An Introduction and Long-Term Viability of Community Sustainable Agriculture Projects within Marginalised Communities

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Introduction

This study assesses the socio-cultural viability of community sustainable agriculture projects—with a focus on permaculture and the use of traditional knowledge and practices as examples of this—within a First Nations community in the Pacific Northwest (USA). A permaculture community project was undertaken at the Northwest Indian Treatment Centre (Washington State) in order to determine participant understanding and perception of food sovereignty and security prior to the project initiation, changes during participation, long-term attitudes toward such projects, and potential barriers to project longevity and impact. The initial set-up of the project included an analysis of soil quality to determine whether the area would support this approach to food production. The Northwest First Nation project serves as a case study to demonstrate the benefits of permaculture and to provide an action plan that ensures the longevity of permaculture practices in relation to soil quality.

This study is multidisciplinary and follows the theoretical framework of permaculture, which shifts the view of traditional knowledge as being rudimentary and basic to one that recognizes its intricacies and complexities, while offering an alternative knowledge perspective and management of small-scale agricultural food production systems that has been little-studied by the scientific community.

Research Questions and Objectives

This study aims to identify the change in understanding and attitudes of First Nation communities with regards to their current food security and production methods through the introduction of sustainable agriculture community projects, and to identify potential barriers to the longevity of such projects.

Research Question 1:

Can communities that are considered marginalised utilise sustainable agriculture practices such as permaculture and traditional ecological knowledge as a development framework to successfully address food insecurity with the establishment of a sustainable food production scheme?

A high proportion of indigenous populations experience food insecurity (FAO 2015). Studies have shown that failure rates of introducing traditional agriculture schemes in indigenous communities are high (Bell-Sheeter 2004). Of the many possible barriers to successful implementation is the lack of community participation and lack of cultural integration and traditional ecological knowledge (Bauer et al. 2012). Literature suggests Traditional Ecological Knowledge as a possible framework for agriculture applications (Warren et al. 1995; Anderson 2005; Berkes 2012) and thereis an increasing acceptance of the capabilities of TEK agricultural applications in the scientific community (Warren et al. 1995; Anderson 2005; Berkes 2012).

Objectives:

- Assess the viability of permaculture and TEK in small-scale community food production schemes through introducing a community sustainable agricultural project at the Northwest Indian Treatment Center.

- Assess the influence of social networks on sustainable agriculture adoption within marginalised communities.
- Determine whether permaculture practices are adequate for the soil management that is needed for the establishment and continuation of long-term sustainable community agriculture.

Research Question 2:

What is necessary for a sustainable agriculture community participation project to be successfully established, and what are the barriers to establishment and longevity? What role does the shift in the perception from food insecurity to food security play in maintaining the food production scheme?

Perception is considered a valuable indicator in food security analysis. Perception is a subjective phenomenon that can be used to objectively quantify measurements and monitor food insecurity levels (Segall 2007). Research (Skinner 2013; Dean and Sharkey 2011) has shown that individual perception of food insecurity is a valuable indicator. The community's perception of their level of food insecurity is important in establishing and maintaining a sustainable food production scheme. If they do not believe that there is a food security issue within their community, the success rate of establishing a community food production scheme is likely to decline.

Objectives:

- Assess the community's perception of their current food security and how this changes during the project.
- Assess the community's attitude towards the introduction of sustainable agricultural community projects to enhance food availability and quality.
- Assess perception and attitudes towards TEK and how it is used.

Research Question 3:

Is current soil quality sufficient to support the introduction of a new community sustainable agriculture project at the Northwest Indian Treatment Centre, and if so what are the requirements to maintain this in the long-term?

Objectives:

Compare soil at the NWITC project site with local established and successful permaculture sites.

1. Identify whether permaculture soil management practices support soil quality and compare these to intensive agricultural practices
2. Provide a management plan for the community project introduced to the NWITC to support soil quality and ensure high yield in future years.

Literature Review

Global Food Security

Hunger, climate change, agriculture, and marginalization come together under one issue that challenges both large and small populations globally: chronic food insecurity (FAO, 2015). Figure 1 shows the global hunger map depicting the most concentrated areas of food insecurity. Issues of food insecurity, hunger, malnutrition, and obesity affect a large number of the global population, most notably marginalised and indigenous populations (FAO,

Figure 1: WFP global Hunger Map (Source: http://www.wfp.org/hunger/stats)

2015). According to the FAO 2015 report, *The State of Food Security in the World*, there are currently estimated to be 795 million people experiencing hunger and malnutrition. Hence food insecurity is an issue that requires a greater sense of urgency than that which is generally put forward in popular discourse (Chilton and Rose 2009).

