AGRICULTURAL TRAINING FOR YOUTH IN BHUTAN:
PRODUCTIVITY, STEWARDSHIP, JOY

A Capstone Paper
Presented to the Faculty of the Graduate School of Cornell University in Partial Fulfillment of the Requirements for the Degree of Master of Professional Studies in Agriculture and Life Sciences Field of International Agriculture and Rural Development Global Development

by
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ABSTRACT

In 2021, the Kingdom of Bhutan launched a skilling program for unemployed young adults. The author designed and delivered three hands-on horticultural trainings in 2022: High-Altitude Vegetable Production (three months), Mid-Latitude Vegetable Production (four months), and Special Projects in Weed Control and Cold Storage (one month). Three themes are present in each training: Productivity, Stewardship, and Joy. I discuss the theoretical foundations for experiential education and describe a pedagogical approach to training young adults in farming. Experiential learning occurs in three domains: cognitive, psychomotor, and affective. Affective components of training programs are thought to be critical to transforming knowledge and skills into action. Situational learning theory describes the value of an environment where learners practice alongside peers and mentors. Special attention is paid to these concepts when planning and delivering the trainings. I summarize what was done and share lessons learned from each session. I then consider how farmer trainings for young Bhutanese adults can be improved.
BIOGRAPHICAL SKETCH

Michael Snow grew up in a Midwestern U.S. city and was bit by the farming “bug” as he finished his college studies at Middlebury College. He has been farming and training others the twenty years since, growing a wide variety of organic vegetables, including potatoes and garlic, fruits, grains (even upland rice!), and animals. He has worked in several different climates in the U.S., Central America, and Asia, and at different scales: using hand tools and in greenhouses on less than an acre up to 35 acres of fruit and vegetables and 250 acres of pasture for animals, using 4-wheel tractors and appropriately scaled equipment. He loves growing food, and selling it, too: directly to customers and through local wholesale channels. He has processed produce into value-added products like jams, sauces, and ready-to-eat meals.

In 2009, Michael co-founded a learning and social network for young farmers and their trainees in the Maryland-Virginia region of the U.S. and has also been involved in sustainable (organic) agriculture research and education. With this paper he completes studies in Agriculture and Rural Development at Cornell University in New York State. Michael grew up expecting to be a teacher and has in fact taught in the classroom as well as the farm in rural Vermont and in Washington, DC.

Training youth in agricultural vocations is not just about learning skills and developing work ethic, but also about building a collaborative community of peers to work with and learn with. Michael believes you can learn anything in a farm or garden. It should be fun! And meaningful. And profitable. He hopes trainees get the same bug he has.

“The ultimate goal of farming is not the growing of crops, but the cultivation and perfection of human beings.”

Masanobu Fukuoka, Japanese farmer
To B, thank you for waiting for me.
ACKNOWLEDGMENTS

Peter Hobbs, Advisor: patience, experience, and warmth

Mom, who went to Law School at age 45

Brother, dude I’m trying to work. Mom, brother’s not letting me work on my thesis

My computer, with your lovely worn keypad
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOGRAPHICAL SKETCH</td>
<td>III</td>
</tr>
<tr>
<td>ACKNOWLEDGMENTS</td>
<td>V</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>VI</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>VII</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>VIII</td>
</tr>
<tr>
<td>LIST OF TEXT BOXES</td>
<td>IX</td>
</tr>
<tr>
<td>CHAPTER 1: BHUTAN</td>
<td>1</td>
</tr>
<tr>
<td>Geography and Climate</td>
<td>2</td>
</tr>
<tr>
<td>Governance and History</td>
<td>5</td>
</tr>
<tr>
<td>Land Governance</td>
<td>5</td>
</tr>
<tr>
<td>Development</td>
<td>6</td>
</tr>
<tr>
<td>Migration</td>
<td>7</td>
</tr>
<tr>
<td>Agriculture</td>
<td>9</td>
</tr>
<tr>
<td>Young in Bhutan</td>
<td>15</td>
</tr>
<tr>
<td>The Desuung in Bhutan</td>
<td>20</td>
</tr>
<tr>
<td>CHAPTER 2: PEDAGOGY AND TRAINING DESIGN</td>
<td>22</td>
</tr>
<tr>
<td>Author’s Experience</td>
<td>22</td>
</tr>
<tr>
<td>Theoretical Framework for Experiential Learning</td>
<td>29</td>
</tr>
<tr>
<td>A Few Lessons Learned from Other Training Programs</td>
<td>37</td>
</tr>
<tr>
<td>Learning from Successful Start-Ups</td>
<td>42</td>
</tr>
<tr>
<td>CHAPTER 3: 3 TRAININGS AND PREPARATION</td>
<td>46</td>
</tr>
<tr>
<td>The Pitch</td>
<td>46</td>
</tr>
<tr>
<td>Proposal Accepted for First Training</td>
<td>49</td>
</tr>
<tr>
<td>Pedagogical Ideas and Curriculum Development</td>
<td>50</td>
</tr>
<tr>
<td>Pre-travel Preparation and In-Country Resource Assessment</td>
<td>55</td>
</tr>
<tr>
<td>CHAPTER 4: RESULTS</td>
<td>58</td>
</tr>
<tr>
<td>Training 1: High-altitude Vegetable Production, May – August 2022</td>
<td>58</td>
</tr>
<tr>
<td>Training 2: Mid-altitude Vegetable Production, September – December 2022</td>
<td>62</td>
</tr>
<tr>
<td>Training 3: Special Projects, December 2022 – January 2023</td>
<td>68</td>
</tr>
<tr>
<td>CHAPTER 5: LESSONS LEARNED AND CONSIDERATIONS FOR IMPROVED TRAININGS</td>
<td>71</td>
</tr>
<tr>
<td>CONCLUSION</td>
<td>87</td>
</tr>
<tr>
<td>BIBLIOGRAPHY</td>
<td>95</td>
</tr>
<tr>
<td>Appendix 1: Desuung Request for Proposals, 17 June 2021</td>
<td>100</td>
</tr>
<tr>
<td>Appendix 2: Original Horticulture Trainings Proposal, February 2022</td>
<td>105</td>
</tr>
<tr>
<td>Appendix 3: Horticulture Training, Accepted April 2022</td>
<td>111</td>
</tr>
<tr>
<td>Appendix 4: Amended Proposal for Training #2</td>
<td>119</td>
</tr>
<tr>
<td>Appendix 5: Proposal Training 3, Winter 2022-2023</td>
<td>129</td>
</tr>
<tr>
<td>Appendix 6: Curricula as Covered, Crops Grown, Field Trips for Trainings 1-3</td>
<td>131</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

FIGURE 1. PHYSICAL MAP OF BHUTAN ........................................................................................................... 1
FIGURE 2. TEMPERATURE AND PRECIPITATION IN BHUTAN ........................................................................... 3
FIGURE 3. PRECIPITATION AND TEMPERATURE AT OUR SECOND TRAINING SITE ......................................................... 3
FIGURE 4. CONSTRAINTS IDENTIFIED BY FARMERS IN BHUTAN ............................................................................. 15
FIGURE 6. HOW QUICKLY OR OVER HOW LONG EXPERIENTIAL LEARNING MIGHT TAKE PLACE ...................... 31
FIGURE 7. DALE'S CONE OF EXPERIENCE ........................................................................................................ 32
FIGURE 8. A COMPARISON OF MODELS OF LEARNING ....................................................................................... 33
FIGURE 9. GEIR LIEBLEIN'S DUAL LEARNING LADDER ....................................................................................... 35
FIGURE 10. THE LEARNING LANDSCAPE ............................................................................................................ 35
FIGURE 11. EMAIL TO TRAINING PROVIDERS ON NESAWG LISTSERV ................................................................. 37
FIGURE 12. OUR FARM PLAN IN PHOBJIKHA, AND BEDS MADE ON CONTOUR ........................................................ 59
FIGURE 13. MAKING BOKASHI, BIOCHAR, COMPOST, AND COVER CROPS ....................................................... 61
FIGURE 14. TRACTOR TRAINING ......................................................................................................................... 61
FIGURE 15. MORALE WAS HIGH ......................................................................................................................... 62
FIGURE 16. VEGETABLES FOR SALE ................................................................................................................... 65
FIGURE 17. BUILDING GREENHOUSES AND WATER STORAGE PONDS ............................................................... 66
FIGURE 18. TRYING NEW TOOLS, IRRIGATION STUFFS, AND USING THEIR HEADS ................................................... 67
FIGURE 19. A FEW OF THE FINISHED PRODUCTS FROM TRAINING 3 ...................................................................... 70
LIST OF TABLES

TABLE 1. AGRO-ECOLOGICAL ZONES IN BHUTAN. .......................................................................................................................................................................................... 4
TABLE 2. MAJOR CROPS AND PRODUCTION BY AGRO-ECOLOGICAL ZONE. ......................................................................................................................... 4
TABLE 3. PURPOSE OF FARM PRODUCTION, PER TYPE OF LANDHOLDING. ................................................................................................................................. 13
TABLE 4. ATTRIBUTES THAT CHARACTERIZE FARM START-UPS AND CONTINUATION. .......................................................................................................... 44
TABLE 5: MIKE’S PEDAGOGICAL MANIFESTO ................................................................................................................................................................................... 51
TABLE 6. A FARMER’S REQUIRED KNOWLEDGE & SKILLS; BEHAVIORS; AND AWARENESS OF TRENDS .......................................................... 53
TABLE 7. CURRICULUM FOR HORTICULTURE TRAINING .................................................................................................................................................. 54
TABLE 8. IN-COUNTRY RESOURCE ASSESSMENT ITINERARY ................................................................................................................................. 56
TABLE 9. PROBLEM SOLVING AND TOOL DESIGN PROJECTS, TRAINING 3, RUBESA ........................................................................................................ 69
TABLE 10. SITE INFORMATION, TRAINING 1, PHOBJIKHA ............................................................................................................................................... 131
TABLE 11. CURRICULUM ACHIEVEMENTS AND ACTIVITIES, TRAINING 1, PHOBJIKHA ...................................................................................................... 132
TABLE 12. CROPS GROWN, TRAINING 1, PHOBJIKHA ........................................................................................................................................... 134
TABLE 13. SITE INFORMATION, TRAINING 2 & 3, RUBESA .............................................................................................................................................. 135
TABLE 14. CURRICULUM ACHIEVEMENTS AND ACTIVITIES, TRAINING 2, RUBESA ...................................................................................................... 136
TABLE 15. CROPS GROWN, TRAINING 2 & 3, RUBESA ............................................................................................................................................... 138
TABLE 16. COVER CROP TRIALS, TRAINING 2 & 3, RUBESA ............................................................................................................................... 138
TABLE 17. SITE INFORMATION, TRAINING 3, RUBESA ........................................................................................................................................... 139
LIST OF TEXT BOXES

BOX A. ARE FARMERS AGING OUT? ................................................................................................................................. XI
BOX B. NAVIGATING YOUTH MENTAL HEALTH .............................................................................................................. 18
BOX C. THINGS WE SHARED BY ORGANIZING CHESAPEAKE CRAFT ........................................................................ 27
BOX D. ENTREPRENEURSHIP ............................................................................................................................................. 84
In January 2022 I received an email from the wife of a close friend:

“Hello Mike,

I am reaching out about an opportunity to host a skills training workshop in Bhutan for unemployed young Bhutanese adults which is fully funded by the government. My travel company partner is assisting in setting up this program which they're coining as "national occupational therapy". They are offering all expenses covered, plus compensation. They are specifically looking for people in horticulture and farming, so I thought of you. I have attached the program description if you're interested in learning more about it. The only hitch is that a 14-day quarantine requirement is still in place for fully vaccinated individuals, but you still would be compensated part of your stipend during this time. Anyhow, it sounds like a very cool opportunity. Let me know if you're interested and I can explain more and put you in touch with Uli, who is my business partner.

Hope all is well and that we get to see you soon!

Best,
Ashley”

To which I responded, of course, "Holy shit, are you kidding? I’d love to! Yes, please!"

A new farmer myself once (and perhaps in ways still), I have been involved in farming and beginning farmer training in different capacities for more than two decades, including several USAID Farmer-to-Farmer projects. This was an opportunity to become intimate with a new country and develop a high-quality program for young adults. And, hopefully, inspire them to proudly enter agriculture as a career.
I am a firm believer in personal experience as a driver for change at the individual level. That is, experiences can shape our interests, ambitions, and life direction. My goal as an educator is to orchestrate experiences that might "hook" learners into pursuing a life that provides them sufficiency, pride, and contentment, and more particularly farming as a livelihood or part of a livelihood.

Agriculture in nearly all countries, of course, has been changing for decades. It has been widely reported that farmers are aging, implying that young people are exiting rural and agricultural life, leaving their elders to continue without them (HelpAge, 2014, IFAD, 2018, Hilchey, 2010, Mitchell et al, 2008, White, 2012, White 2020). The data on this is somewhat nuanced and deserves some conversation (see Box A).

**Box A. Are Farmers Aging Out?**

Aslıhan Arslan (Arslan 2019) points out in an IFAD report, “How Old is the Average Farmer in Today's Developing World?” that the age-related data commonly cited reflect the way that questions are asked, that is, how the data is collected. IFAD's Rural Development Report 2019 uses different data (thanks to dramatic changes to how data can be collected and analyzed in the last decade) which suggests the need to question the assumptions that: the sector is aging, and that rural youth are leaving farming because it's not cool or profitable. While the head of a household may be getting older, the average age for all household members involved in farming is 10 years younger - rural youth do spend part of their time working and farming. Rigg et al (2020) concurs that what is happening is nuanced, and this should affect policymaking. Arslan goes further saying farming is becoming "younger and more dynamic." Several close observers of peasant agriculture agree, at least with the idea that we need to look more broadly at cycles of de-peasantization and re-peasantization (Bernstein et al 2018). For example, Brian White (Bernstein et al 2018) identifies three types of farmers in a new peasantry: ‘continuers’, who grow up on the farm, help, and take it over; 'other continuers' who grow up on a farm, leave it, and return when land is available or their parents get older, perhaps coming back in their 40s; and 'real' new farmers, who have no farming background. In many parts of the world, he thinks groups 2 and 3 will become more important. All quite interesting, and my approach is to learn to support all three groups.
However, it is undeniable that in much of the world, young people are leaving the farm, either pushed by family dynamics, poverty, economic or a combination of these, or pulled by education, opportunity, exposure to a world different than their home. This leaves us with a near-universal question in agriculture:

Who will farm in the future?

