ENTREPRENEURSHIP EDUCATION IN THE AGRO-BIODIVERSITY SECTOR: A Case Study of G-Tech PLA Roll Planter Value Creation for a Youth Community of Practice in Gauteng

Half -Thesis

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Mabora Thupana
15T5734

Supervisor
Distinguished Professor H.B. Lotz-Sisitka

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ABSTRACT

Entrepreneurship is widely recognised as a basic skill that can be learned through practice. The main focus of this study was to investigate entrepreneurship education and the type of biodiversity entrepreneurial practices and opportunities that could create value for youth via the use of green technology: the PLA Roll Planter in the biodiversity and agriculture sector. The study was inspired by the need to identify and analyse knowledge, skills and entrepreneurial aspects associated with the use of green technology to strengthen entrepreneurial learning for youth participation in the green economy and green work.

The study employed the use of Communities of Practice (COP) and Value Creation adopted from Wenger as theories and a focal lens to portray the contribution of technological practices to youth sustainable livelihoods and green work in the biodiversity sector. Research on the G-TECH technology that was in focus in this study, the PLA Roll Planter, shows that newly introduced green innovations can increase agricultural outputs without depleting presently available resources.

The study applied qualitative research approaches in a case study of the G-Tech PLA Roll Planter training and participation of a youth Community of Practice (COP) in Gauteng. It started by examining the knowledge capital as potential value embedded in the training and knowledge, skills and entrepreneurial aspects of the G-Tech PLA Roll Planter practices. The study then constructed four value creation stories of youth in the COP to understand other forms of value that were created for youth. The findings of the study depicted that the adoption of improved agricultural technology (PLA Roll Planter) has positive impacts and knowledge capital that can translate into other forms of value to support the emergence of viable economic activity in the agricultural sector. This can help increase food security and the ability to withstand risk of damaging the environment. The study shows that different forms of value were created for youth, and offers insight into how learning in communities of practice can help to advance entrepreneursip education in the biodiversity and especially the agro-ecological production sector.

LIST OF ACRONYMS

ARC Agricultural Research Council
AEOs Agricultural Extension Officers
ASSAF Academy of Science of South Africa
CATHSSETA Culture, Arts, Tourism, Hospitality, & Sports Sector Education & Training Authority
COP Communities of Practice
CBD Convention Biological Diversity
CGS Council for Geoscience
CSR Corporate Social Responsibility
CSIR Centre for Scientific and Industrial Research
DEA Department of Environmental Affairs
DOE Department of Education
DMR Department of Mineral Resources
ELRC Environment Learning Research Centre
ESE Environment for Sustainable Education
ESD Education for Sustainable Development
ESSP Environmental Sector Skill Plan
FTFA Food and Trees For Africa
GDP Gross Domestic Product
GEO Green Entrepreneurship Opportunities
GTECH Green Technology for Sustainable Livelihoods
HSRC Human Science Research Council
ILO International Labour Organisation
IOE International Organisations of Employers
ITUC International Trade Union Conference
NEMA National Environmental Management Act
MEA Millennium Ecosystem Assessment
NRF National Research Foundation
NYA National Youth Act
OECD Organisation for Economic Cooperation and Development
PLA Polylactic Acid
SAEO South African Environmental Outlook
SAGE South African Green Economy Modelling Report
SANBI South African National Biodiversity Institute
SEED Sustainable Environmental Enterprises Development
STATSSA Statistics South Africa
SDG Sustainable Development Goals
TEA Total Early Stage Entrepreneurship Activity
UNESCO United Nations Education Scientific and Cultural Organisations (UNESCO)
UNEP United Nation Environmental Programmes
UNDP United Nations Developmental Programmes
WGSEO World Global Social Employment Outlook
YEF Youth Entrepreneurship Facility

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CHAPTER 1
Introducing the Study

1.1 Introduction

This chapter outlines the background of the study. The main goal was to investigate entrepreneurship education in the biodiversity sector in a selected Environmental Youth Programme called G-Tech (Green Technology for Sustainable Future Livelihoods). The chapter begins with a description of the state of biodiversity which influenced establishment and functioning of an Environmental Youth Programme in the biodiversity sector. The chapter further describes how youth within the programme are working in an entrepreneurial manner to address the impacts and challenges caused by human activities on biodiversity. The chapter introduces the research questions, and then outlines the study chapters.

1.2 Researcher's role and brief introduction of the G-Tech programme

The G-Tech programme, as noted above, is an Environmental Youth Programme which focusses on Green Technology for Sustainable Future Livelihoods, hence the acronym 'G-Tech'. This programme is operational in Gauteng Province in two sites (see below), as will be described later in this study in more detail (see Chapter 4). It proved to be a suitable case to study that was working with youth who were learning in a community of practice, and who were also using green technology to strengthen entrepreneurial learning in the biodiversity economy.

The study is located in Gauteng in two municipalities, Randfontein and City of Tshwane. More specifically, it is located in Laezonia, in Diepsloot, where G-Tech has been found to grow resourceful and scarce plants such as *sorghum* and *soya bean.* The motivation of the G-Tech project was to introduce new knowledge and the idea of green technology to grow the plants in a sustainable manner while also addressing socio-economic issues such as *poverty* and *unemployment.* The focus of the study was to reveal newly introduced green innovations that can increase agricultural outputs without depleting resources. The research gap that was filled by this study was to share insight into young people learning in a community of practice in the context of this green technology innovation and its implementation.

Ultimately, I chose to focus on one site, Laezonia due to the duration and the limitations of the study. In the study these types of plants have broadened my understanding, and I was able to explore further the botanical and horticultural benefits including the influence and contribution of the plants mentioned above within the biodiversity economy. South Africa occupies only 2% of global land, yet it contains a significant share of global biodiversity (South African Environmental Outlook [SAEO], 2012). Studies have indicated that the value added by the biodiversity economy to agricultural practices accounted for 6,2 % of the goods and services produced in the Northern Cape but less than 1% in Gauteng according to Stastistics South Africa Report (StatsSA, 2015).

As a young researcher interested in youth, the study has enabled me to reflect on my own role in participating as well as the development and dissemination of knowledge and entrepreneurship of young people in the country. As a qualitative researcher, I recognise that I am also an instrument and centrally involved in the research process. Using qualitative research approaches, and focusing on a case study of G-Tech, the study examined the knowledge, skills and entrepreneurial aspects of the G-Tech practices, and then also studied the roles played by youth in adding value, knowledge and skills within the G-Tech project, exploring the value created for them via these sustainable practices or greening projects in learning entreprenueurship skills.

What made the study of G-Tech interesting, was the way in which G-Tech used the innovation technology of a Polylactic Acid (PLA) Planter as a viable product, process, technology, service and solution to promote and stimulate the green economy that fosters infant green industries. This technology formed a key focus of the learning in this study. G-Tech further emphasised that opportunities such as the use of the PLA Planter stand a chance to drive social inclusion and foster consumption as recommended by the Industrial Labour Organsiation (ILO, 2006). I have used the concept of *green, sustainable practices* in this thesis (see section 2.6 for further clarification) to refer to the practices associated with the PLA Planter and other practices in the G-Tech programme. These practices involve innovations that require an integrated redesign of products, lifestyles, process and structures (Wals, van der Hoeven& Blanken, 2009). G-Tech used the PLA Planter to create change and it was useful to explore the relationship between *agriculture, biodiversity, environment and technology.*

Having come from the Limpopo province that is rich in biodiversity, I was not aware of how

biodiversity is valued by people, especially youth until I started this study. Therefore, this study could be seen as an example of how to get to understand how all human beings and particularly the youth could get to understand how to protect and treasure biodiversity for future generations.

1.3 Broader background and context

At the beginning of 2017, South Africa had a population of 55,436.360 million. Of these people, 18,5% are between the ages of 10-19 and 24% are aged 15-24 (StatsSA, 2015). The youth unemployment rate stands at 26,7% (Tshwane Vision 2055 Report, 2013; StatsSA, 2015). Although youth unemployment is increasing globally, in most African countries it is very high, in some cases it is even up to 50% (ibid.). Gauteng Province, where this study was conducted, is the smallest of South Africa's nine provinces and is commonly known as the *economic hub,* yet it also has a large number of unemployed youth.

South Africa is well known to have an attractive environment which is rich in biodiversity (HSRC, 2009). Being the third most biodiverse country in the world, biodiversity forms the cornerstone of our economy (MEA, 2005). However, that rich biodiversity tends to be threatened and disturbed due to activities including human activities (ibid.). Biodiversity refers to living organisms and species including plants and animals (DEA & DMR, 2010). Biodiversity also forms part of agriculture; it constitutes all forms of life relevant to agriculture such as , crops, natural plants and animals. People depend on biodiversity as a source of their livelihood. The loss of biodiversity is unavoidable, because people depend on biodiversity for their livelihoods, they grow plants for food, forestry plantations and farming (Vass *et al.*, 2009). The loss of biodiversity is associated with loss of local opportunities, poverty and food security and as a result conservation of biodiversity is not merely important but necessary.

In this regard, Abrahamse of South African National Biodiversity Institute in the State of Biodiversity Report in South Africa (2012: 2), commented on the state of biodiversity in South Africa noting that, "Biodiversity represents an asset that we do not understand and value enough. Sometimes it is because we do not see the value of it now. Once we see the value we get from it then we will protect it for future generations". In addition, biodiversity has been found to be the foundation and source of food and services (MEA, 2005). There is therefore a strong need for younger generations to respond to the challenges of conserving biodiversity.

This study sought to investigate how youth in performing sustainable practices related to biodiversity in the biodiversity economy have acquired, assimilated and demonstrated *entrepreneurial skills* and *knowledge* that yields a creative green project while meeting the country's developmental needs such as job-creation, poverty and skills development. Biodiversity plays an important role in addressing South Africa's priorities of sustainable rural communities, service delivery and job creation.

The South African Constitution (1996), the Bill of Rights of (1996) (Section 24) and the amended National Environmental Management Act (NEMA) of 2014 stipulate that all human beings have the right to live in an environment that is healthy and not harmful to their health, and that is free of pollution. These same policy documents argue that South African citizens have the right to an environment that is protected for the benefit of present and future generations. Relevant studies validate the value of biodiversity, for the reason that its richness contributes to the support of social and economic development in many ways, either directly or indirectly (MEA, 2005; DEA & DMR, 2010).

Entrepreneurship is a key term used in this study and it refers to the process where individuals become aware of business ownership and are likely to develop ideas, learn the process of becoming entrepreneurs and undertake the planning and development of business (Stevenson, Roberts, & Groubeck, 1985). Entrepreneurship in this study was used interchangeably with the development of business skills; however more detail about the definition, similarities and differences between entrepreneurship and business skills are discussed in detail in *Chapter* 2. An entrepreneurial orientation lies at the heart of integrating social, economic and technology aspects (Hart & Stafford, 1998). Entrepreneurship is an emerging issue in the biodiversity sector (Nasser et al., 2003). It is widely recognised that entrepreneurship is a basic skill that can be acquired through learning and practice (Nieman & Nieuwenhuizen, 2004; Fonsecha et al., 2006), yet little is known about this process, especially amongst youth.

Entrepreneurship at G-Tech has been recognised as a platform for development of business knowledge that can be used to generate opportunities for self-employment in the biodiversity sector. South Africa is a nation with great diversity amongst people, cultures, languages, and religion. With regard to *entrepreneurship education* research, few young people are found to be taking actions in educating and encouraging each other in creating livelihoods in local solutions, and this area needs more attention in research and practice. Further to youth

educating each other, there is hope that young people have the potential for growing small business practices, both for their advantage and that of the community they serve (Nasser et al., 2003).

The role of entrepreneurship in Environmental Youth Programmes is linked to development of environmental entrepreneurial practices in the communities, colleges and universities in terms of sharing knowledge and ideas (ibid.). Therefore entrepreneurship is considered important in developing young people to be more *knowledgeable, experienced* and *insightful a*bout what is happening as well as what type of opportunities are emerging from and around their communities. This is what this study sought to investigate, as outlined in the research aims and questions below. In this study I also use the term *enterprise development learning* as this offers more specific insight into the *learning* of entrepreneurship.

1.4 Research objectives, aim and research questions

The main objectives of the study are, in the context of a case study of a biodiversity enterprise involving youth, to:

- Examine how a biodiversity enterprise involving youth creates a platform of new knowledge, skills and entrepreneurship learning that can be used to generate opportunities for self- employment in the sector;
- Establish the biodiversity entrepreneurial knowledge and skills that youth gain throughout their involvement with youth development programmmes;
- Establish the knowledge and skills that youth bring to youth biodiversity enterprise development programmes;
- Understand what value is created as youth learn and participate in the programmes, in order to examine how entrepreneurship could be an important element in youth development programmes in the biodiversity sector.

The study's **main research aim, which relates to the main question of the study** is: How can the learning of entrepreneurship knowledge and skills in a biodiversity enterprise in the biodiversity sector be stimulated through educational youth programmes involving youth communities of practice?

To address and answer the main question I have developed **sub-questions** below, which are

contextualised to the G-Tech biodiversity enterprise development case study:

1. What kinds of biodiversity entrepreneurship practices are promoted in the G-Tech youth environmental programme and what knowledge, skills and entrepreneurial (enterprise development) learning do these promote?
2. What experiences, knowledge, skills and ideas do youth come into the G-Tech programme with?
3. What and how are youth learning in the youth G-Tech biodiversity enterprise programme community of practice?
4. What value is created for youth as they participate in the G-Tech biodiversity enterprise learning community of practice and what contributes to their learning of the practices?

1.5 Overview of the chapters

Chapter 1 is an introductory chapter that focuses on providing an *overview* of the study, including a *broad description* and *contextual data* about the study. The chapter introduced the problem statement to guide the reader and introduced the intentions of the study as well as the limitations of the study. It provided the objectives and aims of the study, and the research questions designed for the study.

Chapter 2 presents the literature review. It shares what been done in the study field. It broadly defines and provide more details of the background of the study, the role and value of environmental practices in the biodiversity sector, clarifying the meaning of concepts. The chapter further brings into focus the role played by youth in transition to a green economy. Current and previous studies, statistics and trends are used as a lens to highlight how the study fill the gaps identified, thus clarifying the field in which the study is located, and where it seeks to make its contribution. The chapter also introduces the theoretical framework of the study, namely communities of practice, and value creation for youth in learning in communities of practice, and elaborates especially on knowledge capital formation as a form of potential value which influences all other types of value creation.

Chapter 3: The third chapter presents the methodology and research approach in detail, including the *selection of the case study* and *research participants,* and explains how I used the theoretical framework of the study (shared in Chapter 2), to guide the abductive data analysis process used in the study. It provides "*a playbook*" and a research design presenting the role of

theory in guiding the study, showing how the chosen theoretical framework has helped in interpreting the data and the explaining the findings of the study. I explain in detail the processes conducted in all stages of data collection. The chapter also shares how I considered ethical and validity issues in the study.

Chapter 4: This chapter offers an in-depth look at the G-Tech programme and its objectives. It highlights the knowledge capital as potential value associated with all of the different green, sustainable practices identified in the G-Tech case study via document analysis. The chapter therefore shares the main findings associated with potential value. It also shares how the youth came into the project's community of practice, and what they brought with them. This chapter primarily addresses Research Question 1, but also sheds light on some of the other research questions.

Chapter 5: This chapter shares the data from the value creation stories that I developed to capture what the youth were learning in the G-Tech green, sustainable practices. It shares insight as to how the youth were learning together, and the forms of value that were generated for them in terms of their entrepreneurship learning in the G-Tech programme. It reflects on the knowledge capital that they gained as potential value, but also sheds light on other forms of value, especially applied value and reframed value where it was evident. This chapter addresses Research Questions 2, 3 and 4.

Chapter 6: This chapter summarises the study, and draws conclusions related to the main research question, and makes recommendations. It considers the contribution the research has made in terms of reflecting on youth experiences and capabilities. It further provides recommendations based on the study findings. Lastly, I also reflect on the study, and what I have learned by doing the study.

1.6 Limitations of the study

With regard to the scope of the project, I have experienced limited time and resources for the project in terms of researching the full scope and depth of learning associated with business entrepreneurship in the biodiversity sector. As mentioned above, this is an interesting, yet under researched concept in the 21st century. In particular, there has been limited research done on these type of projects for youth. As noted above, I only focused on one study site. Due to

resource constraints, time in the field was also an issue. I drew heavily on document analysis of the G-Tech programme, as well as site-based observations. I was, however, also able to interview some youth members to develop their value creation stories for analysis. The research process has enabled me to be both learner and a participant in many ways.

CHAPTER 2
Literature Review

2.1 Introduction

This chapter presents a literature review. It shares what been done in the study field. It broadly defines and provide more details of the background of the study, the role and value of environmental practices in the biodiversity sector, clarifying the meaning of concepts. The chapter further brings into focus the role played by youth in transition to green economy. Current and previous studies, statistics and trends are used as a lens to highlight how the study fills the gaps identified, thus clarifying the field in which the study is located, and where it seeks to make its contribution. The chapter also introduces the theoretical framework of the study, namely communities of practice, and value creation for youth in learning in communities of practice. The chapter elaborates especially on knowledge capital formation as a form of potential value which influences all other types of value creation.

2.2 Biodiversity, youth unemployment and green entrepreneurship

South Africa has an attractive environment and is rich in biodiversity (HSRC, 2009).There is a strong felt responsibility for South Africans to respond to the challenge of conserving biodiversity while meeting the country country's developmental needs such as unemployment, poverty and job-creation (Privett , Heydenrych, & Cowling, 2002). The Millennium Ecosystem Assessment Report reveals that over the past 50 years, the natural ecosystem has been affected by human actions (MEA, 2005). According to the guidelines for mainstreaming biodiversity into the mining sectors, (DEA & DMR, 2010*), biodiversity* refers to living organisms, plants and species in terrestrial, marine and aquatic environments. With regard to the status of biodiversity, the Convention on Biological Diversity Report of 2014 indicated that South Africa has 95 000 known species including plant species, reptiles and mammals.

Biodiversity is a vital source and foundation for goods and services that are essential to human well-being and stability of ecosystems services, yet South Africa's biodiversity is under threat (MEA, 2005). The loss of biodiversity is associated with the loss of local opportunities as a result conservation of biodiversity is important (ibid.). The loss of habitat through land use practices is now recognised as the major threat to biodiversity (Rougeut, Egoh, & Reyers, 2011). It is, however, argued that the concept of biodiversity leads to simplification of

understanding how our ecosystems need to be conserved, protected, maintained and restored, for the reason that our ecosystems sustain all humans around the flora and fauna (Egoh et al., 2008). Thus, ideally, all actions taken to conserve biodiversity should focus on protecting ecosystem services to strengthen biodiversity and conservation i.e. biodiversity should be interpreted within a wider ecosystem services lens.

Many initiatives in South Africa are geared towards *sustainability* and *poverty alleviation* and present an opportunity for improving biodiversity and job creation (ibid.). In the biodiversity sector there are other initiatives to support youth enterprise development such as GreenMatter, Imvelisi initiative, but there is no research as yet on the social learning related to green enterprise development in the biodivesity sector, hence this study. Biodiversity forms part of agriculture. With a relatively small land mass, South Africa contains a huge share of global biodiversity (South African Environmental Outlook, 2012). Biodiversity is necessary to improve environmental and economic activities such as horticultural and agricultural industries. South African ecological infrastructure development programmes such as the *Grassland Programme, Working for Ecosystems, Working for Wetlands* and *People and Parks* target safeguarding of both biodiversity and ecosystem services, while also seeking to support improved ecological infrastructure for sustainable development and poverty alleviation.

With regard to the state of South African natural resources, the country has relatively low annual rainfall and water is extracted from the main rivers to supply the growing number of domestic, agricultural and industrial users (SAGEM, 2013). South Africa is a water scarce country, and it is estimated that the national water requirements will exceed availability by 2025. Such challenges, while serious and threatening, also represent an excellent opportunity for education and awareness to play a significant role in contributing to additional knowledge and new practices and developments in society. The 2009-2015 SEED survey among the South African application and recipients of the SEED Awards shows that contributions to entrepreuneurship practices in South Africa come from agriculture (36%), training (29%) and health related social services (25%), with agriculture leading entrepreneurship practice developments (SEED, 2015).

One of the major challenges in South Africa is unemployment with an official rate of 26,4% (StatsSA, 2015). Approximately 60% unemployed people are youth who left high school and amongst these, many have moved to the city and are hopeful for job opportunities. Statistics

South Africa (2015) regarded youth as persons aged 15-34 years (see Table 2.1), while Pfeffer of the International Labour Organisation (2012) reported that the age group 18-24 are the least likely to start businesses. This raises the challenge of supporting entrepreneurial knowledge, skills and learning amongst this age group. In South Africa, the National Youth Act of 1993 identified youth as the persons in the age range of 14-35 years, who are permitted to participate in the labour market (NYDA, 1993).

Due to the scarcity of jobs and a lack of a wide range of opportunities, there is potential for young people to be trained and educated in the field of entrepreneurship to become future job-creators not merely job-seekers (Mitchell & Jessylyn, 2006). There is also a need for introducing green thinking, knowledge, innovative ideas and creative ideas on green businesses and green skills for youth in the society through *green entrepreneurship.* As mentioned by Abrahamse (2012 ; 2015) cited in Chapter 1, biodiversity has potential to be valued differently, including amongst youth.

The labour force comprises people who are employed and people who are unemployed; employed persons are those aged 15-60 years, who during the reference unit of the week did any work for at least an hour whilst unemployed are those who were aged 15-64 years, who were not employed in the reference week and who are actively looking for work and tried to start a business (StatsSA, 2015; Bux, 2016). Table 2.1 below indicates youth working population by age group as of 2008-2015, compared to adult working age populations.

Table 2.1: South African working population by age group (2008-2015)

Age group	2008	2009	2010	2011	2012	2013	2014	2015
15-19	4989	5047	5095	5130	5156	5167	5164	5147
20-24	4704	4752	4806	4871	4940	5009	5075	5734
25-29	4441	4515	4580	4635	4688	4744	4806	4876
30-34	4075	4091	4127	4188	4269	3902	4460	4550
Youth	**18209**	**18405**	**18608**	**18824**	**19053**	**19283**	**19505**	**19707**
35-39	3431	3590	3720	3812	4269	3260	3937	3992
40-44	2740	2780	2850	2957	3868	2601	3420	3556
45-49	2435	2479	2516	2850	3098	2291	2646	2720

50-54	1978	2049	2116	2516	2573	1825	2336	2380
55-59	1561	1601	1646	2116	2238	1395	1896	1965

Source: StatsSA (2015)

The table above shows that in 2015 the working age population was 35.8 million in South Africa, with 55% of these (19.7 million) being youth, and 45% being adults (16.1 million) (StatsSA, 2015).

Studies indicated that there is a constant increase in the number of unemployed females compared to males. Age is seen as another important control variable that accounts for job creation or business developments rates amongst youth; however rates differ among older and younger persons as older individuals tend to be more risk averse than the younger individuals (Sober & King, 2008). Unemployment poses a great challenge in society; it was noted by Bux, (2016) that the majority of youth are *not economically active* (i.e. people who are neither employed or unemployed in the reference week) and they are not in a *formal education or training programme*.

Tables 2.2 and 2.3 below show unemployment rates for male and female youth per province respectively, showing higher unemployment rates for males than females.

Table 2.2: Male unemployment rate for youth (15-34 years) by province, 2008-2015

Province	2008	2009	2010	2011	2012	2013	2014	2015
Western Cape	23,6	24,8	27,2	29,5	32,2	31,9	29,6	27,6
Eastern Cape	37,2	34,4	37,4	38,4	34,5	39,1	39,4	39,3
Northern Cape	28,4	30,7	37,2	34.9	29,8	35,8	39,5	38,1
Free State	27,8	30,9	38,2	35,1	35,8	39,7	45,5	35,1
Kwa-Zulu Natal	26,1	29,1	26,0	25,9	26,9	28,8	27,7	30,5
North West	24,0	34,3	30,0	33,4	37,6	33,7	34,5	36,8
Gauteng	27,7	27,3	34,8	34,5	31,5	35,2	33,2	37,5
Mpumalanga	28,7	31,2	36,7	35,3	36,6	34,5	38,9	33,2
Limpopo	27,8	38,6	35,6	24,9	28.8	24,3	25,8	25,6
South Africa	**28,4**	**29,8**	**35,7**	**32,2**	**31,8**	**33,5**	**33,4**	**33,8**

Source: StatsSA (2015)

Table 2.3: Female unemployment rate for youth by province, 2008-2015

Province	2008	2009	2010	2011	2012	2013	2014	2015
Western Cape	28,6	30,3	28,1	35,2	30,9	34,7	32,6	32,4
Eastern Cape	38,1	44,7	43,4	35,5	42,1	40,8	42,4	42,8
Northern Cape	40,1	48,6	41,5	49,6	43,7	45,6	46,0	52,6
Free State	41,8	42, 4	43,4	45,5	55,2	47,5	51,8	45,,5
Kwa-Zulu Natal	36,0	35,8	28,4	34,1,0	33,5	32,6	34,1	36,8
North West	42,9	44,3	49,1	45,4	46,1	44,2	43,7	44,48
Gauteng	38,6	37,8	45,0	45,6	43,7	40,8	40,5	42,6
Mpumalanga	39,5	41,5	46,3	51,7	50,2	48,9	48,1	46,9
Limpopo	49.7	42,7	44,6	33,4	34,8	37,2	33,4	37,2
South Africa	**38,0**	**38,5**	**39,5**	**40,9**	**40,7**	**39,7**	**39,5**	**40,7**

Source: StatsSA (2015)

The tables above show notable differences amongst youth. Table 2.1. indicates that there is an increased rate of youth who are not employed, and Tables 2.2 and 2.3 show how the rate varies from males to females with female youth unemployment being as high as 40.7% in 2015, compared to 33.8% of male youth unemployment. StatsSA (2015) go further to analyse unemployment per racial category in South Africa, and they report that there are large gender-based differences in unemployment rates per gender and race group, noting that it is particularly black African young women who are most vulnerable to unemployment. The unemployment rate of young black African women stands at 42-46% each year, compared to black male youth which stands at 30-37% respectively between 2008-2015 (ibid.). These figures show that there is a need for further research to strengthen entrepreneurship knowledge in all genders, but especially amongst black African young women.

Sobel and King (in Blau, 1987) have shown that entrepreneurial intention rates differ significantly by sector. A study by Diwan et al. (2015) highlighted that gender and the role of cultural constraints are shaping the character of women in business, accounting for how they deal with business tasks and how they network with other women within the centre of women associations. However gender and age are not the only control variables in the study of employment of women in business.

Green entrepreneurship, to be defined in the next sub-section, can be encouraged by bringing more youth, particularly women into business-led opportunities that enhance balancing-gender barriers amongst youth. The Corporate Sustainability Report (CSR, 2015: 20) highlighted that women's participation in environmental practices is low, yet women play a role as "*mobilising resources"* to drive *innovation* and *creativity.* There is a need for also embracing *diversity* and *culture* where individuals can apply their talents irrespective of their *personality, background* and *experiences.* Studies highlighted that in terms of the impact on gender mainstreaming in the small business or start-ups, the role of women in advancing their social missions is overestimated and challenging, however, gender inclusiveness can be balanced through the need for the right skills and abilities (SEED, 2015).

2.3 Entrepreneurship and green entrepreneurship

Entrepreneurship is defined as the process where individuals become aware of business ownership and are likely to develop ideas, learn the process of becoming entrepreneurs and undertaking planning and development of the business (Stevenson, Roberts, & Groubeck, 1985). The term "*entrepreneur*" is a French word derived from the verb "*entrepende"* and evolved in the 1700s and 1800s out of the work of the French Economist Jean Baptiste. In more recent studies, Sharma and Chrisman (1999) defined an entrepreneur as someone who undertakes a venture, while Allen and Mallin (2008) claimed it is an individual who invents new business opportunities and creates enterprises from scratch using business knowledge, innovation and creativity in terms of identifying opportunities to offer services to society. An entrepreneur is a person who organises and manages any enterprise, small or big.

Fatoki (2011) emphasised that youth entrepreneurial intention tends to be very low in South Africa as compared to ten other sub-Saharan African Countries as shown in Table 2.4. Fatoki (2011) and Pfeffer from the International Labour Organisation (ILO, 2012) further highlighted that Total Early Stage Entrepreneurship Activity (TEA) is the lowest here compared to other southern African countries or sub-Saharan countries and that not much has been done with regard to *entrepreneurial activities* particularly in the environmental sector. The phenomenon of *entrepreneurship* is still emerging here.

Table 2.4: South Africa's entrepreneurial abilities, compared to ten other African countries

South African's perceive their entrepreneurial capabilities as the lowest of 10 sub-Saharan countries			
Country	Perceived capabilities	*Quality of education	TEA 2012
Malawi	86%	65	36%
Zambia	84%	39	41%
Namibia	76%	126	18%
Ethopia	74%	85	15%
Ghana	86%	62	37%
Nigeria	86%	83	35%
Botswana	70%	55	28%
Uganda	88%	69	36%
South Africa	40%	140	7%

(Source**:** Pfeffer, 2012)

Mitchell and Jessyln (2006) stressed that creation of entrepreneurial ventures is crucial in youth developmental programmes mainly as an educational process that involves sharpening of the mind-set towards green thinking, as a developmental method for individual growth and considering risks and rewards of a given practice. For this reason, *entrepreneurship* is not predictable. In most start-ups of youth programmes, much attention was placed on how opportunities were detected in an established entrepreneurial practice (Sharp, 2002; Nieman & Niewenhuizen, 2004). In the case of this study, the entrepreneurial process at G-Tech was recognised as the capacity to develop, design, organise and manage activities that respond to offering services to ensure that *knowledge* and *skills* acquired were aligned with the intentions of the programme *(see Chapter 4).*The biodiversity component focused more on practices that are associated with a*gricultural*, *botanical a*nd *horticultural* spheres *(see Chapter 4). Green entrepreneurship* involves introduction of green thinking, green knowledge, and green skills and values (Fonseca et al., 2006). For young people to embark on these type of practices will require taking entrepreneurial knowledge and utilising it for the effectiveness and benefits of the social practices as applied to sustainability or green economy, in the case of this study, the biodiversity economy.

This focus situates the study in green entrepreneurship located in the agricultural employment sector, within the wider context of youth employment as outlined in Table 2.5 below, which shows employment by sector amongst youth:

Table 2.5: Employment by sector amongst youth (2008-2015)

Sector	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Formal sector	4555	4507	4150	4034	4221	4182	4388	4434
Informal sector	1132	999	944	1025	961	965	1022	1030
Agriculture	382	354	307	282	297	372	283	436
Private sector	391	436	388	363	394	330	307	339
Total	6460	6296	5789	5704	5874	5850	6000	6239

Source**:** StatsSA (2015)

*Agricultur*e has an influence on macro-economic indicators for a green economy. The South African Green Economy Modelling Report (UNEP, 2013) stipulates that agricultural investments were allocated to adopt ecological agricultural practices. Agriculture still needs further attention however, from a sustainability, green entrepreneurship or green economy perspective, as the use of sustainable agricultural practices (such as organic fertiliser use) is projected to increase by 5,5% and 23,9% by 2030 (ibid.). Studies conducted in the 21st century have demonstrated how youth aged 25-35 are more likely to engage in entrepreneurship at a younger age as compared to the older generation (Driver, Wood, Segal, & Herrington, 2001). This scenario seems to indicate that young people have different desired values.

