RE-INVENTING CONSERVATION AGRICULTURE PRACTICES BEYOND 21ST CENTURY

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ABSTRACT
Conservation agriculture (CA) is gaining prominence and has been found to be a better option in solving food scarcity and biodiversity loss. Industrial agriculture (conventional) for a long time has been practiced with the view of maximizing food production under economic gains without environmental integrity. Approximately, 30% of the greenhouse gases emissions are produced from agricultural activities and this has contributed to environmental degradation and poor human health. To save the world from losing its potential to feed the increasing human population and interrupting ecosystem services, there is greater need to reinvent agricultural practices and develop more environmentally friendly ways of producing food and saving biodiversity. This research paper examined reinventing conservation agriculture practices beyond the 21st century by studying CA practices in two different settings both in developed and developing countries. The aim is to showcase the importance of CA as a means of saving the world from further degradation and recommend to the farmers, policy makers, researchers, scientists, politicians, economists, ecologists among others the dire need to adopt CA technologies. CA is undoubtedly an option that can result in substantial benefits for certain types of farmers in certain locations. However, benefits from CA at field level do not necessarily overcome the economic constraints at farm scale and many of these benefits are only realized in the longer term. CA profoundly alters the flow of resources (nutrients, labour and cash) at the scale of the farm and above, and hence strong trade-offs exist when implementing CA. A survey design was employed to collect data through questionnaire and interviews. The results were discussed and descriptive analysis was used. The study found that CA is a better option to improve human health through feeding on nutritious food products, protecting biodiversity and balancing ecosystem services.

Keywords: Reinventing, Farmers, Biodiversity, Food Production, Nutrition

INTRODUCTION
As the population of the world increase, land areas under agriculture are increasing through clearing of vegetation to produce more food. On the other hand, agricultural land is reducing due to more land allocated to urban expansion, industries, and other economic activities (Musa and Odera, 2015). Agriculture itself is facing an immense challenge on how to feed the world global population at the same time not destroying biodiversity, depleting soil in an environment faced with climate change (Swaminathan, 2010). How to increase yields to feed a growing population is a huge task. The world must double food production by 2050 while adapting agriculture to climate change and reducing its emissions of greenhouse gases. Agriculture is responsible for about 30% of the total greenhouse gas

emissions of CO_2, N_2O and CH_4 while being directly affected by the consequences of a changing climate (Theodor et al., 2014). The type of farm power and farm machinery, have a significant influence on intensification and optimization outcomes, and for profit. However, until now, agricultural intensification generally has had a negative effect on the quality of many of the essential resources such as the soil, water, land, biodiversity and the ecosystem services which has caused yield and factor productivity growth rates to decline (Theodor et al., 2014). Recent study observed that, in Africa, the food situation, coupled with degradation of the landscape is critical. There must be technological ways to increase food production to avoid widespread starvation. Food production per capita has been declining, and cereal yields have remained stagnant, since the 1960s. Is it possible to transform and achieve sustainable and affordable agriculture so that food production is doubled in a way that benefits smallholder farmers and does not further threaten biodiversity? (Morin, 2015)

There is an urgent need to pro react and reverse this trend by employing innovations that are appropriate in addressing these environmental challenges affecting human and the environment. The question of nature and its sustainability is now calling. What is the new paradigm? The new paradigm of "sustainable production intensification" must recognize the need for a productive and remunerative agriculture, which at the same time, conserves and enhances the natural resource base and the environment, and positively contributes to harnessing the environmental services (Thoedor et al., 2014; Caroline et al., 2015). Sustainable crop production intensification must not only reduce the impact of climate change on crop production but also mitigate the factors that cause climate change by reducing emissions and by contributing to carbon sequestration in soils (Seline et al., 2014). Intensification should also enhance biodiversity in crop production systems above and below the ground to improve ecosystem services for better productivity and a healthier environment. Agriculture should also aim at producing food products that are nutritionally healthy for human consumption and avoid creating diseases like cancer.