The Asian Development Bank (2021) adds several related questions to frame the "Farming Crisis" in Asia:

- How to secure future (and present) food supply with an aging population?
- How can female farmers be successful without equal access to education, finance, and productive assets?
- How to supply safe food when land and water resources are becoming polluted, contaminated, and degraded?
- How prepared are we to cope with the impact of climate change on food production?
- Do we need to transform farming and consolidate small and fragmented farms to achieve food sensitivity and rural prosperity?
- Can, and how, we balance domestic food security and resilience with profitable exports wherever a country has a marketable product?

Bhutan is not unique in asking these questions, though it is a unique country, and it will be important to examine how so. But this is a big question, and we don't see it well addressed in policy or in results. I think we have a lot to learn and therefore a lot to try as trainers, farmers, researchers,
and mentors. Development programs are rife with poor results from good ideas, suggesting either the ideas weren't really all that good, or that there is a gap between learning and action.

In fact, working with farmers probably shouldn't be viewed as simply as technical assistance or information sharing. We will see that the life choices of young people are related to things both within their control and things beyond their control. Good policies and a positive enabling environment are important, so that when farmers learn new ideas there might be success implementing them. But also: we need to think about and empathize with youth to address not just expertise, but also motivation, aspiration, personal well-being, and other factors. We want actions, and there are teaching strategies that help turn knowledge into action.

Which brings me to the point again: can we encourage new farmers in Bhutan with this training?

My objective with this paper is to describe the attempt to answer that question. I will provide some context to the training: the geography of Bhutan, relevant history, information about land governance, the state of agriculture in the country, and present issues related to youth and opportunity. I will try not to take too long, but understanding what may be going on with any one trainee can help us as educators.

I will also explain the pedagogical approach I take with this training, based on my own experience and a review of literature.
Next, I will describe the curriculum and what we did during three trainings: a first introduction to growing vegetables at high altitude; a mid-altitude training for those with more experience; and a short additional training to extend the second, focused on problem solving in agriculture.

I will finish with a section on what went well, what could have gone better, and what we can learn from these trainings. Finally, I will offer recommendations that might be useful for future programs.
CHAPTER 1: BHUTAN

Bhutan is a small, landlocked country in the eastern Himalaya. Tibet and China lie to the north, former kingdoms and now Indian states of Sikkim and Assam to the west and south, Arunachal Pradesh to the east. Bangladesh is not far to the south. Bhutan is roughly 38,390 square kilometers, just smaller than Switzerland, with a population around 775,000 people. The largest city is Thimphu, the capital.

![Figure 1. Physical map of Bhutan.](https://www.worldometers.info/img/maps/bhutan_physical_map.gif)

Gangte in the Phobjikha Valley and Wangdue Phodrang, both near the center of the map, mark our training sites. Source: [https://www.worldometers.info/img/maps/bhutan_physical_map.gif](https://www.worldometers.info/img/maps/bhutan_physical_map.gif)
**GEOGRAPHY AND CLIMATE**

The country is mostly foothills and high mountains on the southern slopes of the Himalaya. The southern-most part of the country includes a slice of low plains, barely ten miles at most, before the border to India. Glaciers, mainly in the north, feed rivers than generally run south toward India, feeding the Brahmaputra River.

The country is biophysically diverse. Agro-ecological zones are mostly closely associated with altitude: subtropical plains from 200 meters above sea level; low foothills with subtropical broadleaf forests; temperate, Eastern Himalayan broadleaf forests in the west and central hills (where most people live); alpine areas in the high mountains. Bhutan is notable for steep and rugged terrain: 49.5% of its area has slope greater than 50% (Dendup, 2018).

Of its roughly 9.5 million acres, less than 8% (<8,000 acres) are considered arable. Less than 3% of that is used now for farming.

While the Ministry of Agriculture and Forests (Gadal, 2015) identifies six agro-ecological zones in Bhutan, agricultural areas are commonly divided into three main zones: Low-Altitude (<1,000 m), Mid-Altitude (1,000 - 2,000 m), and High-Altitude (>2,000 m) (RGB, 2019, p. 7). Most annual cropping occurs below 3,000 m thought there may be occasional home gardens at higher elevations. Yak herding is a traditional use of open areas higher than that, and yak graze lower elevations seasonally moving higher up in the summer and moving down in the winter.

Bhutan's climate is monsoonal, with five seasons: summer, monsoon, fall, winter, and spring. Rainfall varies by altitude and location, but most rain falls during the monsoon months in July, August, September, with occasional precipitation in May and June, and tapering in October.
Blessed Rainy Day marks the end of the monsoon season and is celebrated sometime near the autumnal equinox.

*Figure 2.* Temperature and precipitation in Bhutan.

The numbers may change but the temporal pattern is consistent through most of the country. Source: World Bank, 2023

*Figure 3.* Precipitation and temperature at our second training site

Source: https://worldweather.wmo.int
Bhutan is susceptible to a variety of natural hazards, including flooding, earthquakes, landslides, glacial lake outburst floods, wildfire, and windstorms. It is climate vulnerable, meaning it can expect changes in precipitation patterns (erratic start and end dates, extreme events), heat events, retreating glaciers (which is being recorded already), and distribution of pest and disease (World Bank, 2023, UNDP, 2022). Bank, 2023, UNDP, 2022).

Table 1. Agro-ecological zones in Bhutan.

<table>
<thead>
<tr>
<th>Agro-ecological zones</th>
<th>Altitude (m.a.s.l)</th>
<th>Temperature (°C)</th>
<th>Mean Rainfall (mm)</th>
<th>Proportion of Geographical Area (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max</td>
<td>Min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alpine</td>
<td>3500–7500</td>
<td>12.0</td>
<td>-1.0</td>
<td>&lt;650</td>
</tr>
<tr>
<td>Cool temperate</td>
<td>2600–3600</td>
<td>22.0</td>
<td>1.0</td>
<td>650–850</td>
</tr>
<tr>
<td>Warm Temperate</td>
<td>1800–2600</td>
<td>26.0</td>
<td>1.0</td>
<td>650–850</td>
</tr>
<tr>
<td>Dry Sub-tropical</td>
<td>1200–1800</td>
<td>29.0</td>
<td>3.0</td>
<td>850–1200</td>
</tr>
<tr>
<td>Humid Sub-tropical</td>
<td>600–1200</td>
<td>33.0</td>
<td>5.0</td>
<td>1200–1500</td>
</tr>
<tr>
<td>Wet Sub-Tropical</td>
<td>100–600</td>
<td>35.0</td>
<td>12.0</td>
<td>2500–3500</td>
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</table>

Adapted from Renewable Natural Resources Research Strategy and Plan Document 1992, Ministry of Agriculture, Planning and Policy Division, Thimphu, Bhutan. https://doi.org/10.1371/journal.pone.0219804.t001

Source Bdr and Bazile, 2020

Table 2. Major crops and production by agro-ecological zone.

<table>
<thead>
<tr>
<th>Agro-ecological zone</th>
<th>Altitude range (m.a.s.l)</th>
<th>Annual rainfall (mm)</th>
<th>Farming systems, major crops and agricultural produce</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpine</td>
<td>3 600–4 600</td>
<td>&lt;650</td>
<td>Semi-nomadic people, yak herding, dairy products, barley, buckwheat, mustard and vegetables.</td>
</tr>
<tr>
<td>Cool Temperate</td>
<td>2 600–3 600</td>
<td>650–850</td>
<td>Yaks, cattle, sheep &amp; horses, dairy products, barley, wheat &amp; potatoes on dryland, buckwheat &amp; mustard under shifting cultivation.</td>
</tr>
<tr>
<td>Warm Temperate</td>
<td>1 800–2 600</td>
<td>650–850</td>
<td>Rice on irrigated land, double cropped with wheat and mustard, barley and potatoes on dryland, temperate fruit trees, vegetables, cattle for draft and manure, some machinery and fertilizers used.</td>
</tr>
<tr>
<td>Dry Temperate</td>
<td>1 200–1 800</td>
<td>850–1 200</td>
<td>Maize, rice, millet, pulses, fruit trees and vegetables, wild lemon grass, cattle, pigs and poultry.</td>
</tr>
<tr>
<td>Humid Subtropical</td>
<td>600–1 200</td>
<td>1 200–2 500</td>
<td>Irrigated rice rotated with mustard, wheat, pulses and vegetables, tropical fruit trees.</td>
</tr>
<tr>
<td>Wet Subtropical</td>
<td>150–600</td>
<td>2 500–5 500</td>
<td>As for the humid zones – irrigated rice rotated with mustard, wheat, pulses and vegetables, tropical fruit trees.</td>
</tr>
</tbody>
</table>

Source: MoA, 2002

Source: Gadal, 2016
GOVERNANCE AND HISTORY

Bhutan was a hereditary monarchy, direct Royal rule from 1907 until 1998, transitioning to a constitutional monarchy and adopting a new constitution in 2008. Jigme Khesar Namgyel Wangchuck is the current, 5th King of Bhutan. Democracy is young and the monarchy still strong and engaged. Bhutan was never colonized and began to open to outsiders in a controlled and measured way, in the 1970s: joining the UN in 1971, allowing tourists in 1974, and television in the 1990s (Dendup, 2018). Bhutan is known for measuring national success in terms of gross national happiness (GNH) rather than gross domestic product. GNH encompasses socioeconomic development, environmental conservation, the preservation and promotion of Bhutanese culture, and good governance. Government is administered at the federal level, in each of twenty dzongkhags (districts), and 205 gewogs (sub-districts) level.

LAND GOVERNANCE

The government of Bhutan has taken steps to protect, conserve and make equitable access to land. The 2008 constitution requires Bhutan to maintain at least 60% forest cover (actual treed land is closer to 70%). Forest lands were nationalized in 1969. The 1979 Land Act nationalized much land in the country, in urban areas, forest (managed for leaf litter,) grazing, and land in rural areas. There is a focus on protection of habitat (a goal of 40% land protected) and on creating corridors for wild flora and fauna (Dendup, 2018, Hayward, 2021).

There is also a land ceiling, 25 acres per family (with exemptions for the royal family, government institutions, and certain community groups). Again, agricultural land makes up a small portion of the country's total area (less than 8%, of which much has been abandoned), and landholdings are
increasingly fragmented (Hayward, 2021 and Gup Phurba Namgay, pers comm 2022). *Kidu* is one means to address this: the king provides relief in the form of money or land, even citizenship. *Kidu* is an old practice, from at least the 17th century, and the 3rd King used it in a series of reforms in the 1950s. A 2007 land *kidu* established the National Land Commission, which furthered land reforms, and gave over 140,000 acres to over 61,000 beneficiaries from 2009-2013 (Hayward, 2021). Some arable land is still available to request.

**Development**

Bhutan is still considered a Least-Developed Country (LCD) but has developed quickly in the last two decades; poverty has dropped 60% from 2009 to 2019. Education is universal and health care provided by the government. Access to electricity is nearly 99% in both urban and rural areas. Internet is available in most gewogs, if not most villages. Access to water has improved, though water shortages are still common. Surface water provides most drinking and irrigation water but decreasing snowfall and long dry seasons conspire to cause both acute and chronic problems (Editors, 2023).

Hydroelectric power is now the biggest contributor to GDP (developed with India with agreements to sell electricity there) and provides jobs in certain areas of the country. Tourism is highly regulated and, until the COVID-19 pandemic, was an important industry (both in terms of income and employment). Many Bhutanese work and study abroad and provide remittances back to their families. Agriculture is still an important sector, contributing almost 17% of GDP in 2017 (Dolma, 2020).
Bhutan has a close developmental and military relationship with India, and most imports and exports flow between the two countries. Bhutan courts private investment and works with regional and international development banks, particularly the ADB. Bhutan has warm development-related relationships with Japan (JICA has been a major development partner since 1964), Switzerland, Austria, Canada, and several other countries. Bhutan has six embassies abroad (Australia, Thailand, Belgium, Bangladesh, Kuwait, and India); missions to the UN in Geneva and in New York, and a consulate in the US. Only three countries have official embassies in Bhutan: India, Bangladesh, and Kuwait.

**Migration**

A major feature of the last decades has been migration, both domestically and from Bhutan to other countries. Population data before 2005 (the first official census to meet international standards; a second was done in 2017) is not considered reliable, but it is estimated in 1994, 15% of the population lived in urban areas, 30% in 2005, and 37.8% in 2017 (Gosai and Sulewski, 2020). It has been reported that the number in urban areas has continued to go up over the last several years, to over 42% (Haywood, 2021). Population has also shifted heavily east-to-west - 60% of the country now lives in the west of the country, where there are more employment opportunities and better infrastructure. Thimphu, the capital city, grew from 30,000 residents in 1993 to 138,736 in 2017 (Haywood, 2021), and is said to be well over 150,000 today (roughly 20% of the population).

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1Defined as 1,500+ people, 1,000 people per km², 50% of the population depends on non-primary activities, and settlement not less than 1.5 km².
Bhutanese migration has been much more "intense" (that is, they live in gewogs different than where they are born) than in other countries: close to 40% compared to 8% in China, 4.2% in India, 12.1% in Nepal². It is interesting is that, while rural-to-urban flow dominates, 37% of domestic migration is rural-to-rural. Urban-to-urban migration is 11% and Urban-to-rural migration 8% (Gosai and Sulewski, 2020).