Food Security

Food insecurity is defined as "the state of either having limited or uncertain access to food that is nutritionally adequate, culturally acceptable, and safe or having an uncertain ability to acquire acceptable foods in socially acceptable ways" (Bauer et al. 2012:15). Food insecurity in marginalised communities is a topic that needs to be further studied and examined so that the issues of hunger, obesity, and diabetes can be addressed through solutions that honour the cultural, social, economic, and environmental needs of marginalised peoples (Ford 2009). Skinner (2013) identifies the factors that contribute to food insecurity

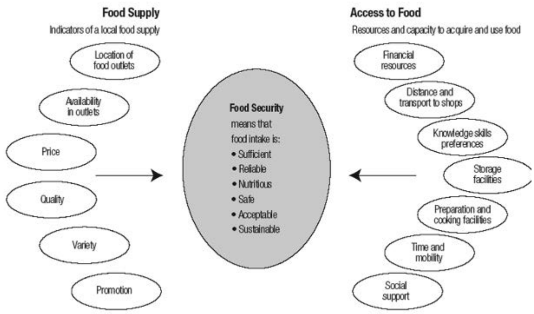

Figure 2: Drivers of Food Security, Rychetnik et al. (2003)

in indigenous communities (Figure 2); these include food supply and the ability to access nutritious food. As such, it is essential that we identify the full extent of current needs with regards to food availability and quality in order to identify solutions to food production schemes that are sustainable, such as permaculture.

It has been calculated that 2,720 kcal per day of energy from food is currently produced for each person on the planet (FAO 2002). As such, the current industrial agriculture model distributes 18% of food produced for use in biofuels and industry, 35% to feeding livestock, while only 47% goes towards feeding our ever-increasing population (Cohen 2015). According to Cohen's statistical analysis, there is only enough food produced for about 6.5 billion people, and with a current global population of ~7.3 billion, almost a billion people are left hungry.

The issue is not one of scarcity; cereal production per person has tripled globally over the past 50 years, although there has been a notable decline in yields in recent years because of climate change and soil degradation, whereas the population has only doubled (Vivas 2014).

North American First Nation Food Security

The lack of access to nutritious food is a growing issue in marginalised and indigenous communities (FAO 2010;Vivas 2010). For instance, in the "First World" nations of North America, poverty, unemployment, and food deserts are major drivers of food insecurity (Sarche and Spicer 2008). Food security research in these communities is primarily focused on access to food, including the distance that is needed to travel to reach adequate food and the ability to afford nutritious food, rather than the ability to grow food (Sarche and Spicer 2008). Yet there is a growing shift in food security research to encompass community agriculture as a possible solution to food insecurity in marginalised communities (Hallberg 2009).

A major issue that stems from food insecurity in the Native North American communities is obesity. Obesity has been associated with a growing number of health and quality of life issues, and is one of the surprising struggles associated with food insecurity. A myth that surrounds hunger and food insecurity is that a person cannot be hungry and obese at the same time. As stated by Chi miigwech, of Native American Netroots, "to the contrary, one of the most obvious manifestations of malnutrition is obesity, and it's rampant among our peoples. It's also killing us at a rate that rivals anything tried in previous centuries." Nutritionists link poverty, food security, and obesity (Davis et al. 2004). Obesity in high poverty areas has been explained by the lack of access to nutritious food while concurrently only having access to high fat, high sugar content, processed food (JHC 2015:3). An increasing volume of literature links industrialised agriculture with high calorie, low nutrient foods that leads to obesity (Davis et al. 2004; Ikerd 2013).

Drivers of Food Insecurity

Causes of food insecurity include current and historical marginalisation, exploitive land ownership policy, and the current global industrial agriculture model (FAO 2010; World Hunger 2013; Vivas 2010). Sonnino and Spayde (2014) argue that "food insecurity relates to a complex interaction of factors that encompass the entire ecology of the food system", such as agri-food policy and the accessibility of healthy, nutritious food. As such, the global industrial food model is rarely mentioned in British reports as a driver of food security (Caraher and Dowler 2014; McClintock 2013; Perry et al. 2013).

In globalised conventional agri-food markets, socio-environmental problems such as destabilisation of food prices, increased rates of obesity, diabetes, and hunger are becoming more apparent in marginalised communities (Veteto and Lockyer, 2008). These problems make it increasingly important for academic research to be directed towards the development of theoretical and practical approaches to alleviating food insecurity (Veteto and Lockyer, 2008).

The Role of Conventional Agriculture in Food Insecurity

Conventional industrial agriculture increases the disparities that economically marginalised communities experience and aggregates instances of food insecurity (Lutz & Samir 2010; Godrey et al. 2010). The "developed world's" food systems became industrialised and globalised in the aftermath of the Second World War and through the Green Revolution (P.Fitzgerald-Moore and B.J. Parai 1996). While conventional industrial agriculture food production systems vary, they share similar characteristics: they require large initial capital investment, are technologically innovative, are large scale, are one-crop high-yield continuous farming, have extensive consumption and a dependence on fertilisers, pesticides, and energy inputs, and have high labour efficiency (Stauber and Rampton 1995). Industrial agriculture operates under the assumptions that 1) agriculture is in competition with nature; 2) larger size equals higher yield; and 3) technology is vital to production and growth (Stauber and Rampton 1995).

Conventional industrial agriculture has been able to produce a great amount of food. According to FAO 2015, 2534 million tonnes of cereal is projected to be produced this year (as shown in figure 3), but at a great expense (Drury and Tweeten 1997; UCS 2015). The gap between the return on investment is closing, however the expenses still outweigh the reward, with reduced production and increases in both inputs and waste, while hunger in marginalised and indigenous populations grows globally (UCS 2015).