A set of soil-crop-nutrient-water-landscape system management practices known as Conservation Agriculture (CA) delivers all of these goals. CA saves on energy and mineral nitrogen use in farming and thus reduces emissions; it enhances biological activity in soils, resulting in long term yield and factor productivity increases (Theodor et al., 2014). Other studies indicate that, a few countries in Africa, Zambia, Malawi, Niger and Burkina Faso are already successfully restoring exhausted soils with richer sources of organic nutrients, and dramatically increasing both their crop yields and incomes through the adoption of Evergreen Agriculture. Evergreen Agriculture is emerging as one particularly affordable and accessible, science-based solution to caring better for the land and increasing smallholder food production in the tropics (Theodor et al., 2014).CA is a set of soil management practices that minimize the disruption of the soil's structure, composition and natural biodiversity. CA involves the following; maintenance of permanent or semi-permanent soil cover (using either a previous crop residue or specifically growing a cover crop for this purpose); minimum soil disturbance through tillage (just enough to get the seed into the ground); regular crop rotations to help combat the various biotic constraints.

CA has also promoted; utilization of green manure/cover crops to produce the residue cover; no burning of crop residues; agro-forestry; integrated disease and pest management; controlled/limited human and mechanical traffic over agricultural soils; direct seeding; conservation tillage (AGNIC, 2016). It aims at higher crop yields and lower production costs. Conservation Agriculture is widespread in developed countries such as North America, Australia and some parts of South America and yet, adoption of CA on farms in Africa has been limited (Kassam et al., 2009).

Adoption of CA

Given the complexity and knowledge-intensive nature of CA systems and the need to tailor CA practices to local conditions, a strong capacity in problem-solving around CA among farmers, development agents and researchers are required. Development and adoption of CA are a dynamic, iterative innovation process, involving interacting agronomic, socioeconomic and cultural factors that are specific for the local conditions and institutions. Production objectives and constraints, and risk attitudes

of farmers on the one hand, and the expected benefits and costs of implementing CA on the other hand are two important aspects that influence adoption (Tangcalagan et al., 2014).

Farmers in Africa often attribute a substantially higher value to immediate costs and benefits than those incurred or realized in the future, due to the immediate constraints of production and food security that they face. Yet, many of the benefits of employing CA are only realized in the long term. Farmers adapt and implement CA technologies with their own understanding of the principles, their aspiration and possibilities to integrate it into their farming systems, and their actual access to knowledge, advice and resource (Ngwira et al, 2014). Priority is often given to "demonstrating" CA rather than to reinventing or adapting it in a participatory manner to the local context, even though the use of local group-based learning approaches such as, farmer field schools "is increasing. Also, interventions tend to place little attention on the need of a support system to make the necessary inputs and small equipment available to farmers e.g. in village shops. Overall, the experiences with CA development in Africa teach us that no blueprint or silver bullet exists, and no dogmas or rigid prescriptions will do (Theodor, 2014).

Case Studies

Two research studies was conducted in two areas where conservation agriculture is being practiced; one in a developed country USA among the Amish community in Pennsylvania and another one in developing country Kenya at Cheptebo community in Keiyo valley. The two areas have completely different socio-ecological settings and practice CA uses different techniques in food production and land management. One thing they both have in common is that their agricultural practices are based on deep spiritual values. In this paper, Amish community was selected for study because of their long history of practicing conservation agriculture for over 300 years without being influenced by any external economic mode of farming. The farming tradition has been kept by their spiritual belief. Very little change has taken place from Amish agriculture except a few cases of farmers who have tried to practice conventional agriculture. The research was conducted in Lancaster County, Pennsylvania USA. Lancaster County's consist of 1,200 Amish farm families. The Cheptebo AIC Rural Development Project was chosen for study because of practicing the Farming Gods Way, which in itself is one of the CA practices. Guided by the Biblical principles, the Cheptebo project has transformed rural communities in Keiyo in farming skills and this, has resulted in increased food production and conservation of the environment in the area.

CASE STUDY ONE

The Amish Community

The Amish are a group of traditionalist Christian church fellowships with Swiss Anabaptist origins. They are closely related to, but distinct from, Mennonite churches. The Amish are known for simple living, plain dress, and reluctance to adopt many conveniences of modern technology. The history of the Amish church began with a schism in Switzerland within a group of Swiss and Alsatian Anabaptists in 1693 led by Jacob Ammann. Those who followed Ammann became known as the Amish (Garret, and Garret, 1998) About 250,000 adults and children live in Amish communities in North America, in 28 US states and the Canadian province of Ontario. Settling in Pennsylvania in the early 1700s, the Amish were originally a breakaway group led by extreme Anabaptist Jacob Amman. As part of his holy experiment, his followers live a devout, simple and family oriented life completely separate from the rest of the world. The Amish have proved to be a resilient social group, but as in every society, there are pros and cons to the Amish lifestyle (Garret and Garret, 1998).