Voluntary out-migration is a major issue in Bhutan, though, and one which the Royal Government of Bhutan is struggling with. Tens of thousands of Bhutanese, mostly young people, have left for opportunities in places like Kuwait (for work), Canada, and, especially, Australia. With the end of the pandemic, thousands of Bhutanese apply for visas each month (Drukpa, 2022). Australia welcomes them, though only 20-30% are given visas (Lester, 2020).

While most of those migrating are young people, it is noteworthy that attrition in various industries suggests they are not the only ones going abroad to work³. This is significant because it indicates dissatisfaction in general: in civil service, private business, and healthcare (Tobgay, 2022), too. Bhutan is experiencing a loss of present productivity and that of the future.

²There may be several explanations for this. Bhutan is a small country with a small population, and it is easy to move from one administrative area to another, which is qualitatively different than in countries like India or China. Unique differences in history might also help explain: Bhutan was largely isolated from outside influences until the 1960s; the impacts of tourism are limited by regulation. Marriage practices often take men and women to other villages. Over the years there have been various kidu and other programs that make land available in different parts of the country. And, while this isn't acknowledged in Gosai and Sulewski, resettlement programs in the 1990s, related to refugee and citizenship issues, encouraged resettlement in southern districts (Acharya 2009).

³My own host, a farmer, left for Australia shortly after our training! Ostensibly to join family members on a cultural exchange, he has stayed and plans to work.
In Bhutan this is largely (though not only) an issue of economic opportunity: it begins as, "I'd rather work in Australia for a few years and earn what I still wouldn't make in my entire life in Bhutan" (Tobgay, 2022). For many it is a much longer trip. Couples can go to Australia to study and work - one spouse (the Bhutanese call them "de factos" for they are often marriages of convenience) is accepted as a student, while the other is allowed to work. After three or four years, they change places. By the end of eight years of study and work, they are eligible for resident status. There are sizable clusters of Bhutanese now in Perth, Canberra, and Melbourne.

The important take-away here is that people are on the move – meaning that not only are there fewer people to farm, but there are also fewer people building and improving society. We will investigate several of the reasons as they relate to youth in the next paragraphs.

**AGRICULTURE**

Bhutan is still largely an agrarian country. Agriculture employs over 56% of the population and a major economic sector, contributing over 15% of the country's GDP. That contribution has decreased as a share of GDP, from 26.8% in 2000 to 16.8% in 2014 to 16.51% in 2016 (Pelzom and Katal, 2017).

Just less than eight percent (7.8%) of Bhutan is considered arable and 2.74% is used, meaning more than 64% of arable land is fallow. The land used for agriculture has decreased by more than 15,000 acres between 2010 and 2016 (Dolma, 2020). The average landholding is roughly 3.4 acres and for many, these acres are scattered across the landscape.
Less than half of households irrigate their land. This proportion varies widely, in some dzongkhags more than half do and in other dzongkhags less than a quarter do. Most irrigation is surface water diverted by channel or black pipe and used to flood fields; less than eleven percent of irrigated holdings use overhead or drip irrigation (RBG, 2019).

Animal power is still the most common source for tillage; the most recent agriculture survey found 55% of farms use draft power, 26% machine power, and 19% hand power. This also varies widely by dzongkhag. In Wangdue Phodrang, where our trainings was held, 71% of farms use machines, while not far away in Tsirang, 5.5% use machines and over 80% use draft animals (RGB, 2019).

Bhutan is not food self-sufficient, though it is a stated goal of the government to produce at least 65% rice. Bhutan relies on imported commodities, mainly from India. Infrastructure improvements meant to improve access to markets have also made rural areas a market for cheap imports of rice, cooking oils, and other products, mostly from India.

Agricultural modernization began in earnest with the country's first five-year plan in 1961-1966. Shifting from traditional village-oriented peasant agriculture to market-based farming for national and international markets. In recent decades, the government has encouraged a transition from peasant agriculture to entrepreneurial farming: cultivation of low-volume, high value products; mechanization; and the expansion of farmer groups and cooperatives for marketing.
There are few holistic or systematic reviews of Bhutan's agricultural transformation, but Dendup (2018) described five main components: urbanization, mechanization, community institutions, high-value products, and youth aspirations.

- **Urbanization and infrastructure improvements**: Thimphu has tripled in size in the last ten years, as have other urban centers, creating domestic market opportunities such as the Centenary Farmers Market, other daily and weekly markets, Kaja Throm (a market established by Royal Command) and roadside vegetable outlets along highways⁴. Infrastructure improvements have made it easier for many farmers to access new domestic and foreign markets. Roads, electricity, TV, and cell coverage have improved access to market information as well.

- **Farm Mechanization**: while access to markets incentivizes farmers to increase production, labor is in short supply. Mechanization began in the 1960s with the efforts of a Japanese national, Keiji Nishioka, who worked in Bhutan 20 years until his death in 1992. He effectively brought many technologies to Bhutan: two- and four-wheel tractors (2WT and 4WT) for tillage, combines for harvest, threshing machines, "new" vegetables and seed of new rice and vegetable varieties, greenhouse/polyhouse technology, and many practices that can be used to increase productivity (Dorji and Penjore, 2011). The Agriculture Machinery Center (AMC) was established in 1983, and in 2016 the Farm Machinery Corporation Limited (FMCL) was established to "make farming an attractive livelihood

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⁴Well, highway. Highway 1, the major east-west route, is jokingly referred to as The Highway One of One highway in Bhutan.
enterprise that is socio-economically and environmentally sustainable" and now sells equipment, supplies, and services, including mechanized tillage services.

- **Community institutions**: communities in Bhutan have historically been isolated and traditionally Bhutanese value togetherness, reciprocity, and care for each other and other living beings. In most villages labor is exchanged with kin and neighbors during peak seasons. These relationships still exist, though they seem to be on the decline. The 2001 Cooperative Act of Bhutan, and its 2009 amendment, formalized the governments support for cooperative and community efforts.

- **High-value products**: the traditional agricultures of Bhutan were integrated systems, enough to feed the family with a small surplus to trade. In some areas farmers practiced shifting cultivation, as recently as the 1990s. The government now encourages farmers to grow high-value products, such as cardamom and fruit (oranges, apples, and others), and has pursued a policy to make all agricultural production organic by 2020 (it is not, see Tashi and Wangchuk, 2016).

- **Youth aspirations**: the Royal Government of Bhutan encourages young people to choose agriculture as a career.

We should note that these improvements are relative, and that progress is slow; agriculture in Bhutan still struggles to provide sufficient household income. Much of the agriculture in Bhutan is still for self-sufficiency (subsistence), often with some crops sold at market (see Figure 6). There
are pockets of market-oriented agriculture, such as Paro (where JICA was active from the 1960s through the 1980s under the direction of Keiji Nishioka), Phountsholing, and Phobjikha Valley, where potato is grown now in place of wheat and barley. Yields are still lower than many neighboring countries, though this is a common mountain experience (Naudiyal et al, 2019).

Table 3. Purpose of farm production, per type of landholding.

<table>
<thead>
<tr>
<th>Holding Type</th>
<th>Only for own consumption</th>
<th>Mainly for own consumption with some sale</th>
<th>Mainly for sale with some consumption</th>
<th>Only for sale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Percentage)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household</td>
<td>36.61</td>
<td>53.29</td>
<td>9.25</td>
<td>0.84</td>
</tr>
<tr>
<td>Private Ltd Company</td>
<td>24.00</td>
<td>4.00</td>
<td>56.00</td>
<td>16.00</td>
</tr>
<tr>
<td>Groups/Co-operative</td>
<td>1.90</td>
<td>3.81</td>
<td>78.10</td>
<td>16.19</td>
</tr>
<tr>
<td>Monastery</td>
<td>79.35</td>
<td>14.13</td>
<td>1.09</td>
<td>5.43</td>
</tr>
<tr>
<td>Others</td>
<td>50.17</td>
<td>26.10</td>
<td>12.20</td>
<td>11.53</td>
</tr>
<tr>
<td>Total</td>
<td><strong>36.67</strong></td>
<td><strong>53.02</strong></td>
<td><strong>9.38</strong></td>
<td><strong>0.93</strong></td>
</tr>
</tbody>
</table>

Source: RGB, 2019

Many farmers in Bhutan do not have or are not willing to access credit or financing to make improvements at the farm level and few have made investments to improve production quantity and quality. As we will see, government programming has not (not yet?) been enough to overcome negative perceptions about agriculture and its ability to provide sufficient income. In some cases, government efforts have contradicted this effort. For example, progressive conservation and protection programs have in many ways brought wildlife and humans closer together. Farmers still face many challenges, from human-wildlife conflict (a major problem in Bhutan) to dysfunctional markets, labor issues, and land issues:
• land and labor (RGB, 2019, Dendup, 2018)
  ◦ small land-holding size
  ◦ fragmented landholding
  ◦ poor fertility
  ◦ lack of labor

• environmental factors (Chhogyel and Kumar, 2018, Wangchuk and Wangdi, 2018)\(^5\)
  ◦ human-wildlife conflict (this is a major problem in Bhutan)
  ◦ erratic precipitation and less predictable weather
  ◦ declining sources of irrigation

• infrastructure (RGB, 2019)
  ◦ lack of irrigation
  ◦ lack of road connectivity
  ◦ lack of cold storage facilities

• inputs and skills (RGB, 2019, Dendup et al, 2021)
  ◦ limited access to relevant inputs
  ◦ declines in manure (due to labor shortage and subsequent reduction in animals kept)
  ◦ Lack of management skills in business administration; enterprise management; leadership skills in producer groups (Dendup et al, 2021)

• policy and institutional challenges (Dendup et al, 2021, Dendup, 2018)
  ◦ lack of access to finance and credit

\(^5\)Bhutan has experienced significant changes in weather patterns, associated with signs of climate change (Chhogyel and Kumar 2018, Wangchuk and Wangdi 2018)
improper implementation of existing schemes

legal and illegal flow of cheaper goods from India

some still prefer animal traction due to the logistics of terraced land, but no effective policy schemes for this.

religious opposition to certain livestock production and husbandry practices

Figure 4. Constraints identified by farmers in Bhutan.
Source: RGB 2019

Youth in Bhutan

Let's look more closely at the youth experience in Bhutan, and to try to understand why they might not be inclined to pursue agriculture as a livelihood.
Bhutan is a unique country, never colonized, ruled by kings, and until recently closed to foreigners. It is rapidly modernizing and rapidly Westernizing, and some blame this for many individual and social problems (Pelzom and Katel, 2017). In the last twenty-five years, electrification has reached nearly every mile, television introduced, democracy installed, and cellular phones and internet are ubiquitous. This is fast! The concept of Gross National Happiness is a valuable concept, and it has rightfully gained interest and attention in other countries, but individual happiness is only a small consideration, unlike what is expected of the idea in the Western world. In a country with a steep power hierarchy, a slower pace, an emphasis on collectivism and respect for elders, all common to agrarian societies, it is no wonder there is turbulence during a dramatic introduction of new ideas (some of which are well marketed).

Development has not been a smooth process, and some sectors have moved forward more quickly than others. Education is now universally available, has been successful in improving literacy and numeracy rates. It has also transformed what students want and expect professionally: professions like medicine, engineering, and civil service (and even more recently, politics, since it pays well) are higher on a hierarchy of aspiration than teaching or farming (Roder, 2016). And families generally support this: at the same time adults wish for cultural continuity, they also expect their educated children to get well-paid jobs to support the family.

In fact, school has become a competitive place for Bhutanese students. Many children are sent to boarding schools from a young age. Students often report feeling very alone. School can be a
strict place: clothes and hairstyles are regulated in schools, and tattoo parlors are illegal\textsuperscript{6}. It can be hard for young people to explore their identity.

Part of the problem is that professional opportunities have not come in step with changes in education and professional expectation. Likewise, farming has not become a lucrative endeavor, or even a sufficient one. Young people aspire to be white collar workers while class hierarchy, stigma and unreliable income that can support the lifestyle they desire makes farming a last choice.

Young adults were unemployed at rates upward of 16\% in 2018 (Dolma, 2020) and this number skyrocketed during COVID. There are, in fact, manual jobs, and the labor force to do them, but class hierarchy and stigma keep Bhutanese from taking manual jobs (Lester, 2020) and these are filled by imported Indian workers.

Perhaps more important, young adults are facing emotional distress at their prospects, at their relationships with older generations, and exploring their individual identities in a changing world. They often leave home after school to find employment or to continue their education (in hopes of then finding better employment). In the cities they find: few jobs, signs of other people's wealth, and poverty; and they are disconnected from their family support networks. Substance abuse is high among young people in Bhutan, also a major problem the government has tried to ease.

\textsuperscript{6}Hair styles, clothing, tattoos can all be used to feel power over appearance and to project individual identities (Lester 2020)
It may not be surprising then that suicide has become a serious issue in Bhutan, and is likely under-reported as it is in many Asian countries (Ranjan and Asthana, 2017 in Lester, 2020): 69% of completed suicides and 90% of attempts are youth and young adults. Students are the second highest "profession" reported, farmers the highest. Lester (2020) counts all the factors related to this: dim job prospects, poverty, school pressures, mental health problems, addiction, and stressful events including domestic violence. I was shocked to read that at least 44.3% of women report domestic violence in the family. See Text Box B for seven tensions that youth must navigate for mental health.

These phenomena are not unique to Bhutan. White (2012) observes an extended youth, where being "young" (or treated as young) tends to last longer than it used to – people stay in school longer, get married later, start working later. In much of the world, youth are better educated than their parents. That is, students are more literate, and more capable of existing in a literate world; perhaps know more about the sciences, numeracy, and other cultures. Education can help students learn to think critically (if it is done well) and to expose them to new ideas, and school is often expected to prepare them for non-manual work, for secure employment and higher incomes. But it also effectively de-skills students at the same time, from the kind of work that may be available to them.

