the micro and macro organisms in the soil with a constant supply of "food"; and alter the microclimate in the soil for optimal growth and development of soil organisms, including plant roots.

(2) Improve infiltration and retention of soil moisture resulting in less severe, less prolonged crop water stress and increased availability of plant nutrients.

(3) Increase humus formation. Create a source of food and habitat for diverse soil life: creation of channels for air and water, biological tillage and substrate for biological activity through the recycling of organic matter and plant nutrients.

(4) Consequentially reduce runoff and erosion.

(5) Create better conditions for the development of roots and seedling

In Vietnam, azolla (water-fern) on the surface of rice field in the Red River Delta and Mekong River Delta is good soil cover crop and supplies for rice field as good green manure. it can produce 10 ton to 15 ton to 1 hectare in one crop

Some of bean-family weeds are effectively grown as soil cover crops in fruit farms, coffee,

Permanent soil cover with a mulch of PVC film for peanut makes increase to 30% of output in some peanut areas in the North provinces



*Figure 2. Peanuts is covered on the soil-surface by nylon film*

### **3.4 Crop rotation**

The rotation of crop is not only necessary to offer a diverse "diet" to the soil micro organisms, but as they root at different soil depths, they are capable of exploring different soil

layers for nutrients. Nutrients that have been leached to deeper layers and that are no longer available for the commercial crop can be "recycled" by the crops in rotation. This way the rotation crops function as biological pumps. Furthermore, a diversity of crops in rotation leads to a diverse soil flora and fauna, as the roots excrete different organic substances that attract different types of bacteria and fungi, which in turn, play an important role in the transformation of these substances into plant available nutrients. Crop rotation also has an important phytosanitary function as it prevents the carry over of crop-specific pests and diseases from one crop to the next via crop residues

The effects of crop rotation: (1) Higher diversity in plant production and thus in human and livestock nutrition. (2) Reduction and reduced risk of pest and weed infestations. (3) Greater distribution of channels or biopores created by diverse roots (various forms, sizes and depths). (4) Better distribution of water and nutrients through the soil profile. (5) Exploration for nutrients and water of diverse strata of the soil profile by roots of many different plant species resulting in a greater use of the available nutrients and water. (6) Increased nitrogen fixation through certain plant-soil biota symbionts and improved balance of N/P/K from both organic and mineral sources. (7) Increased humus formation.

Crop rotation is an essential element in the success story of no-tillage expansion. Only those farmers that have understood the importance of these practices are obtaining the highest economic benefits from this system. When practiced in monoculture or even in double cropping, i.e. when the same crop or crops are repeated on the same land each year, no-tillage is an imperfect and incomplete system, in which diseases, weeds and pests tend to increase and profits tend to decrease.

In Vietnam, there are a lot of effective systems of crop rotation , of intercrop depending on crops condition such as : the rice – soybean/maize/vegetable/potato - rice, rice – fish, soybean – maize, intercrop of sugarcane with peanut/soybean, green bean / maize with sweet potato, maize with soybean



*Figure 3: Peanut are intercropped to sugarcane*

### **3.5 Fertilizers application**

Nitrogen fertilizers is mainly used for rice, sugarcane, vegetables and other crop in Vietnam, Recent research results in Vietnam urge that: there is a large potassium imbalance for paddy for example, because each tone paddy exploits from soil about 20 kg K<sub>2</sub>O, it means 200 kg K<sub>2</sub>O per ha for a rice annual yield of 10 tons. The nutrient depletion is also indicated not only for other major elements (N, P, K, S, Mg...) but also for micro-elements (Mo, Bo). Further, more imbalance (depletion or eutro-phication) and not friendly fertilization alters the chemical and physic-chemical characteristics of soil and destroys the microorganisms' lives. The management of the soils requires integrated practices that can increase fertility, and the nutrient and water holding capacity. Biological management of the soils can be an effective way to increase soil quality through management of biomass.

The use of large amounts of fertilizers, pesticides and irrigation help to offset the deleterious effects of erosion but in themselves have the potential to degradation soil , create pollution and health problems, destroy natural habitats, and contribute to high energy consumption and unsustainable agricultural systems.

In Vietnam, microorganism fertilizer is widely applied for crops: rice, sugarcane, peanut, coffee, tea. Product of crops gives good quality.