The Amish community, a religious society is guided by a strong emphasis on family and community ties. The Amish are an agrarian people who have a long history of using less energy-intensive, albeit productive, agricultural methods. The low-input farming systems practiced today by Amish farmers have developed over 300 years and have sustained the Amish as one of the most persistent and successful subcultures in North America. Strict socio-religious rules control Amish farming practices. As a result, Amish agriculture depends on traditional elements, such as horse farming and hand labor, and therefore contrasts starkly with conventional high-input agriculture. However, contemporary Amish agriculture is a blend of old practices with new ideas, similar in many respects to the low-input sustainable practices that agricultural researchers are currently experimenting with and designing

(Stinner et al, 2015). The Amish view horses as farm equipment and work with the animals on a daily basis. Horses are used to pull farm plows, as transportation, and to haul building materials. Knowing how to saddle a horse and enjoy a leisurely trail ride is wonderful, but does not mean you possess the ability needed to harness a team and drive them to accomplish food growing and building tasks. The Amish are expert horsemen (and horsewomen) in every sense of the word. In an Amish community you will readily find a pseudo-vet, blacksmith and leather shop. Much can be learned from the skilled craftsman for folks hoping to build an off-the-grid homestead or individuals preparing for a power grid down scenario.

Amish Farming

Amish people honor the Amish farming traditions that have interconnected the family and community for many generations**.** At the same time, farmers are building on those traditions by incorporating conservation practices that will benefit their farms for generations to come (Gaber, 2013). By studying the immune systems of plants, they have developed a technique that eliminates the need for chemicals.

Response from Amish Farmers

The interviews were conducted in three farms of Amish families. The results include some of the farmers who tried to blend by embracing conventional practices, but found problems still with pest control. The farmers narrated how they introduced conventional methods by using chemicals such as pesticides and herbicides to keep crops healthy and away from diseases. Going out into the field to spray crops with chemicals is "a chemical warfare". A farmer explained how he almost lost the crops on his 50 acre farm when attacked with funguses and pests. That the chemical treatments did little to reduce pest attacks. Disillusioned by standard agriculture methods, he searched fervently for an alternative. After several searches, he found what he was looking for. For two years, he studied research in biology, chemistry, and agronomy in pursuit of a way to save his fields. The breakthrough came from the study of plant immune systems which, in healthy plants, produce an array of compounds that are toxic to intruders. The immune response in plants has been dependent on well-balanced nutrition just the same way our own immune system works. Modern agriculture uses fertilizer specifically to increase yields, he added, with little awareness of the nutritional needs of other organic functions. Through plant sap analysis, he has been able to discover deficiencies in important trace minerals, which he can then introduce into the soil. With plants able to defend themselves, pesticides can be avoided, allowing the natural predators of pests to flourish. The farmer said instead of growing crops that are healthy with fungicides and pesticides, he grows crops that are healthy with nutrition**.**

Methods to grow crops developed through experimentation on the farm are now being used across North and South America, Hawaii, Europe, and Africa. The methods promise clients high-quality crops, bigger yields, better taste, and produce that carries a lucrative "organic" label. The Amish farming technology focuses on actively restoring the nutritional balance found in natural systems. The Amish farmers were asked questions about their farming techniques and reasons why they have not changed their farming systems for a long time. The responses were recorded:

Q. Are you Amish by tradition or birth?

R. All the farmers are Amish by birth and tradition.

Q. Are there any differences between how you used to farm and how you farm now?

R. We have kept our way of farming since the beginning except in a few situations (7 % of farmers) have blended two practices.

Q. Why do you practice this kind of technology in your farms?

R. The technology is safe for human and the environment. Instead of trying to grow crops that are healthy with fungicides and pesticides, we grow crops that are healthy with nutrition.

Q. Are you facing any pressure from County government to change to conventional methods of farming?

R. Yes, the government officials put pressure on us to go conventional by using chemicals and pesticides.

Q Are your methods of controlling pests effective in controlling pests and other diseases?