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8Many things that are increasingly common are still stigmatized in Bhutan: divorce, substance abuse, mental health...
9I want to be clear that the Royal Government of Bhutan is responsive to these issues. The government makes good efforts to study and then craft policy responses to deal with them and has made progress on many fronts.
Box B. Navigating youth mental health

The literature on youth mental health has described seven tensions that are universal, if navigated in unique ways:

1. Access to material resources. Mental health and other resources to help individuals and families.
2. Relationships. One of the strongest protective factors for young people is strong adult relationships and presence.
3. Identity, although this is less notable in collective cultures
4. Cohesion, or duty to self and the greater good. People who feel connected to the community and to making good change.
5. Power and control. Over their prospects and life choices.
6. Cultural adherence.
7. Social justice as well as solidarity and standing up to oppression

(IRP, 2006 in Lester, 2020)

At the same time, young people are also exposed to lifestyles and expectations of high earners, with well-marketed aspirations to have and spend money on goods and services. Employment opportunities haven't matched the expansion of education and changes in aspiration, though. Youth unemployment rates have increased, typically at much higher rates than for adults. Many others are under-employed. It is common for young people to go to cities both for work and to avoid returning home, where they might be expected to help and to be subordinate to older generations (White, 2012).

White (2012) reports a common theme with different names: People are not necessarily idle, they might have short-term jobs, or help family, but are unemployed because they are waiting for what they consider appropriate jobs as "working unemployed." In Mali, they are called the-chomeurs (the tea-drinking unemployed). In Ethiopia, they have "the problem of passing excessive amounts of time." In Egypt and other parts of the Middle East, they call it "waithood." Some Indian graduates keep enrolling in school, describing their lives as "timepass," a kind of "purposeless
waiting” (White, 2012). I haven't heard a term like this in Dzongkha but the concept is similar for many Bhutanese youth.

**THE DESUUNG IN BHUTAN**

In 2011, His Majesty King Jigme Khesar Namgyel Wawngchuck launched the Desuung Integrated Training Program, a volunteer corps intended to instill community service, integrity, and civic responsibility in society. Desuung means "Guardians of Peace," and Desuups, as volunteers are called, work during disasters, along borders, at community and charitable activities. They operate outside of the parliamentary civil service, falling under the budget and direction of the King. They are well known for their discipline, efficiency, and preparation; all qualities generally perceived as lacking in civil servants.

In its first eight years, from 2011 until just before the pandemic started in 2020, there were 37 groups of roughly 125 trainees each (batches of the general public, teachers, executives, medical teams, tour guides, university graduates, and even former monks). Those batches trained almost 4,500 citizens: 3,235 men and 1,221 women. Between April 2020 and February 2023, over 30,000 additional Desuups have been provided training; room, board, and stipends; and meaningful work managing pandemic response, crowd control at events, patrolling borders, or in one of four national projects: the National Service Water Project, National Accelerated Dog Population Management and Rabies Control Program, Million Fruit Tree Plantation, and National Service Road Construction Project.
In April of 2021 the Desuung program, at the behest of the King, initiated a program of short-term trainings to unemployed Bhutanese youth. Called the Desuung Skilling Program (DSP), trainings were intended to provide a runway for youths into meaningful economic activities, with particular emphasis on self-employment and entrepreneurship. Trainings were to be provided mainly by international experts and trainers, and courses would be offered in a wide variety of disciplines. In the last year and a half, the program has grown quickly, providing thousands of Desuups with more than 200 courses.

Framed as a gesture of gratitude for their service during the first years of the Covid-19 pandemic, the DSP was initiated as the pandemic exacerbated issues already present in Bhutan: high unemployment, dim economic prospects, substance abuse, and significant cultural change in a country still developing and still opening itself to the modern world.

This is where I enter.
Chapter 2: Pedagogy and Training Design

So, we have a narrative that rural youth are not interested in farming futures. Is this inevitable?

Jan Douwe van der Ploeg writes that the state of 'being a peasant' has "evolved from a destiny to a choice" (Bernstein, 2018). White (2021) argues that farming can be attractive, and that some young people also desire an independent economic existence. That is, if the conditions are right, they would choose farming. Is there something we can do about it then?

Can agricultural training affect aspirations - and actions?

In this section I will describe my own experience as an entering, "real" new farmer, and as a farmer trainer, and how this informs my approach to delivering training in agriculture. I will also look at literature related to adult vocational education and take lessons from a sampling of farmer training programs and new farmer experiences.

Author’s Experience

My own experience as a new farmer, experienced farmer, and educator informs my priorities in designing a contribution to the DSP. I have been the farming-learner, a trainer of farming-learners, a farm employer, and an agricultural technical assistance provider. As I articulate in my proposals (see Appendix 2-5), I think there are three core pieces to the mission:

- Productivity
- Stewardship
- Joy
Allow me to, in four pages or less, describe a few key points of my personal background to explain how and why I have distilled training into these three principles. I grew up in a very different context: comfortable, well-educated in an urban/suburban environment. My parents would say they gave me "roots and wings" - not money, but a gift of education and opportunity to study and work in fields of my own choosing. I studied Geography in Vermont, with particular interest in the complexities of the human impact on the environment (local and global), which was a natural gateway to, along with non-academic interest in, agriculture and landscape theory.

That study and my geographer's work with a local dairy farm lead me to a Permaculture Design Course (PDC) of three weeks, on-farm, and hands-on study in ecological design. Permaculture is a design methodology based on how ecosystems work (Mollison and Holmgren, 1978, Mollison, 1996). Patterns observed in mature ecosystems are distilled into a handful of principles that are then applied to human systems. It emphasizes functional relationships between elements in a system – that is, it matters where things are located and how they interact with other things. Which seems to me a natural extension of a geographical lens on the world, where things are the way, they are by where they are in space.

Most important is that I entered the training with so many questions about how humans can exist in some balance with the rest of the world, if our impact on our habitat must be as messy as it is. And I began to find answers, successes, things to try - a place to start, at least. I lived the training for three weeks, eating food from the gardens, which were designed according to the very same principles we were learning, foods I had never heard of before. I slept and learned in
simple, sturdy, interesting, and hand-built structures that met basic needs and comfort, nothing superfluous. I studied and did projects with peers, learning to think and act like a designer of things. I felt like I had more direction, and tools to move forward in that direction.

My experience is common to trainings like PDCs, based at least on anecdotal evidence (just my own experience and my impressions from speaking with dozens of "graduates" over years, having participated in or hosted several courses...). Graduates use words like:

empowered  inspired  rewarding
agency   exposure  optimistic
control  sensical

When I am imagining a strong, ag-vocation strategy, I imagine a runway that exposes the youngest to farm and food experiences – a runway with on- and off-ramps from early childhood through middle school through secondary school and beyond, including college for some. Each stage focuses on different things, appropriate for the stage of development: early childhood, early and middle schoolings, teenage years and secondary schooling, and young adults.

We live in a time when teenagers and young adults suffer from severe anxiety and other mental health issues related to contemporary issues (climate change, gun violence in schools, economic outlook, and more) (Gifford and Gifford, 2016, Schrobsdorff, 2016). Some are pessimistic about their futures, or uncertain, or discouraged. Do educators have a role in engaging them, helping them to find their own motivations?
As I tend to emphasize when training, or offering tours of a farm, history has brought us to a point in

time when we have real, serious challenges (economic, ecological, social). This is the legacy of our

predecessors. It is not a judgement of the past – no one, as Amory and Hunter Lovins and Paul

Hawken explain in Natural Capitalism (2013) planned the Industrial Revolution and designed it to

pollute the air, water, and soil – but it does give our future generations something to do: repair the

world.

Which is why we now use terms like Regenerative Agriculture instead of Sustainable Agriculture or

Conservation Agriculture. Our charge is not to sustain a low level of fertility or soil health, but to

improve it, rebuild it, leave things better for our own children. The term is full of intention.

This is intoxicating to many young people. It was for me. It is for others. It gives youth permission to

break with the past and to create new things. Not just justification but imperative. It gives meaning to

their future.

I returned to Vermont after my PDC to complete an undergraduate thesis looking at whole-systems

design and cooperative structure in a Vermont dairy. My farm training started there. I read... I read a

lot. I worked on a vegetable farm. I visited other farms. I purchased tapes and CDs of past farming

conference sessions. I went to workshops. I continued my training in California, a new agro-

ecological context; took that experience back to the Northeast, to apply it, experiment with it, test it.

From there I took on more responsibility at several farms, growing organically and conventionally,
growing flowers, ornamentals, and food crops in commercial greenhouses; I raised animals for meat

and other products, learning to graze with adaptive management.
For two years I took a break from farming and taught middle and secondary school physical and environmental science. My curriculum focused on critical thinking, public policy, and literacy.

I returned to agriculture as manager of the Ecosystem Farm and Training Program at the Accokeek Foundation, running a small, non-profit organic vegetable farm and training apprentices each year. Eager to continue my own education (what better way to learn than to teach?!), I developed a detailed curriculum that involved formal and hands-on training, site visits, workshops, and a gradual release of responsibility. I crafted this curriculum over three years, trying new things each year. Sustainable or regenerative agriculture is highly context specific, meaning the principles may be the same, but they may be put into practice in different ways in different places. We made many, many visits to other farms to see how they practiced agriculture and to learn why.

My first year running the program, my trainees and I joined a neighbor farmer and her employees on a trip to Polyface Farm in Swope, Virginia. Together we drove a good five or six hours each way, and in addition to our private visit at the well-known farm, we built a camaraderie around shared interest and the enjoyment of a shared experience. And we found we liked each other, too, making friends. "We should do this again," we agreed.

Over the next two years we expanded and formalized these group visits, networking, developing an email list, and including livestock producers, nurseries, and fruit farms. The idea wasn't new; farmers in the US have taken their education into their own hands for generations. We took the name Chesapeake Collaborative Regional Apprentice Farmer Training (CRAFT), which had been used first in other regions of the US for similar purposes. Before CRAFT there were Twilight Tours, Field Days,
Granges, cooperatives, and all sorts of formal and informal get togethers, before (and after). Extension or Departments of Agriculture became involved.

Together we learned, we taught, and we had fun. Labor on our small farms could often be a challenge; learning to manage people can be as steep a learning curve as growing and selling produce. Providing training to other new farmers was often a part of the "compensation" and could attract employees. But few of us had the time to meet high expectations of what "training" can mean. With CRAFT we could share this burden. And social time with friends and time for employees to make their own friends could play an important role helping people make it through heat and hard work of long vegetable seasons.

Any culture or subculture may require different strategies aimed at cultivating vocations. I've always felt there are three main ways new farmers in the US go about their career development:

- formal training programs
- working for others
- getting out and starting all by themselves
Over a twenty-year history of training apprentices at the Accokeek Foundation (I oversaw four years) there were roughly sixty trainees, of which not more than 5 went on to farm professionally. It often seemed that more successful farms in the region were started by former employees of already successful farms, though it's not clear if there are data to back that up. This made me curious about how and why.

When an opportunity came to start a larger farm for a community development project, I took a more hands-off approach to training employees to become farmers. I stopped looking for people who wanted to learn to farm, rather people who were looking for work and willing to work hard. I trained them in the systems I developed as a good farmer. I gave them responsibilities and oversight. And I learned to make the farm a safe place where employees would feel part of a community. That was the hook – and when I would describe a need, often they would be interested in meeting the need. They felt and were valued, supported, indispensable, and came to enjoy what they were doing. That set the hook for several of them over six seasons. My sense is that learning skills related to farming is important, and that it must be accompanied by... something more... to turn into action, to turn trainees or employees into farmers.

In recent years I've undertaken short-term technical assistance projects through the USAID Farmer-to-Farmer program. Organizations contracting with USAID develop a list of projects requested by farmers and rural development programs in host countries. The organization recruits farmers or professionals in the U.S. to visit the working location, assess the situation, conduct a training, and make recommendations to the trainees and to the organizations involved.

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10Many more have been involved professionally in food systems work.
Freire, in “Extension or Communication” (Freire, 1969), associates the "banking model of education" (where a student is treated as an empty vessel to be filled with knowledge like a piggy bank) with cultural invasion. He preferred a problem-posing model, a discussion between teacher and students where everyone learns alongside each other. I don't claim to know everything as a grower. When I visit with farmers, in the US or in other countries, I see an opportunity to learn. Freire's position resonates with me. Rather than tell farmers what to do, I:

1. listen to what they do and why they do it and learn about their context, then
2. explain where I am from, how I do something (e.g., grow organic garlic), and why I make those decisions. I show lots of pictures, if possible,
3. then ask, do you think any of this would work here? What might we try here?

I think this is what he means when he writes and emphasizes dialogue, and recommends working as a team, treating learners as co-creators of knowledge.

THEORETICAL FRAMEWORK FOR EXPERIENTIAL LEARNING

"Neither skill nor business ability can be learned from books alone, nor merely from observation of the work and management of others. Both require active participation, during the learning period, in productive farming operations of real economic or commercial importance." R.W. Stimson, 1919

Literature applied to adult education and experiential learning supports many of these instincts. Experiential learning has a strong theoretical foundation. John Dewey explored how people make

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11Stimson 1919 in Roberts, 2006
sense of the world around them over a century ago. He outlined five steps through which people progress during the learning process:

1. a felt difficulty.
2. its location and difficulty
3. suggestion of a possible solution
4. development by reasoning through the suggestion, and
5. further observation and experiment leading to its acceptance or rejection (Dewey, 1910)

Joplin (1981) also described five stages of learning (of which all is experiential): focus, challenging action, support, feedback, debrief (Figure 8). She gives educators a few pointers:

1. Focus: this stage should be specific enough to draw a student's attention but leave room for spontaneous learning that can result from an experience.
2. Challenging Action: don't make this too easy, it should be challenging.
3 & 4. Support and Feedback: students should be given support and feedback throughout the process, this gives learners a safe space to take risks, where risk-taking is encouraged/endorsed, help is available, and feedback is given.
4. Debrief: give learners a time and place where they can articulate what they learn; this is when they order their observations and relate them to what they already know.