The notion of *green entrepreneurship* in the study was aligned with the possibility that youth can acquire *knowledge, innovation* and *ideas* on green skills within communities of practice in green entrepreurship programmes and emerging enterprises. Nieman and Nieuwenhuizen (2004) argued that entrepreneurship is best learned through experience and practice. The study focused more on youth's various *experiences, lessons learned* and *value-creation stories* as this allowed for a probing of whether youth can discover *identity* when they are within communities of practice (see section 2.4 below). Nasser *et al.* (2003) contended that the future of young Africans could be more rewarding if the basic skills to support small enterprises are well established and put in place effectively. Research in South Africa reports that such processes are lacking and there are factors that hinder youth from developing *entrepreneurial*

abilities (Qumza, 2011: 53). Qumza (ibid.) argued that there are barriers, inhibitors and limiting factors that hinder entrepreneurship development, which include *lack of entrepreneurial background* and *experience*, *lack of exposure* and *experience* at younger age, *less engagement in business venturing activities*, and lack of encouraging entrepreneurship as a career choice at early ages or stages. Additionally there is a lack of sources of funding for business start-ups (Qumza, 2011: 53).

Consequently, this study sought to understand *green entrepreneurship educational practices* such as the ones being used by G-Tech and how these were used as a platform for encouraging *entrepreneurial knowledge and learning* and, in order to identify some of the gaps and opportunities for youth in the biodiversity sector. Drivers *et al*. (2002) argued that *education* can be a significant key factor influencing entrepreneurial activity, for the reason that matriculation increases one's capacity to pursue entrepreneurial activities, whereas at tertiary level individuals are more matured and are likely to focus better when exposed to various opportunities during or after the duration of their studies. In this study I was interested in entrepreneurial learning in the workplaces where the entrepreneurship activities were taking place.

2.4 Youth entrepreneurship learning contributing value to sustainable practices

Fatoki (2011) emphasised that youth entrepreneurial intention tends to be very low in South Africa as compared to ten other sub-Saharan African Countries. With this background of the broader contextual key challenge, there are also problems with extending entrepreneurial activities beyond the initial stages. For the reason that entrepreneurship is not predictable, emphasis should be placed on how *opportunities* may be noticed, discovered and identified in the early start-ups of youth programmes, but more than that, strong support should be given to carry through the start-up activities over a period of a number of years. This will necessarily involve ongoing learning throughout the process, yet, as mentioned in Chapter 1, little is known about such learning.

This emphasis on ongoing learning is important, as the role of South African Environmental Youth Programmes matter to the wider economy and well-being of people, including from an access to opportunities point of view, given the statistics outlined above. For the South African economy to grow, the country depends on the creation of better opportunities (Nieman, 2001). Adoption of sustainable practices will require youth to be *knowledgeable, experienced*,

insightful and to be up to date with what is happening surrounding the communities. This explains further the need for both *social learning towards sustainability* (i.e. learning what is not yet known) and *social learning in the context of sustainability* (i.e. learning what is already known about sustainability practices to participate in them). *Learning* refers to the flow and engagement with information, meaning making and coming to understand and being able to do something not known before.

Sustainable practices such as those promoted in G-Tech *(see Chapter 4*) are examples of a shared practice (Wenger, Trayner, & De Laat, 2011) that participants in the practice come to learn. As an *asset a*nd a *shared practice,* the sustainable practice symbolised *openness,* of engaging with new knowledge and skills, learning to produce the outcomes of the practice. In the G-Tech programme, youth involved in the green entrepreneurship practices all fell into the age category 25-35, and age was not seen as a *restriction factor.* This was also emphasised by the Deputy Minister in the Presidency for Planning, Monitoring and Evaluation, who said in his speech at the Second Annual Green Youth Indaba in 2015, that the key trending themes are youth, green economy and environment and he stated how the above-mentioned themes are interlinked, noting that "… youth are the future, the economy is growing green, young people need to be educated now … young people need to be skilled now … young people need to be employed now … young people need to run their own businesses now ... and we need to protect and care for the environment now.'' (Minister Buti Manamela, September 2015)

A *shared practice* requires continous improvement and engagement (Wenger, 1998). What differentiated G-Tech as an appropriate organisation to focus on in this study, was its focus on youth willingness to *learn*, *building relationships*, *connections* and transformation (see Chapters 4 and 5). It was therefore their openness to supporting learning in the context given above that I was interested in following up on in this study, especially because they were also enabling learning in youth communities of practice. Wals et al. (2009) characterised social learning as a learning process that actively commits people to reaching processes of change, potentially allowing for youth *social learning* to contribute to the success of the sustainable practice in a manner described by Wenger et al. (2011) that is bringing people from various disciplines together with different *perspectives*, *knowledge* and *experiences.*

This emphasis on learning is also carried in the United Nations Education, Scientific and Cultural Organisations (UNESCO): Education Agenda 2030, *goal number four* which indicates

that education should be equal for all women and men, and should contribute to a sustainable society. In addition, education should lead to *affordable* and *quality technical*, *vocational a*nd *tertiary education* including university. For all the 17 Sustainable Development Goals (www.globalgoals.org), it is expected that by 2030, there is a need to substantially increase the number of youth and adults who have *relevant skills* including *technical* and *vocational skills* for employment, decent jobs and entrepreneurship (GEMR, 2016), developed within a sustainable development orientation.

Sharp (2002), as well as Nieman and Niewenhuizen (2004), stressed the idea of unlocking such opportunities through formation of new green enterprises or practices where youth can be engaged actively and learn from each other collectively and build trust. They argued that learning can be monitored by how youth have acquired appropriate skills. They also reported that as the need for creation and development of green businesses continue, *opportunities* can be enabled for youth to thrive as *change agents, primary creators*, *economic drivers* and *drivers of business* with passion and tenacity (ibid.).

Entrepreneurship is viewed as a solution and a catalyst for economic growth (Nieman & Nieuwenhuizen, 2004), but as discussed above, it is also important as an educational process where youth can potentially learn together to be part of *innovation a*nd *application* of new ideas, especially in the context of sustainable practices which promote the possibilities for creating value *environmentally*, *economically* and *socially* (see Chapters 4 and 5).

2.5 Green, sustainable practices

Green entrepreneurship involves the initiation of "*green sustainable practices*" (ILO, 2006; OECD, 2016). Thus this study describes the significance of green sustainable practices that are being learned in the youth communities of practice in G-Tech (see Chapter 4). Because of the focus of the G-Tech programme, these are more focused on *agricultural, botanical* as well as *horticultural* practices because biodiversity plays a significant role in providing sources of goods and services in this context. *Sustainable green practices or projects* are considered practices that influence and shape the learning pathways and learning contexts of the youth, and include *green initiatives*, *campaigns, social* and *community projects* such as biomass projects, recycling projects, farming and agricultural projects as well as conservation projects (FAO, 2012, 2013).

My botanical knowledge was transformed as I conducted this study. The goal of planting and growing vegetables were valued in the study, however the *milleu* and *locale* were different. The study clarified what types of plants were planted, different names of plants, their common uses, and what value they are contributing to the society (see Chapter 4). Vachon and Klassen (2006: 797) explained green practices as practices which encompasses external activities pertaining to preventing pollution and fostering green innovation. *Green practices* and *venture*s are useful in transforming society, alleviating poverty and creating employment, as well as addressing how raw material is recycled, how products are made or formed with aim of reducing pollution. Vachon et al. (2006) reiterated that *sustainable green practices or projects* mostly focus on introducing green thinking in horticultural aspects, maintenance of plants, protection and irrigation of the plants. In addition, green practices are best known as environmentally conscious practices of green organisation with green management categories.

Studies indicated that in Brazil projects have gained from Sustainable Development Initiatives for implementing environmental aspects by teaching communities about organic farming and sustainable harvested products (SEED, 2015). The United Nations Environmental Programme (UNEP) affirmed that green jobs contribute directly to preserving environmental quality in a sustainable manner; at the same time they protect ecosystems and biodiversity through efficient strategies.

The summary of other *green initiatives* which exists in the biodiversity sector locally and in international contexts are listed in Table 2.6; however as a researcher I became aware of other green practices when I conducted this study (see Chapter 4). As a result, I have learned to be up to date with the current information and have been doing *ongoing document analysis* of emerging green practices. Table 2.6 also describes what characterises a greening project and clarifies what has been done within these research areas in South Africa as well as in other sub-Saharan countries.

Table 2.6: Green practices and educational initiatives that exist locally and internationally

South Africa	
Claire-Reed Gardening (Gauteng)	An initiative that alleviates food shortages by offering bio-degradable paper strips embedded with organic seed that produce vegetables and herbs.
Green Shift Africa (all regions)	Embarked on the project Green Entrepreneurship opportunities (GEO) to harness green opportunities in Africa to lower youth unemployment on the concept. Green entrepreneurship opportunities are believed to provide some answers to Africa's unemployment problem globally.
Muthi Futhi, Dakeni	An initiative which protects local biodiversity by cultivating and processing traditional medicinal plants and empower women to gain new employment opportunities, and generate income.
Mooi River, KwaZulu- Natal	An initiative that contributes to climate change mitigation, conservation and reduction of air, land and marine pollution by collecting, compacting and selling recyclable waste.
Sub-Saharan countries	
Eco-Post (Nairobi, Kenya)	An initiative that offers a solution to waste that is upcycled into fencing posts.
Youth Entrepreneurship Facility YEF, Tanzania and Uganda)	An initiative that focuses on supporting youth in unleashing their entrepreneurial potential and turning their ideas into productive wage employment as part of holistic strategy.
Hortinet, Malawi	SEED Africa Winner, an initiative which cultivates horticultural products and provides solution, training in organic agronomic techniques and skills to small scale farmers. Economically it has created more opportunities for youth and women to increase income for female farmers. It has helped in mitigating the effects of climate change by sharing agriculture practices minimising soil disturbances for composition of natural biodiversity (http://www.ecopost.co.za)
Gambia	700 people were trained to develop entrepreneurship policy and plan with the concept of aiming to creating 10% of jobs. Women empowerment forums prioritise agriculture and agricultural developmental programmes.
Sudan	Start-ups were established to support women in entrepreneurship.

Sources: Diwan et al., 2015; SEED, 2015; Global Entrepreneurship Congress, 2017 Reports

These green sustainable practices are often also described within the concepts of green skills, green jobs and green work, concepts which I elaborate below.

2.6 Concepts: Green Economy, Green Skills, Green Jobs and Green Work

Generally these three concepts concepts are used interchangeably and are often confused (Martinez-Fernandez et al., 2010). ***Green Economy*** is a broad concept; in this study it is used as an umbrella concept that encompasses the concepts of green jobs and green work. The SEED Policy Report South Africa (2015) indicates that South Africa is the second largest economy in Africa and has a relatively high Gross Domestic Product (GDP) per capita. South Africa, like other countries, is moving towards achieving the Sustainable Development Goals. The South African Green Economy Modelling Report (2013) stipulated that in the allocated agricultural investments, there is movement towards adoption of ecological agricultural practices such as organic fertilisers, the use of which is projected to increase by 5.5% and 23,9% by 2030.

Green skills refers to the skills required for environmentally skilled occupations and it is often used as shorthand to indicate skills gaps or occupational needs in the labour market (Martinez-Fernandez et al., 2010). In biodiversity entrepreneurship practices, green skills are often referred as *biodiversity skills* or *green entrepreneurship skills* (GEMR, 2016). They are a set of technical skills that are associated with running a green organisation regardless of the sector, and include anything from recycling, energy efficiency, conservation and agriculture. Researchers have argued that no one is born with this set of skills, but such skills can be constantly developed through learning and practice (Fonseca *et al*., 2006; Tripp, 2006; Bux, 2016). *Green skills* are part of the agenda of the competence-movement, for instance, they constitute entry level, medium skills and high skills for occupations required to sustain basic needs (GEMR, 2016). On the other hand, green skills are classified as requisite skills provided for both formal and informal learning to advance the green economy and sustainable development (Fernandez et al., 2010). In the context of this study's focus, green skills related to sustainable green practices were considered skills that provide an opportunity for green occupations likely to lead to *green jobs* and *green work*. The main focus was in relation to utilisation of relevant skills enabling youth to learn new insights, knowledge and values which translated into opportunities and building capacity (Qumza, 2011).

Green skills involves environment and incorporates sustainability and climate change. Green businesses and practices are mostly dependent on natural resources for sustainability and growth (Fonsecha et al., 2006). The only way for entrepreneurship to become integrated into

daily activities is for individuals to use the knowledge and skills acquired in green skills training programmes and to constantly equip themselves. For youth to integrate such learning opportunities into their practices, much is required with regard to shifts in mind-sets towards sustainability (i.e. green thinking) and there is also likely to be a need to focus on identifying real opportunities and risks from an agriculture and biodiversity aspect in the G-Tech case study. Maintaining natural resources, green skills or entrepreneurship skills requires a change in mind-set (Parlova, 2015). The study has introduced green thinking to conserve water, grow plants, protect the environment and sort waste through the use of PLA Roll Planter as a form of green technology, to be discussed in detail in Chapter 4.

Entrepreneurship skills are one of the scarce skills (i.e. skills that are virtually absent in the system) needed in the environmental sector. The South African Qualifications Authority (SAQA) defined them as critical skills (skills that help to change existing practices) (Fonseca et al., 2006). Green skills are needed both as environmentally-focused occupations and as critical competencies in a wide range of general occupations. As indicated in Chapter 1, this study will explore how such skills can be developed through learning and practice in youth-based communities of practice. As mentioned above, I also look at these skills as *enterprise development* skills, which are a bit more specific than *entrepreneurship skills.*

Green jobs are described in the International Labour Organisation (2016) report, as jobs in enterprises that produce green products and services which contribute to preserving, and enhancing environmental quality (www.Ilo.org/green jobs). Platforms such as SEED reward youth for entrepreneurial ideas (Hart & Stafford, 1996). Green services are regarded as services that are recognised to promote respect for social environmental assessment (Boyer et al., 2008). The concept of a '*green job'* is used as a one-size-fits-all; however, most studies define green jobs as jobs that help contribute to improving environmental quality and to reducing the harmful effects of human activity on environment, directly or indirectly. In some cases, green jobs are viewed in terms of the necessary skills and competencies required to perform the job, or the skills and abilities required by workers (ibid.). The ILO has identified the challenge of articulating how *green the economy* is, and links it to the response that the *economy* can only go green when there is collaboration and partnerships between organisations, because skills shortages are hampering the transition to green economies. The ILO (2016) identified major challenges and ideas on how to transit to the green economy, including the need for green skills that must also be accompanied by green structural change.

Green jobs according to Martinez et al. (2010), are classified as actual employment in environmental occupations. Green jobs are scarce in the environmental sector. Occupations will change at different rates and in different ways as economies are growing greener. As a final point, the skills required in the green economy to produce green jobs need to be identified clearly and appropriate training needs to be put in place promptly (www.greenskills.co.za). *Green entrepreneurship skills* are recognised as emerging skills in the field of environment. However, as already mentioned, there are some challenges in developing these skills in various business organisations to produce jobs, sometimes also because the jobs and occupations are not yet well articulated (ibid.). There is still a lot that needs to be done in this area, as a result the skills need to be embedded in current and existing environmental training programmes as cross-cutting issues.

Green work refers to work that is environmentally oriented; it may be a formal occupation or an informal job (MartinezFernandenz et al. (2010). *Green work* includes more informal jobs such as gardeners and vendors. This study uses the term *"green work"* to describe the self-created entrepreneurial opportunities within the Environmental Youth Programme. Green work focuses on reducing the environmental impact of the practice. This definition covers work in agriculture, industry, services and all administration roles that contribute to preserving and restoring the quality of the environment (UNEP/ILO/IOE/ITUC, 2008). Green work is considered as many forms of clean and decent work needed in society, that involves practices across all sectors to protect biodiversity, restore ecosystems and eliminate pollution and waste including the inefficient use of energy and water (ibid.). In order to recognise better biodiversity skills to conduct green work, more needs to be done to embed these in job descriptions in environmental organisations (www.greenskills.co.za), as was also argued by the HSRC (2009), and the SANBI/Lewis South African National Biodiversity Human Capital Development Strategy (2010).

2.7. Learning in Communities of Practice, and Value Creation for Green Entrepreneurship

This section focusses on learning in the context of green, sustainable practices that promoted value for green entrepreneurship. As mentioned in Chapter 1 and above, entreprenuership in the environmental sector is often called *"green entrepreneurship"*. This refers to the introduction of green thinking, knowledge and development of creative ideas that lead to green

business developments in the society (Fonsecha et al., 2006). As noted above, green sustainable practices are not characterised by size, but can be identified and considered through the period they have been in existence and also by how members have been actively involved in learning the practices over time, which is the approach I take in this study. For this, a relevant learning theory is necessary in order to interpret this, and hence I have worked with the theory of Communities of Practice (Wenger, 1998), and also sought to identify a site (G-Tech) where youth have been working together in a Community of Practice to learn new green entrepreneurial knowledge, skills and entrepreneurial competences. I also needed a way of capturing the value that was created for the youth in the community of practice where they were learning, hence I drew on Wenger, Trayner and De Laat's (2011) Value Creation Framework, which was developed for reviewing learning in communities of practice. I discuss these two frameworks below in more detail.

2.7.1 Learning in Communities of Practice (COP)

This study was inspired by Wenger's (1998) theory of Communities of Practice and social learning systems as well as value-creation (Wenger et al., 2011) as a focal lens. The choice of theoretical framework in the study was guided by the nature of the problem the study aimed to address, to understand how learning happened in a social interaction associated with *biodiversity entrepreneurial practices.* Wenger (1998) describes communities of practice as follows:

> **Communities of practice –** are groups of people who share a concern, set of problem or a passion about a topic and who deepen their knowledge and expertise in the area by interacting on an ongoing basis. As they spend time together, they typically share information, insight and advice. They help each other solve problems, they discuss situations, aspirations and needs. They ponder common issues, explore ideas and act as sounding boards, they may create tools, standards, generic designs, manual and other documents or they may simply develop tactic understanding as they share. (p. 3)

Wenger (ibid.) further explained communities of practice as involving the following:

> **A domain of knowledge** … defines a set of issues … The domain creates common ground and a sense of common identity. The well-defined domain legitimises the community by affirming the purpose and value to members.
>
> In **a community of knowledge,** the community creates the social fabric of learning. A

strong community fosters interactions and relationships based on mutual respect and trust. It encourages a willingness to share ideas, expose one's ignorance, ask difficult questions and listen carefully.

Shared practice involves a set of networks, ideas, tools, information, styles, language, stories and documents that community members share. Whereas the domain denotes the topic the community focuses on, the practice is the specific knowledge the community develops, shares and maintains. (pp. 28-29)

In Chapter 4 , I consider the dimensions of the domain of knowledge, and the shared practice in the G-Tech programme with a focus on green entrepreneurship development. In Chapter 5, I look at how the community of knowledge was functioning in the G-Tech and I also use the value creation framework to review this.

2.7.2 The use of a Value Creation framework

The use of theoretical framework in the study was associated with the connection between theoretical knowledge and alignment with what was taking place in the G-Tech case study context. Wenger, McDermott and Synder (2002) emphasised that when examining value in communities of practice, the significance of stories represents the best way to transverse the knowledge system in a way that explains linkages between communities' activities, knowledge, resources and performance outcomes (p. 168). *Value-creation stories* represent a great means of telling personal stories with the purpose to provide ways and solutions to address the problems and promote awareness (ibid.).

With regard to Value-Creation, Wenger, Trayner and De Laat (2011) defined five cycles of value that are possible from social learning processes which include: Immediate value, potential value, applied value, realized value, reframed value. These are described as follows:

- **Cycle 1. Immediate Value: Activities and Interactions –** this is the most basic cycle of value which considers that networking and community activities have value in and of themselves, for example participants in a community of practice can co-operate in seeking innovative approaches, or get comfort or relief from being with others who are doing similar things. In this study I also saw the youth's existing knowledge and experience when coming into the CoP as immediate value that could be mobilized for further learning.

- **Cycle 2: Potential Value: Knowledge Capital –** this form of value recognises that not all value produced by a community or network is immediately realised. Activities and interactions can produce 'knowledge capital' whose value lies in its potential to be realised later. This knowledge capital can take different forms, such as *personal assets* (e.g. a useful skill, new idea, a new perspective, or inspiration, caring or confidence), *relationships and connections* (e.g. social relationships and connections, sense of companionship), *resources* (e.g. documents, tools and materials), *transformed ability to learn* (e.g. ability to share knowledge with others or learn by doing a new practice). This type of value was important for this study, whose interest was on the learning of youth.
- **Cycle 3. Applied Value: Changes in Practice –** this form of value emerges when and knowledge capital is adapted and put to use in a specific context of application. For example, trying out a suggestion provided by G-tech managers, or implementing an idea that was demonstrated or shared in interactions. This form of value can be identified by looking at changes in practice, actions, tools, approaches or organisational systems. To identify applied value, the researcher must look at the changes that are taking place in practices or actions in the setting; in the case of my study this would be the G-Tech context of practice.
- **Cycle 4: Realised Value: Performance Improvement –** this type of value builds on applied value or changes in practices. Changes in actions or practice do not necessarily lead to changes in performance, therefore it is important to look at how the changes in practice add value in terms of improved performance in a given context. For example, the youth can implement a practice, but if it does not contribute to their goal of learning green entrepreneurship skills and improving their performance overall, it may not be realised value, but only applied value.
- **Cycle 5: Reframing value: Redefining success** – this type of value is created when social learning in a community of practice leads to a reconsideration of the learning imperatives and the criteria by which success is defined. This includes reframing strategies, goals as well as values. This can happen at individual, collective or organisational levels. For example, youth may join the G-Tech programme simply to get a job, but may come to re-define their success by valuing green entrpreneurship, not only for the job opportunity, but also for the contribution to the environment.

  (Adapted from Wenger et al., 2011: 20-21)

Wenger et al. (2011) specified, however, that a value-creation story does not necessarily have to cover all cycles of value-creation, an aspect which I reflect on in the methodology chapter (Chapter 3). As can be seen from the above, gaining **knowledge capital** (Cycle 2; potential value) is crucial for other forms of value to be realised. I therefore focus more on this below, and in more depth in Chapter 4.

2.7.3 Gaining Knowledge Capital: Knowledge, Skills, and Participation in Practices

Reckwitz (2002) termed knowledge as a *social learning practice* which results in the combination of expertise counting; *knowing how to* (practice), *knowing who to trust* (trusting and *knowing who to run for help*) as well as *knowing why*. As can be seen from the research questions in Chapter 1, this study was interested in the *knowledge, skills* and *values* youth bring to the practice, as well as what knowledge, skills and values they could and did learn. Here *knowledge* can be seen as information that youth have been taught in order to practice effectively (Wen, 2009). *Skill* signifies the ability to use knowledge, once trained or equipped with certain knowledge. In Communities of Practice theory, changing *knowledge* and *skills* are part of developing identity (Lave & Wenger, 2008: 122). When people are skilled and *knowledgeabl*e, they are able to do new things, and participate more actively and effectively in practices (ibid.). The focus on knowledge and skills can also help to identify potential value in the form of activities to be *learned, what is meant to be learned* and *what should be learnable* (see Chapter 4). Wenger elaborated on this in his social learning theory, by emphasising knowledge as being learned via participation in practices.

The nature of knowledge described by Wenger et al. (2002) helped in explaining how youth knowledge was disseminated in the G-Tech activities and *social practices* in relation to how it was derived and developed from other people's understanding and practices (see Chapters 4 and 5). Wenger's work drew attention to how, within a community of practice, participants internalise knowledge, how knowledge can be discovered, transmitted and experienced in interactions, as people pursue full participation and active engagement in a practice. Wenger (1998), together with Wals (2007), stressed that *knowledge* and *learning* are inseparable; however, knowledge and skills can increase and encourage individual participation to be more fully effective.

In this study, I considered what youth have done with their *indigenous or experiential*

knowledge, passive knowledge, self-taught and intergenerational knowledge as they participated in the G-Tech practices (see Chapter 5). I also considered youth's abilities to use a specific technology practice in G-Tech, namely PLA (see Chapter 5), and how their knowledge was aligned with individual professional development, thus how their level of knowledge of using the technology increased and encouraged them to participate more fully and effectively in the G-Tech green entrepreneurship community of practice.

Knowledge is also a matter of competence. Knowledge management is now recognised as a significant factor in various enterprises (Wen, 2009). Learning requires acceptance of one another's differences and the ability to use such difference effectively (Wals et al., 2009), thus *competency* in this study was considered in relation to how youth utilised information or artifacts to create value that would benefit the community now or at a later stage, as is also reflected in the categories of potential value and applied value in the Value Creation Framework above. Participation in sustainable practices can also shed light on youths knowledge as a characteristic of a person, referring to individual's *behaviours, responsibilities, capabilities* and *potential* (Hunt, 2003). In the context of knowledge as participation in practices, youth would have acquired *self-knowledge* that is translated into a *usable level* and through this, they can discover new value that can still be created as is also shown in the value creation framework (Visser & Kymal, 2015).

This raises the importance of also seeing knowledge as meaning. According to Wenger (1998: 4), knowledge in a practice is acknowledged as the ability to engage in a way that ultimately produces results. In the case of this study, this can potentially be realised if youth in the G-Tech sustainable practices acquire new knowledge of using new technologies, and later encode it into *artifacts* (Lave & Wenger, 1998: 105). With this, it is possible to say that knowing is not simply a matter of information, but understanding what matters in learning and what matters about learning (Wenger, 1998). Here participation in green, sustainable practices can give knowledge meaning by enabling youth participants to channel the manner in which learning takes place via the way in which they participate. Thus, knowledge has power to transform and renegotiate the meaning of the past (Wenger, 1998). It is in this way that knowledge acts as *a potential value* with regard to implementation of the idea, adaptation and applying the knowledge in different contexts that can lead to changes in actions, practices and approaches in green, sustainable practices amongst youth, as outlined above in the value creation framework descriptions and explained further by Wenger (1998) through his emphasis on

knowledge being integral to practices. This brings the issue of transformation and learning into focus, captured above as 'reframing value' by Wenger et al. (2011).

Monray and Pietrosemoli (2012) categorised transformation as a basic strategy to allow learning to happen regardless of failures and successes. Wenger et al. (2011: 20) explained *transformative learning* as the learning that leads to action and reframed value, as transformation is associated with production of new knowledge and changes in not only practice, but also identity and ways of thinking about practices, and can include changes in values. Thus, transformation means being involved in processes of changing social relations, identity and values within the ongoing community of practice (Lave & Wenger, 2008). In this study, I therefore also sought to understand how participants experienced change within the practice, but also how this influenced their identities and values as evidence of reframing value or transformation. As Wenger et al. (2011) argued (see above), evidence of significant learning can happen in a community of practice that enables participants to transfer learning experiences to other practices and contexts such as development of individual *artifacts* that uses creativity and performances to form a new value for success to be explained (see Chapters 4 and 5). Transformation of skills into new ones is about measuring progress in relation to what change has occurred and what value has been created (ILO, 2006). In the study, transformation was also recognised by reports of the success and value creation stories as will be discussed in Chapters 5 and 6.

Table 2.7 below summarises the dimensions of knowledge and learning associated with knowledge capital formation (i.e. potential value creation) that I was able to identify. I used this to inform the analysis of the knowledge capital formation of the youth in the G-Tech programme (see Chapter 5). This helped me to understand the knowledge and learning in the Communties of Practice as associated with the green, sustainable practices that youth were learning in the G-Tech programme.

Table 2.7: Dimensions of knowledge and learning associated with knowledge capital formation

Knowledge and Learning	Implications for Youth Involvement in Practice	References to the literature
Practical and technical knowledge	Knowledge is associated and linked with formal 'scientific or technological knowledge' and can be shared via specialised training for practical farming experience e.g. horticulture, gardening. It also involves indigenous knowledge, customs and traditions that reflect in practices.	Hunt (2003); Tripp (2006)
Personal, self or own knowledge	Knowledge as a capacity to act to the belief that something is true and justified. It is also a characteristic of a person referring to individuals' behaviours, responsibilities and capabilities to act. Knowledge can be acquired, learned and translated into usable level.	Hunt (2003); Wen (2009)
Tacit knowledge	Knowledge that can be acquired through learning by doing and situated social learning, such that it becomes almost 'invisible' or 'just done'. It can be related to how such knowledge was derived and developed from other peoples understanding and practices. It is a form of knowledge that is either invisible that can only be experienced in relation to how knowledge involves deeper complex issues in the practices. It is based in practice and experience. It includes subjective insights, intuitions, hunches, is highly personalised and hard to formalise.	Wenger (1998); Wenger et al. (2002); Hunt (2003); Monroy et al. (2013)
Common or general knowledge	A valuable knowledge that can allow learning to happen from success and failures. A considerable knowledge can be attained as a result of learning. As a result an opportunity to promote knowledge sharing, reuse and valuable resources to solve problem.	Wenger et al., (2002); Lee-Yung Ting (2007); Wenger et al. (2011); Monroy et al. (2013); Edward (2014)
Learning	As a means of accessing of new information flow, knowledge resources, and exchanges. Learning involves a series of connections. This can explain how youth are connected with agriculture (i.e. the relationship between human and nature). Learning as part of a development process, referring to what participants were trying to achieve. Learning as part of receiving help from others as well as recognising and identifying self and benefits, what was learned to be achieved.	Wenger (1998); Wenger et al. (2011)
Social learning	Learning in a community of practice, learning together how to engage in and participate in a new practice; learning from others via interactions and modelling of practice. As a means of indulging into the day-to day practice conversations and stories that. Addresses social and other problems within the practice. As a potential of people to learn effectively in a social context. It is a form of collective learning.	Wenger et al. (2002); Wals (2009); Wenger et al. (2011)
Transformative learning	As learning that responds to both short- and long term opportunities. As the part of learning that shaped the reflexive engagement and actionable and reframed value in the development of the sustainable practice. As an act of participating in a facilitated network or community of practice that helps to change identity, values and action competences.	Tripp (2006); Wenger et al. (2011)

2.8 Knowledge capital formation and value creation for green entrepreneurship

As discussed in the contextual and theoretical framework above, biodiversity is the foundation and the source of basic needs. Sustainability in this study was used as the concept that integrates environmental, social and economic issues. Sustainability and biodiversity concepts of green skills, green jobs and green work were explained in section 2.6, all of which falls under the category of green economy (Martinez-Fernandez et al., 2010). As mentioned in Chapter 1, the biodiversity green economy is described by the United Nations Environment Programme (UNEP), in terms of preventing loss of biodiversity and ecosystems services *as well as* maintenance of natural assets and environmental services (http://www.unep.org) which in this study linked it to the G-Tech objectives and intentions.