R. Yes, it is effectively safe with challenges. We would see a couple bugs out there and feel like doing something about it. They learned that, if we do nothing about it, things will often take care of

themselves. In the beginning during summer for instance, we saw a lot of horn worms. Before that, we would have to spray them right away, but this time we waited and a bunch of wasps came along and killed them. Once we saw that, we started getting really excited.
Q. What are some of the problems that you are dealing with now?
R. One of my major issues in the greenhouse is spider mites, little insects that just love a warm, dry environment. It's very hard to control them, even conventionally. We usually get them under control, but we often lose some yield.
Q. How do you get them under control?
R. Mainly through applying specific trace minerals like iodine and a whole line of ultra-micronutrients. We analyzed the sap of the plants with the help of a lab and think we have narrowed the problem down to excessive ammonium nitrates. If ammonia builds up in the plants, it's bug food, so we need to figure out a way to convert ammonia fast. One of the scientists developed an enzyme cofactor which we use to stimulate that ammonia conversion. We figure things out ourselves now rather than call up the chemical representative.
Q. What is your view on the use of chemical sprays on food crops?
R. Chemical sprays are dangerous not only to plants but to humans. Precautions are taken when spraying so that you are not in contact with the chemical and children are kept away. One week period is given which everyone must stay away from the field, but all that is gone.
Q. What else can you tell by looking at your plants not grown with chemicals?
R. They are healthier not just outside but inside also. I don't fear of any disease.
Q. Do you think plants also have weakened immune system like animals when they take antibiotics (chemicals like pesticides)?
R. Yes. It might kill the disease, but then because it has weakened the plant, a week later the plant is much more susceptible to that same disease again. That is the way it is with a miticide. If you come in here and spray the mites with it, it would kill some of them, but it kills by messing with their hormones, and the ones do survive will then mature 50 percent faster. So, it is pretty much guaranteed that you have a huge mite outbreak 10 years later. Instead of doing that, let us figure out what this plant wants and provide it. They really do respond.

Q. What do agricultural experts say when you don't need their services?
R. They kept on coming every week with the same story telling us to spray the crops with chemicals, but we had made up our minds not to spray. The last time they came here, we were out picking tomatoes and he walked over. He was looking around and talking about this and that, and he didn't even mention pesticides. "Well," he said, "your tomatoes look pretty good." I thought, "Yes!"
Q. What is the purpose of using minimal tillage or no tilling?
R. Not to disturb the soil and kill useful soil organism important for fertility of soil through aeration and decomposition.
Q. I can see in your farm, you use organic manure. Why do you prefer this method?
R. It maintains soil fertility by keeping the soil structure in place, not killing microbes in the soil and does not pollute environment like industrial fertilizer.

Q. Why do you apply mulch in your farm?
R. To protect the soil from exposure to soil erosion and reduce moisture loss.
Q. All the farm activities, horsepower are used and compressed air to operate some machine equipment you have. Why is this so?
R. The fuel energy is dangerous to the environment and we don't use it. Horses are part of the farm equipment, are environmentally friendly and efficient.
Q. You don't use fuel energy or mechanized system on your farm. Is it traditional or a farmer's decision?
R. The farming system is deeply embedded from our faith and is passed from generation to the next. We cannot break it, less it becomes a curse. The farm products are healthy and we depend on nutritious food to keep us healthy and environment pollution free.
Q. Your crops look healthy, tasty and smell good. Is that the reason?
R. For human to stay free from modern diseases, we need to eat nutritious food free from any chemical.

RESULTS AND DISCUSSION

The survey showed 90% CA adoption practices such as cover crops, minimal soil disturbance and organic manure. The Amish communities strive to live apart from the “world” and may be discouraged from working with government entities and attending non-“Plain people” events. Educators must design outreach strategies that take into consideration the diversity of Plain producers and that overall these materials should be practical and straightforward. In most cases how farmers care for their land and animals can be interpreted in dramatically different ways by individual farmers. This results in a myriad of technological and philosophical adoptions that do not necessarily imply community consensus about what it means to be an “Amish dairy farmer.” Views on organics, GMOs, agricultural technology, and animal care differ not only between settlements, but family members. These attitudes are found to be fostered through close attention to contemporary science, consumer trends, and national economic and political infrastructures (Joerger, 2013). Horsepower is the main source of energy in the farms. 95% of Amish farmers use horse power and about 5% modern machines. Modern farm equipment can be adapted to horse-drawn power, or purchased ready to roll from the Amish farmers. Horse-drawn farm equipment became scarce after the 1940s. Amish mechanics often operate shops which both serve their community and members of the general public seeking non-gas powered farm machinery. Seed preservation, natural fertilization procedures, crop rotation, irrigation and drought survival tips are also valuable agriculture tips we can learn from the Amish.