Figure 5. Joplin's five stages of experiential learning
From Roberts, 2006. Note the spiraling pattern.
Joplin also wrote that experiential learning could happen in a "flash of insight" or can last through an entire curriculum. That is, a learner might gain insight in a moment, or over several years.

Indeed, learning experiences come in different ways. Dale presented a hierarchy of learning experiences that make knowledge and experience more or less concrete (see Figure 10). Essentially, we can remember and use after 24 hours 10% what we hear, 30% what we see, 50% when a demo is added to telling us, 70% with a workshop exercise, 90% by doing the real thing and talking about it (Norris, 2003).
In 1984, David Kolb published "Experiential learning: Experience as the source of learning and development." His theory of experiential learning essentially explains that hands-on learning plays an important role in developing understanding. Experiential learning theory also posits a cycle where a learner takes a concrete experience, combines it with "reflective observation," conceptualizes it in abstract terms, and then actively experiments with the new concepts (Perez, Parr, and Beckett, 2010).

Experiential learning is not the only useful approach. Other models of active learning include the Problem-Solving Approach, a group-based strategy to learning through solving a problem together, and Inquiry-Based Learning. I experimented with Inquiry-Based Learning myself as a high school science teacher: instead of just learning facts, learners are presented with a question, and, through a series of
investigations that require practice with a variety of skills, find an answer. Roberts compared them in a neat chart (Roberts, 2006, see Figure 10). In fact, each can be useful in different circumstances, and they can all be used together in a whole curriculum.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Comparison of Models of Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiential Learning</td>
<td>Problem-Solving Approach</td>
</tr>
<tr>
<td>(as presented in Figure 5)</td>
<td>Phipps &amp; Osborne (1988)</td>
</tr>
<tr>
<td>1. Initial Experience</td>
<td>1. Experience provocative situation</td>
</tr>
<tr>
<td>2. Reflection</td>
<td>2. Explore references/sources</td>
</tr>
<tr>
<td>5. Evaluate the effects</td>
<td>5. Evaluation</td>
</tr>
</tbody>
</table>

1As reported by Parr and Edwards (2004)

Figure 8. A comparison of models of learning
From Roberts, 2006

Clearly, learning through experience can be an effective strategy in agriculture education. And there is more – we don't just leave it at providing experiential learning opportunities. We need to reach people on multiple levels.

In Taxonomy of Educational Objectives, Benjamin Bloom suggests that learning is a series of activities or steps (Bloom, 1956). Perhaps more relevant, he identified three domains of learning: cognitive, psychomotor, and affective. The cognitive domain is about acquiring content knowledge. The psychomotor: physical and mechanical skills related to a topic or discipline. The affective domain relates to a learner's awareness and growth in emotion, attitudes, and feelings (Bloom, 1956). Klein
and Lawver (2007) added another list of five steps relating more specifically to the affective domain: receiving, responding, valuing, organizing, and characterizing [information, insight, emotions].

Cognitive and psychomotor domains are standard in many adult agriculture programs. We know them as lectures, webinars, pruning demonstrations, equipment demonstrations and the like. Much less attention is given to attitudes and values, though, and these are things that enable learners to move from knowledge to action (Lieblein et al., 2007, Boyd et al., 2006). This is the domain that I think is key to a positive training outcome.

Geir Lieblein reframes Bloom's "learning ladder" in the context of agro-ecology, and she applies it both externally and internally, creating an affective learning ladder to go with Bloom's cognitive one (see Figures 11 and 12):

1. Training: learning routine skills
2. Memorizing facts, principles, and theories
3. Exploring: learning to link theory and practice
4. Visioning: learning the capacity to imagine future wanted situations
5. Implementing: the foundation for purposeful direction
Figure 9. Geir Lieblein's dual learning ladder  In Lieblein et al, 2007

Figure 10. The learning landscape  In Lieblein et al, 2007
The important piece here, what we’re trying to reach, is that step where a learner turns knowledge into action. Again Lieblein: "An important part of the learning process builds on a foundation of personal attitudes and individual growth. In the process, the learner gains the confidence, values, and vision to move forward and apply his or her knowledge in action" (Lieblein et al., 2007).

Boyd et al. (2006) describes how a learner internalizes information and there can be a change in attitude when cognition [and perhaps even psychomotor muscle memory] and affect are combined. Basing the idea on Dewey's philosophy that we learn new things by fitting them into what we already know, Francis et al. (2013) also recommends anchoring agro-ecological lessons in the real world, and then tying them to theory, remarking that "action is primary to cognition." I think they mean: a learner understands when they say, "I can" not "I think."

Let's take this one step further. Lave and Wenger (1991), as explained in Perez, Parr, and Beckett, 2010) looked at a variety of apprenticeship models, and observed that, following what we've learned above, a person develops understanding through participation – by doing. This works best when the work is authentic (McKibben and Murphy, 2021), when it is meaningful, production-based work. But they also situate it in a community or environment (the “situated learning theory”) where learners practice alongside peers and mentors. This way, they say, they develop an identity as a practitioner within a community-of-practice.

This seems like an imperative for an individual setting out to find a profession! And this is a good explanation of why learners who complete a residential training and work with their peers often describe this as a key part of a program (we’ll discuss this more shortly).

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12My own experience, and results from surveys in Perez, Parr, and Beckett 2010
So: learning is a process of steps that we take whether we notice or not. Learning through experience is a great way to really learn something, to learn something to a point of wanting to do it. There are three domains that we develop through experience: our brains, our muscles, and our hearts. It is our heart that helps inspire us to act on what we've learned. And there's a magic in living, working, and relaxing with peers and mentors that helps us envision ourselves doing and being what we are training for.

Let's take a moment to look at selected farmer training programs to see what might apply in Bhutan.

A FEW LESSONS LEARNED FROM OTHER TRAINING PROGRAMS.

I recently received an email on a listserv for food system practitioners:

Subject: Assessing Farmer Progress toward Meeting Goals - Networking Session, May 5th, 2023, 1 - 2 pm EST

Join New Entry Sustainable Farming Project and the FIELD Network to connect with staff of land-based farm incubator and apprenticeship training programs! Share challenges faced by land-based training programs supporting a diversity of beginning farmers and brainstorm ideas, solutions, and shared resources. Network in breakout groups to mix and mingle with other incubator farm program staff and apprenticeship staff across the country to connect and share project updates!

This month's networking topic is: Assessing Farmer Progress toward Meeting Goals. Evaluating farmer “success” is more complicated than it seems. Is it possible to assess aptitude in an objective way – and can you even attribute progress to your program interventions? How can busy farmers play a role in defining and evaluating their progress? And how to balance these questions with the expectations and definitions of success from funders and other outside interests?

We will explore key questions such as:

- What are the biggest barriers you run into when trying to evaluate farmer success?
- What do you wish you understood about farmer progress in your program?
- What methods or tools have been most helpful to your program?

Even if you don’t have all the answers, come, and learn and share challenges with your peers. See you soon!

Figure 11. Email to training providers on NESAWG listserv
Based in the Northeast U.S., the New Entry project was launched in 1988 and continues to improve and adapt their program. That is a common theme among people working to grow new farmers: reflecting, sharing, adapting. There has been progress in the U.S., but the training community is still learning. While several training programs have been around for decades, many organized thanks to the first Beginning Farmer and Rancher Development Program grants (first authorized in 2002 and dormant until 2008), launched in 2009 (Niewolny and Lillard, 2010). I managed a program in Maryland (established in 1994) and was a board member of an organization involved in one of the early BFR grant awards.

Niewolny and Lillard, 2010, reviewed more than thirty beginning farmer programs in North America and made the following points and recommendations:

1. Beginning farmers need more than just technical skills: they also need marketing training, financial planning and resource assistance, business planning and management, land acquisition and transfer, and, I will add, employee management.
2. Build viable social networks to facilitate beginning farmer knowledge communities-of-practice.
3. Implement participatory and experiential learning methods that integrate knowledge with trainer experience (and reduce the number of lectures)
4. Integrate social media to generate and sustain interest in agriculture and food.
5. Integrate new approaches such as networking, creating business incubator programs, marketing training-design.

In 2015, Santiago and Roxas looked at approaches to reviving farming interest in the Philippines. They examined four of them, each model targets particular groups of students and young adults.
1. **Family Farm Schools (FFS, started in Spain and found in France, Spain, Romania, and the Philippines).** These are farm schools without a farm; they rotate the program (alternancia) so that students spend one week in school, 1-2 weeks at home and farm and then back to school again. After observing several privately run schools, in 2013 the Philippines established a public FFS in each of 80 provinces (15 managed by private sector, how do they compare?), during the last two years of secondary school (grades 11-12). FFS encourage classroom education while inculcating in children a love for farm. This approach can help strengthen family bonds and help the family with labor as needed.

2. **SAKA program.** The SAKA program is for high school graduates unable to pursue higher education. It is a 1-year non-degree certificate program in farm management. 70% time is spent in the field. The organization will help graduates gain access to microcredit afterward. Students can use idle farmland to earn money toward their own farm purchase.

3. **Farm Business Schools.** For out-of-school youth who have finished secondary school, and not necessarily children of farmers. This is an agri-preneurial training program, and trainees are trained on farms managed by "successful agri-preneurs." It is privately funded and collaborates with a nearby university so that graduates can continue to a degree in entrepreneurial management if they wish.

4. **Social Enterprise Model, Gawad Kalinga Foundation (CK).** This is a project that combines sustainable community development, social entrepreneurship, and social tourism. The site acts as a business incubator. It is not clear how successful this model is; the evidence they give is largely based on claims by the founder.
The Apprenticeship in Ecological Horticulture (AEH) at University of California, Santa Cruz is a well-known and well-regarded program. Formally established in 1975, a goal of the AEH is to increase the number of people who understand and are skilled in organic horticulture and agriculture, so that they can go on to work in related commercial or social service projects. AEH is a seven-month training for thirty or more apprentices. They work at three sites of scales, using a variety of tools and equipment: a small garden, a 3-acre Chadwick Garden, and a 10-acre farm using 4-wheel tractors and mechanical cultivation equipment. There are four managers, one full- and one part-time coordinator, and seven second-year apprentices that assist the instructors. All apprentices live on the farm; they rotate chores and responsibilities; they grow or purchase, prepare, and eat meals together, clean common areas, and work together on the farm and at their marketing channels (Perez, Parr, and Beckett, 2010).

The program is neither entirely production work nor entirely academic. It maintains a 70:30 balance: 700 hours are given to hands-on, in-field training and work and 300 hours are class-time, which includes formal lectures, talks, group activities, field walks, field trips, and discussions. The primary approach to instruction is "I do, we do, you do."

In 2010, Perez, Parr and Beckett evaluated the achievements of the AEH between 1989 – 2008. In their survey of AEH alumni, they sought to understand if the program met the goals and served the mission; how the program contributed to actions and life decisions; and what components of the program were most important. They found that, indeed, many alumni worked in agriculture or related fields: 87% work in sustainable food systems, 81.9% work in farming or gardening, 31.8% (nearly a third!) owned a farm, and 64.5% were farming or gardening at the time of the survey. They also overwhelmingly responded that they gained knowledge (cognitive domain) and skills (psychomotor) (Perez, Parr, and Beckett, 2010).
Moreover, alumni responses showed the degree to which the affective domain was impacted during the program. Almost 80% of alumni responded saying the program provided confidence and that their values were confirmed, and 54% said their values were refined or changed. Seventy-five percent - 75%! - responded that the program shaped personal goals and that they were inspired or motivated to action by their experience. They answered with variations on the theme of "inspired": motivated, empowered, emotionally triggered to act, drive, far more informed, help make a commitment, and so on.

This reflects a significant impact on trainees' attitudes and values, and these and other responses reinforce the importance of common parts of an experiential agriculture training program: practical, hands-on work; room to explore and make mistakes; tying experiences to theory; and assignments or opportunities to reflect and internalize experiences. The living experience and working and sharing with peers were among the highest rated components of the program.

Perez, Parr, and Beckett conclude that the significant affective component of the program is critical to alumni transforming knowledge and skills into action.

Perez, Parr, and Beckett also reviewed surveys done at another California program, the Agriculture and Land-Based Training Association's (ALBA) Small Farmer Education Program. ALBA is another well-regarded program. They found that 69% of graduates were independent farmers after graduation, and 51% still were at the time of evaluation. ALBA alumni reported obtaining skills, confidence, self-esteem, and connection to others in the program as key outcomes from their experience there.
Perez, Parr, and Beckett (2010) then offer recommendations to other trainers:

1. Recognize the things your program does well and learn from trying new training components or strategies.

2. Design activities and assessments that develop all the domains of people's learning – and, especially, don't neglect the affective domain. Connect attitudes and values to knowledge and skill-building. Provide a safe space to clarify their own attitudes through role play, case studies, open-ended situations, in-depth discussion in the learning community. Journaling, semi-structured discussions during or after field work connect ethics, values, emotions, subjective to the knowledge and skills people are developing.

3. Experiment with implementing each of Kolb's aspects of experiential learning theory, in a systematic way – implement reflective observation; active experimentation; provide space to implement ideas generated through learning.

4. Provide and assess the quality of their time with each other as peers and with teachers as a cohesive community of practice – not just in class but at the farm and recreation time, too.

5. They also suggest areas for future research.
   1. What role does inspiration and motivation play in facilitating learning and taking action?
   2. How are these best cultivated in individuals and community?

Exactly.

LEARNING FROM SUCCESSFUL START-UPS

Since our real goal is for trainees to start and continue farming, can we learn anything from the experiences of beginning farmers after they have become established?
This question is under-researched, and it would be excellent to find information from a variety of contexts, especially ones relevant to young adults in Bhutan. Gillespie and Johnson (2010) looked at success in farm start-ups in the Northeast US and, rather than "success" or "failure" preferred the terms "continuation" and "exit". What they found is that there are four main contexts to explore, and for each trainee to assess themselves (see Table 1).