As also highlighted above, the green economy focuses on education and training to achieve a greener and more sustainable future, as many of the practices are new and have to be learned. It has increasingly become a mainstream concern in green skills research and practices over the past years (Dao et al., 2011; www.greenskills.co.za), including in South Africa. Green entrepreneurship educational practices however, are in need of expanded support, as was also communicated in Chapter 1. In this study, they were seen to provide a platform for encouraging entrepreneurial opportunities for youth in the biodiversity sector. It was reported that few organisations are investing in resources to support entrepreneurship activities and business start-ups for young people (Nasser et al., 2003), and the need for this in South Africa is clear, given the demographic of youth unemployment shared at the start of this chapter, and the low level of entrepreurship in South Africa.

Sustainability is a measurable outcome and is about improving the environment to best value (Wals et al., 2009). The concept of green economy encompasses the interrelations of environmental, social and economic issues as represented in Table 2.8 below. I developed the set of questions outlined in Table 2.8 below to assist with interpreting the G-Tech's contribution to green entrepreneurial skills and green, sustainable practices in the study.

Table 2.8: Framework to interpret green, sustainable practices and learning

Social impacts	Economic impacts	Environmental impacts
How is the programme providing training and development of transferable skills? How is the programme encouraging participation and empowerment?	How is the programme introducing innovation that relates to local development of new skills? How is the programme seeking to break the cycle of poverty while also promoting sustainability? Is the programme offering a viable economic opportunity for youth?	How is the programme promoting the enhancement of environmental awareness amongst communities? Is the programme offering transferable skills and knowledge that can benefit present, as well as future generations? How is the programme using eco-friendly growing practices?

Source**:** Adapted from Tripp (2006); Kumar (2014); Monroy and Petrosemoli (2013); Musetha (2016)

This framework was used to investigate the green, sustainable practices of G-Tech, especially to consider how these were shaping the potential value of knowledge capital formation for the entrepreneurship education for youth in the project, described in more detail in Chapter 5.

2.9 Conclusion

This chapter has outlined the wider context of the study, giving a background to the need for entrepreneurship education in South Africa, especially amongst the youth who are underemployed in larger numbers than adults. Additionally, the chapter considered the context of biodiversity entrepreneurship within a green economy frame, linking this to concepts of green jobs, green skills and green work. I positioned my study as focusing on the learning of biodiversity entrepreneurship in the context of green work that is emerging in G-Tech, for youth who are learning together in a community of practice. I then shared the theoretical framework of the study, drawing on communities of practice theory and value creation framework theory which identifies knowledge capital as an important form of potential value, which I will consider further in the thesis. I was also interested in other forms of value creation, as will be discussed later in the thesis. In the next chapter I discuss the research methodology.

CHAPTER 3
Research Methodology

3.1 Introduction

This chapter describes the research methodology. It presents the research design, and describes and clarifies how I went about generating data. The chapter also gives insight into how I conducted the analysis, and provides an overview of the ethical and quality dimensions of the study. As a researcher, I became a primary instrument in data collection. This required a reflexive process in which I had to check if all data generation tools I used to conduct the study were used as planned, and if not, I had to account for how things changed.

3.2 Research design and methodology

In this section, I discuss reasons underlying the choice of study design and the use of specific methods that guided the research process. Research design is the 'master plan' or the blueprint of the study which guides how the study is conducted (Kauda, 2012: 49). This study is designed as a qualitative, interpretative case study, which is a suitable method for studying individuals (i.e. small groups of participants) and specific historical events in particular settings as explained by Yin (2013). The case study research design allowed me to generate insights to green solutions for youth in the biodiversity sector so that I could address the research questions in depth and with detailed insight. Kauda (2012) and Paulus et al. (2014) stressed that qualitative research methods allow participants to express their feelings and offer their viewpoints (perspectives) in their own words. I discuss the methods in more detail below.

3.2.1 Case study

A case study allows researchers to focus on participants' perceptions and experiences (Cresswell, 2009). In the context of this study, use of case study allowed me to portray the experiences of individuals by observing and interviewing them in their setting. Kauda (2012) suggested that case study is a useful approach to gaining in-depth insight into a setting, as it allows for focusing on individuals' interpretations of how they view and experience things on site. As indicated in Chapter 1, in this study I was interested in young people's experiences of the G-Tech programme, and I also wanted to gain in-depth insight into the G-Tech programme opportunities for learning.

The case study was bound by the G-Tech programme and how it operated (Chapter 4) and the study of four young males who were working, learning and participating in the environmental community of practice in the G-Tech for sustainable livelihoods programme. The case was also bound geographically: it was based in Gauteng around two municipalities, namely the City of Tshwane and Randfontein municipality, which was where project sites were identified (see Chapter 1).

3.2.2 A qualitative, interpretative approach

The research is mainly qualitative in that, as a researcher, I have inquired into a particular phenomenon by seeking insights into the meaning made by the G-Tech programme participants. I also had to take account of my own subjectivity in the research. In qualitative, interpretive research, interpretations and findings are shaped by subjectivity, understanding, perception, experience, of both participants and me. In qualitative research, there is need to give attention to the unique circumstances of the setting and the individuals in the setting (Cohen, Manion & Morrison, 2007). As noted by Flick et al. (2004: 3),

> Qualitative research claims to describe lifeworlds 'from the inside out', from the point of view of the people who participate. By so doing it seeks to contribute to a better understanding of social realities and to draw attention to processes, meaning patterns and structural features.

An interpretative approach involves deriving meaning from the data. In the case study analysis, I used an interpretative approach, using inductive and abductive modes of inference (see below) to generate meaning from the data (Cohen et al., 2007). With this process, I have reflected and taken into consideration the views of the participants carefully and with integrity. It has allowed me to identify personal values, assumptions and even biases at the onset of the study.

3.3 Research methods

This section describes the data collection methods used in the study. As mentioned above, as the study was a qualitative, interpretive case study, I used well-known qualitative research techniques which comprised of document analysis, field observations and interviews (Baxter and Jack, 2008; Cresswell, 2009; Miles et al., 2010), as discussed below.

3.3.1 Observations

The study relied on making observations on site first before continuing with other research

methods such as document analysis and interviews. Observations were an important tool in the study, to observe and confirm if the study was feasible. With the permission of group members, regular and repeated observations were made at the research site, which occurred over a period of two to three months (see Table 3.1 below).

Table 3.1: List of observations

Observation Date	Place of Observation	Purpose of Observation
29 April 2016	Randfontein	To confirm the feasibility of the study. Familirise self with G-Tech project activities onsite
29 April 2016	Laezonia	Familiarise self with G-Tech project activities onsite. To get clarity on aspects that were not well understood
MAY		
05 May 2016	Ranfontein	Get first-hand look at site where G-Tech operated, familiarise self and investigate further and continued with subsequent observations
06 May 2016	Laezonia	Understanding in detail how youth community of practice was functioning
19 May 2016	Laezonia	To monitor youth's active participation when growing crops onsite
29 May 2016	Randfontein	To create familiarity and connection of G-Tech research sites
29 May 2016	Laezonia	To observe youth's participation and connection in learning in G-Tech domain of practices
JUNE		
07 June 2016	Laezonia	To monitor youth interactions and learnings in G-Tech domain of practices
12 June 2016	Laezonia	To observe youth active participation in the G-Tech practices and identify what value was being created
19 June 2016	Laezonia	To observe how the harvesting season has been conducted
30 June	Laezonia	To investigate various techniques after crops have been harvested

As an observer, I sought to create familiarity with the participants', and the research site to establish a good comfortable relationship for the research (Cohen et al., 2007). Kauda (2012) indicated that observational methods are useful when issues investigated can be observed through people's behaviours or, in this study, I was interested in their learning in a community of practice, thus I sought to observe their participation in the practices to identify types of value that were being created for the youth.

To start with, as part of the face-to-face observations I conducted, I took a first-hand look at the site in which the G-Tech project operated. I conducted field observations with the permission of the group members and discover what the project entailed and to explore the regular programme activities. Preliminary observation helped me to familiarise myself with the project activities and subsequent observations helped me to understand in detail what youth were learning in the Community of Practice. It also helped me to gain insight into the domain of practice, the community and the types of practices conducted. With their permission, I took photographs of the G-Tech practices and those that the youth were learning to practice (see Chapter 4). In sum, I focused on the following in my observations:

- The site,
- Activities on the site,
- G-Tech practices (types of practices),
- Youth participation in G-Tech practices (the domain of practice),
- How the youth community of practice was functioning (community),
- What the youth were learning in the community of practice (participation), and
- What value was being created for the youth.

Notes and stories told by participants were captured in my field notes which helped me to make inferences of what I observed (Wenger et al., 2011; Kauda, 2012). Kauda (2012) pointed out that a common practice for a participant researcher is to engage in dialogue during the observations which I also did. To avoid making assumptions and wrong inferences, however, all the activities that happened onsite were examined to determine accuracy of the inferences which I also tried to triangulate with document and interview analysis, and verify with member checking.

3.3.2 Document analysis

Document analysis involved review of documents that are used and are aligned with the activities of the G-Tech sustainable practices; these included summaries of events and discussions (Wenger et al., 2011). In addition, Kauda (2012: 20) highlighted the value in reviewing of documents to seek guidance from relevant theories. The documents used as a source of information included mostly historical documents, formal and informal documents, learning support materials such as newspapers that reported what has happened since the project has been piloted. In addition, I reviewed and analysed nine Corporate Social

Responsibility (CSR) reports by Toray (see Table 3.2 below) which are aligned with the main goals and objectives of what the research sought to uncover (namely the G-Tech practices and how they support youth learning). I analysed the CSR reports carefully to understand previous project activities and the material PLA Roll Planter which was a key focus of the G-Tech practice that the youth group was learning about (see Chapter 4). I analysed the practices so that I could understand the knowledge and practice challenges, as well as entrepreneurial learning potential, as can be seen in Chapter 4.

The full list of documents analysed is contained below.

- Report: Mining weekly: Mine dump rehabilitation being undertaken at Mintals tailings (www.miningweekly.co.za)
- Report: Small scale farmers eradicating poverty and extreme hunger in Soweto South Africa. (www.miningweekly.co.za)

Table 3.2: Toray Group Corporate Sustainability Reports analysed in this study

Year	Description
2007	Toray Group CSR Report
2008	Toray Group CSR Report
2009	Toray Group CSR Report
2010	Toray Group CSR Report
2011	Toray Group CSR Report
2012	Toray Group CSR Report
2013	Toray Group CSR Report
2014	Toray Group CSR Report
2015	Toray Innovation by Chemistry: Leveraging the Power of Materials to change the world

Source: www.toray.com and www.g-techoldings.co.za

The above-mentioned documents helped me to review and gather more detail on the project's history and practices since its establishment. The documents provided insight into the significance of activities including critical issues, challenges and gaps. Furthermore, the documents assisted me to triangulate the data from the observations and interviews, and to seek deeper information to assist with addressing the research questions.

3.3.3 Interviews

Following the observations and document analysis, I developed and undertook a set of individual semi-structured interviews (Cohen et al., 2007). Kauda (2012) argued that qualitative interviews are used to gain insights of lived experiences of the person being interviewed. Collectively, I conducted approximately ten interviews with members of the G-Tech, which comprised five individual interviews with the youth participants, which enabled me to create a value creation story for each participant (see Chapter 5). In addition, five interviews were conducted on site in conjunction with the observation schedule including two in different settings or times slots with G-Tech Senior members. I also conducted a semi-structured focus group on site with youth actively working and participating in the project. As referred to in section 3.3.3 , the interviews were conducted in that format because the working schedule of the youth varied. Cohen et al. (2007), as well as Wenger, McDermott and Synder (2002), emphasised that interviews are useful in exploring an individual's background, values and for understanding experiences and perspectives of the issue and to get more in-depth insight into individual stories.

Interviews, constituted as a conversation between researcher and participant (Babbie, 2010) provided me with new perspectives on interviewees' knowledge with regard to the area of interest. I used individual interviews to explore and clarify views and to probe aspects of the practice that would have been left as unspoken assumptions (Kauda, 2012: 21). In the same way, the interviews helped to construct value-creation stories of participants, which I explain in the next sub-section on data analysis, and which are shared in more detail in Chapter 5.

3.4 Data analysis

3.4.1 Inductive analysis to identify G-Tech practices and learning possibilities

Qualitative data analysis is a circular process (Dey, 2005: 32) which involves description, classification and connection, which involves making sense of data in different forms (Dey, 2005; Cresswell, 2009; Cresswell, 2014). The data in the study was analysed in various layers in order to help me get an in-depth perspective on the youth's learning of the G-Tech practices.

Analysis of the data involved inductive analysis in which I immersed myself in the data to derive concepts and themes relevant to the research questions (Ryan, 2006; Thomas, 2006). I

found this to be an iterative and ongoing process, which involved me in working with data to get deeper understanding of the G-Tech practice, and to describe the knowledge and learning potentials (Chapter 4). This process of iterative inductive analysis has been described by various authors (Dey, 2005; Ryan, 2006; Thomas, 2006; Cresswell, 2009; Paulus et al., 2014) and involves mainly analysing data to gain insight into concepts. In conducting the inductive analysis, I started by describing, comparing and summarising findings from data. I used the stages of *description, classification, and connection* to generate the first layer of inductive analysis which I describe in depth in Chapter 4.

- *Description* is often undertaken during the preliminary analysis. In my study, I drew on information from various sources (including observations and document analysis) for preliminary descriptive analysis (Dey, 2005). This was complemented with interview transcripts, that were rigorously read and transcribed.
- *Classification*, extends the analysis. In my study, observations, document analysis and transcribed interview data was used for the establishment and development of themes and categories. I arranged data under different themes and headings based on the key concepts from literature and theory – such knowledge, experiences and value of learning guided me in answering research questions. Cresswell (2014) and Paulus et al. (2014) indicated that coding represents the relationship between codes that are used to annotate data, which in turn are related to each other iteratively to form categories. Categories were developed, then conceptualised into broad themes, in which I grouped segments to form a coding frame that later was used as a codebook (Cresswell, 2009, see Appendix 3) which shows how analytical induction was performed. Analytical memos are commonly used in qualitative data analysis (Thomas, 2006). As a result, analytical memos were constructed that guided the process of developing analytical statements leading to relating concepts with the analytical framework and research questions, which helped me to summarise the findings of the study.
- *Connection* was also used in the analysis work. Although data can be interpreted in various ways (Kauda, 2012: 116), the process of casual connection amongst concepts involves building linkages between categories. Connection was also an important strategy for the abductive analysis, which I describe next.

3.4.2 Abductive analysis: Understanding the community of practice and constructing value creation stories

Data was also analysed abductively, which involved a process of analysis based on how the

data reflected aspects of the conceptual framework or not, and how the data was aligned with specific research questions. To guide the abductive analysis, I worked with the value-creation framework from Wenger et al. (2011) [which is a later development of Wenger's social learning theory of learning in Communities of Practice] (see Chapter 2) to make linkages (i.e. connections and differences) and to construct and interpret youth stories and learning processes around the learning of the G-Tech practices. This helped me with making meaning of the data. In this analysis, wherein I constructed value creation stories of youth's experiences, I mostly focused on looking at components associated with youth's background, their learning experiences, training they undertook as part of participation, learning within the practice or intervention, including insights they had from previous years of growing plants (see Chapter 5).

The value-creation framework (see Chapter 2), was used as a 'yardstick' or tool which I used to assess and generate findings, as it helped to capture a nuanced view of learning outcomes. It also provided an abductive means for making connections between the literature review, theory and the evidence presented from qualitative data generation methods used. Danermark et al. (2002) described abductive analysis as a process in which the researcher recontextualises the data in relation to theory and/or context.

To construct the value creation stories, I focused on youth's characteristics based on their individual values, perceptions, background, prior knowledge, experiences, lessons learned, differences, challenges, assumptions, attitudes, intentions and aspirations as summarised in Table 4.10. The synthesis of youth learning experiences has led to formation of findings to be described in Chapter 5.

As discussed in Chapter 2, Wenger, Trayner and de Laat (2011: 34), explained value creation stories as "genre or pioneering stories that focuses on the value of learning enabled by community involvement and networking". In my study, to construct the value creation stories, I used both personal and collective experiences to make sense of the data being collected. Paulus et al. (2014: 8) similarly referred to such stories as vignettes (i.e. the stories written by qualitative researchers in the field). For the reason that these stories are told by participants, Kauda, (2012) highlighted that these types of stories are linked to results and best practices of common knowledge.

In other words, value-creation stories acted as a dialogue platform where participants could tell

a story explicitly (Wenger, McDermott, & Synder, 2002). In listening to participants' stories, I was able to identify that their narratives highlighted mostly the experiences that have evolved over time around their community of practice. In the study, it was important to note how the activities they participated in created value for self and community amongst the youth participants. According to Wenger et al. (2002), the best way to assess value in a community of practice is by collecting stories. In this study, youth participation in the G-Tech project was considered via the process of constructing personal stories and converting them to real life stories that can benefit the community in return as argued by (Wenger, Trayner & deLaat, 2011: 34).

In constructing the value creation stories, I needed to consider the domain of practice carefully. The domain of knowledge according to Wenger et al. (2002) is a domain of knowledge, which defines a set of issues and possibilities for learning (see Chapter 4). The domain creates common ground and a sense of common identity. A well-defined domain (e.g. a well-defined set of G-Tech practices that the youth are engaged in learning), legitimises the community by affirming the purpose and value to members. In a community of practice, the community creates the social fabric of learning and hence it is also important for the researcher to identify the community involved in learning the practice. Wenger et al. (2002) argued that a strong community fosters interactions and relationships based on mutual respect and trust, and this encourages a willingness to share ideas, expose one's ignorance, ask difficult questions and listen carefully. Thus, it was also important for me to identify how the group was interacting.

Importantly, in community of practice research, there is the need to develop good insight into the shared practice. Wenger et al. (2011) noted that "the practice is made up of a set of networks, ideas, tools, information, styles, language, stories and documents that community members share. Whereas the domain denotes the topic the community focuses on, the practice is the specific knowledge the community develops, shares and maintains." (28-29).

As discussed in Chapter 2, communities of practice are

> …groups of people who share a concern, set of problems or passion about a topic and who deepen their knowledge and expertise in the area by interacting on an ongoing basis. As they spend time together, they typically share information, insight and advice. They help each other solve problems, they discuss situations, aspirations and needs, they ponder common issues, explore ideas and act as sounding boards, they may create tools, standards, generic designs, manuals and other documents or they may simply develop tacit understanding as they share. (ibid.: 3)

These insights into what a community of practice is and how it may operate were helpful for my abductive analysis of the community of practice of youth involved in the G-Tech practices and how they were relating and learning together. The value creation framework was particularly helpful for identifying the value that was created through this process. Wenger, McDermott and Synder (2002) emphasised that when examining value in communities of practice the "significance of stories represents the best way to transverse the knowledge system in a way that explains linkages between communities activities, knowledge, resources and performance outcomes" (168).

I found that value-creation stories represent a good means of capturing the personal stories and experiences of the youth involved in the practice. As mentioned in Chapter 2, Wenger et al. (2011) specified that a value-creation story does not necessarily have to cover all cycles of value-creation. In Chapter 2 I introduced the types of value that one can consider in an analysis of value creation stories, which are briefly outlined here again in Figure 3.1 below, namely immediate value, potential value, applied value, realised value and reframed value.

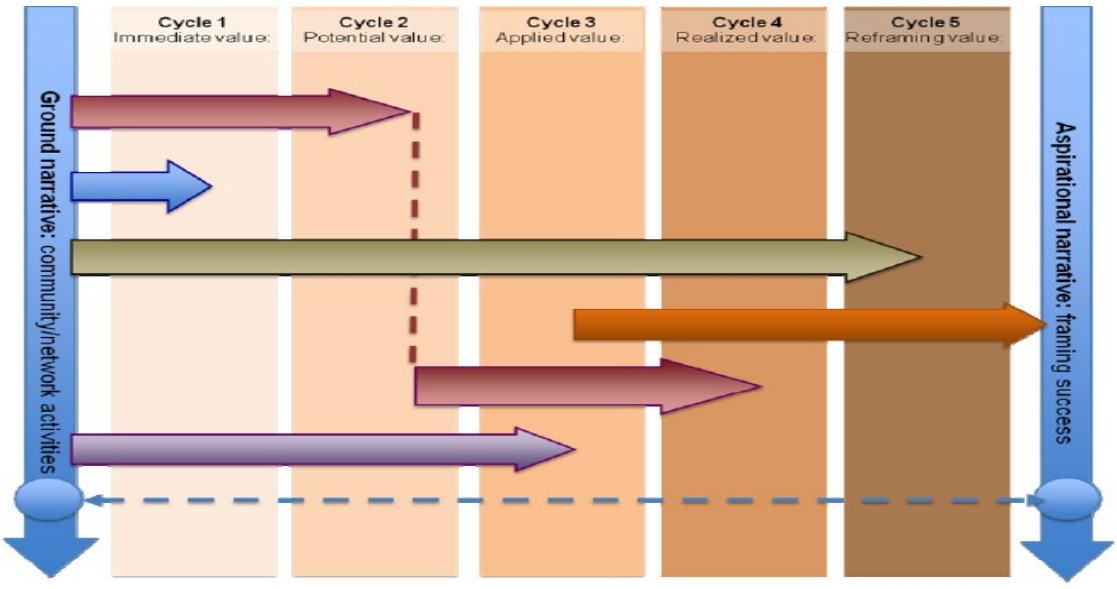

Figure 3.1: Value creation cycles (Source: Wenger, Trayner & DeLaat., 2011)

3.5 Ethical Considerations

With regard to adhering to ethical procedures that are required for conducting educational research, the study followed the following ethical practices:

- Permission to conduct the study was granted by the G-Tech senior managers, which included taking videos and photographs of practices at the site.

- Before proceeding with data collection, participants were informed and made aware about the data collection schedule, devices to be used and the activities that were involved in the research. Their agreement to the use of these was sought at all times.
- Interviews were transcribed and with the participant's right of interest and wishes, their personal information such as names were protected and kept confidential and anonymous. pseudonyms were used to protect participant's identities and photographs of people's faces that reveal identities were blocked out where used.

As argued by Flick et al. (2004), according to the principle of informed consent, there is also need to make sure that participants can withdraw from the study at any time. I gave participants this choice. I also followed the principle of damage avoidance by ensuring that participants identities were protected, and by making sure I had permission from the G-Tech senior management to undertake the study and by sharing my interpretations with them.

3.6 Validity and trustworthiness

Validity and trustworthiness relates to the quality of the research (Cohen et al., 2007). This involved me giving attention to making sure that I was making accurate and honest inferences from the data. I had to try to ensure that no misunderstandings would emerge between what was observed and what was communicated between myself and the research participants hence I had to work carefully to ensure good communication in the field.

Kauda (2012) emphasised that trustworthiness in qualitative case study research involves taking careful responsibility for triangulating the interpretations that are made from the data using different sources of data. To address this, and as described above, I employed the use of in-depth semi-structured interviews, document analysis and observations to triangulate the data, and to represent these in the description of the project's practices (Chapter 4) and the value-creation stories (Chapter 5). I also member checked the interview data, and I sought inputs from the participants on their value creation stories to member check my interpretations. Wals, (2007) emphasised member checking and reporting back as it gives both researcher and participant an opportunity to check whether things were well understood and reproduced correctly. To enhance rigour of the analysis, I used both inductive and abductive approaches as outlined above, and I carefully interpreted the data using the theoretical tools from Wenger's social learning theory, including the value creation framework as outlined above. This allowed

me to offer a ‘thick description’ of the case, which Cohen et al. (2007) identified as important to establish trustworthiness of the data. I also ensured that I have a ‘data trail’ and that the sources of the data were made known throughout the study. This also enriches trustworthiness in case study research.

3.7 Conclusion

This chapter has summarised the research methodology, particularly types of methods used when conducting the study. However, much attention was placed on how data was analysed to provided an overview of the data of the ethical and quality dimensions of the study. The research methodology was a reflexive process whereby various research instruments used in collecting data were checked as well as the data generation tools used to conduct the study.

CHAPTER 4
G-Tech Green Economy Sustainable Practice using the PLA Roll Planter Technology: Knowledge Capital as Potential Value

4.1 Introduction

In this chapter I present data collected via *observations*, *document analysis*, and *interviews* as described in the previous chapter. Chapter 3 outlined how data was collected and analysed; the findings on the value created for youth will be described in Chapter 5. This chapter provides a detailed *description of the G-Tech project*, how the sustainable practice was *established* and made *known*. It provides a description of the Polylactic Acid (PLA) Roll Planter, how it was manufactured and pilot tested using PLA Fibre, its applications in various countries, the *uses, benefits* and *impacts*. The practice is explained in some detail, in order to make visible the nature of the practice being learned, as well as the knowledge, skills and entrepreneurial aspects of the G-Tech practices that were shared with youth in the South African agricultural PLA Roll Planter Community of Practice implemented by G-Tech. The focus is mainly on the knowledge value capital (i.e. potential value) created for youth; but the chapter also shows applied value as the knowledge value capital was also applied by youth in learning the practice.

4.2 History of the PLA Roll Planter Technology and G-Tech Company

This section provides detailed historical information about the sustainable practice that is in focus in this case study. Drawing on documented information, mainly from a series of Toray Corporate Social Responsibility Reports (hereafter referred to in short as 'CSR'), the chapter shares what has been done in relation to the scope of the G-Tech project, and what has influenced the establishment of the project. *Sustainable practice* is defined in Chapter 2 (section 2.4.) as a *green practice* or *green project* that fosters learning about green innovation whilst responding to environmental issues (Vachen & Klassen, 2006). Historically, the Japanese company Toray, commonly known as 'Toyo Rayon' founded the manufacturing of the materials and fibres including the PLA Roll Planter (CSR, 2015). The materials were developed to solve issues related to *biodiversity loss, natural resources* and *energy*. The 2007 CSR noted that "there is potential that the material can contribute to promoting *sustainability"* (2007: 27). Globally, there are only two places where the PLA Roll Planter has been

manufactured, that is Japan and Soweto in South Africa. The idea became *customary* when the funders of G-Tech, the United Nations Development Programme (UNDP) based in Japan, attended a conference where different technologies were exhibited and established the partnership which led to the technology's testing and establishment in South Africa.

The world is advancing in science, technology and innovation as populations expand, and as challenges become more complex. Some of the challenges faced by South Africa and other developing countries include *youth unemployment*, *vulnerability to climate change*, *loss of biodiversity*, *desertification*, *soil degradation* and *poverty* as discussed in Chapter 1. Due to the ongoing unprecedented high levels of unemployment in South Africa, with the most recent figures being 29% (StatsSA, 2019), a *green economy* presents an opportunity for African *'jobless'* youth, through, amongst other approaches, the introduction of *green entrepreneurship*, as discussed in Chapter 2.

The G-Tech project, as the case under study in this research, illustrates the type of *practices* and *opportunities* that exist in the biodiversity sector to introduce new *sustainable mechanisms* to minimise *environmental impacts.* Green technology for sustainable livelihoods which is commonly branded as 'G-Tech' is a piloted project that has introduced *new knowledge* of addressing social and biodiversity issues via various pilot projects including youth Communities of Practice, as introduced briefly in Chapter 1. G-Tech as a sustainable practice provides green technological solutions and agricultural production methods for sustainable livelihoods (Esty & Winston, 2006). Toray Industries (a leading Japanese-owned chemical company that produces fibres and textiles, chemicals and plastics), Mitsukawa (a Japanese wholesale distribution company), and Sakata EMEA (a company providing seeds) are G-Tech business partners who established the G-Tech project in 2010 as an idea and technology.

These partners, with support from the United Nations Development Programme (UNDP), have been supporting the G-Tech project in South Africa which is the only company outside of Japan with the PLA Roller Planter technology. The G-Tech company in South Africa, with UNDP support, was initiated with the intention to create *opportunities* and *practices* for youth development and job creation in the biodiversity / green economy sector through the use of a new *advanced material fibre* and *technology* called PLA Fibre, and the PLA Roll Planter (www.g-techholding.co.za). In the context of science, technology and innovation becoming potential catalysts for economic development, the PLA Fibre, and its application in the PLA

Roll Planter technology (see below) has been promoted in terms of its potential in South Africa for revegetation and restoration of biodiversity biomes, and for its further use for *agriculture* and *renewable energy*. Polylactic Acid (PLA) is a plastic substitute made from fermented plant starch, which offers an increasingly popular alternative to petroleum based plastics, as it is biodegradable after a period of time.

The G-Tech website states that PLA Fibre has the following qualities:

- It is made from plant-derived raw materials, which enables it to be readily degradable – as opposed to petroleum and other fossil resources
- It is environmentally friendly due to its reduction in carbon dioxide emission and soil rehabilitation when degrading
- It has a high melting point, therefore can extend its capability even in extremely hot weather conditions
- It has a long life span (about ten years or more)
- It has a high water retention capacity. (www.g-techholding.co.za)

The PLA Roller Planter, manufactured using the PLA Fibre, is used for a variety of applications, and has been pilot tested by G-Tech in contexts such as rehabilitation of mine dumps, bioenergy, food production, and restoration of indigenous biomes and biodiversity. G-Tech have implemented a number of pilot projects in South Africa in each of these areas, with the food production pilot being implemented between 2011 and 2016, with UNDP as a partner (ibid.). The food production pilots are taking place in two municipalities in Gauteng Province, in Randfontein and Laezonia. The project's business contribution in South Africa involves addressing biodiversity issues through the use of advanced technology, namely the PLA Roll Planter to promote new knowledge and applications that are needed in developing countries including sub-Saharan African countries. Gauteng though the smallest province in South Africa, is an economic hub (StatsSA, 2015). The province is one of the major economic engines of Africa with rapid growth population. Approximately 60% of youth who have left school are unemployed and amongst these many have moved to cities and reside in Gauteng, hopeful for job opportunities (ibid.), which is one of the reasons why the project is based here.

The project became legally operational in 2011, when G-Tech collaborated with the United Nations Development Programme (UNDP) as project funders. The project, from the start, has included other local partnerships, especially research institutions such as the Agricultural Research Council (ARC), the Council for Scientific and Industrial Research (CSIR) as well as the University of Pretoria (UP). Other institutions connected to the project include the

Department of Mineral Resources (DMR), Mintek and the Council for Geoscience (CGS), who serve as advisors.

Initially, the project comprised of six workers including four young males (i.e. aspiring entrepreneurs) and two senior members of staff including the Business Development Manager and Chief Executive Director. Key facts about the establishment of the G-Tech Project are summarised in Figure 4.1.