*Picture 4. Plant for manufacturing microorganism fertilizer*

### **3.6 Weeds**

Herbicides are used for controlling cover crop and weed development. A comprehensive publication is needed that describes all the products available on the market with all their chemical and toxicological characteristics, amount to be used per hectare as

well as listing of the weeds that can be efficiently controlled by each specific product. This is very necessary information without which not only farmers, but also technicians, extensionists and scientists would have a hard time to make no-tillage work.

### **3.7 Forest**

In 1998 Decision 661 allocated funds to the successive 5 M ha Reforestation Program. Loans and ODA funded projects contributed to the objectives of programs 327 and 661. National 5 M Ha Reforestation Program aims to establish 5 million ha of forest between 1998 and 2010 to restore forest cover of the country back again to 43%, the same percentage that was under forest in 1943. The stated objectives of this effort are to reverse environmental degradation. At the same time the project means to boost the productivity of the national forestry sector. 2 M ha of “degraded” lands are to be converted to industrial wood plantations, 1 M ha to cash crops and 2 M ha to conservation forest. 1 M ha is to be grown through natural regeneration.

Biodiversity is reduced in conventional agriculture since bare soil for a long period of time does not provide food and shelter for wildlife at critical times. In contrast, high-residue crop production systems have been shown repeatedly to be attractive and valuable for helping several forms of wild life to thrive in agricultural areas (birds, small mammals, reptiles and soil invertebrates especially predators of key pests).

In forestry, many new technical advances have been applied, especially the techniques of quick selection and creation of new varieties, and quick multiplication by cutting and cell culture techniques. As a result, the productivity and quality of forest plantations have got extensive improvements.

### **3.8 Water resources**

Soil water content is often a very important limiting factor in agricultural productivity. It has been reported by many authors that conservation techniques increase the water content in the soil profile in comparison with conventional techniques. The straw over the soil decreases soil water evaporation, while each tillage operation increases it.

Water quality is seriously impaired by conventional agriculture. Soil sediment from eroded agricultural land is by far the most important contaminant of surface water. Because conservation agricultural systems greatly reduce soil erosion (>90% for direct sowing/ no-till, > 60% for non-inversion tillage), the adoption of these systems significantly improve surface water quality by reducing sediment. Further, these systems also result in a reduction of about 70% in herbicide runoff, > 85% in oxidized nitrogen, > 65% in soluble phosphate, and about

69% less water runoff than moldboard plough, all of which are a real boon to improving water quality.

In Vietnam, system of water and irrigation and drainage have basically met the demands on agricultural development in the low land areas, but still lack for dry land, inclined land areas.

## **4. Solution for conservation agriculture**

### **4.1 Conservation soil and water**

Use of appropriate/improved seeds for high yields as well as high residue production and good root development.

Use of various cover crops, especially multi-purpose crops, like nitrogen-fixing, soil-porosity-restoring, pest repellent, etc.

Optimization of crop rotations in spatial, timing and economic terms.

Transfer step by step monocrops to crop rotation

Design and implementation of crop rotations according to the various objectives: food and fodder production (grain, leaf, stalks); residue production; pest and weed control; nutrient uptake and biological subsurface mixing / cultivation, etc.

Establish to system of water irrigation and drainage, dams, water reservoirs supplies to crops

### **4.2 Development biotechnology**

Development biotechnology in agriculture for improves capacity and quality of crop products; promote wide application of bio-technology and preservation of gene pools of local plant.

Apply on advanced techniques and technologies in agriculture biotechnology.

**Varieties:** Use of appropriate / improved seeds for high yields as well as high residue production of above-ground and below-ground parts, given the soil and climate conditions

Fertilizer: establishment of microorganism fertilizer plants supply to crops, develop production of organic and biological fertilizers, fertilizers with slow dissolubility for the development of conservation agriculture.

Pesticide: use of organic pesticide to protect environment.

#### **4.3 Biodiversity**

Strengthen conservation of biodiversity in agriculture, protect environment

Biodiversity is reduced in conventional agriculture since bare soil for a long period of time does not provide food and shelter for wildlife at critical times. In contrast, high-residue crop production systems have been shown repeatedly to be attractive and valuable for helping several forms of wild life to thrive in agricultural areas (birds, small mammals, reptiles and soil invertebrates especially predators of key pests).