1. Attributes of a conducive social context
2. Appropriate personal characteristics
3. Suitable business characteristics
4. Things to navigate well

Meter (2010) interviewed people working in food systems and identified three qualities that distinguished successful strategies: relationships, resilience, and recycling (they use financial flows that recycle money and other resources through their locales, helping to build local economic multipliers). We might add these to the lists in Table 1.
Table 4. Attributes that characterize farm start-ups and continuation.

<table>
<thead>
<tr>
<th>Attributes of a conducive social context</th>
<th>Appropriate Personal Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to land, equipment, livestock, facilities, operating capital, etc. on &quot;reasonable&quot; terms given market conditions.</td>
<td>Willingness and physical capacity to work hard and long hours.</td>
</tr>
<tr>
<td>Practically available farm input suppliers, info providers, service providers</td>
<td>Appropriate managerial knowledge and technical skills including ability to work smart, to multitask and to manage other people effectively, if needed</td>
</tr>
<tr>
<td>Practical availability of &quot;good&quot; markets for products.</td>
<td>Flexibility and innovativeness in face of challenges</td>
</tr>
<tr>
<td>Supportive family and significant others who value and acceptence.</td>
<td>Ability and motivation to gain needed information from a wide variety of sources and astute personal observations that enable avoiding mistakes as well learning from any mistakes made.</td>
</tr>
<tr>
<td>Supportive ag &quot;community&quot;</td>
<td>Aptitudes for needed skills.</td>
</tr>
<tr>
<td>Neighbors who support the particular kind of farm, or at least accept it</td>
<td>Appropriate technical knowledge and skills</td>
</tr>
<tr>
<td>Uses of surrounding land compatible with the enterprises</td>
<td>Willingness and capacity to curb personal consumption in favor of operating expenses and investment in the businesses wisdom to avoid too rapid growth, too many new things at once, and other sources of overstretching management and resources.</td>
</tr>
<tr>
<td>Taxation of income, sales, and property that are reasonable.</td>
<td>Ability to take outside perspectives (i.e., customers) in evaluating products and IDing marketing opportunities.</td>
</tr>
<tr>
<td>Suitable policies pertaining to farming and marketing that manage land uses and ensure public safety without strangling farm enterprises.</td>
<td>Skill in communicating and negotiating combined with cultural knowledge needed for initiating, being open to, maintaining effective working relationships with important others who provide needed and timely...</td>
</tr>
<tr>
<td>Access to &quot;adequate&quot; health care and other benefits</td>
<td>Strong entrepreneurial motivation to do what is needed to produce successfully and efficiently and to market effectively; and</td>
</tr>
<tr>
<td></td>
<td>Persistence and perseverance</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Suitable business characteristics</th>
<th>Events to navigate well.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate resources from accumulated capital, current farm income, current nonfarm income, lenders, or other investors for cash flow.</td>
<td>Weather</td>
</tr>
<tr>
<td>Sound, rational farm vision and business strategy (that might be manifest in business plans, contingency plans, etc.; slow, incremental business development; or an appropriate balance between the two tendencies.</td>
<td>Low market prices</td>
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<tr>
<td>Good match among production scale, production technologies, and available labor for each enterprise.</td>
<td>Loss of markets</td>
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<td>Serious production problems with equipment, diseases, pests, etc.</td>
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<td>Poor information</td>
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<td>Loss of key support business or person</td>
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<td></td>
<td>Lack of needed contacts or info sources</td>
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<td></td>
<td>Management decisions</td>
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<td></td>
<td>Labor shortages</td>
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<td></td>
<td>Health problems</td>
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<td></td>
<td>Family issues</td>
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</table>

Adapted from Gillespie and Johnson 2010
Gillespie and Johnson (2010) make the following recommendations for entering farmers:

1. find and use good mentors
2. conceive of your farms as part of a larger food system, their piece in a bigger picture
3. focus on playing to individual strengths

Oreszczyn et al., 2010 apply a framework of communities and networks of practice in an agricultural setting. They look at the web of people and organizations that influence the choices farmers make – we might add developing networks like this to Gillespie and Johnson's recommendations.

Finally, we might look to a study of youth and farming in Nepal for a last comment. Khanal et al., (2021) reiterate the power of empowering youth to be "agents of positive change." They encourage adults to emphasize what goes right rather than what goes wrong with youth. And they identify that connectivity to information and to each other via the internet and social media as a unique opportunity for this generation. "Youth can conceive ways to shape the future and economies around them in ways not really possible (Fletcher in Khanal et al., 2021). Their optimism is infectious.
Chapter 3: 3 Trainings and Preparation

THE PITCH

In response to the Request for Proposals sent by my friend’s wife, I drafted a training for urban farmers called Urban Horticultural Training: From Start-Up to Sale (see Appendix B for the full proposal):

Urban/Peri-Urban Horticultural Training: From Start-Up to Sale

Productivity
Stewardship
Joy

As an introduction I described our intention:

Agriculture is not just a job; it can be a meaningful way of life. This training is intended to give youth a runway to learn to grow and sell food as a business. It is designed to develop a cadre of dedicated, creative farmers, to empower them with horticultural, business, and critical thinking skills, and to associate growing crops with important personal and group development.

Broad themes include production skills, business planning, post-harvest handling, marketing, and farmer-community building. This will be a hands-on training that includes formal training, fieldwork, farm visits, and teamwork. We will encourage students to find their own interests and specialize if they wish to. A critical aspect of the training will be to develop a sense of pride and joy in growing food, and a network of peers to support each other materially and socially. Students will be cultivated to mentor others.

The goal was to achieve the following outcomes:

1. A small group of dedicated young urban farmers
2. A collective or network of farmers growing, harvesting, storing, marketing, and distributing produce together.
3. A collective or network to provide material and social support for each other.
4. Pride, joy, and meaning in growing food for community and for income.
To achieve these outcomes the training would have three parts:

1. **Hands-on Training.** A 2-month intensive training, set at an urban farm that we would start together.

   Dividing time between formal learning, and hands-on work, we would design and launch the farm in or near the city of Thimphu. We would start with the basics: site-assessment, infrastructure needs, crop planning, and light construction. Field trips would be a regular part of the schedule.

2. **Enterprise planning and start-up.** After several weeks, trainees would search for and find a plot of their own to develop into a small farm. Working alone or in small teams, they would be supported by trainers and other students. The group would continue building out the training farm, including a modest cold-storage center that could be shared by all. As crops began to be ready, we would discuss other roles in the supply- and value-chain. Trainees would collaborate to aggregate, market, and distribute produce. After the first month, students would meet weekly at rotating farm-sites, as work-learning-social events.

3. **Enterprise support.** After two months, trainees would meet every two weeks, or more often, at rotating farm-sites, as they focused more on their own enterprises.

   As a second training would begin, the first batch of trainees would continue their own project, and the trainer would attend the bi-weekly meetings and visit their sites to provide support.

I requested two weeks before the start of the first training, during which I would assess resources and make further preparations.
Finally, I insisted that we all live at or near the training farm, with a farming family or by ourselves. Most DSP trainings are held in central locations and often with strict supervision, even police officers. We would be largely independent of this supervision and responsible for our meals, water, chores, and social time.

I stressed to the DSP Steering Committee that agriculture is not a 9-5 career – it sometimes requires long days, flexible schedules (e.g., meals early or late in order to finish while weather permits), immediate attention to repairs, pests, and other unscheduled occurrences… and the ability to be at the farm evenings or early mornings to observe and learn about the farm ecosystem.

I explained that agriculture can also be lonely work, farmers isolated from each other in many ways. Living and working together was intended to build relationships and to develop camaraderie among these trainees – they may well collaborate and support each other in important ways in the future.

The proposal was met with enthusiasm ("I think this is exactly what will inspire the young farmers in Bhutan, - your enthusiasm and the knowledge that you will share." Also, of a young farmer as it was relayed to me, "she loves the practical aspect of it: 'standing in the field and not sitting in a classroom' (her words)"). The DSP gave me two more parameters: these should be rural trainings, and the trainees would come from various parts of the country, not from one village or region. The DSP suggested hosting one training in Mongar dzongkhag and one possibly in Zhemgang. Both eastern districts are remote and underserved dzongkhags with challenging conditions. This would make it more challenging to capture some of outcomes related to building a community of practice and perhaps developing meaningful change in attitudes.
PROPOSAL ACCEPTED FOR FIRST TRAINING

Given my own inexperience in-country and the multiple challenges farmers face in these districts, I offered a new proposal that DSP accepted in April 2022 (see Appendix C for the full proposal). I proposed two three-month trainings at locations that would be based on the timing of the trainings. At this point I would not have arrived before May, which would make it difficult to grow annual vegetable crops in many parts of the country. We would be at the edge of planting season in higher elevations, so I suggested a high-altitude valley from May to August, so that we could grow cooler-season crops (Cole crops, greens, root crops, etc.), which in those months would have receptive markets (it is too hot then to grow them at lower altitudes and points south). Then, we would move to a mid-latitude location for the autumn months, September through December.

To ensure we had easy access to materials, supplies (in particular, equipment dealers and hardware stores), and useful sites for field trips, I requested the sites be in the more developed western part of the country. We decided on two trainings:

- High-Altitude Vegetable Production in Phobjikha Valley, 2,800 - 3,100 m
- Mid-Latitude Vegetable Production in the Wangdi or Punakha area, 1,200 m

During these trainings we would grow vegetables “from seed to sale,” so that our farm would harvest and market vegetables. Concurrently, toward the end of the course, each trainee would begin writing a business plan for their own enterprise.
While we indeed completed the two 3-month trainings and achieved many successes, we adapted in real time to realities on the ground. Most notably, trainees had very little work or farming experience and so our first training was more topical than in-depth. We framed the second training as an Advanced course. A third of our first group continued to the second training. The second batch was otherwise drawn from Desuups with some evidenced experience on a farm. We added a third training, an extension of the second, to continue harvesting and selling produce and to focus on “special projects” intended to cultivate creative solutions to common farm challenges. I will expand on this in Chapter 4.

Before discussing the trainings in more depth, let us look at the basic curriculum and pedagogy we would employ. Then, I will briefly describe in-country resource availability.

**PEDAGOGICAL IDEAS AND CURRICULUM DEVELOPMENT**

It was important for me to give a holistic training, to work through every step of a vegetable season. It needed to be grounded in the practice of growing and selling produce. Practice would be complimented by formal learnings, guest speakers, field trips, and individual and group projects. Given the context described above, I set priorities for the trainings (Table 2):

1. Togetherness
2. Reciprocity
3. Farming
4. Mentorship
5. Real work
6. Shared responsibility and consensus-building
7. Critical thinking skills
8. Don’t steal their learning
9. Make space for the affective domain
10. Use what’s here
Table 5: Mike's pedagogical manifesto

**Togetherness.** We would be in the project together, good days and challenging days. We would make rules together for all of us to follow, and we would hold each other accountable.

**To listen, to have a reciprocal relationship.** I would need them to teach me about Bhutan and themselves in order for me to offer my experience and knowledge as a farmer. I would also need to be honest, and at times vulnerable, and to let them help me, just as I would help them.

**To be a farmer,** my role would not be an educator or extension agent. I wanted to model behaviors and skills that a farmer uses, so that they would associate them with farming, not any other profession (though of course they are transferrable). Sometimes I would do this with the urgency that farmers need. While we would not have the higher pressure of a commercial farm, our actions and inactions would have consequences that we would account for.

**To be a mentor, a positive adult presence in my trainee's lives.** I wanted to build trust, and to do that, rapport. I would live at the farm with trainees and a host family, eat the same meals, and have any appropriate responsibilities. I would work hard. I would do any work I'd ask of anyone else. I would put the interests of the trainees first above all else, even before my own and before institutions (as much as possible). I would show care for them as a group and individually. I would be as consistent as possible. I would respect each trainee as an adult, capable of making decisions for themselves.

**Authentic projects and work.** All activities would be relevant to building our farm and growing produce for market. When it was time to learn about pest control, we would do so and apply our learnings by dealing with the pests we face at the farm or that trainees deal with at home.

**Shared responsibility and consensus building.** Much of farming is risk-management, and decisions are always made in the specific context of a farm and its farmers. We would make decisions together.

**Critical thinking skills.** Above all else, I want trainees to feel confident in their observations and their own decision-making skills. They should learn to find information for themselves, apply that information, reflect on the results, and make changes as they think fit.

**To not steal their learning.** I like farming. I like building greenhouses, operating equipment, planting seeds and seedlings. I would show them how much I like that, but I would need to step out of the way to let them do these things. I want the accomplishment to be theirs, or perhaps ours together. I want them to leave more confident in themselves.

**To make space for the affective domain.** The deepest learning takes place in the affective domain - people remember when they feel something and might turn it into action. I want to intentionally design - or intentionally neglect to design - spaces for feelings, attitudes, emotions to grow. Above all, I want each trainee to have experiences that they will remember fondly or well, and associate with farming.

**To work with existing and available services, materials, and technologies,** in so far as they are appropriate, and to add them to a toolbox of practices and strategies from around the world. I wanted to draw on resources that trainees would have access to after the training, be it practices, services, or materials. At the same time, we might use them in new ways, and find or make new tools to solve specific problems or bottlenecks, and to experiment with other practices that might be useful.
In 2000, the New England Small Farm Institute developed an occupational profile for “sustainable” farmers in the Northeast US. This is a good starting place for a training curriculum, and, truthfully, I have used it to assess my own readiness to farm successfully. They created a list of the work that we DO (should do): duties (large areas of work) and tasks (specific units of work) associated with each duty. They also compile a list of general knowledge and skills, behaviors, and awareness of relevant trends that successful (entering and continuing) farmers develop (see Table 3).