G-Tech Facts:

Location: Gauteng, South Africa: Laezonia and Randfontein
Founded and established: 2010
Active: Soweto
Workers : 4 young males
Senior Staff: 2 males
Products and services: Skills development in gardening using PLA to compost and grow plants
Space: 2 hectares

Figure 4.1: Key facts about the project G-Tech (www.techholding.co.za)

4.3. Description of the PLA Roll Planter

4.3.1 Type of material technology

Green agricultural production forms an integral part of a response to climate change (ASSAF, 2014). The PLA Roll Planter is a registered trademark material made from plant based polylactic acid to enable *agricultural production* and *revegetation* (CSR, 2015). It is a combined model, and consists of PLA fibre which is represented in the form of a whitish-sock based material, whilst the PLA Roll Planters, represented in tubular form, are made from *Ecodear* (CSR, 2014, 2015) to help with water efficiency – water moves through pipes mixed with fertilisers and herbicides within the material (ibid.). The material description focusses mainly on how it has been produced and its uses.

The PLA Roll Planter is certified under ISO 14001 (CSR, 2015). The practice of growing plants using a PLA Roll Planter can be used as an opportunity for increasing awareness and transferring new knowledge about reducing impacts on the environment and encouraging restoration of biomes. The CSRs (2014, 2015) indicated that PLA is a plant-based material which is a biodegradable polymer that stimulates the regrowth of uprooted plants on various types of sources, after which it can be broken down into carbon dioxide and water (ibid).

What makes the material a source of *green innovation* is its capability to prevent desertification and turn non-arable land into green areas, which is called "*revegetation*". Kumar (2014) and Tripp (2006) described revegetation as the process of restoring vegetation in deserts and dry areas to prevent topsoil loss. PLA Fibre has been regarded as a *key polymer* that can have a wide range of benefits in various sectors and its application as the PLA Roll Planter is shown in Figure 4.2.

Figure 4.2: The PLA Roll Planter materials at Laezonia, Diepsloot
Source: www.g-techholding.co.za; own observation)

The PLA Roll Planter has been used as an *educational instrument* to promote knowledge of *green innovation* and has created *opportunities* for green entrepreneurial practices. The idea of growing plants with the material serves as an opportunity to translate into job creation.

4.3.2 The manufacturing process

The PLA Roll Planter is used to restore biodiversity biomes, whilst contributing to reducing *carbon dioxide emissions* or the *carbon footprint* (CSR, 2007; CSR, 2010). Globally, the material has been manufactured in Japan and Soweto in South Africa. The material was exhibited at the Eco Products 2012, Japan, at the Tokyo Big Sight, one of the world's largest environmental exhibitions (CSR, 2013). Toray, as the main material manufacturer, sought to implement environmental conservation measures and contribute to sustainability (CSR, 2013), taking into consideration the cost of proper recycling in compliance with environmental control standards (CSR, 2007).

G-Tech seeks to empower youth with relevant *knowledge* and *skills* on how to use the PLA Roll Planter to conserve the environment and promote environmental awareness, which I focus on in more detail below. Studies emphasised that this newly developed composite material has been manufactured as an *asset* and *core technology* (CSR, 2007; CSR, 2013). Research has been conducted on the quality of its production. As a raw material, much emphasis was placed on the manual monitoring and improvement of the PLA itself (CSR, 2013). For maintenance purposes, the material is monitored to identify and reduce potential risks (CSR, 2013). The manufacturing process plays a critical role in terms of quality (CSR, 2011). This process is valued as a *measure of fundamental responsibility* to ensure that materials procured and distributed are of value, hence are subjected to review before they are commercialised.

A highly reliable raw material such as PLA, is known to be used for various purposes. The environmental benefits of PLA are made clear in the sections that follow. Every organisation needs to vouch for the safety of its products, be able to introduce new material and explain how it has been made (Esty & Winston, 2006), and certify that the material is not a banned substance and products (CSR, 2007). Much careful research has gone into the quality of PLA, and the research institutions in South Africa mentioned above have payed close attention to its local production, use, manufacturing and quality. For my research, which focusses on learning how to use the technology amongst youth, it is important to have an understanding of the material and how it has been developed, as this forms part of the knowledge and skills that youth need for the enterprise development. I focus on this in more detail below.

PLA, like the material *Foresee* (CSR, 2008), is manufactured using the application of a *melt spinning technique*. Using this technique, it is manufactured from *plant-organic material* such as *corn* and *carbon fibre* that does not increase the carbon dioxide level even when incinerated, drawing on knowledge of cultivating synthetic fibre. Organic synthetic materials that use this technique are shown in Figure 4.3 below (CSR, 2007; CSR, 2008) which illustrates how PLA is manufactured.

Figure 4.3: How PLA material is manufactured in Soweto
(Source: G-Tech brochure, www.g-techholding.co.za)

PLA material can be used in a range of potentially high quality *products* and *services* (CSR, 2015), one of which is PLA Fibre. PLA Fibre is a knitted thread made of natural cellulose polymers that are derived from plant waste materials. This fibre is used to make the Roll Planter, which is a biodegradable sock (tube) structured type of a knitted PLA fibre or yarn (www.g-techholding.co.za).

The manufacturing of the PLA Roll Planter, as an application of PLA fibre, was recognised for its high potential for supporting various applications for plant growth in dryland areas, based on its flexibility to be adaptable to changing climates and conditions, and especially for its applicability in low quality soil areas, and or dryland soil areas (www.g-techholding.co.za), although it has also been used for roof gardening in Japan. The PLA fibre *substrate* sheet produced in Japan and in a manufacturing facility in Soweto with an annual capacity of 5 000 tons (see Figure 4.3).

Qualities of the PLA fibre include:

- It can be applied as a substrate and growing medium
- It mitigates against the loss of land and soil in agricultural production
- Carbon dioxide neutral
- Long life span / durability
- High water retention and moisture capacity
- Light, flexible and easy to transport. (www.g-techholding.co.za)

4.3.3. How the PLA Roll Planter is constructed onsite

The PLA Roll Planter is constructed by placing the whitish-sock PLA material on the ground and stuffing the stocking-like tubes with local soil and sand (CSR, 2015). The tubes are then laid down on the ground to provide the base for *revegetation.* The planters have excellent breathabilty and water retention for drip irrigation as demonstrated in Figure 4.4 below.

Figure 4.4: PLA Roll Planters being constructed onsite
(Source: CSR, 2007 and CSR, 2015)

Filters, which can be seen as spots or pipes, provide for a *drip irrigation system* for running water in between the roll planters. In the agricultural and other pilots, the PLA Roll Planters were filled with soil and placed on denuded land (CSR, 2015). In the agricultural pilot, the *drip irrigation system* was set above them and seeds were planted between them. Studies confirmed that the simple setup of the equipment makes it relatively easy to restore biomes and enables easy food production (CSR, 2013). It is the combination of PLA *Roll Planters* and the *drip irrigation system* that ensures high water retention and the distribution of small amounts of water and fertilisers that are transported within the pipes. In the pilots, the channel through which water has to run was laid down and soil was stuffed on the lower side to form a type of embankment.

According to CSR (2015), the purpose of the pipes was to also aid *"water harvesting"*. Small amounts

of water can move through the drip irrigation system which is seen as an effective water harvesting technique. Discharge *runoff water* can also be captured as water runs through the pores of the fibre, and is held in the soil. Construction of the PLA Roll Planter system is labour-intensive. Filters and pipes were found to be useful, especially in the semi-arid areas and dry lands for water harvesting on low slopes (ibid.).

For combatting soil erosion and for enhancing revegetation, G-Tech enables *youth* to employ *sand tubes* made of polylactic acid to prevent topsoil loss and restore vegetation (CSR, 2015). Combining the use of sand tubes and tree-planting is known to help prevent desertification. Kumar (2014) described desertification as a process whereby an area becomes dry due to drought and inappropriate agriculture, leading to erosion and topsoil loss. To combat this, the PLA Roller Plant *tubes* were filled with sand and laid out in a *grid-like pattern* as demonstrated in Figure 4.5. The tubes also helped to prevent sand from shifting or 'sand drift'. The pilot cases showed that seeds carried by the wind settle and take root and local vegetation begins to grow within the spaces laid out between the grids, leading to grasslands that can be cultivated in future.

Figure: 4.5: Sand tubes and PLA Roll Planters in a grid-like pattern for revegetation (Source: CSR, 2013 and 2015)

Further piloting of this approach led G-Tech to identify that the most effective method was to use a 1m x 1m roller planter layout. This approach has also been used for mine rehabilitation projects, and for biodiversity ecosystem restoration. A particularly interesting pilot undertaken by G-Tech has also been to grow biofuel feedstock on mine dumps which makes previously unusable mine dump areas economically viable for biofuel feedstock production. G-Tech indicates that this technology and application can be used for transforming mine dumps into sustainable commercial assets, can provide new livelihood options for communities, and it can also increase sustainable energy supplies, and more importantly it does not take productive agricultural land out of agricultural production for biofuel stock production (www.g-techholding.co.za). Of interest for youth green skills development, green

entrepreurship and green economy development is the fact that these pilots are all quite recent, with the biofuel pilot only recently completed in 2016. There is therefore as yet untapped potential for expansion of these applications and income generation possibilities into the future.

In the agricultural pilot using the PLA Roller Planter, youth in the COP grew various crops on a daily basis, including maize (*Zea mays*), sorghum (*Sorghum bicolor*) and soya bean (*Gylcine max)*. Fast growing crops are desirable, depending on the water culture systems (Longely et al., 2006; Musetha, 2016). The PLA Roll Planter used in the agricultural pilot has been found to degrade slightly from ultraviolet rays (CSR, 2013; CSR, 2015). Further detail of the agricultural pilot will be discussed below, as this is the main focus of the learning in this study, as the PLA Roller Planter technology was also used as a means of transfering new knowledge towards sustainable livelihoods. The benefits of using PLA Roll Planters in the COP include enabling youth to equip themselves with the *right knowledge* and *skills* on how to grow crops in a unique manner with the intention to produce and generate income. The PLA qualities include the ability to be applied as a *substrate* and medium for a production cycle system of over five years (CSR, 2007), and it was considered to be flexible and easy to use (CSR, 2015).

4.3.4. Additional benefits of PLA

PLA, as an advanced material, is measured based on its material efficiency (CSR, 2007). As indicated above, the PLA Roll Planter has been piloted in a number of sites. It has been found to enable the production of crops in otherwise adverse conditions. PLA substrates are known to improve heat *resistance* (CSR, 2007; CSR, 2015). Additionally, the PLA Roller Planter in the G-Tech agricultural pilot was used as an opportunity for integrating new knowledge to address issues such as *food security*, *malnutrition* and *hunger* (CSR, 2007). The material is also known to have high durability (CSR, 2015).

4.3.5. PLA Roller Planter applications at a global level

Climate change is unpredictable and PLA enables growing plants which can strengthen its use for *sustainability purposes* both in business and society. G-Tech, in collaboration with Toray, has been involved many practices globally that have been using PLA and the PLA Roll Planter technologies. In addition to South Africa, countries such as Japan**,** Europe, Saudi Arabia and America (CSR, 2015) are using PLA technology. The product has been used for different applications and practices that tend to offer solutions to global environmental problems and energy related issues. It has been recognised as a material that is likely to guarantee extensive uses in *agriculture* and *renewable energy*.

Carbon fibre springing from PLA is a high-performance fibre that can be used in *crop rotations* and *maturing practices* (Tripp, 2006), with these practices being found useful in the arable lands of Africa, Asia and America (ibid.). For this reason, various practices have been developed to be used locally and globally, with some of the more innovative examples of piloted projects in countries such as South Africa, Japan and China.

In South Africa, pilot projects were recently launched in Gauteng, Laezonia and Randfontein where the PLA Roll Planter was used as an *opportunity* to facilitate growth and job creation. Further benefits include contributions to learning about *sustainability* and *agricultural production*. The Toray business contribution in South Africa is involved in addressing sustainability to address *food shortages* and *poverty.* Based on the evidence the PLA Roll Planter is not for use by youth only; *small scale farmers, agronomists, agriculturists, business developers* and *researchers* can use the product. (www.g-techholdings.com).

In Japan, piloted projects were launched in Gansu province, where the PLA Roll Planter was used for *greening urban rooftops* and *green buildings* (CSR, 2013). In addition, Tripp (2006) has described how this method was associated with placing native grasses that allow the formation of *natural vegetative strips.* Other developing countries such as East African countries are now becoming aware of the South African example and opportunities.

In China, projects have been successfully launched to control desertification using PLA. The use of sand tubes and tree-planting helped to prevent desertification in the Inner Magnolia Autonomous Region of China, a project which started in 2007 (CSR, 2015), following a traditional Chinese method of preventing dispersion of seed. The layout of sand-filled tubes in a *grid-like pattern* (see Figure 4.4) over 10 000 square metre areas prevented dispersion of seeds by allowing airborne seeds to settle and germinate. Studies confirmed that the method is aligned with the China National Sand Control and Desert Industry Society (ibid.).

The PLA Roll Planter applications portrayed in the pilot studies have been shown to have numerous benefits and opportunities that relate to the emergence of possible industries. The PLA Roll Planter has been used also for the unusual application to make *soprano recorders,* in addition to reducing carbon dioxide emissions by 20% and to decreasing resource extraction to waste disposal (CSR, 2003; CSR,2015).

4.4 Youth activities associated with the G-Tech PLA Roll Planter in South Africa

Sustainable practice is described as green practices or projects that foster learning about green innovation whilst responding to environmental issues without damaging the environment for future generations (Vachen & Klassen, 2006). Environmental awareness in the context of the G-Tech PLA Roll Planter in South Africa focused on introducing sustainable mechanisms and minimising environmental impacts (Tripp, 2006). G-Tech has been used as a *case study* that is able to promote insights into green biodiversity agricultural practices for young people in South Africa. G-Tech aimed to introduce the PLA Roll Planter to develop youth led green economy practices via training and practice of organic gardening through promoting a culture where young people promote sustainability using tools and artifacts in green enterprise developments (Esty & Winston, 2006; Tripp, 2006).

G-Tech employs mainly young males aged 24-35 who come from different backgrounds including construction, nursery practice (horticulture) and those who are straight out of school without any training or employment experience. Amongst them are aspirant horticulturists, botanists, environmentalists and entrepreneurs. In the projects so far, they have learned how to use the PLA Roll Planter to grow plants to encourage revegetation of biomes, and to develop agricultural practice, where the adoption of new approaches towards agricultural technologies systems are modelled. The G-Tech model and approach was to introduce agricultural knowledge to connect youth with the technology of the PLA Roll Planter (www.g-techholdings.com).

Sustainable practice strives to achieve sustainable development (Fonsecha et al., 2006). G-Tech represents a social learning network; its value creation and success relied on youth learning and adapting to the technology. It also enforced strategies that could unlock opportunities for gaining knowledge (i.e. it has a potential value creation interest in the form of knowledge capital development) and that furthers active participation and individual self-realisation and transformation (i.e. it also has an applied and reframing value creation interest). Figure 4.6 demonstrates the entrepreneurial concepts and notions that relate to youth intention and functionality in the sustainable practice of G-Tech.

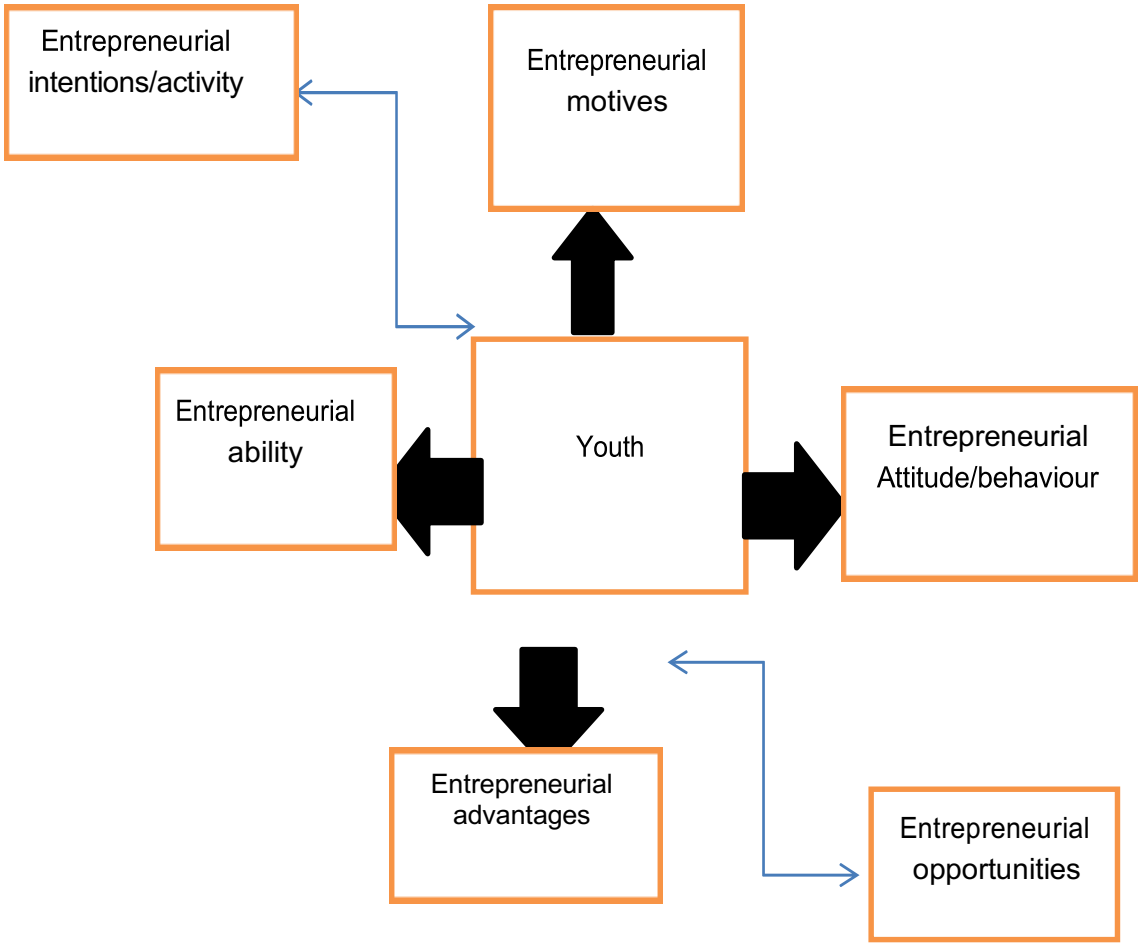

Figure 4.6: Schematic figure illustrating the connection and linkage of components that relate to youth functionality in the G-Tech sustainable practice of introducing the PLA Roll Planter (Source**:** Nieuwenhuizen, 2004; Nieuwenhuizen , 2008; CSR, 2013; Bux, 2016)

In the next section I look into what youth can bring into the practice as the schematic above indicates that youth, being the centre of the practice, bring attitudes, as well as intentions and motives to participate and entrepreneurial abilities. These combine with entrepreneurial advantages such as those provided for by the PLA Roll Plant technology (described above) and entrepreneurial opportunities, such as the G-Tech intention to involve youth in PLA Roll Planting practices such as agricultural production and biodiversity regeneration, as was shown in their pilots. G-Tech also put effort into training youth in Communities of Practice, and hence I look into what G-Tech did to train the youth, with emphasis on the potential knowledge capital value and applied and reframed value potential that the G-Tech project offered youth within the above mentioned enterprise development schematic. Chapter 5 gives more insight into the actual value created for the youth who participated in the project.

4.4.1 What can youth bring into the practice?

The first important thing that G-Tech did was to recognise youth as a group of people within Laezonia in Diepsloot community that had the ability to come and learn together, understand each other, build relationships with each other and identify themselves as a Community of Practice (COP) (described in Chapter 3). This emphasises that they recognised what youth can bring in terms of interest, attitude and motive to participate. The COP was used as a structure for shaping and transferring technology knowledge, and knowledge of enterprise development skills to youth, in this sense G-Tech sought to support the development of enterprise development behaviour and practices amongst youth. In developing communities of practice, G-Tech recognised that youth could have an interest in such knowledge and practice, and if they share this interest they can contribute to building a healthy social relationship (Wenger, 1998); hence they recognised that "active participation" results in using experiences as practices, and as learning resources in making use of collective contributions of the youth. Therefore the CoP was used as a structure for shaping youth's mind-set in the G-Tech context in South Africa. In Chapter 5, I comment further on how youth demonstrated passion and commitment towards the work that they were able to do in the PLA Roll Planter enterprise development environment of the G-Tech project.

Learning in a community of practice refers to continual flow of knowledge as it relates to practice in a series of direct and indirect connections (Wenger, Trayner, & DeLaat, 2011). In relation to this, G-Tech have supported various practices that contribute to knowledge generation and practice-based skills development which I unpack in more detail below. Lave and Wenger (2008) argued that learning and sense of identity are inseparable, hence the learning of the practice was also relevant to the development of youth enterprise behaviours and identities, and I therefore also focus on the enterprise development knowledge below, not only the technical knowledge of the PLA Roll Plant technical competences.

Documentary evidence in the CSRs and my field observations showed that amongst their daily activities, youth were able to participate in the CoP as envisaged by G-Tech, and have practised seed germination and planting practices, stacking and packing practices, companion planting practices, multi-cropping and inter-cropping practices; seed formation practices, succession planting, storing and packing practices, harvesting practice, and uses and benefits of plants (see section 4.5.2 below). Additionally, youth also learned about green technology, and the

environmental benefits of the PLA Roll Planter technology (see section 4.5.3 below). The sections to follow present the means of daily methods and activities by which the youth were involved in the practice, and reveal the knowledge capital value (potential value) as well as some aspects of the applied value of the G-Tech practices that were made available via the involvement of youth in the CoP focusing on learning enterprise development using the PLA Roll Planter technology. In the next section I draw not only on documentary data, but also on interview and observation data, and in Chapter 5 I consolidate insights into the value creation of the G-Tech project.

4.4.2 Knowledge capital value: G-Tech training in plant-growing practices for the youth CoP, and on-site sustainable practice involvement

Youth during interviews reported that whilst participating, the project has enabled them to practice growing vegetable crops and plants that can be used to produce and generate income opportunities in return. Amongst the list of plant growing *practices* they were involved in, youth started with the process called "*hardening off*" which is described by Food and Trees for Africa (2011) as the process of planting seedlings in a well composted soil to keep the roots growing strong and straight down in specific holes while not bending.

They were also taught how to plant the plants next to each other using the PLA Roll Planter technology. As outlined in the sections above, three 'sausages' of the stocking like materials were filled with local soils and laid next to each other. After this they were also taught how to plant and cultivate different plans using the technology, and how to manage water using drip irrigation systems to irrigate plants regularly, as also outlined above.

For proper maintenance of sustainable resources, youth in the CoP used various methods to grow different types of crops on the same space for various reasons (Kumar, 2010; FTFA, 2011). They also practised using black crates as containers to ensure that the process goes smoothly and sometimes windowsills, at times hanging the PLA Roll Plant tubes on buckets with holes to facilitate the seed germination process. Learning is an ongoing process (Wenger et al., 2011), with new things to be learned all the time. As shown below, the plant growing practices using the PLA Roll Planter involved a number of dimensions, elaborated on further below.

- ***Seed germination and planting practice***

Seed germination is a traditional practice that allows regrowth and formation of new plants. As one of the requirements for plant growth, Kumar (2014) stressed that seeds need *proper temperature*, *enough sunlight* and *spacing* for growth. The process of seed germination onsite was observed by the youth, and was said to happen when seeds had enough warmth and water, and when seeds were out of the wind, though being placed where air is circulated (Kumar, 2010; FTFA, 2011; site observations). Youth in the processes of making a *seedbed* for seed germination, used *seed trays* with holes. The spacing between the seeds was to ensure that water runs through gently, keeping the seeds moist. Studies by FTFA (2011), Kumar (2014) and Musetha (2016) informed the training of the youth, and emphasised that for plants to grow, the following are required;

- *Seeds do not need any detergent before they are planted, except direct sunlight;*
- *Plants grow well within a limited temperature;*
- *Most vegetables, plants and flowers require sunlight, at least eight to ten hours daily;*
- *Each crop has its own growing time and season* (ibid.).

In relation to planting, youth were taught that adequate *spacing* between plants is commonly known to ensure that each plant receives sufficient light and air. The length of the growing season, climate and crop selection determines successful planting. For the fact that vegetables planting times and seasons vary, shorter days and cloudy weather may reduce the light, hence climate and crop selection are recommended as key factors to improve seed germination and planting (FTFA, 2011; Kumar, 2010 ; Tripp, 2006).

As fast growing plants are always required for the PLA Roll Planter, youth in the CoP conducted various activities for different plant types. Because plants, vegetables or crops grown onsite were rotated, climate selection played a major role in their practice. They learned that some vegetables will do better if grown (FTFA, 2011), Kumar (2014) and Musetha (2016 from January to June, while others were best planted between July to December. To validate this, a calendar indicating crop season times was used, shown in Figure 4.7 below.

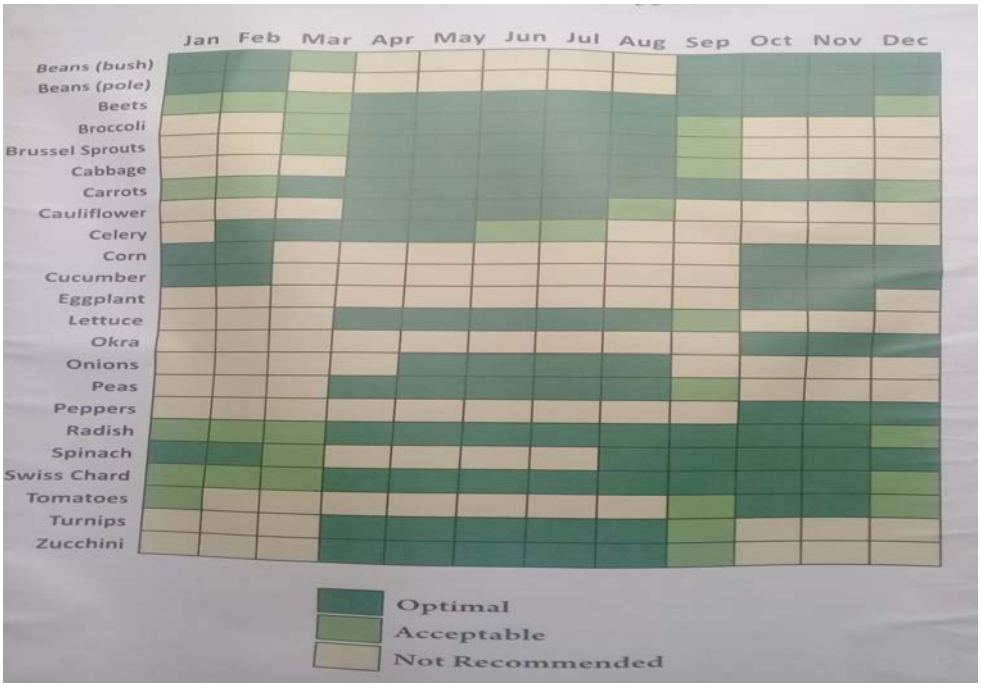

Figure 4.7: Crop calendar
(Source**:** FTFA, 2011)

Youth practised continually protecting and take care of the self-seeding plants that were planted according to the calendar. Initially the process started by making a shade cloth and seedbed groundcovers for vegetable plants namely beetroots, carrots and green peppers as they need to be planted with great care.

Youth during interviews onsite confirmed that each plant growth depended on its needs and climate conditions. The self-seeding plants were placed and shaped outside the plot or yard to allow germination to take place. The practice of growing plants using this method was useful in helping decide *which plants grow well where*, *how to plant* and *how to grow them well.* Youth in the COP have utilised this method further to increase their knowledge and skills in agriculture, horticulture and gardening. The idea of growing crops using the PLA Roll Planter may increase and promote youth's entrepreneurial knowledge, ability, intentions and behaviours on how to grow more plants to sell and raise funds. Figure 4.8 shows the use of the PLA Roll Planter to grow crops such as green peppers, one of the plants grown by the youth.

The table that follows (Table 4.1) provides a summary of knowledge, skills and learning associated with *seed germination and planting practice.* I consider this from different vantage points, including the technical, practical and biodiversity agricultural knowledge needed and being learned in the G-Tech sustainable practice, the skills being learned by the youth, and

insights into youth enterprise development learning, while learning the practice together at G-Tech. Together this demonstrates the knowledge capital potential value of the G-Tech practice in the agricultural PLA Roll Planter sustainable practice in Gauteng. I use the same framework to analyse knowledge, skills and enterprise development learning applied to the other plant growing practices in the sections ;

Figure 4.8: Green peppers grown onto PLA Roll Planter
(Source: www.techholdings.co.za)

Table 4.1: Summary of the knowledge, skills and entrepreneurial learning associated with seed germination and planting practice

Knowledge needed and being learned	**Skills needed and being learned**	**Youth enterprise development learning at G-Tech**
Technical knowledge: use of agricultural practices such as self-seeding plants to cultivate new seedlings; drip irrigation techniques; knowledge of root systems, soil quality, water and sunlight for growth of plants.	Seed germination, self seeding plants, seedlings, watering of seedlings	Youth sharpening their mind-sets towards green thinking and suggesting possible ways of how to use practices to bring income returns; recognising that a plant-based business starts with taking care of or cultivating seedlings from self-seeding plants.
Practical knowledge: seedbed formation and care; formation and regrowth of new plants	Seedlings, spacing between seedlings, successive planting	Youth considering methods and measures to care for seedlings to produce plants for growing a business practice, especially regular caring practices.
Biodiversity agricultural knowledge: Knowledge of discovering and naming type of plants, seasons, uses and benefits; climate effects on seeds	Plant nomenclature, seasons, plant calendar	Continual practice, capacity to act on what type of plants grows well for each season, cultivation of seedlings from self-seeding plants.

Source**:** FTFA, 2011; Kumar, 2014; Musetha, 2016; observations and interviews

- ***Stacking and Packing Practice***

Stacking and *packing* practice in the garden has been described as the method of sowing seeds and crops (Kumar, 2010; FTFA, 2011). With regard to new technological development using the PLA Roll Planter, the practice acts as a *greenhouse* method of growing plants supported by *stakes* or *strings* (Kumar, 2010). As explained above, and shown in Figure 4.9 below, plants were grown along the PLA Roll Planter supported by irrigation drip lines and pipes, whilst stuffed with local soil, compost and fertilisers.

What is so interesting about the *process* is that it can be done indoors and outdoors, as the practice involves fitting more plants together to save space. As each plant has its general requirements for growth, stacking and packing in the practice was done by putting shorter plants closer to tall ones. For instance, in the G-Tech youth CoP, the practice of stacking and packing was demonstrated in and as rows, placed along the PLA Roll Planter (see Figure 4.9 below). Participants during interviews referred to it as a good way of packing plants and labelling them in rows, just like "packing a box" carefully to fit as many things as possible (interviews, FTFA, 2011). In the practice, stacking and packing has been designed as the process of fitting more plants to save space as some plants protect each other from *sun* and *pests*. The practice is shown in Figure 4.9.

Figure 4.9: Illustration of the process of stacking and packing as seen during observation when plants such as sorghum were grown together with soya bean using inter-cropping (Source: Author – *picture 2 shows me in the field with a youth member of community of practice*)

In this G-Tech practice, youth were trained to label plants according to rows when growing for various reasons. This is known as an essential formula for growing any crops anywhere in the presence of sunlight and suitable weather (FTFA, 2011; Kumar, 2010). The practice of growing plants close to each other helps to put plants systematically in rows. Youth during interviews reported that planting small plants close to each other helps plants grow and not to be disturbed by other factors (interview data).