Amish farmers have greatly diversified their crop farming and every member of the family participates in farming activities including children who are taught techniques in farming. With diverse crops on small farms, with a conservative approach to farm technology and with constant manual exertion, even by little children, this region's Amish has largely escaped the high debt that has put over 300,000 family farms out of business since the 1970’s.The Amish is providing a stable economic base for a country with one of the nation's most vibrant farm economies. Sloping fertile Lancaster County is crowded with white farmhouses and silos spring from the valleys like silver-topped mushrooms. Amish farmers protect themselves from the cycles of boom and bust in agriculture by operating diverse production systems. Most have herds of milk cows and grow feed corn, alfalfa, hay, wheat, tobacco, vegetables and fruits. Some raise poultry and cattle. Others breed horses and raise mules. One farmer can own up to 65 dairy cows, but most farmers own on average 45 dairy cows.

The Amish also avoided Government farm supports. The programs require farmers to idle acreage as a requirement for receiving benefits. The farmers are proud of their system and do not need handouts. An Amish system of farming has been found worth adopting and their system has been used as a model for the Mennonite and "English" farmers in the region. The Amish community of Lancaster County numbers approximately 7,000 people and is growing quickly. Although the Amish owns less than a quarter of Lancaster County's 5,000 farms, Amish farmers generally till 70 to 80 acres, enough for one family to handle, but one-fifth the size of the average American farm. The average non-Amish farm in the county is not much bigger. Mules and horses haul implements at a cost Amish farmer say is one-third that of a tractor. The Amish buys mechanical harvesting equipment that is pulled through the fields by teams, but whose machinery is powered by independent gasoline or diesel engines. The Amish developed advanced programs for rotating crops, applying manure and fertilizer and growing along ridge tops to lessen erosion. They buy the best seed. Amish farmers produce as much corn per acre and as much milk per cow even better than the conventional practice in dairy farming.

In the farming system labor is shared and hence less labor cost. From the time they are toddlers; Amish children are regarded as important additions to the farm system. Children are educated in one-room schoolhouses until the eighth grade, and then become full-time helpers. Eight children in a family are not unusual. 'They have to work for it. Amish families help one another at planting and harvesting and that children are taught that they are central in the community. "We have to eat," they said. It was found that the Amish system would not work for most American farmers and their families. "People just don't want to work that hard anymore, Lancaster County farm agents said. Farmers also believed that, that smaller farms might be more suitable. Other studies have agreed with this finding that small farms would be appropriate to practice conservation agriculture (Thuo, 2013). Net profits on Amish farms are unusually high. An Amish farm of 80 acres, 40 cows, and five acres of tobacco, vegetables and fruit can earn a gross annual income of $125,000 or more. Because of their religion's demand for "plainness,"

annual expenses for feeding, clothing and housing an average Amish family with six children total $6,000 to $8,000. Amish farmers generally have moderate debts, principally in loans for land.

Discussions on Techniques of Amish Farmers

No-till planting techniques, has been used on the farms since 1979. No-till has kept the soil in place and the crops in good condition. Contour strips also add extra benefit and improve crops. Farmers construct a variety of on-farm conservation improvements that will do for the rest of his farm what the no-till and contour strips have done in his fields; improvements like the construction of a new manure storage facility, a storm water collection system, stream bank fencing and crossings, and the planting of streamside trees and shrubs. Established on-farm conservation improvement effort and conservation, nutrient and manure management plans (Garber, 2013). Pennsylvania Agriculture Program Manager indicated that, Amish farmers really address all the conservation needs that we might find on a Plain Sect farm and beyond (Garber, 2013). Other researchers found organic farming as a lark, a profitable process for a handful of farmers and an indulgence for a handful of consumers, a pie-in-the-sky dream that sounds nice but won't fly in our quest to feed the world. But a new survey suggests otherwise (Nosowitz, 2016).

Amish farmers, mostly use the forest as a buffer and to protect their farms. The Lancaster County in Pennsylvania Sate is beginning to encourage farmers to use the forest as buffers in order to conserve and manage wetlands. The County is making efforts in the restoration of entire stream systems--restoring water quality, bringing back fisheries and aquatic life (Nosowitz, 2016).Some conservation practices found include; a new manure storage facility; barnyard waste and run-off collection system; storm water collection system, including gutters and downspouts; milk house waste rerouting system takes milk waste to newly constructed manure storage pit; streamside tree planting of mixed native shrubs and trees; stream bank fencing and stream crossing; cropland terrace; and grassed waterway.