1. Whole Farm Planning
2. Set Up Business
3. Manage Farm Business
4. Pursue Education and Professional Development
5. Nourish Family and Community Relations
6. Manage Farm Labor Resources
7. Manage Tools, Equipment and Supplies
8. Manage Farm Infrastructure
9. Manage Production and Natural Resources
10. Raise Livestock
11. Raise Crops
12. Market Farm Products and Services
13. Review and Re-plan Whole Farm (NESFI, 2000)
Table 6. A farmer’s required knowledge & skills; behaviors; and awareness of trends

<table>
<thead>
<tr>
<th>General Knowledge and Skills</th>
<th>Behaviors</th>
<th>Future Trends &amp; Concerns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant science</td>
<td>Well-organized</td>
<td>Urban/suburban sprawl</td>
</tr>
<tr>
<td>Animal science</td>
<td>Persistent</td>
<td>Rapid “development” of land</td>
</tr>
<tr>
<td>General knowledge of ecology</td>
<td>Flexible</td>
<td>Rising land costs (incl farmland)</td>
</tr>
<tr>
<td>General knowledge of meteorology</td>
<td>Attentive</td>
<td>Disappearing ag infrastructure</td>
</tr>
<tr>
<td>Whole systems thinking skills</td>
<td>Observant</td>
<td>Fewer family farms</td>
</tr>
<tr>
<td>Informational research skills</td>
<td>Detail-oriented</td>
<td>Ageing farmer population</td>
</tr>
<tr>
<td>Regulatory expertise</td>
<td>Personable</td>
<td>Farmer burnout</td>
</tr>
<tr>
<td>Planning skills</td>
<td>Analytical</td>
<td>Increasing govt regulations</td>
</tr>
<tr>
<td>Administrative skills</td>
<td>Patient</td>
<td>Corporatization of agriculture</td>
</tr>
<tr>
<td>Supervisory skills</td>
<td>Prompt</td>
<td>Globalization of food industry</td>
</tr>
<tr>
<td>“People skills”</td>
<td>Entrepreneurial</td>
<td>New &amp; resistant crop pests</td>
</tr>
<tr>
<td>Community-building skills</td>
<td>Sense of humor</td>
<td>Increasing wildlife populations</td>
</tr>
<tr>
<td>Time management skills</td>
<td>Humble (in the face of natural systems</td>
<td>Genetic engineering</td>
</tr>
<tr>
<td>Basic business &amp; bookkeeping</td>
<td>Environmentally aware</td>
<td>Consumer buying habits</td>
</tr>
<tr>
<td>Computer skills</td>
<td>Endurance</td>
<td>Convenience foods/more highly processed foods</td>
</tr>
<tr>
<td>Marketing skills</td>
<td>Tolerance for hard physical labor &amp; long hours</td>
<td>Consumer concerns: food safety, urbanization, food system consolidation</td>
</tr>
<tr>
<td>Crop production</td>
<td>Self-motivated</td>
<td>Growing support for “re-localization”, fresh local products</td>
</tr>
<tr>
<td>Animal husbandry skills</td>
<td>Disciplined</td>
<td>Growth of organic industry</td>
</tr>
<tr>
<td>Equipment operation skills</td>
<td>Resourceful</td>
<td>Growing support for “working landscapes” &amp; open space</td>
</tr>
<tr>
<td>Basic mechanical skills</td>
<td>Resilient</td>
<td></td>
</tr>
<tr>
<td>Basic construction skills</td>
<td>Focused</td>
<td></td>
</tr>
<tr>
<td>Basic maintenance and repair skills</td>
<td>Able to prioritize</td>
<td></td>
</tr>
<tr>
<td>Tool use and safety</td>
<td>Creative</td>
<td></td>
</tr>
<tr>
<td>Basic first aid</td>
<td>Optimistic</td>
<td></td>
</tr>
<tr>
<td>Basic physical fitness knowledge &amp; skills</td>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Go-getter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Self-reliant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Informed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Multi-task capable</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Self-confident</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Committed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nurturing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ability &amp; commitment to learn from experience</td>
<td></td>
</tr>
</tbody>
</table>

Source: NEFSI, 2000
This is a good place to start before refining to better fit contexts in Bhutan. It a long list, and it is ambitious to think a learner can internalize all of it in a short time; few can. That is not the point. A list like this can be used to guide the training but is also meant to be shared with trainees, in some form or forms, to provide a big picture of their career discovery arc. I would do my best to identify and to model as many as possible, and emphasize critical thinking, reflection, and resourcefulness so that trainees might continue nurturing their own growth.

Table 7. Curriculum for horticulture training

<table>
<thead>
<tr>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to botany, soil science, and related sciences: what does a farmer need to know?</td>
</tr>
<tr>
<td>Business planning and budgeting: thinking about workflow, cash flow, labor, and material needs; where to find financing; how to write a business plan.</td>
</tr>
<tr>
<td>Organic Farming and Stewardship – Big Picture and little picture</td>
</tr>
<tr>
<td>Site selection and farm design</td>
</tr>
<tr>
<td>Horticultural skills: plant production, seeding and planting, cultivating, ergonomics, efficiency, plant care, and more</td>
</tr>
<tr>
<td>Fertility and nutrient management: assessing soil and plant health, choosing fertilizers and soil amendments, and how, when, and where to apply them.</td>
</tr>
<tr>
<td>Crop Protection: pest and disease management – scouting for pests, identification, choosing interventions (Integrated Pest Management), application and safety: how, when, and where to apply controls.</td>
</tr>
<tr>
<td>Irrigation: water sources, types of irrigation, how, when, and where to irrigate</td>
</tr>
<tr>
<td>Tools, Equipment, and Technology selection, use, maintenance</td>
</tr>
<tr>
<td>Harvest and Post-harvest Management</td>
</tr>
<tr>
<td>Food Safety</td>
</tr>
<tr>
<td>Marketing, Maintaining Customer Relationships, and Communication Skills</td>
</tr>
<tr>
<td>Distribution</td>
</tr>
<tr>
<td>Value-added Products</td>
</tr>
<tr>
<td>Winter harvest: planning and planting for winter vegetable harvest, hoop house/ greenhouse construction.</td>
</tr>
<tr>
<td>Adapting to climate change, natural disasters, and economic shocks</td>
</tr>
<tr>
<td>Taking care of yourself: Nutrition and Farm safety</td>
</tr>
<tr>
<td>Work skills and expectations: how to be efficient, observant, and reliable.</td>
</tr>
<tr>
<td>Training Trainers: public speaking and leadership skills</td>
</tr>
</tbody>
</table>
The second training would include and build on the training curriculum in Table 4:

**Section 1:** Review production basics - formal lectures, presentations, small projects; farm planning and infrastructure development; tool and 2WT training; enterprise and business planning

**Section 2:** Enterprise execution – group and individual work on the farm; field work; project implementation. Explore production topics in more detail.

**Section 3:** Next steps – support trainees as they plan for their next steps: location, improvement, expansion; capital/materials needs and acquisition. Harvest and sell produce from training farm.

With this I prepared a thirty-week training timeline, budget, and materials list, which are presented in Appendix 3.

I would bring several items with me from North America I felt would be important to demonstrate use of and did not expect to find in Bhutan: long-handled cultivation tools, vegetable and cover crop seed; pH meter; Mazzei fertilizer injector; books and farm supply catalogues.

**PRE-TRAVEL PREPARATION AND IN-COUNTRY RESOURCE ASSESSMENT**

I was fortunate to have as an ally the contact that reached out to my friend’s wife. Dr. Ulrike Cokl (Ulli) has lived, studied, and worked in Bhutan on-and-off for over twenty years, earning a master’s degree and a Doctorate studying the roles that relationships play in Bhutanese life. She founded two networks, one for farmers and one for homestay providers. She is experienced and well-connected in the country. Ulli has provided critical advice about working with Bhutanese government officials, civil

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13 [www.bhutan-network.com](http://www.bhutan-network.com)
servants, farmers, and foreigners working in Bhutan. She helped ground the trainings geographically and culturally.

By early May 2022 I had arrived in Bhutan to quarantine and requested the following schedule of visits to network and to assess resources available to Bhutanese farmers (Table 4). I had also hoped to visit each trainee at their home.

Table 8. In-country resource assessment itinerary

<table>
<thead>
<tr>
<th>Government Institutions</th>
<th>Private Enterprises</th>
<th>Errands and Social</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bondey Farm in Paro</td>
<td>Agricultural seed and supply stores (Sherab Enterprises, Karma One-Stop, etc)</td>
<td>Book store</td>
</tr>
<tr>
<td>Ag Machinery Center (AMC)</td>
<td>ASSR ag commissary</td>
<td>Electronics store</td>
</tr>
<tr>
<td>Central Machinery Unit (CMU)</td>
<td>Farmer's markets</td>
<td>Pharmacy</td>
</tr>
<tr>
<td>Farm Machinery Lending Corporation (FMCL)</td>
<td>Shangri-La cold storage</td>
<td>Other Bhutan-Network contacts</td>
</tr>
<tr>
<td>National Post-Harvest Center (NPHC)</td>
<td>Hardware and building supply stores in Thimphu, Paro, and local to training</td>
<td>Restaurant/culinary contacts and others via Ulli</td>
</tr>
<tr>
<td>National Seed Center</td>
<td>Other supply stores</td>
<td>Aum Damchoe's urban farm and homestay</td>
</tr>
<tr>
<td>National Soil Services Center</td>
<td>Super FABLAC, Thimphu</td>
<td></td>
</tr>
<tr>
<td>National Plant Protection Center</td>
<td>Other successful/innovative farmers and value-chain enterprises</td>
<td></td>
</tr>
<tr>
<td>National Organic Center</td>
<td>Agriculture Research and Development Center (ARDC)-Bajo</td>
<td></td>
</tr>
</tbody>
</table>

I also began to consolidate information from a variety of resources to provide to trainees. This included lists of varieties and seeds said to be available in-country; machines, tools, and inputs with
their costs; planting calendars appropriate to Bhutan; and a profitability index of crops;\textsuperscript{14} as well as planting charts, cold storage recommendations, and other resources that might be useful.

Then, after a bout of COVID-19, we began the first training.

\textsuperscript{14}All compiled from various government documents. The profitability chart combines crop information from the ARDC, national and district-level averages for productivity and expenditures (RGB MOAF, 2020, RGB MoAF, 2021 prices via MOAF and our own (trainees') market research.
Chapter 4: Results

Here I will provide a summary of each training. More detail about sites, curricular activities, and crops grown can be found in Appendix 6.

Training 1: High-Altitude Vegetable Production, May – August 2022

The first training was held on a high, sloping field that had been abandoned for more than a decade for lack of productivity. Phobjikha Valley is one of few valleys in Bhutan marked by the gentler U-shape of glacial action, where most are steep, dramatic V-shaped river valleys. Potato is the major cash crop on nearly all farms, and the farm site was located at the National Seed Center seed potato farm. The season is relatively short, roughly 120 days, but the climate is very good for growing well-liked vegetables like Cole crops and greens, which are out of season for the rest of the country and in India. One objective of the training was to practice growing these crops to demonstrate their potential for commercial production, allowing potato growers to diversify. Four-wheel tractors (4WT) can access most fields and, while not ubiquitous, are more prevalent than in most parts of the country. We had access to a 2002 New Holland 60 hp tractor for the length of our training.

The field is notable for occasional large rocks that make operating tractor-mounted equipment a painstaking process that can damage or limit the effectiveness of the available equipment. The field showed signs of low fertility and biological functioning and was thick with rhizome-nous grasses. Available preparation time and equipment made this difficult to deal with. Our site was located 1 km from our classroom and nursery site, with an elevation gain of 100 m. This was good for our health but admittedly made it difficult to come and go to and from our fields. A good lesson in "zone and sector" analysis.
As a group we developed a plan to grow crops on 1.5 of 4 acres, and the rest would be dedicated to soil improvement for use in subsequent seasons. Another DSP expert who also has experiencing designing and establishing water harvesting structures in dryland and monsoonal regions joined us for one week. We learned and applied basic surveying skills to lay out fields and beds on contour and to site a future irrigation pond, swale, and agro-forestry plantings. The pond, swale, and agroforestry projects were designed and not completed. We built one 5 m x 15 m polytunnel and an intensive garden near our nursery and classroom. We designed a walipini, or sunken greenhouse. We would continue that project during the following training.

*Figure 12. Our farm plan in Phobjikha, and beds made on contour*

The site was indeed challenging; sourcing materials and even seed slow, and tools and equipment were limited. Due to a second quarantine, the training began somewhat late for the cropping season, and we felt behind the ball for most of the summer. By the time we were functioning more efficiently the rainy season had begun, which affected our work and study schedules. Production was low; while there were successes in the nursery and in the field, there were many failures: germination, healthy growth, weed control.
Trainees were given several projects to share with the group. These included pest and disease identification and management and two in-depth projects of their choosing. They were also given responsibilities over different production areas. We were asked to participate in a study on the cultivation of saffron, one of four sites, and we used this to discuss on-farm research, the scientific method, and cultivating curiosity.

Trainees were engaged and productive, working through adverse conditions. At times our failures in the field felt overwhelming, but we continued working and emphasized that failures are learning opportunities. Resilience is an important quality for farmers; at the same time, successes build confidence and can be critical in vocational training. We covered a breadth of topics, enjoyed field trips and even an event with the King, and each trainee learned to operate the tractor. Trainees generally worked well together in large and small groups. Group dynamics overall were very good. One of our first orders of business was to decide on rules for our little community. As is the case when young adults live together, away from home for several months, conflicts did arise. We took these events in stride, working through them using conflict resolution processes we agreed upon as a group. These events were sometimes related to mental health, emotional distress and substance use. We had a warm and supportive relationship with our hosts, harvested potatoes with them, and leave-taking was emotional. Trainees continue to communicate via social media.
Only four trainees came to the training with experience working in the field. All but one finished the course. Brief surveys created by the DSP returned favorable reviews. Common themes included: more practical elements, less theory; quality of tools, equipment, and safety materials; and a desire for more about specific topics of interest (e.g., strawberry production, nutrition, smart technologies, value-added products). Close to half of the trainees indicated interest in continuing to train at the second site, and over a third of them joined the second training.