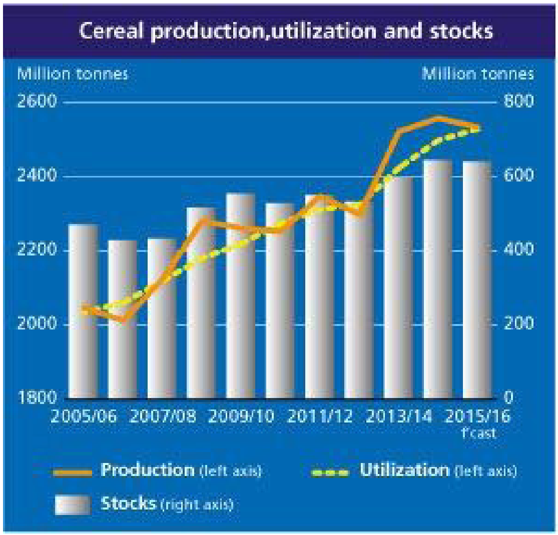

Figure 3: Global Cereal Production as projection by FAO 2015

Marginalisation

> *"Marginalisation is defined as the peripheralisation of individuals and groups from a dominant, central majority. Marginalisation can be seen as a sociopolitical process, producing both vulnerabilities (risks) and strengths (resilience) "* (Hall 1999:89).

The 2013 Sociology Guide agreed that marginalisation is the practice of consigning particular groups of people to the outer edges of society, placing these groups of people in the economic, political, and the cultural margins. This effectively denies them resources and opportunities. This unequal access propels them into poverty and insecurity, while denying them "equal access to the formal power structure and participation in the decision-making process leading to their subordination to and dependence on the economically and politically dominant groups of society" (Sociology Guide 2013).

Marginalisation Perpetrated as Land Grabs

Land grabs are a common way in which the current agricultural system perpetrates the exploitation of indigenous and marginalized populations (White 2012; TNI 2012). Currently, land grabs occur predominantly in the global south, most notably in Africa and Indonesia (OXFAM 2012; TNI 2012). However, land grabbing is not new; its name has evolved, but it can be traced back through many centuries (McMichael 2012). Land grabs were the basis of colonialism, acquiring land for the purpose of control, resources, and economic gain.

An alternative political economy understanding of land grabs is that they are essentially a capture of power. The power comes from control of the land and resources and the benefits of its use (TNI 2012; Graham et al. 2011). Land grabbing separates communities from their healthy affordable food supply, and is one factor that contributes to the inability of communities to feed themselves (Maquitico, 2014). Once that happens, a community becomes dependent on the market for their food.

Historically, Northwest First Nation Native Americans have been subjected to cultural and physical marginalisation as a result of colonisation, economic, and environmental exploitation (Kuhlein et al. 2013). Such nations still deal with the repercussions of being forced from their land and onto undesirable land.

As written in *A Short History in American Capitalism,*

> *"The greatest economic swindle in American history…was the stealing of the Indians' land, Without Indian land, the developments in nearly two centuries of colonial history would have been unthinkable. During the 17th and 18th centuries, land was the principal means of production in America. Instead of acquiring wealth by retail means such as piracy on the high seas, European Americans stole other people's wealth wholesale" (Weinberg 2003: 2).*

In the First Nations of North America, the long-term effects of land grabs and other effects of colonialism have resulted in a poverty rate of 40% (Sarche and Spicer 2008), an unemployment rate as high as 35% (Sarche and Spicer 2008; Sandefur and Liebler 1997), and 40% of the families are reporting food insecurity (Bauer et al. 2012). These numbers reflect the struggles that indigenous populations experience with marginalisation, food security, chronic disease, and the disappearance of indigenous foods (First Nations Development Institute 2014).

Research from Within

There is a disproportionate amount of research that is completed and published by "outsiders" rather than research completed by the indigenous population themselves (Piquemal 2001). In the greater context of marginalisation this leads to an imbalance of power and distrust (Marshall and Batten 2004). This distrust and notion of power can be lessened when researchers create a partnership with the community and work from within rather than being seen as an "expert" (Crigger, Holcomb and Weiss 2001). This was taken into consideration in the design of this research project.

Sustainable Agriculture

There are many attempts at defining "sustainable agriculture." Ikerd (1990:4) views it as a food production system that is "capable of maintaining it's productivity and usefulness to society indefinitely. Such systems… must be resource-conserving, socially supportive, commercially competitive, and environmentally sound". The US Food, Agriculture, Conservation and Trade Act of 1990 (USDA 2007) describes sustainable agriculture as an amalgamation of food production systems that will:

Lewandowski and colleagues (1999) state

Table 1: Sustainable Agriculture Techniques

Crop rotation	**The process of planting different crops consecutively in the same field**
Cover crops	**The process of planting crops such as oats or clover between main crops**
Soil enrichment	**Various natural materials (compost, mycelium and manure) are used to enrich and maintain the soil**
Natural pest predators	**Natural farming without the use of pesticides and chemical promotes a diverse ecosystem that promotes natural pest predators**
Companion cropping and interplanting	**A common practice that promotes soil nutrients and pest control**
No till farming	**The soil is minimally disturbed during planting to maintain soil structure and nutrient content**

that sustainable agriculture is the administration of an ecological agrarian system that preserves its biodiversity, production, regenerative capacity, and functionality while addressing current and future ecological, economic, and social needs. "Permaculture", "agroecology", "organic farming", "ecologically intensive", "biologically diversified", or "regenerative farming systems" have thus emerged as descriptions of agricultural practices that seek to encompass the principles and processes of sustainable agriculture (Poniso 2014; Kremen and Bacon 2012).