The *seedlings* of underground plants such as *onions*, *tomatoes*, *carrots*, *beetroots* and *green peppers* were transferred onto the PLA Roll Planter to be converted into rows. With regard to seedlings, they are grown close under extra lining until they reach about eight inches in height (Kumar, 2010), to be transplanted after 14 to 18 days. In the G-Tech youth CoP, their seedlings were spaced apart as they grew so that their leaves were not overlapping to keep plants from getting tall. Kumar (2010) further emphasised that sowing and transplanting at earlier stages prevent any dry spots in the medium that is stuffed into the PLA Roll Planter, hence it is important to grow healthy seedlings that are transplanted in good time. In the G-Tech youth CoP, when the seedlings were transplanted into their growing systems they were reported to be well maintained to allow production. Youth were trained to do this and to learn about the different stacking and packing practices. For example, *tomatoes* grow well within the PLA Roll Planter and are supported by the use of stacking and strings connected vertically to grow upwards, with the mechanisms of drip irrigation systems providing the moisture needed (CSR, 2007). Because plants require adequate spacing in between to grow, the mechanism of correct stacking and packing (allowing each plant enough space, and supporting them to grow vertically if needed) ensures that each plant receives enough air and sunlight for growth. In other words, their roots will be supported by soil within the growing plant (ibid).

Youth were trained to understand that the PLA Roll Planter acts as a *plant adjustment* and *improver*. For the fact that plants help each other to grow; many plants at earlier stages are likely to be killed by insects, frost or hot sun, therefore planting them in a protected area helps them to grow well. During *plant spacing*, it was found that tomatoes require enough spacing, as well as careful planting in rows to allow enough area per plant (Kumar, 2010). Green peppers similarly needed enough space for each plant to grow, while carrots, beetroots and onions also required enough space, but less than that required for green peppers and tomatoes.

Lastly, youth were trained to remove leaves and side shoots from each leaf axis to facilitate

plant growth, and to help to maintain space in between plants and to maximise individual plant growth for production. They were also taught that this helps with maintaining various types of plants correctly to minimise rates of insects that may live on the plants if more leaves are present. To maximise the irrigation capacity of the drip irrigation system that ran along the PLA Roll Plant 'sausages', plants were carefully positioned and supported along the rows. Table 4.2 indicates the knowledge, skills and enterprise development learning associated with stacking and packing in the G-Tech youth CoP.

Table 4.2: Summary of the knowledge, skills and learning associated with the stacking and packing plant production practice

Knowledge needed and being learned	**Skills needed and being learned**	**Youth Enterprise development learning in the G-Tech CoP**
Technical knowledge: knowledge of how to plant optimally for productive growth	Crop spacing, pest control management, optimal planting strategies; drip irrigation	Learning about optimisation practices
Practical knowledge: spacing, plant support, drip irrigation techniques	Spacing of different kinds of plants depending on their growth; optimal arrangement in the PLA Roll Planter system	Optimisation practices facilitated by technologies such as PLA Roll Planter system and drip irrigation
Biodiversity agricultural knowledge: sustainable production strategies	Hydroponics; drip irrigation; spacing to maximise plant growth and minimise insect damage to plants; permaculture techniques	Reducing plant damage Maximising the capacity of plants and other resources such as water

Source: CSR, 2010; Kumar, 2010; FTFA, 2011;observations and interviews

- ***Companion planting and multi-cropping practice***

This practice is similar to stacking and packing as described above (Kumar, 2010; FTFA, 2011;). It involves growing different plants in ways that can help the plants grow together. Youth in the G-Tech practice adapted the approach of companion planting to the agricultural technology of growing plants using PLA Roll Planter, and they used multi-cropping and inter-cropping as shown in Figure 4.9 and Figure 4.10 below, where different crops were planted next to each other at the same time and/or in the same land space (see below).

Figure 4.10: Planting of soyabean and sorghum together in the G-Tech Laezonial trial on clay soil (Source: www.g-techholding.co.za)

Tripp (2006) referred to companion planting as the method of growing two types of plants in the same space. It is often used interchangeably with intercropping to be described in the next section. Studies indicated that when two or more non-competing crops with different maturity dates are planted together in various patterns, careful consideration is required (Tripp, 2006; FTFA, 2011;). Therefore knowledge of pre-planting and of maturity dates is essential.

The challenge of planting two or more non-competing crops may result in *soil-borne diseases* and *insects*. It might also affect one or more plants that may lead to crop failure (Tripp, 2006; Kumar, 2014). Studies indicated that *tomatoes* are able to grow well with *spinach*, because their roots protect each other (FTFA, 2011; Kumar, 2010).

Kumar (2010) and Tripp (2006) emphasised that plants maturity dates vary according to *main, early* and *late season*, whereby crops planted at the same time might mature after or over the season depending on their planting, thus thought should go into planting crop that complements each other from a maturity date (Musetha, 2016). Factors such as climate *changes* and *soil conditions* are itemised as important in companion planting. It has been proven that plant such as *beans, mealies or maize* and *corns* are likely to grow well together (FTFA, 2011). *Companion planting* relates to *multiple cropping* in a sense that two crops are grown in a year when only one is replaced (Tripp, 2006).

Companion planting was emphasised by G-Tech training in the study, as it contributes to weed control, insects and pathogens management. Tripp (2006) indicated that this method in the past has been recommended as a way of responding to threats from specific pests. For example, maize can be intercropped with leguminous crops. As much as multiple planting is concerned, cropping patterns may be modified due to the development of plants in their early days. In other terms, this method is often called *alley cropping* (Tripp, 2006, 30). Alley cropping has been recommended to be useful for *nurseries establishment*, *pruning* and *clearing alleys* (ibid.).

This method, like succession planting, involves increasing crop availability during the growing season by making efficient use of spacing and timing. It is known to be used in organic farming, which symbolisees reduction and minimisation of the risks of crop failure. In the G-Tech CoP, the approach was further enhanced by using manure and composting (Tripp, 2006; Musetha, 2016). Table 4.3 below indicates the knowledge, skills and enterprise development learning associated with companion planting or multiple cropping.

Table 4.3: Summary of knowledge, skills and enterprise development learning associated with companion planting or multiple cropping

Knowledge needed and being learned	**Skills needed and being learned**	**Youth enterprise development learning in the G-Tech CoP**
Technical knowledge: Knowledge that plants mature at different times, and that different plants have an impact on insect distribution.	Applying green manure; composting; planting complementary plants to harvest at different times.	Harvesting of varieties at different times. Learning that diversity can enhance productive outputs.
Practical knowledge: Knowledge of which plants can be grown together and how to space them and also how to time their production outcomes.	Planting complementary plants; monitoring insect life influences.	Creation of new ways, methods of growing various types of plants that complement each other and that can be harvested at different times, allowing for ongoing production outcomes at different times.
Biodiversity agricultural knowledge: Companion species, pest control (natural methods) and natural soil enrichment methods (manure and compost)	Applying approaches that reduce insect damage to plants; principles of permaculture	Intention to promote agricultural products and crops for diversification of the value chain; using sustainable strategies such as companion planting for pest control and improved outputs. Low cost alternatives such as manure and composting instead of relying only on fertilizers.

Source: Tripp, 2006; Kumar, 2010; FTFA, 2011; observations and interviews

- ***Intercropping practice***

Related to multiple cropping and companion planting is the practice of intercropping. *Intercropping* is growing two or more crops together at the same time in the same space in a beneficial manner, while *multiple cropping* is the practice of growing two or more crops on the same piece of land during a single growing season, ***and companion planting*** is planting different complementary plants together as described above. All of these approaches can be used with the PLA Roll Planter technology, and were therefore included in the training of the youth.

In my observations and interviews I found that youth in the G-Tech project have learned to practice *intercropping*, which involves the process of growing different types of plants together in rows in the same piece of land for multiple purpose to improve soil fertility (FTFA, 2011), and to diversify the harvest potential.

Intercropping involves planting different types of plants in between rows and labelling them according to their botanical names and the seasons eligible to plant them (CSR, 2015). Intercropping offers an opportunity to reduce infestation of insects and parasitic weeds. Studies reported that this method is related to crop production and can be used with the PLA Roll Planter technology (CSR, 2007, CSR, 2012; see figures 4.9 and 4.10). The practice of intercropping is associated with low input agriculture (Tripp, 2006, 32). In South Africa, type of crops and their growing calendar and harvesting dates are very diverse as elaborated in Figure 4.7 above. Tripp, (2006) indicated that during intercropping, monocropping might be converted to intercrops offering more diversity of options and opportunities for the agricultural value chain (CSR, 2007 ; CSR, 2012).

Intercropping is often called ‘alley cropping’; it draws on the system of agroforestry management that was designed as an alternative to shifting cultivation systems. Studies indicated that cover crops makes harvesting and sometimes land preparation more difficult (Tripp, 2006; Kumar, 2010). Studies further indicated that during mono-cropping maize 16 plants out of 100 have been affected by pests and diseases, while intercropping maize and cowpea 10 out of 100 maize plants have been affected by pests and diseases (FTFA, 2011, 33).

Tripp (2006) emphasised that intercropping can be useful for various reasons, which also applies to the use of intercropping in the PLA Roll Planter context:

- It can help in converting a traditional monocrop into an intercrop that has not been successful in growing;
- It makes good use of the different growth habits of various crops so that there is a complementary in the use of time;
- It can help with greater production in yields, making use of different growth habits of the various crops with different maturity periods, space, crop physiology and different root arrangements.

As indicated above, the work of Tripp (2006), FTFA (2011), Kumar (2010) and Musetha (2016) have influenced the content and focus of the G-Tech PLA Roll Planter training for the youth CoP, hence I share the insights from their works here as I found it to be influencing the G-Tech training during my fieldwork.

Table 4.4: Summary of the knowledge, skills and enterprise development learning associated with intercropping

Knowledge needed and being learned	**Skills needed and being learned**	**Youth enterprise development learning in the G-Tech CoP**
Technical knowledge: differences and similarities between mono cropping, multi-cropping, intercropping and companion planting	Improved method of plant production, intercropping	Use of technology to save energy and improve crop yields through new methods
Practical knowledge: different cultivation options	Organic farming, agroforestry, cultivation techniques; diversification from monocropping	Diversification of the value chain
Biodiversity agricultural knowledge: more sustainable, energy efficient, and synergistic approaches to producing food	Crop production, seasonal production, risk aversion; alley cropping	Youth ability to adopt alternative systems to make soil easier to prepare, and diversify cultivation system

Source: Tripp, 2006; Kumar, 2010; DEA, 2011; observations, interviews

- ***Crop rotation practice***

Youth during interviews reported that they practice growing plants on a rotational basis in various seasons including *sorghum, soyabeans*, *mealies (corn), beetroots* and *carrots* in the previous years following *spinach*, *green pepper* as well as *pumpkins* and *onions.* Kumar (2010: 109) highlighted that the crop cycles of these plants are beneficial in terms of allowing for the growing of two crops annually instead of one crop per year. This allows for crop rotation, which

is another practice that the youth were learning.

Crop rotation is described as a crop establishment method which involves successive planting (Tripp, 2006; FTFA, 2011). This method involves same crops that have similar planting cycles being grown at timed intervals rather than all at once, mostly in the same space, thus it complements intercropping, multi-cropping and companion planting approaches. Crop rotation is a practice of preventing the build-up of pests, as it involves not planting the same kinds of plants in the same place year after year (Tripp, 2006; Musetha, 2016). Crop rotation relates to continuous harvesting or relay planting (Tripp, 2006). In a crop cycle, this method provides nutrient support and is considered useful for collection of manure and production of compost for plants that grow next to each other (Kumar, 2010). It is also viewed as a lens that helps in deciding what plants to grow, when to grow them, and to protect younger plants from winds (Tripp, 2006). The youth were planting vegetables such as green peppers and carrots rotationally, so that they were able to harvest crops continuously for a period of months. Crop rotation determines how the planting of different varieties are sequenced, and here the planting calendar is very useful, especially also if there is good knowledge of growth periods. Musetha (2016, 23) found that crop rotation is also a useful tool to assess the impacts of climate change on crop production and adaption of potential crops. Indigenous plant crops such as sorghum are often emphasised to facilitate better diversity of agriculture (agro-biodiversity) as it attracts birds that can help to reduce pests. Such plants can also be included in crop rotation cycles, and if combined with the strategies above such as intercropping and companion planting, can help to strengthen biodiversity in the agricultural value chain, and provide for diversification in the value chain (Makina, 2014). This is important for viable agri-business development as studies on exotic plants tend to use a lot of water, and crops such as maize and cowpea are more likely to be affected by pests and diseases, hence mixing rows and intercropping *maize, cowpea* and *pumpkin*s and planning for mixed crop rotation cycles would be a good practice (FTFA, 2011, 39; FAO, 2013,34,).

Table 4.5: Summary of knowledge, skills and learning associated with crop rotation practice

Knowledge needed and being learned	Skills needed and being learned	Youth enterprise development learning in the G-Tech CoP
Technical knowledge: Crop physiology; different growth periods for different plants; complementarity of planting schedules	Successive planting; Crop establishment and management strategies	Improving health of all plants and ensuring that diseases are not spread easily
Practical knowledge: Intensive production strategies; planting according to diverse growth cycles of plants	Intensive and productive planting via rotation of crops	Emerging knowledgeable extension farmers with botanical knowledge, and knowledge capabilities to commercialise crops; greater capability to produce higher yields on a regular basis.
Biodiversity Agricultural knowledge: pest reduction and risk reduction; value of indigenous varieties	Cover cropping; pest reduction approaches; careful planning and management; diversification; planting of indigenous varieties to reduce risk	Making use of a wider range of knowledge to ensure diversity of the value chain, and regular income through more sustainable crop rotation approaches; agro-ecology practice knowledge and experience

Source: Kumar, 2010; FTFA, 2011; Musetha, 2016; observations and interviews

- ***Preparation of seedlings and seedbed practices***

A successful *seedbed* is characterised by having well maintained green manure and compost for agricultural feed. In the G-Tech training, certain methods were promoted with regard to *seed formation* (Tripp, 2006; Kumar, 2010). What was interesting in the COP was how youth habitually adopted the planting practices. This section describes the process of seed formation as it was reported on, and observed onsite.

Youth reported during interviews that *seedlings* were individually planted in a wide space using *crates.* The soil was kept well-drained until the flowering stage, whilst the seedbed was irrigated using water pots to allow *wetting* and for drying periods. Studies informing the training indicate that *wetting, drying* and *wide spacing* contributes to increased yields by increasing root growth and yield (Tripp, 2006). The seedlings were then covered around with compost as an effective source of nutrients, applied in restricted areas of high value crops (Tripp, 2006). Seeds in the *tray* and *crates* when dry were easy to be handled. The *tray method* was used to place seeds by rows in total of six to eight rows with the crate (FTFA, 2011; Kumar, 2010).

In terms of water management, seedbeds are were sprinkled, instead of pouring water on them manually. Watering the seedbed does not require too much water (Kumar, 2010; FTFA, 2011). Studies informing the training, indicated that seedbeds may be covered with net, plastic or banana leaves as they avoid introduction of worms (Tripp, 2006:8). Youth during interviews reported that seed formation and bedding is an *onerous process,* that is able to absorb and retain water fairly well; hence the seedbed should be watered carefully. In the COP there was evidence that the *seedbeds* can be made at any place where there is shade, humus, and protection from the sunlight and heavy rain. Therefore soil in the COP was maintained by using composts, organic matter and manure (Tripp, 2006; Kumar, 2014). Seed formation and bedding was influenced by factors such as size, shape and texture; however bedding methods are relevant in selection of correct materials for successful gardening. Seed formation is necessary for the other processes reported on above, such as crop rotation, staggering planting crops, and pest management, for without the seedlings the rest of the practice would not be possible. Table 4.6 presents the knowledge, skills and learning associated with seedling formation.

Table 4.6: Summary of the knowledge, skills and learning associated with seedling formation

Knowledge needed and being learned	**Skills needed and being learned**	**Youth enterprise development learning in the G-Tech CoP**
Technical knowledge: germination of seeds, micro-nutrients, growing conditions for seeds	Germinating seeds, managing growing conditions for seedlings.	Understanding that seed formation is foundational to the rest of the enterprise development, and that this needs adequate time, process management and care.
Practical knowledge: the practice of seedbed formation, wetting caring for seeds	Biodiversity and soil management, composting, green manure , excellent methods or techniques for seedling growth	Youth's intention to know how to increase yield and root growth for successful planting and germination of seedlings for cash crop generation
Biodiversity agricultural knowledge: soil enrichment with manure, composting and micro-nutrients for seeds, watering and control of worms	Pest crop management, green manure, seedling management and care	Youth intention to care for seedlings for successful germination and growth to feed into the rest of the enterprise

Source**:** FTFA (2011), Kumar (2014) and Tripp (2006)

- ***Harvesting practice***

Harvesting represents *sowing* and *pruning* time in the crop production cycle. The concepts 'harvesting' and 'cultivation are often used interchangeably, which means the process of transporting crops from battlefield to a nourished area (Kumar, 2014). The harvesting process is known to require extra labour, hence there is an increasing demand that threshing labour

leads to higher yields. In the COP, harvesting was done in a unique manner, after the planting season. After all plants were grown, planted and well-maintained, they were then processed and harvested. Studies informing the G-Tech training indicate that *cucumbers* are harvested by removing side shoots, tendrils and flowers (Kumar, 2010, 122). Therefore, as the lower leaves turn yellow, they may be cut off closer to the stem with a sharp knife or pruning shears not more than a leaf per week.(Kumar, 2010; FTFA, 2011).

In the COP, the purpose of harvesting agri-products commonly known as *crops* was done with great care so as not to damage the roots nor PLA Roll Planter itself as demonstrated in Figure 4.11 that follows.

Figure 4.11: How roots grow into the soil through the roll planter, and how they need to be carefully taken up during harvesting season (www.techholdings.co.za)

In the COP, youth practised harvesting mid-year, in the season when there was not too much rain. Plants do not always remain green, during harvesting seasons they loose their colour (FTFA, 2011; Musetha, 2010). In the G-Tech COP, youth practised *periodical harvesting*, which involves retaining some of the compost quality (Kumar, 2010; Tripp, 2006 30). During the harvesting of the crops, certain measures were employed by the youth. Harvesting was done manually, and this involved hand sorting, which required the youth to pick crop plants directly from the PLA Roll Planter using their hands. In other terms *manual harvesting* was done by using *scissors* and *secateurs* to remove and ensure that crops were harvested, and where needed, plants were removed manually from the PLA Roll Planter without damaging the material itself (see Figure 4.12 below).

Fast growing of plants is desirable. As indicated above, the G-Tech system also used the strategy of allowing for different plants that mature at different dates, which allowed also for *continuous harvesting* (Kumar, 2014; Musetha, 2016). In the G-Tech COP, this type of harvesting was done by removing stalks, and by composting leaves, stems and other debris to provide nutrients for the next grain crops. Harvesting is known to regenerate soil fertility if organic matter is retained and worked back into the soil. Youth practiced removing portions of plants and they also collected seeds to be reused with the PLA Roll Planter system of production (i.e. by starting new seedbeds). The seeds that were dried from the harvesting process were kept to be used for the next batch of planting and seedling germination.

Figure 4.12: How harvesting was undertaken in the G-Tech PLA Roll Planting practice, also showing how plants loose colour as observed onsite

During the harvesting process, plants were dried in the sun. This process was done repeatedly until nothing was left on the surface. PLA Roll Planter itself leaves no impact on the environment because it can be broken down into water and carbon dioxide over time (CSR, 2007). Table 4.7 below indicates the knowledge, skills and learning associated with harvesting.

Table 4.7: Summary of knowledge, skills and learning associated with harvesting practice

Knowledge needed and being learned	Skills needed and being learned	Youth enterprise development learning in the G-Tech CoP
Technical knowledge: sorting of harvesting material according to categories (e.g. productive outputs; composting components); harvesting plants in groups and sorting them in bags.	Manual harvesting, implementation of plant 'waste' management strategies in terms of composting material for next cycle of production	Youth's ability to look at the harvesting process in two ways: productive output, and output for re-generative production (via composting i.e. re-cycle and re-use of organic material)
Practical knowledge: using bare hands to take great care not to damage roots in harvesting; reuse of plant material for composting and nutrition for next crop cycle.	Periodic harvesting; manual harvesting; differentiating between productive elements and re-use elements	Youth's ability to recognize methods that allow normal growth and development including revegetation and composting
Biodiversity agricultural knowledge: recycling and re-use of plant material; care of root systems	Re-use of plant material; care of re-growth potential	Youths ability to produce products and harvest plant matter in ways that offer resources (i.e. composting material) for the next generation of crops (i.e. circular economy principle)

Source: Kumar (2006), Longely *et al.* (2006), Tripp (2006) and observations

- ***Storing and packing practice***

Correct storage and packing is important for maintaining moisture and nutrient content.. Youth in the G-Tech COP youth had to take account of the weather conditions that could affect the crops, therefore storing and packing were useful to enhance protection of the crops (Kumar, 2010). Storing and packing also formed part of the waste management strategy as some organic matter was stored for composting (Tripp, 2006). The harvested productive crops were stored and packed in bags in a cool place. In the G-Tech COP, youth confirmed during interviews that four rows of *maize* make approximately four bags, whilst two rows of sorghum makes two large bags at a weight of 50 kg each. The collected bags were then sorted mostly in batches and carried out to reach markets, with this procedure still in progress at the time of writing this study. Kumar, (2010) emphasised that sorting and packing of the collected materials should be done in a way that maintains aeration and prevents nutrient loss, while increasing the efficiency of chemical usage within the bags. In the COP, this practice influenced the type of crops to be grown, as youth in the COP intended to grow crops to sell for income generation, whilst a small portion of their harvested products were taken to other co-operatives around Soweto as a result of a trial to extend the G-Tech PLA Roller Planter practice influence.

In the G-Tech Youth COP, the estimated monthly mean *maize* production was 202kg and *sorghum* production was 152 kg. Tripp (2006) emphasised that biomass transfer technique

brings additional nutrients for maintenance and sustainability of the practice, hence the labour in cutting and carrying the material by hand, must be taken into consideration in the sorting and packaging practice. Table 4.8 summarises the knowledge, skills and enterprise development learning associated with the harvesting and storage practice.

Table 4.8: Summary of the knowledge, skills and learning associated with harvesting and storage practice

Knowledge needed and being learned	**Skills needed and being learned**	**Youth enterprise development learning in the G-Tech CoP**
Technical knowledge: storage conditions; categories and quantities of production	Sorting of crop products according to categories, sorting products into bags; measurement of products; storage conditions	Youth's ability to look at plant storage strategies to enhance crop value and market quality
Practical knowledge: sorting; quality management; quantity measurements	Preparation of products for market and organic material for re-use	Youth's ability to think of the value chain in terms of preparing products for market
Biodiversity agricultural knowledge: organic storage methods and protection of products in natural ways; re-use of organic matter	Using sun and cooling systems for drying and protection of crops in the post-harvest period	Marketing organic products and sharing production system knowledge and outcomes for expanding the practice to other sites.

Source**:** Longely et al. (2006), Tripp (2006) and observations

- ***Uses and benefits of various plants***

In addition to the above mentioned practices in the value chain development in the G-Tech process, in the study I also observed that the G-Tech youth COP were exposed to knowledge of the use and benefits of various plants and organic production processes (some of which are reflected on above). In addition to this, overall, youth learned that biodiversity could support productive use of plants, and plant matter. As explained above, youth in the G-Tech COP that various plants can be grown, and that plant matter not used for sale can be reused and/or processed to provide compost or green manure to enhance soil fertility (Tripp, 2006, 30). They also learned important principles of circular economy production, as the final product of the harvested material was in the form of seeds, which could be germinated for the next cycle of production. They also learned that many crops grow green because chlorophyll activity is responsible for keeping growth compact and shape (Kumar, 2010, 88), and that plants need a period of darkness to germinate, in other words they learned the basic principles of the biology and life cycle of plants through the practices outlined above.

In the G-Tech context, various practices have been devised for planting of diversity of crops

using the PLA Roll Planter as described above. In the G-Tech COP, youth practiced implementing organic waste management principles, and were exposed to principles of recyling, reducing and reusing organic materials, by reusing organic matter and seeds for regeneration. They learned not only to harvest the agricultural produce, but also to harvest by-products in the form of organic matter that can be used for future generation of their enterprise. Table 4.6. indicates the names of plants grown by G-Tech that the youth were exposed to, their uses and benefits. By way of example, in the G-Tech COP, youth during interviews reported that *soya bean* plants were used to produce food, as well as oil as feedstock for animals such as cows therefore, thus their stems can also provide for animal food, and other organic matter from the soya bean plant can be used for green manure.

Table 4.6. indicates the uses and benefits of plants grown in the G-Tech COP, representing further knowledge capital value that the youth are or can be exposed to as they engage in growing the different plants. This knowledge may assist them with marketing of their produce, but I was not able to observe if this had been the case or not.

Table 4.9: Uses and benefits of plants grown in the study

Names of the Plants	Common uses and benefits	Botanical names	Family
Soya bean	Soya is a major staple food for humans, providing a high quality protein and an edible oil. It is an exceptional source of essential nutrients, especially protein, dietry fibre, iron, manganese, and several B vitamins and is also used for animal food, traditional medicine and green manure. Soya can also reduce the risk of breast and prostrate cancer.	*Glycie max*	Fabaceae
Solaris/ energy tobacco	Tobacco plants are engineered to synthesize sorbitol. They increase boron mobility and tolerate boron deficiency in the soil. Manure most commonly used worm feedstock.	*Nicotiana tabacum*	Solaneceae
Green peppers	Green peppers are used as spices and food vegetables. They are used as medicines and as lachrymatory agents. They are rich in vitamins and anti-oxidants, especially Vitamin C and various cartenoids and can help with eye health.	*Solanum Capsinum*	Solanaceae
Beetroot	Used as a vegetable, and as food colouring and medicinal plants. They are also used as culinary herbs, medicinally as edible leaves, and for livestock fodder. They are a good source of essential nutrients such as Vitamin B9, manganese, potassium, Iron and Vitamin C.	*Beta vulgaris*	Chenopodiaceae
Onions	They are used as vegetables as well as tonic (high Vitamin C). Also used as stimulants, expectorants and have antibacterial and anti-inflammatory properties.	*Allum cepa Linn*	Liliaceae
Cucumbers	Cucumbers are high in nutrients, and contain valuable vitamins and minerals. The contain antioxidants and anti-inflammatory properties and may aid in weight loss and can also aid in lowering blood sugar.	*Cucumis satrus*	Cucurbitaceae

Carrots	Carrots are used as vegetables and can be consumed cooked or raw. They are rich in beta carotene, fibre, vitamin K1, potassium and antioxidant. They help with weight loss, and lower cholesterol levels and improve eye health.	*Daucus carota Linn*	Umberlliferace
Tomatoes	They can be consumed cooked or raw fruit and/or vegetable. They are nutritious, are high in Vitamin C and K1, and potassium, and are high in nutrients. They contain antioxidant properties that are said to reduce risk of heart disease and cancer.	*Solanum lycopersicum*	Solanaceae
Cabbage	Cabbage is used as a vegetable and can be eaten raw or cooked. It is a nutritious plant and is high in Vitamin C and K, as well as manganese and Vitamin B6. It also has anti-oxidant and anti-inflammatory properties and leaves are applied to blisters, gout and rheumatism. Its juice is used as a cure for warts.	*Brassica oleraceae*	Cruciliferaceae
Spinach	Spinach is an extremely nutrient-rich vegetable. It contains vitamins and minerals including magnesium, potassium, iron, calcium and Vitamins B6, B9 and E. Eating spinach may benefit eye health, reduce oxidative stress, help prevent cancer, and reduce blood pressure level.	*Spinaceae deracea Linn*	Liliaceae

Source: Adapted from FTFA (2011); Science Reporter (2011) www.grainsa.co.za; Kumar (2014); www.healthline.com (2019)

4.4.3 Sustainability knowledge capital value: Green technology, green economy and environmental management practices

Besides the biodiversity agricultural knowledge and skills, and associated enterprise development knowledge that the G-Tech youth COP were exposed to during the learning of the practice outlined in Section 4.5.2 above, youth in the COP were also exposed to knowledge of green technology (experienced through the use of the G-Tech PLA Roller) and green economy. While much of this has been highlighted above, I summarise the main aspects of this below, given the focus of the study.

- ***Green technology***

Through their engagement and experiential learning using the G-Tech PLA Roller Planter, youth were able to learn practically about a viable green technology, and with this, develop deeper understandings of the role of green technologies. Green technologies from an integral part of a response to climate change (ASSAF, 2014). Green technologies are categorised as products, materials and processes that are useful in attaining energy and enabling green economy development as is the case for the G-Tech PLA Roller Planter (CSR, 2015). They are classified according to how they play a role in saving time and energy, and in the South African context, how they also contribute to job creation and poverty reduction, hence the G-Tech focus on creating a COP training programme, and employment creation opportunities for youth

development. Green technology is described by ASSAF (2014) as a technology that involves or introduces application of knowledge that facilitates the utilisation of green activities for economic purposes. Green technologies are further defined as existing eco-friendly technologies and products that focus on embracing green economy and attaining sustainability (Asfaw et al., 2012; Parlova, 2015; Thangavel & Sridevi, 2015). G-Tech promoted this technology to accelerate and promote sustainability. Tripp (2006) emphasised that new technologies may provide insights on how to develop youth's mind-sets and attitudes towards sustainable agricultural technologies, what I am aimed to understand better in this study.

- ***Green products and green processes***

Green products have been classified as existing environmentally friendly products that are important in offering better solutions that also contribute to minimising environmental impacts (CSR, 2011; CSR, 2014). In the context of this study, green products and processes are classified according to how they are derived, processed and how they can be recycled to enhance sustainability, as also illuminated in the descriptions above. ASSAF (2014) highlighted that green technologies exist, but the challenge is to consider how they are deployed and implemented. Related to this, in this study I am considering what knowledge capital value and other forms of value are created as green technologies (G-Tech PLA Roller Planter) are engaged with and taken up. With regard to technological advancement, as shown above, youth in the G-Tech COP were able to utilise this new innovative idea, technology and product to assist them in creation of new value, a process that was made possible by the creation and mobilising of significant *knowledge capital value* in the form of technical, practical and biodiversity agricultural knowledge, skills *with associated enterprise development knowledge and skills development along the production and value chain process* described above, which represents the development of theory in practice.