#### **4.4 Machinery**

Improve and develop equipment and machines being suitable to conservation agriculture techniques,

For small and medium sized mechanized farms we would recommend that farmers buy a no-tillage machine suitable for wide row crops (i.e. soybeans, maize, sorghum, sunflower) and for narrow row crops (wheat, oats, rye and green manure cover crops in general). Failure in buying a multipurpose machine puts farmers that do not have enough capital to buy two specialized machines in a situation where they cannot plant narrow row crops and therefore they are not able to seed small grains or green manure cover crops and use adequate crop rotations.

#### **4.5 Enhance awareness on conservation agriculture**

The most important limitation in all areas where conservation agriculture is practiced is the initial lack of knowledge

To be widely adopted, all new technology needs to have benefits and advantages that attract a broad group of farmers who understand the differences between what they are doing and what they need. In the case of conservation agriculture these benefits as:

**Economic benefits:** Time saving and thus reduction in labour requirement. Reduction of costs, e.g. fuel, machinery operating costs and maintenance, as well as a reduced labour cost. Higher efficiency in the sense of more output for a lower input.

The positive impact of conservation agriculture on the distribution of labour during the production cycle and, even more important, the reduction in labour requirement are the main reasons for farmers in Latin America to adopt conservation agriculture, especially for farmers who rely fully on family labour.

**Agronomic benefits:** Adopting conservation agriculture leads to improvement of soil productivity: organic matter increase, in-soil water conservation. Improvement of soil structure,

The constant addition of crop residues leads to an increase in the organic matter content of the soil. In the beginning this is limited to the top layer of the soil, but with time this will extend to deeper soil layers. Organic matter plays an important role in the soil: fertilizer use efficiency, water holding capacity, soil aggregation, rooting environment and nutrient retention, all depend on organic matter.

**Environmental benefits:** Reduction in soil erosion, improvement of water quality, improvement of air quality, biodiversity increase, carbon sequestration.

Residues on the soil surface reduce the splash-effect of the raindrops, and once the energy of the raindrops has dissipated the drops proceed to the soil without any harmful effect. This results in higher infiltration and reduced runoff, leading to less erosion. The residues also form a physical barrier that reduces the speed of water and wind over the surface. Reduction of wind speed reduces evaporation of soil moisture.

However, it should be pointed out that if farming practices are to consistently change from conventional agriculture towards conservation agriculture farmers need to be convinced that a new way of farming (conservation) is needed, which is quite different to the traditional/conventional one that they have used for decades. For instances, new techniques for weed management and direct sowing need to be learnt and farm equipment has to be adapted and/or reorganized to correctly implement conservation techniques. Therefore, a tremendous effort at the administrative and technology transfer level is needed.

#### **4.6 Support from Government**

Strengthen investment from Government for developing conservation agriculture. Government need to support farmers adoption of conservation agriculture in the form of financial resources for buying equipment as well as for agricultural research and extension

International cooperation: there are policies to expand the cooperation and exploitation of international collaboration and investment for develop conservation agriculture in Vietnam

## **5. Conclusion and recommendation**

### **Conclusion**

Conservation agriculture aims to achieve sustainable and profitable agriculture and subsequently aims at improved livelihoods of farmers through the application of the three conservation agriculture principles: minimal soil disturbance, permanent soil cover and crop rotations. Conservation agriculture holds tremendous potential for all sizes of farms and agro-ecological systems, but its adoption is perhaps most urgently required by smallholder farmers, especially those facing acute labour shortages. It is a way to combine profitable agricultural production with environmental concerns and sustainability and it has been proven to work in a variety of agro ecological zones and farming systems.

Conservation agriculture has been successfully implemented in North and South America, Africa, Australia for many years and brings benefit to economy and environment.

Vietnam, agricultural country is still poor a backwards, Convention agriculture still is mainly accepted in production with intensive crop and increasing crops. Development of conservation agriculture is slow and unremarkable. But it has initially gained a number of achievements in development of conservation agriculture due to strong investments and people's correct avarice.

### **Recommendations**

Rice is essential crop and grew in the wetland in Vietnam and some countries in the Asia, up to now I have not found any document mentioning to practice conservation agriculture for the rice areas, especially no-tillage culture for rice. So in this workshop, I would like to ask for finding appropriate solutions to acceptance conservation agriculture for the rice areas.

Conservation agriculture will get economic benefit at the later stages. So during the initial stage of adoption, some people worry that adoption of conservation agriculture will take risks to decrease output of product and it is difficult for them to acceptance conservation agriculture. They need actively support from international Organizations.

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