Currently, there is more support and acceptance for sustainable agriculture in mainstream agriculture (Feenstra, 2014), which is increasing its uses and community impact. Sustainable agriculturalists use best farming practices and current knowledge to work efficiently with natural processes instead of against them (UCS 2015; Udoto and Flowers 2001). Examples of these techniques that are weed, pest, disease, and erosion control, as well as high soil quality, are shown in Table 1:

Challenges and Limitations of Sustainable Agriculture

The integration of sustainable agriculture and its evaluation is a challenge for current agriculture research (von Wirén-Lehr 2000). In assessing sustainable agriculture implementation, researchers have found that there are real and perceived challenges faced in both the implementation and maintenance of the food production scheme. The challenges faced are:

1. *The yield gap between conventional and sustainable agriculture*

Previous studies report that the yield gap between conventional and sustainable agriculture is as high as 180% in developing countries (Badgley et al. 2007; Stanhill 1990). Yet, Ponisio and colleagues (2014) found that with practices such as diversification, crop rotations, and multi cropping the yield gap is reduced to 9+4% and 8+5%. There is also an ongoing decline in yield in conventional food crops (Moiser and Kroeze, 2000) because of global soil degradation and reduction of soil fertility (Killham, 2000). This declining yield is reducing the potential yield gap even further.

2. *The National Agriculture Statistic Services reported that 14.5 million additional acres would be needed for sustainable agriculture to produce an equal amount of human-focused crops.*

In response to this issue and to the yield gap, Badgley (2015) points to the fact that 57% of the world's cereals grown are used for products other than food, such as livestock feed. Out of the 43% of grains grown for food, up to 30% of that food is wasted. Reducing waste and prioritising growing acres for food production would reduce the yield gap even further.

3. *Sustainable agriculture is more labour intensive in comparison to conventional agriculture.*

While some studies report that sustainable agriculture is more labour intensive than conventional agriculture (Young 2003), an overview of the literature shows that most studies focus on narrowly-defined economic aspects, but rarely on the social and ecological aspects (Comte 1994).

4. There is a lack of research funding and education (Delonge 2015).

Much of the research on yield and soil management concludes that a major challenge to the implementation of sustainable agriculture is a lack of education programs and research investment (WWF, 2015; Gonsalves 2005; Ferreira 2012).

These issues have long been discussed among policy makers, farmers and researchers as potential barriers to the adoption of sustainable agriculture (Gonsalves, 2005; Fazio, 2015; Young 2003). There is an increasing volume of research that shows sustainable agriculture is a viable alternative to conventional agriculture, especially in marginalised and subsistence farming communities (Wandel and Smithers 2000; Amekawa 2010; Long Blok and Coninx 2015), but in comparison to the research and funding that is directed towards conventional agriculture, it is minimal and should instead be reflective of the need for this type of food production model.

Sustainable Soil Management

'The nation that destroys its soil, destroys itself' –Franklin D. Roosevelt.

Soil is defined by United States Natural Resources Conservation Service as a natural substance that is comprised of organic and mineral matter, liquid and gases that occupies space with "the ability to support rooted plants in a natural environment (USDA 1999)." Researchers have recognised that soil is a dynamic living system that requires a balanced interaction of biological, chemical, and physical components (Karlen 1997).

The Food and Agriculture Organisation (FAO) recognises the need to raise international awareness, together with an understanding of the level of importance that soils have in the establishment and management of food security by making 2015 the year of the soils (FAO 2015).

According to the FAO 2015 report, the specific objectives of the year of the soils are to:

1. Raise full awareness among civil society and decision makers about the profound importance of soil for human life;

2. Educate the public about the crucial role soil plays in food security, climate change adaptation and mitigation, essential ecosystem services, poverty alleviation and sustainable development;

3. Support effective policies and actions for the sustainable management and protection of soil resources;

4. Promote investment in sustainable soil management activities to develop and maintain healthy soils for different land users and population groups;

5. Strengthen initiatives in connection with the SDG (Sustainable Development Goals) process and Post-2015 agenda;

6. Advocate for rapid capacity enhancement for soil information collection and monitoring at all levels (global, regional and national).

This interest in soil quality is not new. Early researchers recognised the importance of having and understanding soil categories and soil variables for agriculture purposes (Carter 1997). Soil management is a vital part of maintaining soil quality within agriculture production. Soil function and balance affects the possible yield, environmental quality, plant health, and production longevity (Karlen 1997) in an agriculture food production scheme. Due to the importance of soil quality, creating a soil management plan for any food production scheme is vital for its success and continuation. An important outcome of this research is to create a soil management plan that can be utilised by the community participants in this research.