G-Tech used the PLA Roll Planter as product and process because of its reusable and biodegradable properties to increase youth knowledge in areas such as biodiversity, agricultural processing and enterprise development. The use of green products in the G-Tech COP therefore refers to application of green knowledge for practical purposes in relation to technological innovation for food production. Green process refers to the procedure of technology uptake and use for food production, and how the product has been processed and manufactured (CSR, 2011; Parlova, 2015). The production process can support enterprise development within a

sustainable agricultural model that includes commitments to circular economy production processes. Through this, we see how a new technological advancement such as G-Tech PLA Roller Planter, is able to create market opportunities and viable knowledge capital value for youth enterprise development. As reported above, G-Tech strives to make high quality material such as biomass-derived products available for enterprise development, which relates well to the concept of green innovation.

- ***Environmental benefits of the PLA Roll Planter and associated knowledge***

Biodiversity, waste and water management were recognised as being important in the G-Tech sustainability practice (Tripp, 2006; Kumar, 2010; Musetha, 2016). The green technology PLA Roll Planter serves as a form of awareness, that is likely to be used as an opportunity to transfer new knowledge of reducing impacts on the environment. As can be seen above, the PLA Roll Planter was used as an educational system to express the relationship between environmental activities and environmental impacts (CSR, 2007). Youth used this new technology to experiment and examine how practices can be used to produce economic gain. With regard to the environmental benefits, G-Tech sustainable practice through the use of PLA Roll Planter has brought different capabilities for botanical, agricultural and horticultural knowledge including names of plants, their scientific names, their common uses and benefits (Tripp, 2006; Kumar, 2010; Musetha, 2016) . From its uses and benefits, it was reported that it need not only be used by agriculturists, and can be used by small-scale farmers, researchers, landscapers, rehabilitation practitioners and Agricultural Extension Officers (AEOs).

Biodiversity knowledge and practice: The value of biodiversity in the G-Tech youth COP was focused on the usage and benefits of a diversity of agricultural plants (agro-ecology) that could be been planted and grown to empower communities with knowledge, skills and an understanding of the value chain (CSR, 2007; CSR, 2011). According to Kumar (2010), every living organism requires certain elements for its growth and developments, as do plants. Contour farming was utilised as a method of growing *mealies* and *corns* together (Federrof et al., 2010;Tripp, 2006), as well as companion planting approaches – *tomatoes* grow well with crops like *onions,* as observed onsite. As shown above, G-Tech used the PLA Roll Planter as a modern method and technology to promote sustainability.

Waste management, with emphasis on organic waste: PLA as a green biodegradable, recyclable and eco-friendly product was designed to reduce environmental impacts, and is

certified under the ISO 14001 quality standards (CSR, 2007; CSR; 2011). Because PLA is biodegradable, youth were able to learn about biodegradable products. After harvesting of plants, PLA was not thrown away; it was kept to be used for other seasons and for new planting. It was reported during interviews that PLA can be used and rotated up to a period of four years. The youth were also encouraged to re-use organic waste to support their value chain development.

Water control and management: PLA is well known for excellent moisture permeabilty, thus facilitating wise water use. Manure, compost and crop residues were used as green manure which also holds water (Tripp, 2006). In terms of frequent planting and managing water, youth adopted the daily routines of working from Monday to Friday, and during weekends on a voluntary basis when they gave attention to the careful watering of seedlings. Kumar (2010) emphasised that we are living in a water scarce era, and conserving water is a key priority, which was why the G-Tech and PLA Roll Planter training stressed these aspects of agricultural development. The PLA Roll Planter effectively transports water and nutrients directly to the roots (CSR, 2015). Drip irrigation systems were described as a good method to grow plants in a vessel or a tube containing a free draining medium such as grow rock or perlite where the nutrient is dripped across the drip lines (Kumar, 2010; CSR, 2015). Kumar (2010) further emphasised that *drip irrigation systems* ensure that roots grow well. Tripp (2006) explained that the PLA Roll Planting method can be associated with *terracing*, which helps slow the water runoff and direct its movement. Additionally, the *system* can be changed easily where leakage of water pipes occurs. *Drippers* are prone to blocking, hence if they are not well monitored they might block channels resulting in loss of nutrients, hence water management was an important part of the learning in the youth COP. In the presence of *pores* and *holes* within the system, daily monitoring is required for the PLA Roll Planter. *Water tanks* were used as water sources available for irrigation, providing water for the drip irrigation system. This *irrigation method* was used to supplement low levels of precipitation. To fill the water tanks, water was pumped using an electric generator directly to the site, offering the youth practical understanding of the water management system, and water flow. Figure 4.13 shows how water was transported along the PLA Roll Planter system.

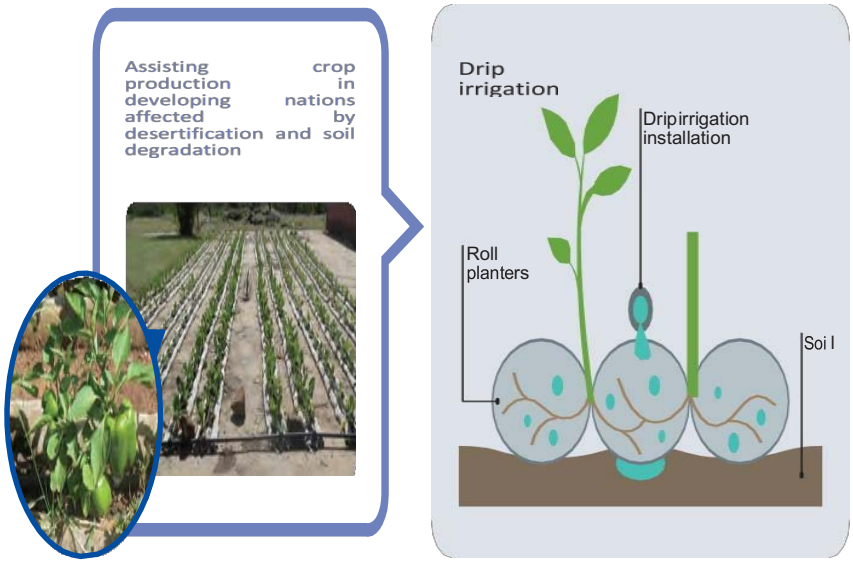

Figure 4.13: How the PLA Roll Planter and drip irrigation are installed and assist in crop production in areas affected by desertification, drought and soil degradation
(Source: CSR, 2015)

4.5 Conclusion

This chapter concentrated on providing an overview of the G-Tech practice of supporting and training youth to use the G-Tech PLA Roll Planter to develop agricultural biodiversity enterprise knowledge and skills. The main focus was on analysing the knowledge capital value as a form of potential value created for the youth. I focused in on practical knowledge, technical knowledge and agricultural biodiversity knowledge, as identified in the PLA Roll Planter practices observed in the G-Tech youth COP on site, and also from the documents that were used to inform the training of the youth. I also focused on how this was applied to support youth to develop enterprise development knowledge and knowledge capital value associated with sustainability, green technology and green economy development. In the next chapter, I consider other forms of value that were created for youth, mainly through considering the interview data in more depth.

CHAPTER 5
Value Creation Stories: Youth's Learning, Participation and Contribution to Sustainable Practice

5.1 Introduction

In Chapter 4, I conducted an in-depth analysis of the G-Tech PLA Roll Planter practice as observed on site, and as found in documents that were guiding the training of the youth CoP. The focus was mainly on knowledge capital value being created for youth (i.e. potential value in the Wenger, Traynor and De Laat (2011) framework). I indicated in Chapter 4 that this also created applied value for the youth, as they were able to learn a considerable amount during their participation in the practices that were described. In this chapter, I share further insight into the youth's experiences. To do this, I have analysed *value-creation stories* of youth in the *Community of Practice* based on their *work-learning setting* and their participation in the G-Tech practice. The emphasis of this chapter is to understand in more depth the value that was created for the youth through their participation in the practice, and how the participants learned new concepts and practices, how their experience has influenced and transformed via their participation on site, and how their learning activities has contributed to formulation of constructive interactions from other youth as well as the community as a whole. I was therefore interested in other types of value that were created for youth, in addition to the potential and applied value shared in Chapter 4.

5.2 Value creation stories: Youth's experiences in the sustainable practice

In this section I share four value creation stories of the youth who were in the G-Tech COP. These were compiled from interview data and observation data. I analysed the value-creation stories of youth from different backgrounds individually, and I sought to confirm and understand their existing views of the practice, their experiences and reflections, and views on different elements of the practice as experienced by them. I also included insights on their *learning experiences* related to the sustainable practice, *lessons learned* and their *acquired knowledge* based on their discussions and stories. I used pseudonyms to protect the identity of the youth.

5.2.1 Story 1: Youth Participant 1 (Sipho)

Sipho is a *supervisor* and the *leader* at the G-Tech youth sustainable practice site. He joined the project when it started in early 2010. When he started, he did not have qualifications in an

agricultural or environmental field, however he had a prior background of environment being taught on site and at home by parents. He first *learned a*bout plants at home from his parents and he currently passes his skills to other team members onsite; as a result he was promoted to be a *team supervisor.* He shared that he had acquired *indigenous and tacit knowledge* which he inherited from his parents while still young. He knows the basics of gardening and maintaining plants.

He started at the beginning of the project. He has been well trained on the current job on how to technically lay the PLA Roll Planter on the ground, how to connect pipes with the PLA Roll Planter and how to manage, maintain and grow plants within it. He has gained both technical and botanical knowledge; as a result, he was promoted to be a team supervisor. He shared that he has acquired valuable experience with the team and the environment has influenced the amount of knowledge that he has acquired and retained as an individual. In terms of his supervisory role, he shared that he has become confident that even when he is not around, his team will do the job diligently.

The CoP has benefitted him, as he has learned to promote his knowledge through communication with his team members. He shared that he has learned to understand who the youth were, their involvement in the COP in terms of responsibilities, activities and commitment towards the work they do onsite. He sees learning as a means of accessing information and exchanging it for personal development of himself and others; his learning reflects a series of connections that explains how youth connect with agriculture, involving relationships between people and nature.

Value has been created for him via experimenting with the technology for crop production, and in the value it presented for him to share it with others. He also learned the skill to use the PLA Roll Planter to become flexible and introduce a practice to others that leads to productive agricultural enterprise development, and change in environmental management.

He demonstrated enthusiasm for the practice, but also indicated that the learning of the practice was not without its difficulties, as shown in these extracts from his interview:

> *When we started with the project and attending the training on how to apply and lay the PLA Roll Planter, we were many, but as we continued with the training the number dropped dismally and I was the only one left …*

It was tiring at first to connect the tubes and pipes, and I was with the short Japanese guy

I have started with the project when it started in early 2010, it was tiring and required a lot of time, at first the group that we used to work with often make jokes about me and the short Japanese guy who trained me when we started constructing the PLA from scratch that I am too short, how do I cope working with him. This taught me that if you like something and have passion about something, go for it. Ever since I joined these project I have now became a supervisor for these young men working here. Now I am confident that even when I am not at work I know and trust that they will do the job better.

… in order to use PLA, only short people were required to do the job …

Sipho's story highlighted his background, what he knows as well as *commitment* and *passion* toward the work he does. His story shows that learning can occur informally, within the practice, even if youth learning experiences varied with the structural dimensions of their previous experiences. The story demonstrated that learning could happen both *formally* and *informally.* The story also confirms and validates that to belong to a CoP and to be successful in such a CoP, does not merely require a particular educational qualification but that individual characteristics such as perception (mind-set shift), intentions and aspirations are also required. His story indicates that persistence and willingness to continue despite adverse circumstances also had a role to play in his learning, and that he was able to learn by doing and observing over time. His story also demonstrates that technical changes and development in agriculture require appropriate knowledge. He has characterised practical, technical and botanical (agricultural biodiversity knowledge) knowledge as being important in his learning, which helped him to seek and develop change in the established practice. Needless to say, *technical knowledge* was not the only factor that contributed to Sipho's success. From the learning styles simplified by the study of Madiba (2016), it is possible to say that Sipho also responded as an *activist (*i.e. people who try something once, tend to thrive on the challenge of new experiences with implementation and constantly involve themselves with other people). Furthermore, his learning in the practice contributed value not to only to him but also other members of the COP.

Sipho's story above, also shows that being knowledgeable is about the ability to engage strongly with what *learning* (i.e. the potential value) was aimed to produce in the practice (i.e. applied value), and in his case *transformed value* was also produced as he became successful enough to become a supervisor, with capacity to train and support others. In his case, the potential (i.e. knowledge capital value) was converted into valuable applied and transformed value that he used to transform his insights and intuitions, and then support others to do the same.

One of the key insights emerging from his experience was the *enthuasism* that he had towards his work. The snapshots of the story shared above show that it is not *age, identity, physicality* that are important in development of skills, specifically when using a new innovative method. Rather, it was willingness to keep learning and make use of the potential value contained in the knowledge capital value that was shared in Chapter 4. Information had become knowledge when new insights were added (Li Yung Ting ., 2007). He demonstrated ongoing interest in learning new agricultural techniques even when others dropped out, as a result PLA Roll Planter was valued as a set of skills and new knowledge that contributed to his professional development in agricultural activities to the extent that he could take up a supervisory role.

As discussed in Chapters 2 and 4, according to the State of Green Technologies report in SA, youth capabilities to adopt, use and apply new technology matters (ASSAF, 2014). In Sipho's case, the PLA Roll Planter set up an intention of G-Tech to help him to develop these capabilities, and to develop a viable job from this and also through learning enterprise development knowledge and leadership skills, showing its potential transformative value for youth development.

5.2.2 Story 2: Youth Participant 2 (John)

John had only recently joined the project. He had less than six months being active onsite at the time of the interviews. He came 'fresh from school'. He did not have an environmental qualification nor work experience, however he actively continues to learn about planting and gardening. His active participation onsite was not explanatory, but he has demonstrated that he can work well technically and both physically.

Through observation, John has become an experimenter, and with his interest in learning by doing, he is actively converting the applied value of experimentation to form concrete

experiences that reveals his state of self-awareness and reflexivity. He shared that his learning started as a practical way of growing plants onto the PLA Roll Planter, which then led to a concrete experience of growing and harvesting crops through which he developed his skills. With regard to the experience he has gained, he demonstrated working well technically during harvesting season using scissors and secateurs. His experience constituted learning as practice that leads to action.

John is still learning how to construct a PLA Roll Planter, maintain it, and how to grow a diversity of plants or crops onto it. He is busy learning intercropping, that is growing intercrops such as *maize* and *sorghum.* This shows that he is gaining immediate and applied value from the knowledge capital value (i.e. potential value) that is being offered through the project, as described in Chapter 4.

The applied value of being able to experiment with the PLA Roll Planter technology has allowed him to recognize the value of participation, that is the value of gaining new skills, knowledge and experience during the project.

He shared,

> *I have just recently joined the project, I do not even have six months here, in addition I did not have more experience or background of environment, but I am still continuing to learn about planting and gardening.*
>
> *My expeience during and after harvesting season includes taking off PLA Roll Planter on the ground using stick-like material, though not scissors. The process and the practice helps to clean the area after harvesting, then clean the old compost for replanting the plants again. It makes it closer again to the way it should look, then new plants can be planted again.*
>
> *The process of maintaining a garden through using PLA is ongoing. I have been doing this for a couple of months. I started with tomatoes, second bed (row), the first bed was beetroot and the third bed was vegetables such as beetroot, even the fourth ones. Then later, onions, keep changing plants for seasons until the vegetables are growing older.*

As in Sipho's case, John joined the G-Tech practice with little experience of environment, agriculture or botany, however as a result of actively participating in the practice with enthusiasm to learn, his learning has changed his perspectives on how he viewed things,

particularly with regard to growing plants using the PLA Roll Planter, and he is beginning to be successful at this practice, even after a short time. Considering that learning is a systematic process (Blackmore, 2010; Wenger et al., 2011), John's story highlights that youth learning started as practical experience (i.e. combining potential value in the form of knowledge capital and applied value), can lead to further applied value and expanded concrete experience and further learning (e.g. he was first involved in the planting, and later the harvesting. John's learning involved learning to learn and learning to know, that is learning that encouraged revelation of ideas through the process of experimentation, showing the importance of combining potential value with applied value in youth enterprise development.

Significantly, in the case of John, *knowledge capital* (described in Chapter 4) available in the CoP (shared by others) was used as a valuable source and strategy to allow learning to happen. In a short time, John learned rapidly in the community of practice (COP) through his willingness to look and learn, and experiment with others' support. In other words, the COP promoted space for *social learning* (Wenger *et al.*, 2011), and allowed John an opportunity to identify himself in the COP, furthermore *recognising* and *discovering* who he was in terms of capabilities *(i.e. knowledge, skills, expertise etc.)*. As shown in Chapter 4 that reviewed knowledge capital available (i.e. potential value) in the practices and activities promoted and conducted onsite, knowledge about enterprise development is still emerging, but it is integrally linked to the knowledge of planting and using the PLA technology for crop production. Learning the crop production practices well using the PLA Roll Planter (i.e. applied knowledge of the practice) can therefore be seen to be an important dimension of gaining enterprise development knowledge, or at least it is a first stage of this process. John's story shows how this process can begin to emerge, and that *knowledge* is embedded in and closely related to emerging competence as identified by Hunt (2003) and Monroy and Petrosemoli (2012). Furthermore, John's story also shows that any individual can 'see' the immediate value of his interest in *learning* to generate applied value, and even transformative value, as shown in the case of Sipho. As shared above, John came from school with little or no experience or qualification nor background of environment or agriculture, but he willingly mobilized the immediate value of his interest in learning, and his ability to learn new things when given the opportunity in a supportive environment where knowledge capital and social and technical practice support were available to him. With this, he was able to grow in knowledge, *technical and practical competence,* and did great work during the harvesting season; thus there is also evidence of personal *transformed value* in his expanded activity competence.

John's story shows that becoming successful in a green technology practice is not *shaped* only what youth know or do when they start, but also by who they are and who they intend to become by mobilizing the knowledge capital and support in a context, and by applying this value in ways that can also help to develop transformed value for themselves. The G-Tech practice can therefore be seen and recognised as an opportunity for generating learning via potential, applied and transformed value at different levels as can be seen from John, and also Sipho's story above.

5.2.3 Story 3: Youth Participant 3 (Mike)

Mike is a participant in the G-Tech sustainable practice. He has a background in horticulture from previous work in a nursery. He does not possess an educational qualification in environment, horticulture or agriculture, though he is knowledgeable about the plants and their uses. He worked for Nursery Pot for a period of four to six years. His role was a casual salesman and he was involved in marketing. His daily duties were to sell plants such as petunia, seedlings and trees. He was exposed to various plants, and how to take care of them and maintain them. He demonstrated that he had learned from this experience.

By December 2016, he joined the G-Tech project and he has been active in learning the G-Tech Roll Plant practice for more than six months. Since joining he has received practical training on how to use PLA Roll Plant technology to grow plants. He reflects that his knowledge of growing plants was transformed. In the G-Tech COP, he was knowledgeable about how to germinate and care for seedlings for crops such as beetroots and carrots as they require foundational care as seedlings, due to his previous experience of working in a nursery. As reported in Chapter 4, seedling germination and care is an important part of the enterprise development practice, as healthy seedlings are required for transferring onto the PLA Roll Planter when the crops are then grown to harvesting point.

While in the G-Tech site, he continued to learn plant management systems, he has practiced growing plants directly from the soil and straight on to the PLA Roll Planter. His learning occurred as a result of his active engagement in various activities such as seedling germination and production, and planting of the seedlings onto the PLA Roll Planter. He has also been actively involved in the day to day practices of companion planting, intercropping, packing and harvesting, showing that he too was mobilising the knowledge capital on offer (i.e. potential value) into applied value.

In Mike's case, he showed strong confidence in his experience, and in the learning of new skills. He was inspired to learn new practices based on his earlier knowledge, and he was also willing to share his prior knowledge and experience gained in the nursery environment with others. His participation in the COP therefore allowed him to build on a set of skills that involved application of new knowledge that promotes sustainability, and co-learning. He was therefore also able to mobilise the immediate value of his previous knowledge and skills, and to combine it with the potential value (knowledge capital) on offer in the G-Tech programme, and create applied value for the G-Tech enterprise CoP. He was also able to create transformed value in himself (i.e. increased confidence) and for others who could learn from him. What appeared to matter in his learning was the identification and recognising of self with regard to his interconnection with other members and the environment itself.

As in the case of Sipho and John, Mike's learning of the G-Tech practice was generated through the experiential learning opportunities that were supported by the knowledge capital of the programme (described in detail in Chapter 4). His agricultural knowledge was transformed when he was growing plants using a unique technology such as the PLA Roll Planter; thus transformative value was created for him. The skills he possessed after joining the G-Tech project included technical skills, communication skills and he also now sees himself as a leader with a sense of knowledge and confidence. As such, and as shown in Mike's case, the G-Tech project contributed to promote collaboration and knowledge sharing by allowing youth to exchange ideas and convert them into *usable skills* (Wenger et al., 2002).

Mike shared these experiences as follows:

> *I have more than three years' experience from the nursery pot gardening. I have background of gardening. My experience in learning these now is mostly involved in the new knowledge of using the PLA.*
>
> *… For plants to grows well, they started with seedlings for crops that grow underneath such as beetroots, carrots and turnips, and then when they have grown taller, they transfer them onto the rows. Though for plants and trees such as Eugenia were planted directly onto the soil, in the sustainable practice, plants such as spinach were placed directly onto the PLA Roll Planter.*

Mike's story therefore demonstrates a form of continued learning and self-development. The sentiment of the story relates to Wen (2009) and Hunt (2003), who argued that *knowledge* is

the capacity to act on a belief that is true and justified, explaining the way that Mike transformed immediate value (of his own prior knowledge) through combining it with potential value in the G-Tech project (new knowledge capital) into applied and transformed value (new practices and confidence in his knowledge and skills). This reflects how creativity and performance can combine to create new value for success, and in all three of the cases discussed so far (Sipho, John and Mike), it is possible to say that individual emotions and determination have an influence in the process of learning. In Mike's case, from his prior practical *knowledge* and *experience* of growing *plants, vegetables* and *herbs* to sell, he has demonstrated expanded skills to develop his *entrepreneurial motives*. His *attitude* was reflected in feelings and enthusiasm for using the PLA Roll Planter technology, and perceptions towards the technology and how this has enhanced his performance and broadened his knowledge and skills in and for horticulture and crop production enterprise development.

Mike's story of his prior experience of working in the nursery highlights that new meaningful activities have happened on site that relate to his previous experience. His story was interesting in that it *produced a*nd *reintroduced* the usefulness of *prior knowledge* that can be expanded and developed from *botanical knowledge* to *technical knowledge for enterprise development*. It was interesting to observe how he modified his knowledge of how activities happened in nurseries for gardening and landscaping as he compared this with to the practice of using PLA Roll Planter for growing plants, indicating that he has a reflective learning style or approach (Madiba, 2016).

5.2.4 Story 4: Youth Participant 4 (Joseph)

Joseph is an active youth participant in the project. He has beenwith the project for five months. He comes from a construction environment, possessing knowledge of housing, building and plastering. He shared that he could do anything relating to housing, showing his level of self confidence in this previous skill learned before he came to the G-Tech PLA Roll Planter enterprise development site. What emerges from his two to three years of prior experience is the degree of confidence derived from previous learning and interactions. As a result of his background in practice-based learning, he had deepened his knowledge and understanding in practical learning environments, a skill that he applied in improving learning and practice by developing artifacts in the G-Tech context.

Like others in the CoP, he received practical training of growing plants using the PLA Roll Planter, and drawing on the knowledge capital that is available in the project (shared in Chapter 4). He reflected that in the short time he has been with G-Tech, he has learned a lot with regard to planting and gardening, how to separate the plants, seedlings, and how to lay the PLA Roll Planter on the ground. He demonstrated that he is becoming confident that he can do the job in the absence of his boss or team, and can even do it alone. He indicated that with the project's experience, learning, knowledge, teachings and lessons he had already constructed and developed a healthy garden using the new skills gained.

He was also able to utilise artifacts such as putting water bottles in the garden to prevent the dogs from eating in the garden. This type of innovation practice can be promoted as an educational practice for people and farmers struggling with animals entering their gardens.

Like Sipho, John and Mike, Joseph used the COP as a platform to continue learning. He learned how to use the green product PLA Roll Planter to grow and water plants. He creatively retained knowledge to a usable level by developing an individual healthy garden, which shows how he was able to mobilise the immediate value of his own prior knowledge and disposition, and combine it with the new knowledge capital on offer to realise applied value that was also transformative, as he developed his own personal garden. His prior experience in learning practical skills, informed his confidence, and ability to apply the new knowledge being learned into practice in a short time, as result the value of learning took place and was extended into other contexts (i.e. his home/community context). As can be seen willingness to learn, as well as a confident disposition, and commitment to experimentation and persistence can contribute to enterprise development skills. Joseph discovered the value of learning as a form of partnership that in turn created new value for him as outlined above.

Demonstrating his practical innovation in applied and transformed value creation, Joseph said,

> *We can use water bottles surrounding the garden to discourage dogs coming from entering the yard, for as they see their reflection in water they tend to run away.*
> *Coming from the construction industry, my participation has encouraged me to learn how to make a garden myself, however staying at home I have also learned this type of indigenous knowledge from my mother.*

In the case of Joseph, his practical innovation knowledge was characterised as a *concept, model* and a *tool* to impose decision (Wen, 2009), when he introduced the use of water bottles to reduce animal damage to the plants. Amongst the others in the COP, this activity of using water bottles in the practice, was valued by the other members of the COP as one of the biodiversity educational practices that could be promoted and used as a source of environmental education in the wider community. CoP members noted during their interview that people who struggle with challenges of dogs and other animals entering the site can use the practice. They went on to describe other common *practices* similar to humans protecting their gardens from small animals which included "*application of sieve, net and using safeguard lockering materials"*.

In this case, it was interesting to see youth introducing their own knowledge into the G-Tech practice to advance the practice. Their certainty about the usage of water bottles was used as tool that indicated that their own knowledge from home and/or experience is also acceptable to be applied in the practice. This story of new applied value created by Joseph, points to thinking about about how projects such as G-Tech PLA Roll Planter enterprise development programme can also encourage youth to be more innovative in the introduction of *green thinking* and *creating opportunities*, and not only draw on or rely on the knowledge capital value that is provided by the project. This has helped me to search for more explanations and holistically search for *meanings*, *connection* and *relationship* amongst the ways that value can be created *for* youth, but also *by* youth in green enterprise development practices.

In the case of Joseph's reflections on learning gardening from his mother too, it can be seen that application of rich knowledge in agricultural practices is important and that not all of this knowledge comes from the training in the project. In his case, Joseph applied *indigenous knowledge* as described by Tripp (2006), as the practice of describing plants and their uses according to the older generation; knowledge was taught from parents and the older generation. Joseph shared that despite his challenges of growing up, he learned from his mother how to grow plants for different seasons, and this also helped him to learn the G-Tech practices quickly. Thus, simialr to Sipho, John, Mike, for Joseph the processes of value creation involved him being able to make use of his prior knowledge and experience, and combine this with new knowledge capital (i.e. the potential value) in the G-Tech programme, in applying this to the PLA Roll Planter enterprise of growing crops (i.e. create applied value), and to create transformed value for himself in the form of new skills and confidence to use these skills more widely. In all cases, the practical engagement with the PLA Roll Planter enterprise was a central

platform for this value creation process. In the next section I reflect further on what can be learned from this study in relation to the research questions.

5.3 Lessons learned from analysing and interpreting youth experiences of value creation

With regard to analysing and interpreting youth's experiences of value creation in the G-Tech PLA Roller Planter enterprise development project , I have developed a framework to characterise the linkage and connections between different facets of the practice and learning associated with the practice in the CoP. I have come to realise that all these facets interact to create the value outlined above for the participants, as demonstrated by the figure below, and as discussed below.

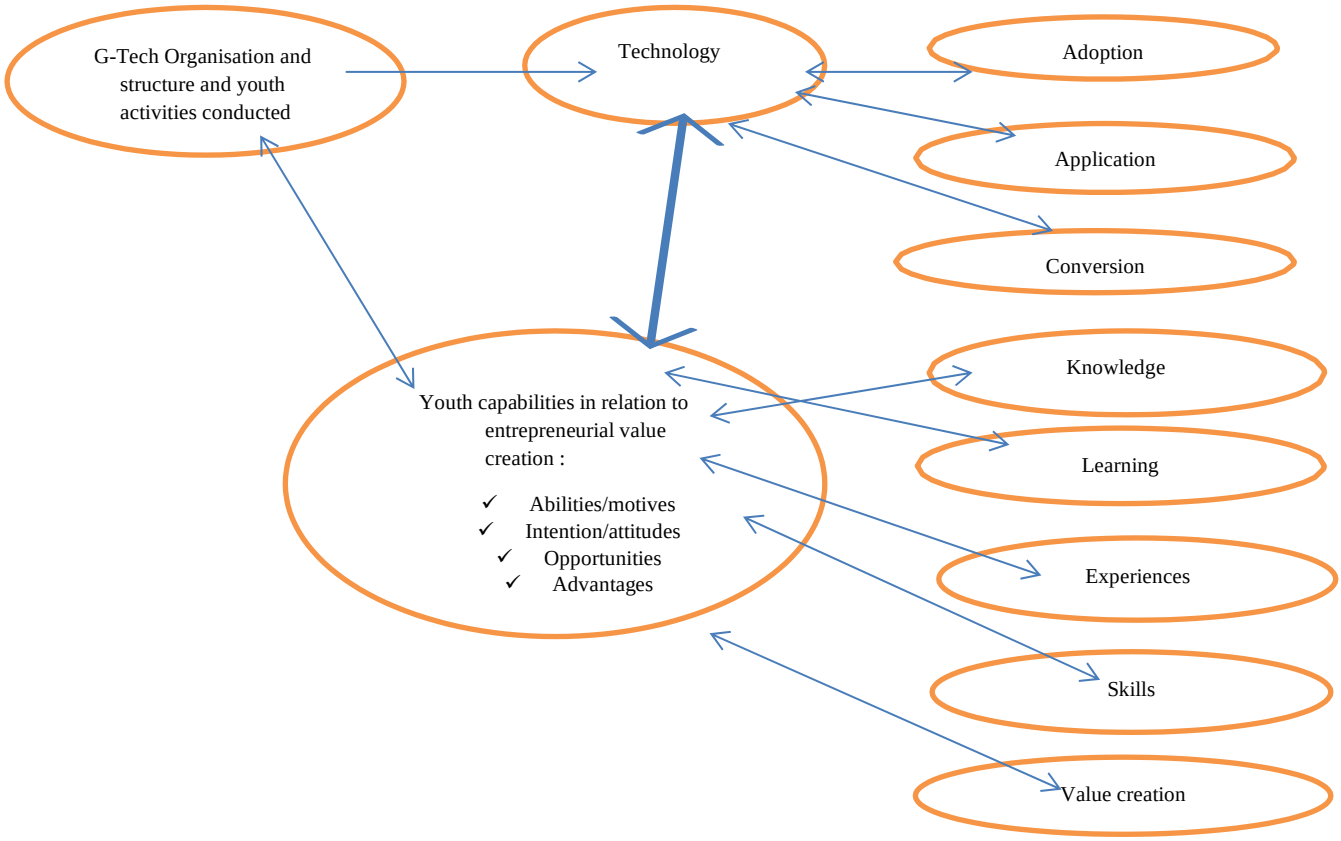

Figure 5.1: Links between technology and value creation in the learning of a sustainable practice

5.3.1 Knowledge capital as value creator for competence

As explained in detail in Chapter 4, the G-Tech programme offered the youth COP training in the practice of using PLA Roll Planter for agricultural enterprise development.Knowledge capital focused on the technology, the practices in the production value chain, as well as

environment and sustainability knowledge associated with green enterprise development and enterprise development knowledge was made available to youth in the CoP. This was through training, but a type of training that was 'on the job' and that involved learning by doing.