Amish for a long time have used organic manure from the animals they keep. The four main pillars of sustainability include productivity, economics, environment, and community well-being, which in essence can all be answered with organic farming. Organic farming, is concerned primarily with soil health, promotes better quality soil, less polluted water, lower greenhouse gas emissions, and greater biodiversity of plants, animals, and microbes (Reganold and Wachter, 2016). Organic farming systems produce lower yields compared with conventional agriculture. However, they are more profitable and environmentally friendly, and deliver equally or more nutritious foods that contain less (or no) pesticide residues, compared with conventional farming. Rather, a blend of organic and other innovative farming systems is needed. Significant barriers exist to adopting these systems, however, and a diversity of policy instruments will be required to facilitate their development and implementation (Reganold and Wachter, 2016).

CONCLUSIONS

Amish community has practiced conservation agriculture for hundreds of years and have found that the CA is one of the best in the world and for a long time have preserved it without any government influence to practice modern farming known as conventional. Spiritual faith in the CA system is important and is the stamina in maintaining the practice. Amish people have large families and in the light of the present economic problems, they have kept a simple life using simple equipment to realize their goals and feed their families with less cost. The Amish families are healthy because they strictly use technologies that do not contaminate their environment and feed on agricultural produce that are grown with less or no chemicals. They eat notorious food to keep them healthy and live a long life'. Their method of agriculture is challenging, especially when the population of the world is growing fast to an extent that the CA may not solve world food problems, but farmers who adopt CA believe that it can bring relief to the world food crisis if all governments embrace it and support farmers. The issue here is not whether CA will support human populations in the future, but it is how CA can be adopted in a manner befitting the Eco socioeconomic differences. In conclusion CA is a better option for all the farmers in any geographical region especially for smallholder farmers. American agriculture is steeped in a chemical-intensive system that wastes money and pollutes the environment. But by making use of

new technology and innovative approaches, farmers can boost production and profits while at the same time improving soil quality, enhancing biodiversity, improving human health and protecting habitat.

RECOMMENDATIONS

1. The US government should encourage Amish farmers and support the reinvention in conservation agriculture, by providing them with the resources they need to improve their yields.
2. Conventional farmers should be encouraged to blend with CA practices until they are able to accept the fact that CA is the system of the future.
3. The government to create a market for the healthy and nutritious Amish produce.

CASE STUDY TWO

Cheptebo AIC Rural Development Project

The data was collected through interviews and focus group discussions. Twenty staff from Cheptebo rural project and thirty farmers from the local community participated in the discussion sessions. I also use observation techniques to build on what was relevant for my study. Descriptive method of analysis was used. The essence here was to establish the techniques used in Farming Gods way and its implications on the farming environment.

Background Information

The conservation project started in 1986 by a missionary from United Kingdom with a view of changing the lives of Cheptebo community in Keiyo valley in Kenya. The project was started on a Christian foundation which targeted local community to do farming in a sustainable manner through spiritual value guidance. This was later known as Farming Gods way. The aim is to improve the standard of living of Cheptebo community in a sustainable way by growing healthy farm products and conserving the environment for now and future (Kimeli, 2016). Since then the project has expanded greatly and is highly diversified. The Cheptebo development project is now integrated and runs many activities such as demonstration farms, forestry, training facilities, tourism agribusinesses, soil conservation among others. The Cheptebo community rural life has been enhanced and poverty has been reduced. Feeding on food raised in an environment involving healthy farming practices is the sole aim of Cheptebo rural development project (Kimeli, 2016)

Farming Gods Way

The initial concept was developed by Brian Oldrieve in Zimbabwe in the late 1980's who coined the practice as "Farming God's Way". The reason for this unique title was in part to bring faith back into agriculture. According to Oldrieve, this spiritual link contributes significantly to its widespread adoption among small-holder farmers in Southern Africa (Twomlow and Lewis, 2006).Farming God's Way is not just a technology but a well-balanced biblical, management and technological solution for the agriculture domain, equipping the poor to come out of poverty with what God has put in their hands and revealing the fullness of His promised abundant life (Dryden, 2013). Farming God's Way' encourages farmers to adopt a Bible-based version of conservation agriculture to curb food insecurity in the continent. "This method of farming helps farmers reap abundantly and in the same way enrich the soil by restoring its original structure just how God made it (Dryden, 2013).