Permaculture

Permaculture is broadly classified as a holistic section of the ecological design of sustainable development (Rhodes 2012) that can be used to liberate human settlements from food insecurity and inequality. Permaculture practitioners claim that their techniques, such as the technique of imitating nature and planting diversly, have a wide range of positive effects on the social and ecological environment (Mollison & Holmgren 1978; Ferguson 2013). In comparison to industrial agriculture, these benefits include reduction of water pollution, increased biodiversity, and increased food yields (Rhodes 2012).

Embraced by many from fields that range from government [for example, Cuba] to smaller social justice organisations [such as Movement Generation], permaculture is seen as a way to create sustainable development at the local level (Adams and Starr, 2003). The nature of permaculture practice can be, in principle, a form of community participation that promotes social justice by creating a space that is separate and resistant to the capitalist form of agriculture that plays a prominent role in widespread food insecurity (Adams and Starr, 2003). Permaculture can be utilised as a strategy to help enable economically marginalised communities reduce their food insecurity and levels of economic inequality, and as such merits further investigation.

Permaculture is an eclectic and adaptive approach that emphasises local and bioregional perspective and practice. At the same time, it is informed by a global view, maintains a strong tradition of technology and knowledge transfer across diverse areas and cultural traditions, and is fundamentally based on empirical observation and experimentation (Veteto & Lockyear 2008). Permaculture provides a way for communities to lessen their dependence on industrial food systems while maintaining ecosystems for future generations (Mollison and Holmgren 1978).

Challenges and Barriers to Permaculture

Similar to other types of sustainable agriculture, permaculture has been subject to criticism in some quarters due to a lack of scientific evaluation of its claims of high agricultural yields and ecological benefits (Kane

2010). It is evident that there is significant lack of research that has been directed towards the potential benefits of permaculture as a form of sustainable agriculture (Ferguson 2013; Veteto and Lockyer 2008).

The majority of the literature that is available on the definitions and uses of permaculture comes largely from NGOs, permaculture practitioners, and other sustainable agriculture enthusiasts. Much of the literature that is available comes from the two founders of permaculture, Bill Mollison and David Holmgren. Key literature by the two founders include *Permaculture One* (Mollison and Holmgren 1978), *Permaculture: A Designers Manual* (Mollsion 1988) and *Permaculture: Principles and Pathways Beyond Sustainability* (Holmgren 2002). These provide guidance on permaculture practice but do not address the benefits in comparison with conventional practices in a scientific manner and thus there are big scientific gaps with regards to this form of land management that need to be addressed.

Another barrier to the acceptance of permaculture is that it is not easily placed into a specific area of research; the scientific community has had difficulty integrating the interdisciplinary nature of the field into a research agenda as it combines the studies of agriculture, biology, forestry, architecture, and community participation (Mollison 1991; Veteto and Lockyer 2008). This issue creates a cloud around research involving permaculture, which has impeded the convergence of knowledge that would be necessary for in-depth research in this field to determine the ability of permaculture to create agriculture that is usable by the masses.

Traditional Ecological Knowledge

The working definition of traditional ecological knowledge (TEK) as defined by Berkes, Folke and Gadil (1995a)," as a cumulative body of knowledge, practice and belief evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment". TEK refers to the cultural, spiritual, and biophysical knowledge of societies. It is an empirical knowledge of species; a framework for practical application and it is a belief system about how societies perceive their cohesiveness and interactions with the natural environment. TEK encompasses thoughts and practices on land use management through holistic cultural integration of biophysical practices. This knowledge is a valuable tool and foundation for current western agricultural science (Martinez and Ford 2000; Berkes 2012).

Indigenous communities and peoples have relied on TEK applications for generations to access the natural resources of their environment. Environmental, economic, and political exploitation has put tremendous pressure on these communities to sustain their culture, knowledge, and livelihoods. In the course of exploitation, communities have had to reestablish their connections to TEK and relearn how it can be integrated into their new landscape.

There is an increasing amount of acceptance for the capabilities of TEK agricultural applications in the scientific community (Warren et al. 1995; Anderson 2005; Berkes 2012). This increased application has also increased the visibility and diversity of the fields where TEK has gained acceptance (Berkes 2012), as seen in the following quote from the World Commission on Environment and Development:

> *"Tribal and indigenous peoples' lifestyles can offer modern societies many lessons in the management resources in complex forest, mountain and drylands ecosystems.*

These communities are the repositories of vast accumulations of traditional knowledge and experience that link humanity with its ancient origins. Their disappearance is a loss for the larger society, which could learn a great deal from their traditional skills in sustainability managing very complex ecological systems" (WCED 1987:115-15)

Also, this accumulated knowledge can give these populations a more balanced position of power within the agricultural landscape. The study of traditional ecological knowledge is key to this research, because it helps to explain how the components of traditional knowledge, culture and beliefs are all key to integrating sustainable agriculture into marginalised communities.