As such, this knowledge capital was a value creator for applied value and competence and confidence development as shown in the four value creation stories . Knowledge is not simply a 'thing to transfer' but in a CoP must be a *living* or ongoing process of engaged enacting of the knowledge in the learning of the practice as was the case for the four youth described above (Reckzwit, 2002; Wenger et al., 2002). The *analysis* of youth's experiences and their value creation stories, confirmed forms of knowledge used in the practice such as *practical*, *botanical* and *agricultural knowledge*. As shown especially in Joseph and Mike's cases, this knowledge was combined with their prior knowledge to advance their competence and confidence. In the case of Sipho and John, they combined this knowledge with an interest and commitment in learning to advance their confidence and competence.

In relation to what knowledge youth were learning and how they have applied it in different contexts as they adopted the technology, knowledge was used as a *critical resource.* The youth, as shown in the value creation stories above, demonstrated *considerable enthusiasm* about what they had learned and how they were able to use this in adapting to the technology. In learning the practice, the knowledge capital was actualised in the practical teachings of promoting biodiversity *agricultural knowledge* as part of practical learning in the form of *formal*, *informal* and *special training* in accordance with plant management and crop production and harvesting using the G-Tech PLA Roll Planting technology.

As shown in the four value creation stories, individual acquisition of knowledge varied and was related mainly to prior knowledge and experience, and time on the project. None of the four youth had prior experience of crop production enterprise development using the PLA Roll Planting approach, however, their value creation stories show that learning in the COP has encouraged a way of transmitting knowledge and stimulated full participation and confidence. Their acquisition of knowledge was based on a combination of their prior knowledge, their *attitudes* and *levels* of confidence.

As a *social learning practice* (Reckwzit, 2002), the way of acquiring new knowledge through practical learning in a COP with more experienced others such as Sipho, while also being able to draw on their own prior knowledge and experience, and even their own innovations (as in

Joseph's case) contributed to competency in the new activity for all of them. The *analysis* denoted that they have integrated, and still are integrating, new methods of growing plants such as *seed germination practice* and *crop rotation* using the PLA Roll Planter, to translate it to new meaning in terms of how it can be adopted and applied in other sectors such as the practice of generating income. The latter is also part of the G-Tech training as reflected in Chapter 4; although there is no explicit enterprise development training, it is embedded, but currently lacks marketing skills development. More emphasis nowadays is placed in the young generation's creativity to invest their knowledge and abilities in advanced technological developments to contribute to a combination of *values, approaches* and *technical abilities* that leads to innovation, but very little is known as to *how best to support this.* The above insights can provide useful insight in this direction. Importantly, the *analysis* endorses the importance of systematic and supportive introduction of knowledge capital that youth can draw on while learning new practices, and this can enable youth to value agriculture to *create better* opportunities and improve livelihoods, as was the case for the four youth in their value creation stories shared above.

5.3.2 Learning as a meaning making process in agricultural enterprise development

Learning refers to the continual flow of information in a series of direct or indirect connections that allow people to make new meaning and mobilise their immediate resources and/or prior knowledge to develop new insights and /or practices. Learning is a complex process, and as we can see from the four stories above, all four of the youth were involved in the same practice, yet were learning it differently, depending on their motives, their commitment, willingness to learn, prior knowledge and backgrounds in addition to their exposure to a conducive environment for learning in the G-Tech practice. To detect how learning happened in the context of the G-Tech sustainable practice (Wenger et al., 2011), I shared the value chain of the practice in Chapter 4, and the potential value that can be created through the knowledge capital (including skills development) for youth as they learn the various linked *practices* associated with the G-Tech PLA Roll Planter agricultural enterprise development project.

As discussed in Chapter 4, this translated to applied value which emerged through learning, as the COP involved the use of PLA Roll Planter which encouraged new *agricultural learning*, that involves application of knowledge and understanding to conceptualise ideas.

As also shared in Chapter 4 and in the value creation stories above, the COP learning encouraged the process of promoting sustainability. As a result, youth in the COP learned together practising growing resourceful crops using different methods such as *seed formation*; the method of plant protection by growing *seedlings* in seedbeds. This was done by using black crates to support propagation (Kumar, 2010; FTFA, 2012; Musetha, 2016). This type of *learning* was done repeatedly to encourage increased production of yields that leads to inspiring *entrepreneurial culture.*

The analysis indicated that youth learned new knowledge of using technology and refreshed and expanded their older, prior knowledge. New practices require *openness* and *willingness* to learn. The *analysis* further reflected that youth's experiential knowledge and background of agriculture varied; however, the COP proved that their knowledge of a new practice could be developed through training and experience.

As a result, the COP was perceived as a *social learning practice* (Wenger et al., 2011, which represented a prospect to demonstrate and promote how *learning* through using artifacts and technology can transform individuals in terms of building their confidence, improving their *behaviours* and *attitudes* towards learning new things, as well as their capabilities to adopt new technologies for enterprise development practice.

- ***Experiences of value-creation***

As explained in Chapters 2, 3 and 4, the concept of value in the study referred to the manner in which youth could apply their prior knowledge and experience as a form of immediate value that could be translated into applied and transformed value via *knowledge, creativity* and d*edication* which formed part of the ability to create value and generate value (Visser & Kymal, 2015; Wenger et al., 2015). Integrated value creation is important in any practice (ibid.) as was also shown in the four value creation stories above.

The nature of value creation in the COP was guided by the ability to mobilise and apply *knowledge* and *skills.* Value-creation in the study was used as a lens to determine if the benefits of activities had been *realised.* As can be seen from the four value creation stories, youth can be regarded as *value-creators,* with capabilities to realise the *opportunity provided by knowledge capital (i.e. immediate and potential value)* while experimenting and using this knowledge in new applied practices in the supportive learning environment of the

G-Tech COP.

The *analysis* revealed that, with the right support in place, youth were able to form a *shared practice* (Wenger, 1998). Based on the evidence presented, it is possible to say that G-Tech has introduced and promoted *new innovation* that is helping developing youths; *growth* and *self-realisation*. As a result, much knowledge was gained which introduced *creativity*.

- ***Skills development: Skills as the agenda and motivation for competency***

There is a need to transfer *skills* and *knowledge* in COPs, hence the importance of understanding the knowledge capital as a potential value for value creation in CoPs (Chapter 4). As shown in Chapter 4, the knowledge capital was closely linked to skills and potential to develop technical, practical and biodiversity agricultural skills, along with associated enterprise development skills. Amongst the skills that youth acquired and learned aligned with the *activities* and *practices* being conducted onsite within the COP, *practical and technical knowledge* and *biodiversity agricultural knowledge* facilitated the process of skills development such as *seedling germination and cultivation, crop rotation, inter-cropping* and *successive planting* as well as harvesting and packaging, water saving and composting. This enabled youth to sharpen mind-sets towards green thinking and suggest possible ways of how to use practices to bring in income. The study by Madiba (2016) emphasised that *green sustainable practice* is a *green job initiative* that facilitates and enables conditions of green jobs that includes: *skilling*, *upskilling* and *retention.* In this study, there was a correlation between *skills* and *knowledge* contextualised within the PLA Roll Planter technology environment, all of which played an important role in strengthening the COP. The *analysis* in Chapter 4 and above, shows that that most *skills* were learned through *practice.* Furthermore, the level of interest in learning and of proactiveness also contributed to how they developed and adopted *skills* towards boosting their attitudes in relation to their ability to look at alternative strategies to enhance yield production in the COP.

This was interesting in the context of none of the youth having had prior environmental experience or much botanical or agricultural experience, however *learning* in the COP has encouraged a way of transmitting *knowledg*e through *skills development.* There could be many ways to look at skills required for *entrepreneurial development*, and in this case study, using technology was perceived as an asset to youth learning the skills, and offering them new options and opportunities, whilst making changes in the sustainable practice. What was missing in the case study were opportunities to engage with the marketing of the produce as shown in

Chapter 4. This could be an avenue for further skills development. However, the following skills were developed:

- *Technical skills* (i.e. skills based on technical competencies), mostly the ability to adopt and use new techniques)
- *Generic skills* (i.e. general skills to be able to understand the basics of using PLA Roll Planter)
- *Soft skills* (i.e. skills that requires one to pay attention to detail, be able to work independently)
- *Foundation skills* (i.e. skills to prepare and develop individuals to be independent thinkers)
- *Life skills (i.e.* skills that allows individuals to be able to do tasks diligently such as time management, decision making and looking for opportunities to offer better services)
- *Green skills* (i.e. skills that are likely to provide opportunities for green occupations, youth have been trained to use PLA Roll Planter, which also promoted environmental management and sustainability skills)
- *Occupational specific skills* (i.e. skills that are based on the type of occupation in focus, in this case agricultural crop production)
- *Entrepreneurship skills* (i.e. set of entrepreneurial competencies for topping up individual green thinking including existing methods and routines towards developing values and interest, as they are known as skills that leads to job-creation; in this case study circular economy thinking; and value chain thinking were developed).

Consequently *learning* through using technology in this case study has brought many *opportunities* and *advantages* for youth in the COP in terms of both knowledge and skills development. Resulting from this was evidence that youth learnt together to achieve the common goal of agricultural productivity using the technology. The use of technology has created a solution that led to an opportunity for *innovation* and *economic growth*, that motivated the youth to learn together in this way.

- ***Technology for sustainable practice opportunities in the biodiversity sector***

The choice and selection technology and its economic use play an important role in the sustainable practice development as discussed across this study (Tripp, 2006; Musetha, 2016). In this case study, the PLA Roll Planter was perceived as a solution in the biodiversity and agricultural biodiversity sector. It also showed that green technology can help to develop

relevant solutions for problems faced in agriculture today. In the study, green technology was used as an *instrument of change.* The findings of the study show that the G-Tech technology allowed a *heterogeneous network* consisting of youth coming from different disciplines to work together as a team (Lave & Wenger, 1991; Blackmore, 2011). Having a similar interest in the technology and its applied use and value creation potential, contributed to building healthy relationships amongst the group.

The case of the G-Tech PLA Roll Planter and how it was supported to be taken up and used by youth in a COP, indicated also the importance of training and knowledge sharing in practice in the uptake of new knowledge and skills needed in the biodiversity sector. For that reason, this type of technology has contributed to helping the COP in raising awareness in terms of *efficiency, re-use and recycli*ng, which helps in protecting the environment by meeting the needs of the present generations without damaging the earth for future generations. Additionally,

- As a new green innovation it serves as an *opportunity* to allow *continuous learning* for activities related to reducing environmental impacts.
- As a *biodegradable, recyclable, environmentally friendly product,* it does not leave negative impacts on the environment because it can be broken down into carbon dioxide;
- As a *technology,* its known for being a reasonable water harvesting technique to be used in arid land for soil conservation activities;
- As a *mode of practice,* it has been recommended as an innovative way of growing cash crops to address challenges in agriculture including job-creation instead of youth unemployment.
- As a *catalyst;* it was used to promote agricultural production in terms of producing certified crops such as *sorghum*, *soya bean* and *maize* for cash returns.

Asfaw et al. (2012) have similarly unpacked the implications of achieving sustainability through new technologies. Therefore, the PLA Roll Planter is a good case that exemplifies how valuable crops can be grown to enhance sustainable livelihoods. The case has helped in offering better *opportunities* to determine cash and income generation for youth development. As an alternative *source of income generation,* a determinant factor of interest was to make a greater contribution towards livelihoods. As such, the G-Tech PLA Roll Planter technology, as shown in this study, is a *valuable tool* that can be used to reduce poverty and hunger and enhance *income opportunities,* while addressing sustainable development concerns, and

national concerns such as youth unemployment.

- ***Creation of an entrepreneurial state***

Reflecting on the youth's experiences in this case study showed that despite them not having prior training in the area of activity, their productivity and willingness to learn in the COP, when well supported with relevant knowledge capital and skills development opportunities in the COP environment, symbolised that they were ready and able to adopt the new technology.

The usage of PLA was based on how it can help in raising income, conserve biodiversity and be used as a yardstick to encourage participation in green practices. *Knowledge capital, as potential value, as shown in this study,* represents an opportunity to learn. From what was observed in the COP, the analysis revealed that youth worked together and learned to practice growing crops in a new way, in the process developing their *self*-confidence and entrepreneurial perceptions.

The value creation stories above, showed that that youth's *knowledge, skills* and *learning* about entrepreneurship were still in the developmental stage; however, in terms of *opportunities generation,* the COP has scope for extensive further development of the type of skills needed to be acquired in the agriculture and biodiversity sector for further enterprise development learning. Fonsecha et al. (2006) validated that *entrepreneurship* is a state of being that *can be learned through practice.* Even though it is not easy to achieve *entrepreneurial excellence* as a start-up, this study provides evidence of how this might be learned over time in communities of practice that are rich in knowledge and opportunities for skills development. G-Tech was found to be an *educational process* for entrepreneurship and enterprise development for this reason.

As indicated in Chapter 2, development of *entrepreneurial knowledge, behaviour* and *attitudes* in youth development programmes is still a huge challenge, and this case study only considered one practice with a small community of practice of youths who were learning a new practice. Nevertheless, useful insights into the role of learning in supportive communities of practice for enterprise development have been gained from the study which can inform other interventions. Further studies of this nature may be needed to extend insight into this important process if the creation of a more entrepreneurial state is to be achieved, and if enterprise development is to be a key activity of addressing youth unemployment and sustainable development at the same time.

5.4 Conclusion

In this chapter I shared insights gained into youth's learning in the sustainable practice via four value creation stories. These highlighted the way in which value was created for the youth, as well as what value was created for them. Throughout, the importance of the potential value in the form of knowledge capital was evident. However, the value creation stories also showed that immediate capital in the form of prior knowledge and experience was important for mobilising this knowledge, as was confidence and willingness to learn. Having practical opportunities for applying the knowledge in practice in the G-Tech PLA Roll Planter enterprise development setting was also critical for enabling the creation of applied value, and this led to transformed value for the youths concerned in terms of their own levels of confidence and competence and abilities to apply the knowledge in other contexts, and to share it with others. This pointed to insights in knowledge, learning, skills development and technology use for green enterprise development, all of which I have discussed in this chapter. I also argued that studies such as this are needed if the goals of moving towards and entrepreneurial state are to be achieved, especially also to understand how to develop youth opportunities to resolve unemployment problems, and to understand how to best mobilise knowledge and skills development in this process. In the next chapter, I summarise the study and offer some recommendations for further research.

CHAPTER 6
Summary and Recommendations

6.1 Introduction

In this chapter, I summarise the outcomes of this study in relation to the research questions. Detailed results of the study are presented in Chapters 4 and 5 and are therefore not repeated here. This chapter concludes the study with recommendations for further research. The chapter considers whether the research questions were answered, giventhat the the study was a case study, focusing on the deployment and establishment of the green technology called PLA Roll Planter, as implemented by G-Tech with a youth COP that also had the intention to support youth enterprise / entrepreneurship development. The study was particularly interested in value creation for the youth, and how the technology contributed to learning in the CoP, and how it helped youth to gain *new knowledge*, *new skills* for biodiversity agricultural enterprise development.

The study's main focus was to identify the significance of *environmental education* in terms of *entrepreneurship education* through the use technology, and to provide insights into how such practices can be supported in future.

6.2 Summary of the study in relation to the research questions

The main focus of the study was based on the need to identify and analyse an appropriate technology, in reference to what type or *what kinds of biodiversity entrepreneurial practices were promoted* in the COP in relation to the technology.

In Chapter 4, the G-Tech Roll Planter Technology as a *sustainable practice* was analysed in depth in terms of the potential value it could create for youth. The knowledge capital as a key feature of potential value was elucidated in detail, and this also gave insight into how youth could participate in the adoption and use of the PLA Roll Planter technology. In reference to what type of *biodiversity entrepreneurial practices* were promoted in the COP, the *analysis revealed* that the *technology* was used as an *instrumen*t for change. *PLA Roll Planter* in the study represented an example of green technology which has been *newly introduced* within the biodiversity sector, as a *fashionable environmental product* to provide change in areas characterised by dry conditions. Its validity and applicability to agriculture was further

described in detail as this was the application of the technology that was in focus in the case study where I studied the youth CoP and their engagement with and uptake of the technology.

The *findings* of this analysis revealed that the adoption of the improved agricultural technology "PLA Roll Planter" has significant positive impacts and knowledge capital that can offer potential value for translation into viable economic activity in the agricultural sector that can help to *lower poverty, increase food security* with a *greater ability* to withstand risk of damaging the environment.The *findings* of this analysis also depict that the deployment of this technology has significant knowledge capital and potential value to be deployed as an *integrated system* to illustrate *ways* and *measures* to reduce environmental challenges through technological innovations, while advancing green economy development and potentially also addressing youth unemployment (Lo, 1996).

Based on the evidence of the data presented earlier, it is possible to say that G-Tech have promoted and introduced new innovation which offers significant potential value for youth's *growth and self-realisation*. Chapter 4 also revealed that this potential value in the form of knowledge capital, was closely associated with skills development and possibilities for developing applied value.

Given the critical importance of the usefulness of agricultural technologies in advancing sustainable practices, ASSAF Report of 2014, highlighted that the implementation of *green technologies* plays an *integral part* and are required to do so, as a form of green economy transition. Therefore, lack of *technological enhancements* and *market imperfections* of agricultural products often leads to lock-in of small productions of crops and may lead to stagnation of the agricultural sector. The knowledge capital of the G-Tech practice therefore has potential to shift this dynamic, if mobilised into applied value and transformative value, especially for youth and new entrants into the potential enterprise stream.

A second interest of the study was related to learning green skills for entrepreneurship addressing the question**: How youth have applied their knowledge and skills in adapting to technology, which created value as they participated in learning communities of practice?**

As shown in Chapters 4 and 5, the relevance of youth learning together in the COP was influenced by the role and value of *knowledge* and *skills* mobilised and acquired. The

technology with its rich knowledge capital (i.e. potential value) was used as a *valuable learning tool* to be applied in different contexts, thus enhancing applied value. The type of *green skills* associated with the practice included; *alley cropping, crop cultivation, hardening off, migration, water harvesting and drip irrigation,* and *composting* as explained in *Chapter 4*, which introduced more insights of how they can use the *biodiversity agricultural knowledge* and *skills* to rotationally growing plants to generate income (i.e. *entrepreneurial mind-set*). As shown in Chapter 5, youth were able to learn this through *participation in the practice.*

Chapter 5 also indicated that youth's learning varied, which included *formal* and *informal* dimensions. *Formally* they learned by practising daily routines taught during practical training; most of which was learning through using PLA Roll Planter to grow *crops* by identifying which crops grow well in what seasons, and in what combinations and under different conditions. *Informally* they also learned from each other, and through trial and error, and through using their own prior knowledge and innovation ideas, and through perseverance, commitment, interest and confidence development. With regard to *skills development,* the skills learned were mainly related to the production cycle as supported by the G-Tech technology, with enterprise development skills embedded in these, but not explicitly advanced. The notion of youth *entrepreneurial intention* in the study was also not clarified, however it was clear that there was room for learning and growth in the practice. Chapter 5 indicated that youth were able to make use of potential value to create applied value and also transformative value for themselves and others.

In terms of *opportunities***,** studies have reported that *entrepreneurship skills* are scarce skills that still need to be identified (Bux, 2016; Qumza, 2011), and it is said that they need to be prioritised as they require an *individual mind-set, attitudes,* and *behaviours*. Similarly, they have been identified as skills for needed in the 21st century and that they can be learned through *practice* (Fonsecha et al., 2006). G-Tech has introduced a green innovation and technology that encouraged youth to develop their *self-confidence* in terms of *entrepreneurial perceptions.* What is interesting in the G-Tech case study is that they use a community of practice approach to developing enterprise development skills, and that the youth were able to learn the skills by *learning and working together.* This challenges individualised notions of enterprise development skills. Chapters 2 and 4 showed that *green entrepreneurship skills* are necessary and needed mostly in the biodiversity sector to provide the flowing services:

- To be able to promote entrepreneurial *opportunities* for cash generation and job creation potential
- To be able to contribute to sustainable development and greening of the sector
- To encourage and promote healthy lifestyle and personalities as well as offering opportunity for learning, employment generation and income generation
- To extend the type of critical skills needed to be acquired in the green sector

It would be advisable therefore for the biodiversity sector and the agricultural sector to consider the importance of *learning and working together* as foundation of enterprise development rather than using traditional individualised notions. Further research can be done on this in future.

Informally youth also learned by introducing their own creativity and innovation by developing *artifacts* as discussed in Chapter 5 that were valued amongst them. They transferred their learning to the homestead and their communities. An unexpected result was youth valuing the practice of growing plants through using PLA Roll Planter to the extent that in Joseph's case, for example, it translated into a rewarding hobby offering a safe environment for learning as indicated in this quote *"the daily learning practices aid in relieving stress from work and provide homes with safe vegetables as adding the flavour of different vegetables at homes"*.

Analysis of youth value creation stories in Chapter 5 indicated the importance of a stimulating *learning* environment for the learning of the sustainable practice. The learning environment for the sustainable practice in the G-Tech case, portrayed a great example of *a shared practice,* in a sense that youth's activities in the COP have *enabled* them to establish *entrepreneurial motives, entrepreneurial attitudes, behaviours around a shared practice, which they needed to learn together.* The value creation stories in Chapter 5 show that youth also found their *unique identity,* and *their uniquenesses* was found in the *aspirations,* their willingness to learn further from each other and show passion towards the work that they were learning to do.

The study was also interested in **understanding youth's capabilities in relation to entrepreneurial content, addressing the question: how have their experiences influenced their participation?**

As shown in Chapter 5, there were important **notions** that characterised how youth learned in the COP. Value creation stories demonstrated that youth were knowledgeable and adopted the technology well. As indicated in Chapter 5, studies have argued that no one is born with a fixed set of skills, however most *skills* can be learned through *practice.* The *analysis* of youth value creation stories detected that the use of technology created an option that youth were interested in, and that they saw value in as a solution that can potentially lead to a viable entrepreneurial opportunity for them that reflects innovation and economic growth.

The *analysis* in Chapter 4 further depicts that the G-Tech PLA Roller Planter practices can be seen as a rich *knowledge system* for *agricultural professionalism* which enabled youth to develop mastery of various skills including biodiversity agricultural knowledge and agricultural production value chain development. Chapter 5 showed that motive and interest to learn, as well as prior knowledge were influential in this process.

In terms of *opportunities generation,* and as discussed in Chapter 5, studies have reported that *entrepreneurship skills* are scarce skills that need to be *identified* and *explored* further (Qumza, 2011; Bux, 2016). The COP portrayed a great example of shared practice that has enabled the youth involved to develop their *entrepreneurial motives.* The uniqueness of their *identities,* and *aspirations,* shown in the four value creation stories, revealed how dedicated they were, and also how important motive was for the development of their practice.

The issue of *employment creation* was not the only criterion to assess the value creation potential of the COP; the practice of promoting agricultural and wider biodiversity entrepreneurial activities characterised the tendency of the practice to advance livelihoods was also noted in Chapters 4 and 5.

6.3 Recommendations for further research

The main purpose of the study was to understand the significance of entrepreneurship education in an environmental youth programme through the deployment of green technology, specifically the PLA Roll Planter in the South African G-Tech implementation context. Based on the evidence provided, the findings of the study reveal that the sustainable practice has increased environmental stability and youth learning, knowledge and value creation applied and transformative value with regard to the deployment of the green technology PLA Roll Planter. Drawing from the existing data, it is possible to say that the sustainable practice has

promoted new green knowledge, green innovation and the idea of effectively growing crops without damaging the environment bearing in mind that the technology itself is characterised as less labour intensive and less time consuming.

As also indicated above, the study has shown that:

- As far as modern agricultural technologies are concerned, there is evidence that agricultural research and technological improvements, such as the PLA Roll Planter, are helpful in creating potential and applied value for increasing agricultural productivity as well as reducing poverty and meeting demands for agriculture and food security.
- In such a context, training involving mobilising knowledge capital and practical applied opportunities for youth developmental programmes in communities of practice are a key element for advancing green enterprise development involving youth, and this offers a window of opportunity to strengthen environmental sector skills, as well as agricultural skills.

While this is the case, there is need for further research in the following areas:

- Further research needs to be conducted on how to involve more young people in participating in technology enhanced interventions such as the G-Tech PLA Roll Planter, in addressing pressing environmental issues towards a green economy.
- Practical training that involves knowledge capital mobilisation and application can be used as an intervention to promote youth start-up green businesses as in the G-Tech cases studied here; however as indicated above, this did not measure youth entrepreneurship ability and further research is required to develop this aspect of the programme further.
- Relating to the findings of the study, it is fair to conclude that *green entrepreneurship* is likely to constitute an important element with regard to youth personal development and well-being; at the same time it is seen as one of the solutions to combat youth unemployment. Young people need to be given help in order to start, run or grow sustainable practices effectively and further research is required to develop the findings of this study further, especially into the focus on how youth learn these skills in collective communities of practice where they can learn together with more experienced people in knowledge and practice-rich environments that are supportive of their learning.
- Efforts to promote use of *knowledge*, *skills* and the ability to provide appropriate solutions using newly innovative technology were recognised as being important in this study. Further studies that focus on this combination may be needed.

- The recent green innovation PLA Roll Planter has received considerable attention in the study, but only the agricultural aspect was studied in terms of its potential for youth learning and development. Further studies associated with this technology can be developed, especially at larger scales as this study only focused on one small community of practice of youth learners.
- Assessing the impact (which includes assessment and culture) of this technology is important and can aid in generating a better understanding of the complexities of the linkages between **agricultural technology** and **poverty;** this value creation process requires further study.
- *Entrepreneurship education* as the driver for youth development, is necessary for developing human's capability in shaping attitudes, skills and promoting a culture of entrepreneurship spirit, but more research is needed on how this occurs and is supported.

6.4 Conclusion

Relating to the findings of the study, it is fair to conclude that *green entrepreneurship* is likely to constitute an important element with regard to youth personal development and well-being, at the same time it is seen as one of the solutions to combat youth unemployment in South Africa. The study has shown that young people need to be given help in order to start, run or grow sustainable practices effectively, and that this requires investment in making the knowledge capital or potential value of enterprises visible and known to young people. It also involves giving them opportunities to learn how to translate this into applied value via practices that they can participate in and learn to do together. Additionally, it involves giving attention to the immediate value that they can realise out of their own prior knowledge and experience, and their motive and interest in learning, and it involves giving attention to the transformative value that can be created out of such learning processes for themselves in terms of enhanced confidence and competence, but also in terms of contributions to their communities and environments. In this study such possibilities were found in the G-Tech supported communities of practice that were well supported by a technology innovation that youth were interested in, and that reflected the company's interest in advancing in the triple benefit of green economy development, sustainability and youth empowerment. As a youth myself interested in this trajectory, I have learned much about how such value can be created.

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APPENDICES

Appendix 1. A letter requesting a permission to conduct the study

Rhodes University Learning Research Centre
P O Box 94,Grahamstown,6140 Tel: 046 603 8389 Fax ; 046 622 8028

02 February 2016

Re: Interest in conducting Research study at G-Tech

My name is Mabora Thupana. I am studying Masters degree in Environmental Education within the Environmental Learning Research Centre(ELRC).

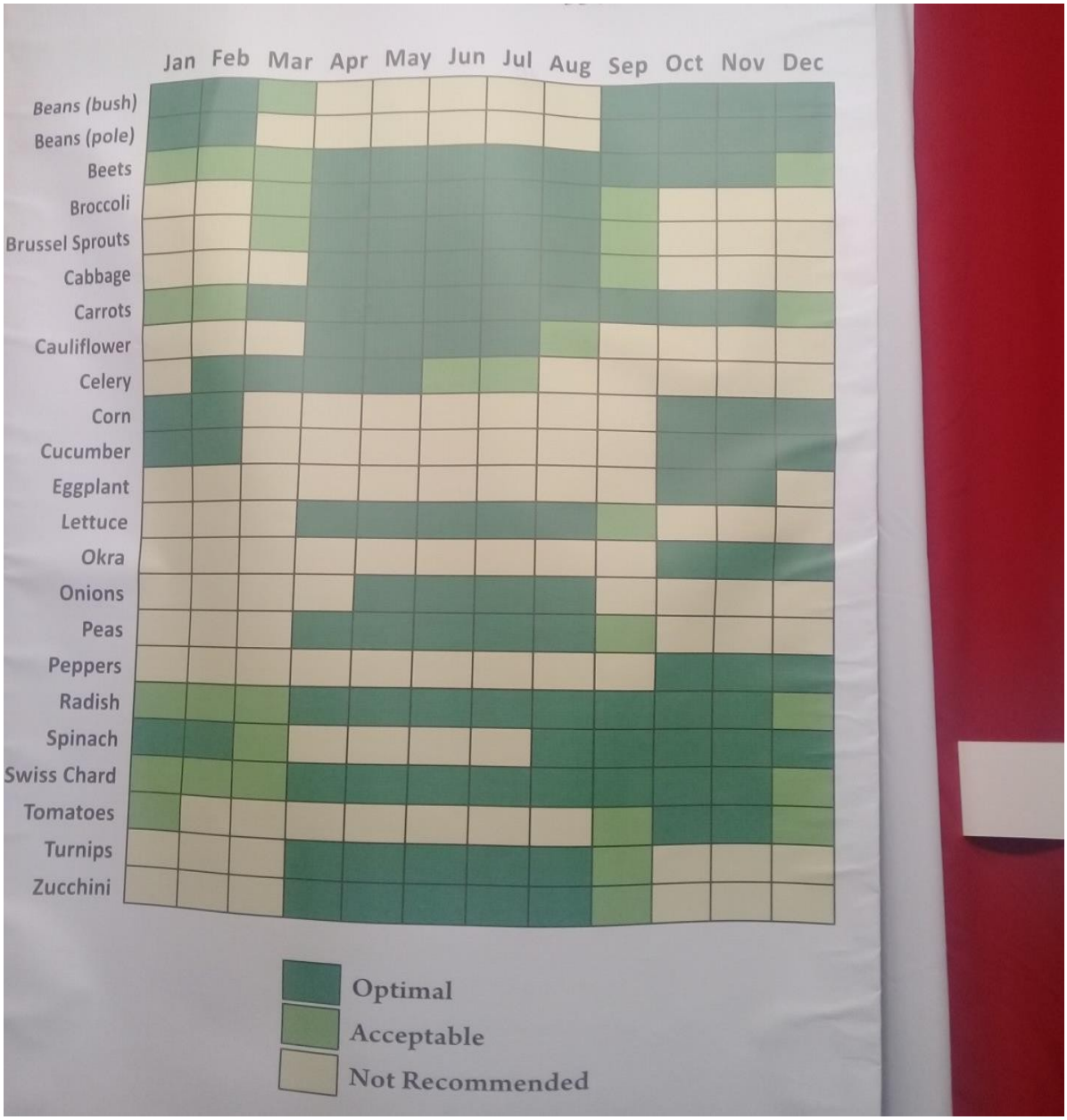
I am interersted in making use of G-Tech as my research study,hence I am requesting for your permission in that regards. My research is centred on the green skills in youth environmental programmes. The study seeks to respond to the type of biodiversity activities that promotes entrepreneurship in the environmental programmes, mostly seeking to understand what type of experiences, knowledge ,skills and ideas about green work do they come to the programme with and the value for youth as they participate in the learning of communities of practice.