The new farming method is pegged on three principles that land should not be ploughed; cover vegetation not disturbed and encouraging crop rotation. The technology, originally developed in Zimbabwe, is being fronted over conventional farming as soil acidity owing to over exploitation of fertilizer had damaged the soil micro-organisms thus lowering yield. That with mulching, water conservation is improved, unlike on bare soil where there is increased evaporation. "There is no weeding thus cancelling out on the intensity of labor," and there were no cases of crop disease where the technology had been employed (Muchui, 2015).Cheptebo Centre is located in the Keiyo District in the heart of the beautiful southern Keiyo Valley. It is served by a good tarmac road (C51) and is 33 Km from Iten town to the west and 20 Km from Kabarnet to the east. The project is located next to the C51 about 5 Km west of Chebloch Bridge on the Keiyo River. The Centre is clearly signposted on the main C51 road. The valley climate is mild with temperatures usually below 28 °C (82 °F). Most rain falls during the March–June and October–November periods and generally below 500mm. The vegetation

is of semi-arid to tropical grassland. The soils here are well drained, deep and in many places have an acid humus top soil. Natural fertility is rather good. The soils here are prone to erosion sometimes experience landslides because of its slope degree.

Objectives of the Project

1. To preach the gospel of Jesus Christ in word and deed
2. Empower local community spiritually, socially, economically and environmentally.
3. Farming God's way, meaning careful use of environmental resources to meet community needs.
4. Reduction of poverty level in a highly dry environment.

FINDINGS AND DISCUSSIONS

Activities Encompassing the Project

Livestock Farming; include dairy cows, dairy goats, poultry and bee keeping. The dairy cows and goats are mainly under semi-zero grazing practices. Zebu animals upgrading (demonstration farm); Jersey, Sahiwal, Friesian crosses – this is mainly to improve dairy animals in the local community and dairy goats for milk. It was found that the dairy crosses are easily managed by the community. The project started with six dairy goats which have increased so far and a lot has been sold to the communities both for sale and milk production. The well-kept indigenous plants are ideal for bee keeping providing high quality honey for consumption and sale. The project has several varieties of crops, mainly grown under drip irrigation because the place is generally dry. Crop grown include; grains and fruits such as; maize, beans, finger millet, sorghum, bananas, oranges, lemons, mango, avocado. Vegetable such as kales, cabbages, onions, tomatoes, sweet potatoes are grown in open and greenhouses using drip irrigation.

The tree nursery stand includes many varieties of both fruit and non-fruit tree. The purpose of establishing a tree nursery is to provide seedlings to the local community for increased forest cover to keep cool, their environment, soil erosion control, increase soil fertility, attracts rainfall, beautification of the environment, medicinal purposes, supply of food (fruit trees), fuel, timber for building and construction. The project aim is to preserve indigenous tree species. Soil conservation is a primary goal of the project. Since the area is on a gently sloppy terrain towards the floor of Keiyo valley, farmers are advised to protect the top fertile soil (alluvial mix) for their continued use of the land to grow crops. This is done through terracing, strip farming, crop rotation use of organic manure and tree planting.

Mulching is done through the use of Vetiver grass used for absorption of heavy metals. Vetiver can be planted along the roadside for erosion control. Training facilities; the project center has created new ways of empowering the local communities through training of farmers. The local farmers now rely on the conservation expertise within the Centre, which is equipped with demonstration farms, equipment and facilities for dissemination of information. The Centre is not only training local farmers at a low cost, but is open to a wider society. Well organized groups, farmers, institutions, visiting teams, education institution's researchers, scientists from all over the world come here to learn "farming God's way". The project Centre contains a wealth of resource information for all fields of research study and learning. It was found that 92% of the local community has benefitted and about 20% from other communities of the project since it started in 1986. Biogas production is made from animal waste. Here nothing is wasted. There is recycling of waste from the farm, from the kitchen, latrine and waste from rotten crop products.

The animal manure is processed into production of biogas which the center uses. The local community has been trained to use their waste generation into fuel gas production and other ornaments. 60% of the fuel used to run the facility is from biogas especially used for cooking. Field days; local farmers and visiting teams are invited for field days, which provide an environment for learning farming God's way. It is used for demonstration, farmer training and commercial production. Located in a semi-arid area, the farm has developed a specialization in production techniques appropriate to such areas.