Methods

Interviews

The different types of interviews included in this research are individual, semi-structured, and structured. (Kvale 1996). Open-ended questions are used, mainly to discover spontaneous responses and to avoid possible bias in the interviewer's suggestions. Open-ended questions or buildable questions are also needed for social network analysis.

Social Network Analysis

"Social network analysis (SNA) is the quantitative method for mapping and analysing patterns of social connections between individuals and organisations" (Scott 2015). Social networks influence behaviour and can be a key factor in accelerating long-term behavioural changes (Borthwick 2014). Organisations, individuals, connectors and social or thought leaders make up the nodes of a social network. Currently, there is an increasing interest in utilising social network analysis in broader fields, such as environmental governance and agriculture (Scott 2015; Borthwick 2014). Social network analysis is said to be key in creating a consensus, generating, and disseminating knowledge and information, which in turn creates trust, thus allowing for a change within the network (Bodin et al. 2006; Bodin and Crona 2009; Bodin and Prell 2011; Scott 2015). Within this project, SNA serves as a necessary tool to facilitate an altered perception or transformational adaptation in relation to food security and sustainable agriculture within the community. As shown by the example given by Figure 4, SNA gives a visual of the different actors and connective relationships in a network.

Research Design

Phase One: Native American Participatory Geographical Study and Soil Analysis

Northwest Indian Treatment Centre Food Forest Agriculture Development Project

This part of the research provides a case study in collaboration with the Centre for World Indigenous Studies and the Northwest Indian Treatment Centre in Elma, WA, with support from Grub who is a sustainable farming non-profit organisation. The fieldwork focuses on an agriculture community development project at the Northwest Indian Treatment Centre. The project consists of participants creating a permaculture "food forest" at the treatment centre, integrating traditional ecological knowledge and historical agriculture practices. Permaculture principles are utilised as a framework to create a small-scale sustainable agriculture project, which has been designed to honour the patterns and history of the traditional agriculture of the Fourth World peoples. The aim of this study is to create an environment that allows for the study of the

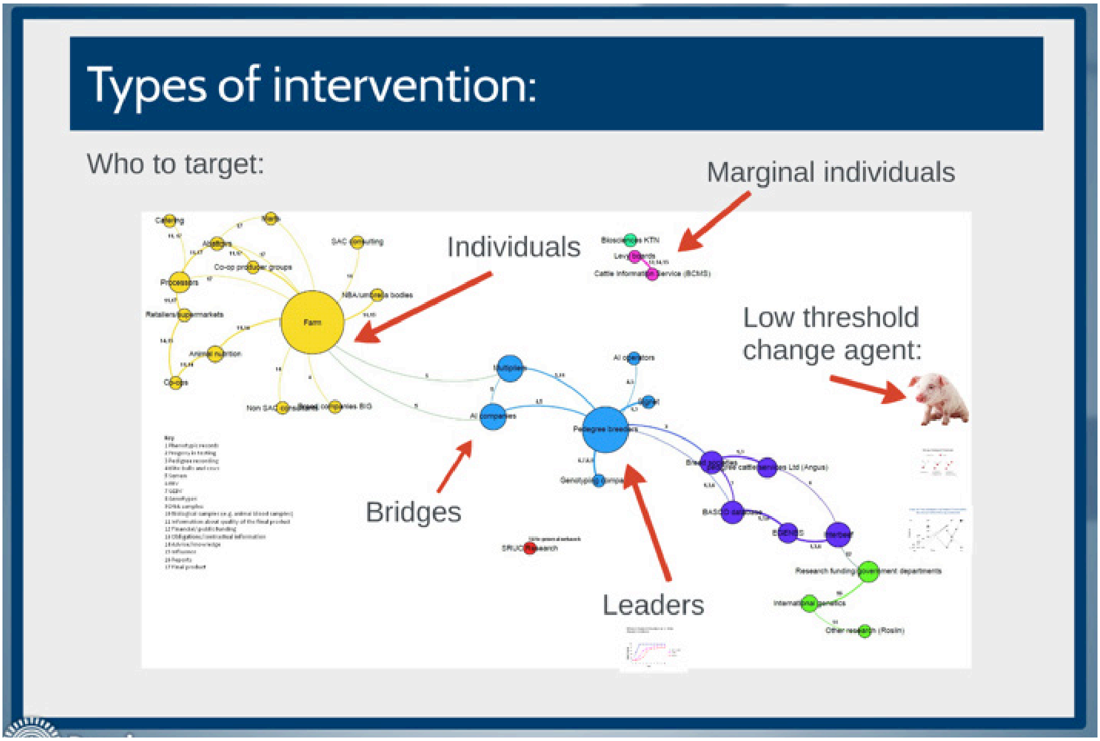

Figure 4. Examples of SNA networks (Dr. Fiona Borthwick 2014)

community-driven processes that are necessary to establish a permaculture project. Historically, indigenous agricultural knowledge, the cultural significance of food, and the specific nutritional needs of indigenous populations have been ignored by efforts to introduce non-traditional agricultural techniques. This lack of acknowledgment of the holistic nature of indigenous food insecurity has resulted in a failure of an adaptation of the western type of cultivation practices (Deur & Turner 2005). Because permaculture is derived from old knowledge of plant and animal systems that combine ecology and environmental sustainability, its foundation is in traditional ecological knowledge.