I trust that you find this in order.

Your support will be highly appreciated

Regards
Mabora Thupana, Ms.

Appendix2: A calender imdicating crop season by month



Source: FTFA,(2012)

Appendix 3: The illustration of the codebook indicating how coding was done in the practice

Category	Data description, connection and classification	Data sources with evidence from analytical statements	Coding: Codes; Page no	Comments
		Research questions(RQ)	**Forms of knowledge**	
		Literature Review(LR)	**Type of skills**	
		Theoretical framework(TR)	**Type of experience**	
		Assumptions, Hypothesis	**Types of value**	
Knowledge	**Participants response**	**Research question: What type of knowledge about green work do youth posses that leads to sustainability?**		**How was these characterized in the sustainable practice?**
		Y1: Interviewee: "The material helps in promoting sustainability because of its high quality	**Practical knowledge; Tripp,2006; Hunt,2003, CSR, 2010, 1;**	Knowledge as a shared practice to inform what was made known to be truth based on the evidence provided:
			Indigenous knowledge;	
		Y2: Interviewee: " I was taught by parents on how to take care of plants at an early age, hence I have discovered types of plants, their used and benefits	**Kumar, 2010, Musetha, 2016** **General knowledge**	Self-taught knowledge being practices in the older generation
		RQ: What type of biodiversity of biodiversity entrepreneurship practices were promoted in the programme? **YI: Focus groups: "**I have learned various type of plants**;** **Y2**:" I have learned how to plant plant for different seasons; **Y3; "I have learned how to water plant using irrigation systems"** **Y4**;" I have discovered different types of plants, their benefits and	**Practical knowledge Tripp, 2006 Hunt,2003**	Knowledge as a practice to acknowledge other methods, measures and techniques
			Indigenous knowledge; Wen,2009 Musetha, 2016	Knowledge as a concept to make decisions of what is known to be truth bases on the results of objects or artifacts
			General knowledge; Monrey et al.,2013 Wenger et al., 2002, 2011	Knowledge as a valuable source associated with intelligence, experience, skills and understanding
			Common knowledge; Ting, 2007; Wenger eat al.,2011	Knowledge as a living process, as an onerous process to assess the value of deeds and to recognise what was known and tendency of knowing how
			Self-taught knowledge; Kumar, 2010; Tripp, 2006;	Knowledge as social and individual , in relation to how knowledge is developed to from other peoples understanding and practices

		uses"	**Wenger et al.,2002**	

		RQ: What type of biodiversity of biodiversity entrepreneurship practices were promoted in the programme? **YI: Focus groups: "**I have learned various type of plants**;** **Y2**:" I have learned how to plant plant for different seasons; **Y3; "I have learned how to water plant using irrigation systems"** **Y4**;" I have discovered different types of plants, their benefits and uses"	**Practical knowledge Tripp, 2006 Hunt,2003**	Knowledge as a practice to acknowledge other methods, measures and techniques
			Indigenous knowledge; Wen,2009 Musetha, 2016	Knowledge as a concept to make decisions of what is known to be truth bases on the results of objects or artifacts
			General knowledge; Monrey et al.,2013 Wenger et al., 2002, 2011	Knowledge as a valuable source associated with intelligence, experience, skills and understanding
			Common knowledge; Ting, 2007; Wenger eat al.,2011	Knowledge as a living process, as an onerous process to assess the value of deeds and to recognise what was known and tendency of knowing how
			Self-taught knowledge; Kumar, 2010; Tripp, 2006; Wenger et al.,2002	Knowledge as social and individual , in relation to how knowledge is developed to from other peoples understanding and practices
			Intergenerational knowledge; Wenger et al.,2002; Kumar,2014; Tripp,2006	Knowledge as tactic concept in relation to how knowledge involves deeper understanding of complexes issues either in the past or current generation
			Tactic knowledge; Wenger et al.,2002; Kumar, 2010;FTFA,2012	Knowledge as a collective good or a common distributor in communities and networks
			Explicit knowledge: Hunt,2003, Musetha, 2016	Knowledge as a formulation of an end attainment process
			Botanical knowledge; Tripp, 2006, Kumar,2010; FTFA,2011	Knowledge as a matter of competence, to demonstrate synthetic, technical and botanical knowledge acquired to seek change in the practice
			Horticultural knowledge; Tripp,2006;Kumar,201	Knowledge as a theory to portray skills and experience working with other people or the type of environment that influence what type of knowledge is retained
			Passive knowledge,	Knowledge as result of combination of expertise, values and personal

			Hunt,2003;; Federoff et al.,2010	approaches to transfer lessons learned from each stage
			Experiential knowledge; Kumar, 2010 Hunt,2003	Knowledge as a matter of participating and being involved and the ability to engage strongly in the practice
Learning	Participants response	**Research question: How and what youth learned in the COP that promotes sustainability?**	**Coding, code no, pg no**	**Comments**
		Focus group: Interviewees share that " Learning was viewed as the process and production of knowledge. Youth who come from different background are and have been capable of learning on how to use Technology as part of their developmental process, as a result they have developed artifacts that has transformed their learning ability to perform tasks in an creative manner that contribute to development of an entrepreneurial state and character.	**Social learning;**	Learning as an ongoing process to facilitate the acquired knowledge
			Transformative learning	
			Experiential learning; **Blackmore 2010;** **Wenger et al., 2011**	Learning as reflective process that involves engaging youth in different activities and other forms of participation
Experience	Participants Response	**Research question: What type of experiences about green work do youth posses that leads to sustainability?**	**Coding, code no, page no**	**Comments**
		Focus group: Youth shared that "their involvement in various activities has enabled them to become independent partakers , their ability to apply knowledge learned has lead them to be creative and committed to the work and activities that they do**."**	**Direct experience;** **Wenger et al., 2011**	Experience as the product of all learning
Skills	Participants responses	**Research question: What type of youth do youth come to the programme with and or they learnt?**	**Coding, coded no, page no**	**Comments**
		BDM: " I did not know anything, however we have learned to use the PLA, is like stockings, in the practice we add compost and put them together and plant them on top of it. That teaches us that we can use it to plant everywhere. Even on top of the surfaces or inside the house or even on top of solid surfaces"	**Technical skills; Tripp, 2006**	Skills as an opportunity to adopt the use of technology to create new ideas, skills that are constantly developed through training and experience.

			Green entrepreneurial skills; Fonsecha et al.,2006; Bux, 2006	Skills as the method to classify requisiste skills for both formal and informal learning and skills that provide an opportunity for green occupations, green jobs and green work
			Basic skills	Skills that allows individual to be able to do tasktasks diligently such as time management, decision making and looking for opportunities to offer better services
			Interpersonal skills	Skills that requires individual to pay attention to detail, be able to work independently
			Foundational skills	Skills as an identity to promote new learning and for agricultural processes and technology
		Y1: " We were just on how to plant,how to use PLA and lay it on the ground, how to plant seeds and crops and how to irrigate"	**Biodiversity skills**	Skills as an identity to promote new learning and for agricultural processes and technology
			Agricultural skills	General skills to be able to understand uthe basics of using techniques such as PLA Roll Planter
Values	Participants response	**Research question: What type of value is created as youth participate in the COP?**	**Coding, citations**	**Comments**
		Focus group: Y3>Y4:" In the COP we have build on set of skiils that involve application of new knowledge ., values lies on the realization of an activity"	**Immediate value Wenger et al, 2011**	Value as the application of new ideas and artificats to contribute to making differences

Appendix 4: Sample of Interview transcript and type of questions asked.

Interview Transcript-

Interviewer: As a business development manager of G-Tech, can you briefly tell me about your background, history and experience?
Interviewee: Background as in it the field of business management? Background I have studied at UCT majored in public administration and politics as the main course. I think I have always being interested in business. In 2012 I have started my own company, that is my own organisation called Tribute to 1976 Youth initiative that focuses on early childhood. In 2013 I have started a company called tribute Core which is a clothing brand funds the organisation, 50% of the products generated from the organisation goes to Tribute to 1976 Youth. That is where I learned about business development. I did not study business but I taught myself business. So, that is where I learned the values of developing an enterprise, positioning it within the industry. I got contracted by 2014, by G-Tech, May to come and do some small administration work for them. I started working for them for 3 months, that is where they decided I should take development enterprise of the company, which is where I started developing G-Tech.

Interviewer: So when you say, now you are a member of G-Tech, when and how was the G-Tech developed who came with the idea?

Interviewee: G-Tech was established in 2010 as an idea. Legally it was started in 2011, some of the funders of G-Tech were based in Japan, so they attended one conference where different technologies companies in Japan were exhibiting their product, one of the founder saw PLA Roll planter and then found how it can be used in South Africa for mine dump rehabilitation, that is where basically where the idea came up. It started as a project for mine dump rehabilitation because of the qualities of PLA, we decided to extend it to agriculture and renewable energy.

Interviewer: So basically you are trying to say the idea came from Japan?

Interviewee: It came from Japan…it is not just an idea. It is an idea and technology. The technology is from Japan and the idea to use and apply technology for mine dump rehabilitation …it is a South African idea. It is a G-Tech idea. I guess if we have to talk about the intellectual property, those will be two different intellectual property. One will be the technology and one will be the idea itself. Japan they don't have problem with mine dumps They don't have boreholes. For them PLA Roll planter was more useful for Green Buildings, and for us as much as we care about Green Buildings, we got far more bigger issues to deal with than Green Buildings, for instead mine dumps, agriculture and issues of food security ad climate change and all those things.. that is the way the concept come in.

Interviewer: And what type of your project focuses on, I know is youth, Why is it targeting youth?

Interviewee: Because our business model as G- Tech it is not really to be the implementer, we do not want to be at the end of the value chain, we want to structure ourselves as the company that patners with youth or community, provide them with technology, teach them on how to implement it, teach them on business skills, provide them with the necessary resources and let them be their own enterprises, that is the model of G-Tech.

Interviewer: So when you say you teach them, are you giving them the skills of be able to do or what?

Interviewee: So that they can be their own enterprises, for resistance for agricultural project, for the project that we are working on now, the large scale for mining dump project, we were producing biofuel feedstocks and we tend to produce biofuels feedstocks. We got the ARC they are the experts in agriculture, all the cycles of agriculture from planting to harvesting, those are the skills we empower

the community so that they can be self-sustaining. We teach them on agricultural fundamentals and then empower them with resources including PLA Roll planter and let them be their own enterprises.

Interviewer: So within your project, what type of documents do you follow or look upon? And are they accessible?
Interviewee: When you say documents what are you referring to?

Interviewer: For resistance, you mentioned that the challenge you are trying to address within the project is the issues of mine dumps, mine as a polluter, so you are trying to rehabilitate through agricultural practices, do you follow some policy or regulations?

Interviewee: For policy, the Mineral and Resources Development Act of 2002, somewhere along the lines, it says that each and every mining house has to rehabilitate post closure, when the mining dump closes they have to rehabilitate all their dump facilities, that is the legislation and is caught to what we follow. Also, the chatter says provided the mining companies have different strategies of rehabilitating, these is not exact it is just hypothetically, that they can do more than just rehabilitation by pulling vegetation covers mine dumps to rehabilitate by establishing types of biomes, ..they also or they should rather look for sustainable solutions for mining communities that is where G-Tech comes in.

Instead of putting vegetation covers on mine dumps we are not really empowering the communities…yeah we are compacting dust and soil erosion, but what about the livelihoods, how are people generate income from those facilities. We decided lets plants biofuel feedstocks, process them and produce biodiesel that is the model of G-Tech we are looking at, it is not just rehabilitate as per legislation but we also looking at sustainable means of communities that are affected by mine dumps.

Interviewer: Any other documents or maybe training? And when you say you are trying to empower youth with skills to be on their own what do you mean?

Interviewee: Yes, we are still working on the document, because ARC and CSIR as business patners they are doing research on the best viable method to use or implement to consider when rehabilitation, so I guess that is where some knowledge, the skills, the intellect which come from learning on how to plant feedstocks , when and how ,what type of skills do we need in order to achieve best yields, all of these things , if we are going to need irrigation, how best do we irrigate, what type of..I mean how often do we irrigate and all of those things.

Interviewer: Do you perhaps…or when actually when all the documents will be available?
Interviewee: I think they will only be available after the study and the study is proposed for a year and more, probably two years. That is where we will have extensive study on the skills and anything else.

Interviewer: Luckily enough I have managed to go to the site, one of the site in Diepsloot Laezonia, I came across young men who are already working on the project or site, before they start with the project did you give them some training or something? What did you give them, what did they follow because they are planting very interesting plants there at the site?

Interviewee: We gave skills but it was not on the formal basis as in attending workshops and all of those things, but ideally we would like to have something like that, where people attend workshops, where we teach about PLA Roll planter and how to use it and agriculture as the whole, on what to plant, when and how to harvest etc. In terms of that project we did not give extensive skills development programmes in a sense, we just taught them on how to plant, how to use PLA Roll planter, how to lay it, how to plant seed on it, how to irrigate , but I cannot say that there is a specific document that they follow or we follow?

Interviewer: So maybe…you are talking about the PLA Roll planter and I have managed to come to site and observe it, can you elaborate more what is the PLA, how it works and what is its main function?
Interviewee: PLA is known as a Polylactic acid, it is made of cellulose of different plant waste materials, so they use those cellulose to form a string or yarn, to design a fibre, flexible but strong fibre, which they call *PLA* Fibre. It is a yarn or string and then after you take that string you knit it into a sock, that is what you call the roll planter. You saw the tubes?.The sock that they seeded in between.. ‘*’tse di circle* “, ‘*tse three’’*…those lines?

Interviewer: Maybe I did not notice that.. (*Thus interviewer trying to respond*)
Interviewee: But did you see what we planted on…that sock –like..? That is what we call PLA Roll planter. That is what we stuff -in fertilizer, we design it in a sock-type structure and we stuff-in fertilizer, we lay in inner three or two lines, close together and then we put seeds in between , so they act as a medium and a substrate for any plants that grow up roots, so the Roll planter that is white sock ,it is biodegradable , it is carbon –dioxide neutral, it has a very long life span, it is elastic but strong , so those are the qualities ‘ *tsa yone* ‘ ..that is technically what the Roll Planter is.

Interviewer: For the fact that I went to the site and observe I am trying to think and to understand
Interviewee: I think it might have worked well and better, if I came with you so that I can explain thoroughly ‘*gore’* this is the Roll planter and how you use it, suppose maybe when you are free let me know so that I can go with you.

Interviewer: So when I was at the site people say that they are planting different types of plants each year. They mentioned that they are planting sorghum, soya bean etc..so where do you actually distribute them to when you harvest?

Interviewee: Sorghum, soya beans initially was for internal studies, but now we try to build relations with independent biofuel products, intending to plant and produce for them, like we produce sorghum and soya beans. We sell it to them and we process and they sell their own ethanol or diesel so that is what we intending but now we just doing an internal studies, so its not really about where do we taking it, it just for study, we got CSIR and ARC working for us, so I guess for now we can say we taking to them for study.

Interviewer: What type of skills do they come to the programme with, to the G-Tech, your employees, I have managed to interview few of them, I was trying to get up to where they come from, what type of training do they come to the project with or the background?

Interviewee: I mean, the Roll Planter on the G-Tech business model as a whole is not a skill intensive type of the program. You do not need to be highly qualified to be able to use the Roll Planter or to understand its technicalities and qualities and how to implement or use it, so we not really focus on what type of background one comes from in order to be capable to absorb the structure and put it into place or the skills we are trying to implement. I am sure you noticed that people from the side they cannot say that they are from specific background, just people who are very passionate about agriculture who want to be skilled on some things that they can live on in a sense I guess that is the whole concept.

Interviewer: Majority of them mentioned that they recently joined the project earlier in January – February, the only person who is in the project for long is the team supervisor , the current supervisor, maybe to ask majority of them are males, what can you say about the valueof women in terms of business development and environmental related activities. What do you think is the role of women?
Interviewee: That project is a pilot project, it does not defines the structures or the ideals of G-Tech to a large extend, by large extend I mean ideally we would like to have a proper working structure , we would like to have women on board, have skills to teach , hold workshops, conferences on how to empower people with skills, but because that is just for the project we just wanted to study the end results for now, actually we want to study the PLA, we want to study the Roll planter before we can invest ourselves in teaching and all those stuffs. As per our organisation we focuses on mining

communities , and if you look at the structure in mining communities you can see that is mostly women and youth who are mostly affected ,because mining in nature or mining historically are male dominated.

If you can go to mining community you will see that all jobs that are reserved in the community are men. Men are traditionally known to be employees to mining, women just go there to offer other services besides working in the actual or benefiting in the actual industry. So we are trying to change that, we trying to bring women in the mining industry but through a different course. I guess that is where women and youth come to the project.

Interviewer: Can you comment on your experiences on managing teams?
Interviewee: From my observation, I have seen passion and the need for income, those are the two things.

Interviewer: So you mention passion and the need for income generation?
Interviewee: There is passion and the need for income generation and I think those are important qualities that pushes us a G-Tech to do more, because you can see a need for salary when people are willing to put passion in whatever they do…those are the things that pushes us as G-Tech to improve people livelihoods to set skills and provide income for people.

Interviewer: Do you see any opportunity for business and of entrepreneurship within the project, do you think they can generate knowledge and be on their own?
Interviewee: Entrepreneurship as in it generate knowledge or business skills?....Yah I think they can, I mean that is what we aim, that is what we are looking forward to, even now the studies that we do we have to analyse how best to empower those people to be self-sustaining and independent, already the guys as at Laezonia they are taking care of the site…you know they are taking care of everything I am never there and my seniors are never there as well. I might pass there today but I tell you if I might pass there I will find everything in place, so those are some of the signs of independence and initiative. In business you need those skills. You might need more finance, working on your finances but t of women in terms of business development and environmental related activities. What do you think is the role of women?
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Interviewer: So how often do you visit the site?
Interviewee: It is random, it is not given. It is not one of those that every month I am there, but I make sure that each and every month I am there, once or twice I am there. This is my first time in May I am probably *gonna* be there in sometime again in two weeks or in a week, so those are the some of those things it is not given at when am I supposed to be there, but whenever I got the chance to go there I pay the visit.

Interviewer: Maybe just to ask, you have shared a lot of interesting information that I was not aware about. Can you share your plans maybe your five-year plan?
Interviewee: Our five-year plan is to have rehabilitated over four or five dumps, and bear in mind that each dump is 20-30 hundred hectares, minimum is 20-200 per hundred hectares. Our plans is to have been rehabilitated at least five dumps in five years, through that we want to also influence the bio-energy in South Africa ,we want to see the whole lot of communities empowered (self-sustaining communities empowered),providing or supplying independent producers with feedstocks on a sustainable basis, that is what we want to see. We also want to branch to out to Africa, West Africa , the Sahara region especially that is where the drought is more dominant and that is where we think that PLA for agriculture most especially will be more viable . South Africa we have too much fertile soil , we have sufficient rain to an extend beside the last drought season, but we fairly well in terms of Agriculture we have the whole lot of arable land in that is not utilised especially in Limpopo, the small farmers. So, South Africa its business does not really offer opportunities in terms of the agriculture component and we not really prioritize South Africa in terms of agriculture anyway, but Africa, the Sahara region ; Senegal, Nigeria, Guinea that is where we want to be most proactive.

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Interviewer: Oh I think I see where G-Tech is focusing, maybe I did not ask about the other information, what are your experiences of managing team, what are challenges that you have come across as managing team?
Interviewee: What I have noticed *ke gore***,** we need to have extensive model in terms of providing agricultural skills for resistance planting, we need to teach on that, there is a certain distance that you have to keep when you seed..*uh*.. 15 millimetre something like that, so that you can allow each plant to have sufficient energy, when you overcrowd the plants they take too much energy, they don't breathe well in a sense I don't know that in terminology *ya* agriculture, but you cannot overcrowd your plants *a di kreye* sufficient sunlight, nutrients and water, so those are some of the skills that are needed because '*a ba so understande*' that small elements, but overall in terms of leadership, initiative and overside I have not come across any problems.

Interviewer: And with team?
Interviewee: With team I have not came across any problems with team and with regard to manufacturing the PLA we need a strong leadership that is what I have noticed as well**,** *gore* there is too much independence and there is lack of commitment and as a result it affects our manufacturing capacity, we need a strong overside and leadership. '*Ntho ye o e boneng ko* Laezonia is perfect.

Interviewer: I am interested in PLA, I have never come across this idea and it so interesting and when I was at the side they told me that after every three or four months they harvest the plants, they grow them for four months. I want to know where do you dispose the material , the PLA?
Interviewee: The material it degrades itself, it degrades with time**,** but *'bjanong'* we have noticed that we can afford to plant seasonal crops, because the minute you cultivate you break the PLA. '*Akere*' is a sock and when the root system develop they penetrate inside it through the Roll Planter, so when you cultivate and pull the feedstocks or the plant it breaks the PLA , the PLA Roll planter. What we think of is to plant perennial crops, is crops you plant for over a long time, '*wena'* you just go there and harvest 'ts*ona*' they come up again, you don't take them from the root system like trees, for resistance mangoes and apple trees. We considering on planting the perennial crops so that we don't cultivate the root system.

Interviewer: It is very interesting, I was concern from the environmental background on how and where do you dispose it.
Interviewee: Nah…it degrades itself.

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Appendix: 5: Focus group interview transcript

Interview transcript
Interviewer: As group, how long have been working together and learning together?. Do you think you have acquired the relevant skills since you joined the project and why?

Group: Interviewee: Yeah we have gained so much experience, since we joined the project

Interviewer: And others? Do you feel more inspired now to do work and for the work that you do and why?
Group: Interviewee: 1, 2 and 3: Yes we have gained a lot

Interviewer: Maybe can you share some of the *knowledge* and *skills* which you learnt before you joined the G-Tech?
Group: **Interviewee:2:** Actually we are from home, there are farms and even garden, but the method that we are using here is not the same that we use there. I know how to harvest *soya*, but I did not know how to plant them under this PLA. I was not aware that you can make space for planting like these, and these is a symbol that you can plant anytime, whether there is rain or no rain,is still the same when using PLA

Interviewer: Have you gained confidence now? What motiviate you to do what you doing?
Group : Yes (All interviewees responded)

Interviewer: Did you see any opportunity for learning about what you do, that you did not see before?
Group: Interviewee: **3**:Yes, I see the opportunity, because after these ones we gonna plant vegetables or tomatoes, even green peppers in summer time

Interviewer: Some of your colleagues were sharing like, I did not know that they have seasons, you plant different plants with different seasons
Group: Interviewee: Yes

Interviewer: Since you joined these project, did you see an opportunity of converting your own skills that you have learned or grown?
Group: Interviewee: 3: Yes you can own your own project, opportunities are there and you can start to sell it when and if you want

Interviewer: What difference did the project or the practice made into your social life or into your career life in general?
Group: Interviewee:2: Yeah, it is a big difference, because sometime maybe when you want to go to your home country you can make more money

Interviewer: A lot has been mentioned here,several times, are you considering yourself as a sales person or an entrepreneur?
Group: Interviewee:3: A salesperson

Interviewer: So with that skills you learnt again, where do you think you will use in country for incase ,when you saying you see an opportunity of what you learn and take it back home in your community?
Group: Interviewee:1: I use it in compost , in between ,then water, the compost. I put a drainage, and I put it in a compost then I plant.

Interviewer: When I was asking about *change*,I wanted to hear even from others , what the difference coming from these project made in your social life or in your career?
Group: Interviewee:4: Especially for me these project has changed my life and made me someone that I know that now I can do something through these project, even the bosses know, he does not come to the site more often, but he know that I can handle in the site very well, because I taught that guys everything even if I am not there , they can perform well.
Interviewer: And how did these new knowledge understandingof using PLA affected what you do, or what you learned to do before, what is these new understanding or skills do in your life not in an ordinary way?
Group: Interviewee:2,3: Actually I was surprised I thought it was not going to work, but I saw it

growing. Because we know we plant *stripping the soil* ,because some people they come and see and check how are you plant it, they asked why do plant ontop of PLA not straight to the soil, it is going to cost you lot of things, you have to cultivate everything right then

Interviewer: Does PLA cultivates itself or it cultivates the soil?
Group: Interviewee: 3: Yeah, we only cultivate in between, no cultivation is done by the sides at the roads

Interviewer: When you saying lazy you are giving me another idea**,** But in terms of maybe job creation would you recommend the usage of PLA in the communities of practice, will you say that people should try to use PLA has it worked?
Group: Interviewee:2: Yeah people should try and use these because PLA is very safe, you can even plant on top of tennis court, ontop of tar road using these PLA

Interviewer: So PLA is safe, so you can recommend it?
Group: Interviewee: 4: Yes it is safe

Interviewer: So since you said last time I came for observation these rows were having *sugarcraze*, when do you harvest I want to come and observe at how you do it,you shared you *use scissors*,you not using barehands…..
Group: Interviewee: 2: It will affect the PLA. When you watering the plants using PLA, you need to monitor it at all the times, monitor water leakages. PLA is suitable for any season, even when harvesting

Interviewer: When you say you use *specific techniques* what do you mean?
Group: Interviewee: 3: *Scissors* make**s** the process more interesting, so PLA is so sensitive, that is what I am saying

Interviewer: Have gained confidence in using these PLA and the ability to use these PLA last you shared the *challenges, with* these *triple lens* the wholes of the water is leaking ,so you have to monitor when you watering the plants. Can you use at anytime, anyhow that is what you are saying? Is it suitable for any seasons?
Group: Interviewee: Yes

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ANNEXURE

Alley cropping:the practice of growing plants on land in a sustainable manner

Artifact: it is the symbol or material that can be employed creatively in the practice

Aeroponic:is a plant-cultivation technique in which the roots are hanged suspended in the air, while the nutrient solution is delivered in for the mist (i.e. a hydroponic gardening)

Agriculture:is the process and source of livelihoods that is associated with the use of sustainable practices

Biannual plants or grasses: They are identified grasses that are useful for moisture preservation of soil and moisture

Biomass: is an organic matter and a form of waste that uses fuel in power stations to generate electricity

Biomass transfer technique: a technique that involves growing a crop in a separate field that can cut and carried to provide organic matter

Chlorotic: a general term for yellowing of leaves through the loss of chlorophyll

Dessertification:the process at which an area turns to become a dessert due to drought, deforestation or inappropriate agriculture

Dispersion: the process of distributing materials over a wide area

Entreprenuerial activity: a proportion of a driven activity as opposed to finding no other option for work

Entrepreneurship education : the practice of using creative ideas, innovation and skills in the context of new business creation and start-ups

Entrepreneurial intention: the conceptual level of individual involved in any entrepreneurial activity or who intend to start business

Entrepreneurial mind-set: is the individual mind-set that combines various thinking capabilities associated with the ability to think creatively, adaptively as well as demonstration of entrepreneurial knowledge, skills and innovative practice

Entrepreneurial behaviour: is a construct of an entrepreneurial intention within an entrepreneurial model to manifest opportunities in a productive way as demonstrated *towards attitudes, motivations, intentions and behaviour*

Employed: is a concept recognised persons aged 15 to 64 years,who during reference did any work for at least one hour or had a job or business but were not at work (temporarily absent)

Experiential learning: the process of learning through experience defined as learning by means of reflection on doing

Green economy: is a concept that is associated with sustainability, referring to the economy that is conducive to opportinity creation**Green manure:** refers to the cover crops with the amount of organic matter to be incorporated with soil, manures, composts

Green technologies: are products, services and procedures that are used in green production and consumption process

Hardening off : as the process of planting seedlings in a well compostable soil to keep the roots growing strong and straight down in the specific hole and not bending

Innovation: are characterised as new source of raw material, a new method, a new product, a new market or the new sustainable practice with the will to contribute to environmental preservation

Intercropping: is a practice that contribute to control pests when grain crops are grown in association with another crop whilst preserving good ground cover

Manual harvesting: is a type of harvesting often used for hand- sorting, picking and compost The process can be repeated several times until nothing left on the flat surface

Multiple cropping: is the practice that involves growing of two crops in a year where only one had been made possible earlier

Perennial plants : are self-seeding plants, grown and practised to protect other plants that are not self-seeding by making shade cloth and seedbed

Periodical harvesting : is the free flow and retain of the compost qaulity associated with harvesting methods such as manual,migration and mechanical

PLA Roll Planter: is a new technology exist with the purpose to grow crops in a sustainable manner

Revegetation: is the process of restoring vegetation in dry areas area and prevent topsoil

Self-harvesting methods: is the type of harvesting that make use of simple mechanisms such as screens or onion bags. The screen method is very common and easy to use, consists of a box constrcuted screen bottom. The system can be set up in a number of locations at once

Social learning: is often reffered to as a way of organising individuals, organisations, communities and networks for creating more reflexive, resillent, flexi, adaptive learning

Seasonal crops: Are regular grown crops, grown in consecutive seasons to provide green

manure

Seed germination is a traditional technique that allows regrowth and formation of new seeds and plants

Sustainability : is the concept that intergartes environmental, socaila and technological or economical changes within the economy for the capacity to innovate and adpat to constant variations , this include modifications, innovations, experiments conducted for *inter-planting* and vegetable production related to the attractiveness of the technology

Sustainable practice: It is a practice or routine that symbolises bringing awareness and addressing the needs within the community of practice whilst minimise the environmental footprints along the value chain.**Sustainabilityeducation:**is the process used for interaction between individuals and communities. It comprises the acquisition of knowledge, values, attitudes and practical skills for enactment

Succession planting: is the practice that often used in organic farming which symbolises the method to reduce and minimise the risks of the crop failure in sustainable agriculture

Unemployed: are persons aaged 15 to 34 years who were not employed in the reference and are actively looked for work or tried to start a business and were available for work

Value creation stories: are considered as the process of constructing personal or historical stories that can benefit the community, where participants shared their knowledge and understanding with the community of practice

Vegetation: the method of contour planting various crops to stabilize hillsides. Vegetation encourages stabilizing and help recover the land

Vermicompost: is classified classified as biodegradable waste (i.e. crop residue, weed biomass, vegetable waste, leaf litter, hotel refuse, waste from agro-industries.

Waste: Any unwanted material that can produce a harm in an environment