Farming Techniques

It was found that 95% of farming activity is farming God's way. The main farming activities involve: Farming focuses on drought tolerant crops such as millet, cassava, sorghum tolerant maize variety,

sweet potatoes, simsim among others. Vegetable and fruit production are under drip irrigation, which use little water. It employs trials and demonstration of water efficient irrigation techniques. Crop rotation and application of organic manure is of the essence in the farm. Fodder is grown mainly for livestock. The Centre maintains a central tree nursery providing farmers with some 50,000 tree seedlings per year. Seedlings are produced in a disease free environment and are of guaranteed type and quality. Fruit tree seedlings, fodder trees, ornamentals and other varieties are normally available for sale. Grafted mango seedlings are in particularly high demand. From a mature mother block at the Centre, Scions are available for grafting from the following varieties – Apple, Ngowe, Van Dyke, Kent, Sensation and Tommy Atkins. Grafted citrus (Washington Navel), papaya (local varieties and Solo), avocado indigenous tree seedlings are available for sale. In addition to stock of seedlings for wood fuel, timber and indigenous varieties are normally in stock. It was observed that the project has realized a number of its objectives:

The poverty rate in the local community has reduced by 30% especially household families practicing new methods of agriculture-farming God's way. Soil erosion has reduced in the area and soil fertility maintained. More trees planted has reduced the temperature, hence lots of tree shades for cooling the environment. Income source from dairy, crops, fruits, and beekeeping has been diversified and increased in the Cheptebo community. More natural plants have been preserved and kept to provide medicine and food products.

The Centre has also impacted positively by providing spiritual guidance to the entire community in order to live a morally upright life. The project has created job opportunities for the community and therefore is an important avenue for growth and development of the community. Compost and mulch; Compost are the biologically active material that results from the decomposition of organic matter under controlled circumstances. Mulch is any material, organic or inorganic, that is spread over garden soil to cover it. They are used to keep the soil fertile all the time and helps to increase crop yield and reduce the cost of purchasing industrial fertilizer or synthetic which is expensive for farmers and causes diseases in human and kill organisms in the soil. The project has developed varies species that are found to do well in a hot dry climate. Lucerne, is a leguminous, high protein livestock feed. Grafted Mango seedlings are now produced in large quantities at the Centre tree nursery. Farmers are able to purchase quality assured seedlings of various varieties suited to their particular needs and preferences. Mango Fruit Fly Pheromone Trap technique is used to get rid of pests. With the very rapid increase in mango production in the southern Keiyo valley, the mango fruit fly has become a major problem which seriously affects fruit quality and harvests. Chemical spraying has been costly, fairly ineffective and leaves chemical residues on the fruit. A very effective alternative control method, recently introduced at Cheptebo, is the Mango Fruit Fly Pheromone Trap which uses pheromones to attract and destroy male fruit flies, thus breaking the breeding cycle. The results have been very positive and local farmers are now adopting this innovation. Tissue Culture Banana plantlets techniques are employed to increase banana production and produce healthier plants.

Slow rates of natural reproduction and disease problems have necessitated the introduction of this new innovation. Plantlets are raised in sterile, laboratory conditions of disease free parent material. The plantlets are then supplied to Cheptebo for growing on and subsequent sale. The known varieties which are disease free and suited to various growing conditions and market demands are made available in this way to local farmers. Drip Irrigation provides a very efficient way of utilizing limited water supplies in semi-arid areas. The Cheptebo farm operates and demonstrates various techniques based on water efficient irrigation principles. The farmers felt they needed more support from the government and NGOs and agricultural subsidies as incentives to food production and biodiversity conservation in the area. The farmers need to be equipped with the right equipment to enable them realize conservation agriculture.

CONCLUSION

There is much more to it than teaching farmers about Conservation Agriculture. Farming Gods Way teaches how to conserve the resources and produce healthy nutritional foods for human health and, not only showing how to farm in a sustainable way but also providing training in transformational

development. We want people's lives to be changed through what they have learned. Ultimately, we want the land and people's lives to be restored. Farming God's Way is teaching farmers how to care for their environment while increasing crop yields, locking carbon into soil and reducing soil erosion. It is also teaching transformational development and key business skills and providing hope for the future. The people in the Cheptebo rural community have their lives have been changed for good. Having the skills and appropriate technology is the key to sustainable development. Reinventing conservation agriculture is the way to go in the future. Farming God's way is beneficial in a number of ways; less cost on land ploughing, increase in yields, adapted to low rainfall regions, low labor cost, soil is kept fertile and grow healthy crops.

RECOMMENDATIONS

1) Develop policy on Conservation Agriculture to support small-scale farmers with a view of increasing their potential in food production.

2) Government forestry department and NGOs to supply free or less cost effective seedlings to farmers, particularly fruit trees and indigenous species.

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