Participation was undertaken in the traditional food educational programme that is part of the rehabilitation of the drug and alcohol addicts that are participating in the NWITC programme. This project consisted of educational segments on permaculture, its correlation with traditional ecological knowledge, and a development project that created a permaculture designed quarter acre "food forest."

"A food forest is a gardening technique or land management system, which mimics a woodland ecosystem by substituting edible trees, shrubs, perennials and annuals. Fruit and nut trees make up the upper level, while berry shrubs, edible perennials and annuals make up the lower levels" (Beacon Food Forest Permaculture Project 2015).

The primary aim of this project is to understand the role that traditional ecological knowledge and permaculture can have in a

Image 1: Photograph of the participants from the NWITC project. Photo Source: Author

establishing the social acceptance of a community development agriculture project.

The key research questions are:

1. Can Native American tribes use permaculture successfully as a framework for indigenous agriculture practices to address food insecurity?

2. Are the principles of permaculture compatible with indigenous knowledge?

3. Is the community-based participatory action method an effective method for utilisation and integration of permaculture and indigenous agriculture for the community?

Specific objectives include:

1. Analysing community participation and planning capabilities of the participants of the study.
2. Analysing the barriers, such as lack of trust and knowledge, to establishing sustainable agriculture in the Native American community.

Phase Two: Feasibility Study with Regards to Soil Quality and Food Production

In conjunction with the development case study, a biophysical comparative study of the current soil quality status of the study site was undertaken against soils collected from other identified local permaculture sites that are already established. The initial results from the soil analysis from the NWITC project site can be found in Table 1 and the initial soil data from the areas surrounding the project site can be seen in Table 2. The study helps establish the viability of permaculture at this site and supports the use of TEK as an agroecology movement through creating solid scientific evidence towards the benefits or shortcomings of permaculture practice in addressing food security with regards to soil management.

The projected results of this study in areas where soil is of equivalent quality, are that the introduction of permaculture such as the 'food forest' may prove to be a successful mechanism for reducing hunger and improving health and quality of life in indigenous populations. A further study will then be conducted utilising a pot experiment to allow comparison of permaculture soil management practice with conventional practices (i.e. additions of straw versus cardboard to enhance carbon (C) content and improve soil structure). Finally, based on these findings and the initial site assessment a soil management plan will be devised to indicate best practice to ensure long-term viability of the site for production.

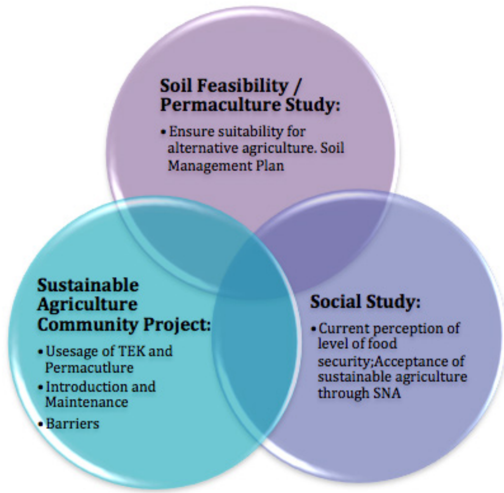

Figure 1: Experimental Design for Phase 1and 2:

Initial Findings:

The chemical composition of the NWITC Food Forest area is Bh. The soil horizon contains more than 1% organic carbon (C), less than 0.3% pyrophosphate-extractable iron (Fe), and has a ratio of organic carbon (C) to pyrophosphate-extractable iron (Fe) of 20 or more. Generally the colour value and chroma are less than 3 when moist.

Table 2 provides a summary of the soil analysis data that was undertaken in collaboration with David Nygard of the Thurston County Conservation District. According to the initial analysis, 16.1 % is a very high level of organic matter, which indicates native prairie, ancient organic matter or muck wet land soil. At 34ppm, the phosphorus (P) level is slightly high, while the potassium (K), magnesium (Mg) and sulfur levels are low.

Phase 3: Final Stage

The final stage of the project is to discuss—drawing on the data and conclusions of the independent sections of this research—the changes in attitude, perception, and behaviour of project participants and comment on the suitability of these projects in terms of small-scale sustainable agriculture to support food security and food sovereignty. Discussion will also address the barriers and requirements to maintain project longevity and continued community participation.

Current Status of Research

Phase 1: Native Reserves

This part of the project is almost complete; the social study data have been collected and full analysis is currently underway. Soil quality has been assessed and analysis of this is currently in progress to ascertain the soil quality of local permaculture sites, which will allow demonstration of the suitability of the introduction of permaculture to sustainably supplement food production on the reserve.

Table 2: The soil analysis report for the NWITC project site.

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2918 FERGUSON ST SW STE A
TUMWATER, WA 98512-

SUBMITTED BY: DAVE NYGARD

GROWER: SUSAN MCCLEARY

DATE OF REPORT: 08/13/15

SOIL ANALYSIS REPORT

PAGE 1

SAMPLE ID	LAB NUMBER	Organic Matter		Phosphorus		Potassium	Magnesium	Calcium	Sodium	pH		Hydrogen	Cation Exchange Capacity	PERCENT CATION SATURATION (COMPUTED)				
		* % Rating	** ENR lbs/A	P1 (Weak Bray) **** * ppm	NaHCO3-P (OlsenMethod) **** * ppm	K ***** * ppm	Mg *** * ppm	Ca *** * ppm	Na *** * ppm	Soil pH	Buffer Index	H meq/100g	C.E.C. meq/100g	K %	Mg %	Ca %	H %	Na %
NWITC	58282	16.1VH	353	34H	32**	90L	80L	1925VH	13VL	6.1	6.2	1.7	12.3	1.9	5.4	78.3	14.0	0.5

** NaHCO3-P unreliable at this soil pH

SAMPLE NUMBER	Nitrogen NO_3-N ppm	Sulfur SO_4-S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Excess Lime Rating	Soluble Salts mmhos/cm	Chloride Cl ppm		PARTICLE SIZE ANALYSIS SAND %	SILT %	CLAY %	SOIL TEXTURE
NWITC	13M	12M													

* CODE TO RATING: VERY LOW (VL), LOW (L), MEDIUM (M), HIGH (H), AND VERY HIGH (VH).
** ENR - ESTIMATED NITROGEN RELEASE
*** MULTIPLY THE RESULTS IN ppm BY 2 TO CONVERT TO LBS. PER ACRE OF THE ELEMENTAL FORM
**** MULTIPLY THE RESULTS IN ppm BY 4.6 TO CONVERT TO LBS. PER ACRE P_2O_5
***** MULTIPLY THE RESULTS IN ppm BY 2.4 TO CONVERT TO LBS. PER ACRE K_2O
MOST SOILS WEIGH TWO (2) MILLION POUNDS (DRY WEIGHT) FOR AN ACRE OF SOIL 6-2/3 INCHES DEEP

This report applies only to the sample(s) tested. Samples are retained a maximum of thirty days after testing.

Darcy L. Peebles, CCA
A & L WESTERN LABORATORIES, INC.

Table 4: The soil analysis report for the permaculture sites surrounding the NWITC.

A & L WESTERN AGRICULTURAL LABORATORIES

10220 SW NIMBUS AVE Bldg K-9 | PORTLAND OREGON 97223 | (503) 968-9225 | FAX (503) 598-7702

REPORT NUMBER: 15-212-234

CLIENT NO: 4352

SEND TO: THURSTON CONSERVATION DISTRICT
2918 FERGUSON ST SW STE A
TUMWATER, WA 98512-

SUBMITTED BY: DAVE NYGARD

GROWER: SUSAN MCCLEARY

DATE OF REPORT: 08/05/15

SOIL ANALYSIS REPORT

PAGE 1

SAMPLE ID	LAB NUMBER	Organic Matter		Phosphorus		Potassium	Magnesium	Calcium	Sodium	pH		Hydrogen	Cation Exchange Capacity	PERCENT CATION SATURATION (COMPUTED)				
		* % Rating	** ENR lbs/A	P1 (Weak Bray) **** * ppm	NaHCO3-P (OlsenMethod) **** * ppm	K ***** * ppm	Mg *** * ppm	Ca *** * ppm	Na *** * ppm	Soil pH	Buffer Index	H meq/100g	C.E.C. meq/100g	K %	Mg %	Ca %	H %	Na %
JOY	58071	19.6VH	422	113VH	122**	259M	240M	1780M	18VL	5.7	5.9	3.1	14.7	4.5	13.5	60.5	21.0	0.5
1310	58072	17.1VH	371	80VH	54**	129M	153L	1901H	11VL	6.1	6.4	1.8	12.9	2.6	9.7	73.3	14.0	0.4
2008	58073	17.8VH	387	91VH	69**	527VH	265M	1435L	85L	6.0	6.4	2.0	13.0	10.4	16.7	55.0	15.0	2.9
1410	58074	24.2VH	514	111VH	133**	303M	184L	2603M	18VL	5.8	6.1	3.6	19.0	4.1	8.0	68.5	19.0	0.4
7806	58075	12.3VH	277	21M	21**	152H	90M	453L	11VL	5.3	5.5	1.5	5.0	7.8	14.9	45.3	31.0	1.0

** NaHCO3-P unreliable at this soil pH

SAMPLE NUMBER	Nitrogen NO_3-N ppm	Sulfur SO_4-S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Excess Lime Rating	Soluble Salts mmhos/cm	Chloride Cl ppm		PARTICLE SIZE ANALYSIS SAND %	SILT %	CLAY %	SOIL TEXTURE
JOY	17M	8L													
1310	2VL	5L													
2008	11L	12M													
1410	13M	13M													
7806	7L	15M													

* CODE TO RATING: VERY LOW (VL), LOW (L), MEDIUM (M), HIGH (H), AND VERY HIGH (VH).
** ENR - ESTIMATED NITROGEN RELEASE
*** MULTIPLY THE RESULTS IN ppm BY 2 TO CONVERT TO LBS. PER ACRE OF THE ELEMENTAL FORM
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