Figure 14. Tractor training. Few trainees had ever driven any kind of vehicle much less a 4WT!
The second training was held at the farm of a local Gup, or political leader; in fact, he spent many years as the Chairman of the district assembly and is wealthy and influential. The Gup is also Desuung and proud of his service. He and his wife have retired and offered the farm to the Program Director of the ARDC-Bajo to use for training purposes. The farm is almost entirely wetland, or paddy terraces: we used fifty of them, an area totally 1.5 acres. The farm looks out over the Wangdi dzong, an army camp, and the confluence of two major rivers. It is one of the windiest places in the country, with winds that gust daily from late morning to late afternoon. The land had been fallowed for the summer but had otherwise been in use for many years. Low fertility and organic matter, with a hardpan from years of paddy cultivation, the soil is sandy loam and stone free. With good management and adequate input, it could be quite productive. Water was available from two irrigation channels from far-off sources; both could be unreliable and at one point we were without irrigation for the fields for several weeks.

With experience finding and accessing inputs, tools, and information, and a few extra weeks to anticipate the needs of the site, this training hit the ground running. Fields were divided into those under the Trainer's purview, where I could model management practices, and those which were
randomly assigned to the trainees, which they would manage themselves. We shared observations during weekly field walks.

Major infrastructure projects included developing water sources, two water storage ponds, and a modern distribution system that made water accessible to each field without flooding. We compared various available drip and overhead systems and used flood irrigation on occasion. We built a fertilizer injector, one of only a few in the country. The group formed a Water Council to manage water resources. We also ran cover crop trials. The group built three greenhouses: one standardly available metal hoop house, one low-cost design made with local materials (wood and bamboo), and we continued work on the walipini at the first site in Phobjikha. Perhaps most importantly, we developed systems for the farm, and the operation and maintenance of the systems made farming there more efficient.

Production was satisfactory; some crops did quite well. Visitors were impressed with the variety and quality of the produce. First major harvest was gifted to the King and Queen; we were given a message from Her Majesty thanking us and applauding the Desuups' efforts. Harvests were made, recorded, and sold to the training mess hall, though the Bajo Sunday market, and to the Desuung culinary arts program. Trainees tasted some vegetables for the first time, learning to cook with them and to share that knowledge with their markets.

This training involved more practical training than the first; having sourced a greater variety of inputs and resources, we used and experimented with different tools, including three different 2WT that each trainee learned to use. We also dedicated more time financial literacy, budgeting, and thinking about
farming as a business. Trainees gave their own plots a lot of attention, often before and after work hours. They also helped each other to do field work and water them.

Group dynamics were more positive than the first group, except for an intergenerational conflict with the hosts early on. Once resolved we settled into a strong family-like community, where the trainer was considered an older brother of sorts, and the hosts as parents. We often recreated and visited local temples together.

All but one trainee came to the course with experience on their family's farms. All but one finished the course; she was granted a visa to work in Kuwait, where she could earn money for her family, and left quickly. No survey was given to this group, but informal exit interviews indicated overall satisfaction with both the theory and practical training. Some trainees said they wanted more detail and practice with some of the theoretical work; for example, we did not complete full business plans as expected, and there were some desired topics we gave attended only topically (e.g., perennial crops, mushrooms). There are also indications of positive emotional and attitudinal responses to the training. We decided with only a few weeks left to extend the training, that five of the fifteen could return home for family responsibilities (it was time to prepare the next crop in many parts of the country). Ten continued to what we called Training 3, and several of those continued to another training in floriculture this spring.
Figure 16. Vegetables for sale at the market and to a local pizzeria. Top right, first crop ever!
Figure 17. Building greenhouses and water storage ponds
Figure 18. Trying new tools, irrigation stuffs, and using their heads

Top row: long-handled hoes from the US (handles made on-site). Middle: trainees teaching the rest of us how to use a heating plate, a fertilizer injector, and overhead sprinklers. Bottom: observing the crop, following a water source, and keeping harvest records.
Training Three was an extension of the second, officially described as a third program for logistical reasons. By this time, we were in a routine at the farm; trainees were taking more responsibility for planning and doing work and the trainer was able to focus more on improving lesson plans and providing project support. Training Three would continue the work started in the second training, harvesting, and marketing crops as they continued to mature.

Young farmers in Bhutan are asked to be excited about new tools and technologies (e.g., app-controlled irrigation systems, hydroponics) that can make farming interesting, efficient, and comfortable (less "drudgery"), but then those tools aren't always accessible or affordable. My sense is that “smart” or digital technologies are less important to productive and efficient production than the real work of cultivation, seeding, nursery production, and then getting product to market in good condition. Tools for these processes don't have to be expensive, complex, or digital, they just need to be available\(^{15}\). They are not, and this is a major gap in expectations, need, and reality.

During the second training students were asked to work through problems and challenges at the farm and had gained considerable confidence in their ability to do so. In this training we first identified major farming problems to solve, such as, "weeding is uncomfortable and it costs money to pay people who are hard to find to do it for me." We used a process of ideation to find solutions to problems like this: working alone or in small groups, trainees described and analyzed the problem, researching potential solutions. Then they would prototype and test practical and appropriate farm tools.

\(^{15}\) Adults who set these expectations do a disservice to young people. Digital systems can indeed be valuable, but should be adopted by those who have mastered the basics, and then when they are cost effective. Entering farmers should not be expected to start with these tools.
This was a lot of fun, and trainees had access to several resources to help fabricate prototypes, including the FMCL in Bajo, a local (female) welder, and the technology hub SuperFABLAB\textsuperscript{16} in Thimphu. The intention was to cultivate a sense of ownership over challenges and to build confidence in taking ideas from a video or page and make something they can hold and use. Trainees were creative, resourceful, and all projects demonstrated degrees of competence. A list of projects is found in Table 5.

Table 9. Problem Solving and Tool Design Projects, Training 3, Rubesa

<table>
<thead>
<tr>
<th>Trainee</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>SY</td>
<td>Hydroponic system made with local materials</td>
</tr>
<tr>
<td>BB, KP</td>
<td>Vertical farming made with local materials</td>
</tr>
<tr>
<td>KW, PT</td>
<td>Evaporative cooler</td>
</tr>
<tr>
<td>TN</td>
<td>Jab seeder</td>
</tr>
<tr>
<td>KL</td>
<td>Wheel hoe</td>
</tr>
<tr>
<td>TC, GZ</td>
<td>Azolla demonstration pond for organic waste management, fertilizer &amp; feed</td>
</tr>
<tr>
<td>TC, GZ</td>
<td>Vertical farming made with found materials</td>
</tr>
<tr>
<td>UZ</td>
<td>Soil blocker made with local materials</td>
</tr>
<tr>
<td>UZ, KW, PT</td>
<td>Seedling trays and pots made with local materials</td>
</tr>
</tbody>
</table>

When the domain lead for agricultural training at the DSP Steering Committee visited the day of our commencement, trainees took him on a tour of the farm. He and the other notables seeing what they

\textsuperscript{16}SuperFABLAB is a USAID-MIT collaboration to support innovation in developing countries. The SuperFABLAB in Bhutan is the second in the world. It has a variety of digital fabrication tools and services - like 3D printing, electronics production equipment, industrial wood, metal, and smithing machines – to support innovators and entrepreneurs. https://www.jnwbhutansuperfablab.bt
had built for the first time were impressed, and pleased. They were articulate, enthusiastic, and, clearly, proud of what they had done.

*Figure 19. A few of the finished products from Training 3*

A jab seeder, being fabricated (above left) and a finished prototype (above right). Below left: a trainee explaining to DSP steering committee member about the hydroponic system he built with local materials. Bottom right: a trainee worked with the FMCL to fabricate a wheel hoe.
Chapter 5: Lessons Learned and Considerations for Improved Trainings

We should all be proud and happy of these three DSP trainings. Despite coming in somewhat blind and learning on the fly, my partners, colleagues, and I all gained valuable experience training Desuups in Bhutan. I group learnings into two groups of topics: the site and organization of training programs, and topics of particular importance (the set and setting).

To summarize, a more permanent training site should be identified and developed. It should be run as a productive farm. It should also budget time and resources to experiment and trial appropriate technologies. It can welcome trainees in a variety of programs: long-term, short-term; it can also incubate agricultural businesses. This training farm should have some degree of independence from the DSP and government.

Because these trainings can’t be separated from the political, economic, and social context of Bhutan, how we approach them may change as the context changes. I have some ideas for what the government might prioritize to do that and will address them in the next chapter.

<table>
<thead>
<tr>
<th>Set</th>
<th>Setting</th>
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<td>Crop and livestock predation is a challenge</td>
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<td>continuous production</td>
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<tr>
<td>Living in community</td>
<td>Tools and machinery are still major</td>
</tr>
<tr>
<td>Differentiation for different learning styles and levels of education</td>
<td>needs for farmers</td>
</tr>
<tr>
<td>Get feedback</td>
<td>So is water</td>
</tr>
<tr>
<td>Organizational Structure: staffing,</td>
<td>Access to Capitals, and Challenges to</td>
</tr>
<tr>
<td>affiliation, and alternative structures</td>
<td>Start-Ups</td>
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<td>Profitability and proofs of concepts</td>
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Site matters. The intention of starting a farm from scratch is good and can be instructive. Without other resources, like a source for grown seedlings to transplant early in a training, a training like this should be at least four months, and perhaps longer. That would give a group time to build out certain necessary infrastructure like nursery, irrigation, and do tasks like primary tillage and soil preparation. In certain circumstances, such as at our site in Phobjikha, it can be difficult to establish the basic systems to have good production and reward trainees with feelings of success and confidence.

I should add that among the primary tasks of the training, demonstrating practices and behaviors of successful is one of the most important. It can certainly be valuable to take a difficult site and make it productive, especially given time and resources. I believe that is a secondary task for a training program; it can be difficult to install and practice. That work, should a farmer choose it, will require experience, mentorship, perseverance, and dedication. Let a young farmer learn good habits, then go through the process of starting from scratch on their own. Of course, better if they have access to a better site, but that is not always the case.

An Established Training Site and Continuous Production. In fact, this is a key point. Good production matters so much. Establishing timing for crop production as well as good systems allow learners to learn good habits and to build confidence. Trainers can do that best by becoming intimate with the farm themselves. We can devise ways to continue to provide meaningful projects that are applicable to the early phases of farm development, expanding production regularly into new fields, incubating enterprises on-site, or even going off-site to "barn-raise" new training sites or to help farmers start new projects or make improvements to their existing farms. As good a learning experience it could be to start a farm together, we struggled at times without the continuity a more permanent site can bestow.
Likewise, such a permanent site might allow the farm to have a continuous production cycle. Trainings can be more flexible in duration, start and stop dates, and a theme if it is constantly planting, growing, and harvesting. Many opportunities can open with a more permanent training location.

**Intergenerational Dynamics.** I saw firsthand how intergenerational tensions can play out in Bhutan. Where I was granting great latitude for our second group to govern and police itself, our hosts were stern and controlling as is often the case in agrarian communities, and particularly given the DSP context (it was considered a great honor to host a training for the King's favorite Desuung program). There is real tension in Bhutan between a modern, youthful desire for freedom and independence and the expectations of the older generations. We came very close to the trainees lodging elsewhere and commuting to the farm. They likely would have lodged at a Desuung camp with other Desuups attending other trainings. The Desuung is a quasi-military organization, providing a useful discipline but many young adults find it restrictive. I think it is important to host trainings in a place where trainees can be free of the strict hierarchies expected to be respected in traditional arrangements.

As I stressed when presenting the second training proposal to the DSP Steering Committee, agriculture is not a 9-5 career – it sometimes requires long days, flexible schedules (e.g. meals early or late in order to finish while weather permits), immediate attention to repairs, pests, and other unscheduled occurrences… and the ability to be at the farm evenings or early mornings to observe.

They should live, study, and work together during training. Agriculture can also be lonely work, farmers isolated from each other in many ways. I firmly believe it is important to develop camaraderie
among these trainees – they may well collaborate and support each other in important ways in the future.

**Diversity of Levels of Education and English Comprehension.** There are wide disparities in English language comprehension\(^\text{17}\) and learning styles among trainees. While I encouraged trainees to communicate in any language with which they feel most comfortable, there are surely missed or misunderstood lessons, and I as a trainer rely on translation. There are nuances that even the best English speakers may miss, too. Sometimes a nod or a smile returned does not indicate comprehension! Experiential and group learning helps to mitigate such misunderstanding, because lessons are either rooted in experience or peers can help communicate what the trainer lays down.

For example, I had a trainee, a young man who comes from the east, who speaks Sharchop, works hard, and is motivated to farm. He was a sponge for new ideas, information, and practice. We bonded well, but it usually took a third person (sometimes more than that!) to communicate well. Now, because of the language barrier our chats and phone calls are short and quite limited. We both would like to have some conversation but can only say “Hello”.

Of course, I would love a Babel-fish to put in my ear and instantly communicate. I could stay in Bhutan longer and learn Sharchop, Dzongha and Nepali. I would also like to explore how to reach students despite language and learning challenges. Using mixed pedagogies is one way to provide differentiation; essentially diversifying the portfolio of learning experiences and hoping learning will

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\(^{17}\)Dzonkha and English are official languages of Bhutan and taught universally in schools. However, there are more than twenty regional or local languages spoken in Bhutan; the most spoken native language is Sharchop, which comes from a language group distinct from Dzonkha and other languages common to the west of Bhutan.
land some way or another. It would be helpful to investigate other strategies of training with language barriers and consider new techniques.

Assessments

While I and the DSP sought feedback, we did not do so in an organized or well-developed fashion. This is an area ripe for improvement. It would be helpful to survey how trainees have developed relative to the three domains of learning, cognitive, psychomotor, and affective, to solicit feedback on curriculum and the quality of trainer and training more formally, and to analyze this data appropriately. I am curious if it is possible to gather evidence that helps assess the extent to which we achieve program goals and pedagogical priorities, and the value of the latter.

Organizational Structure: staffing, affiliation, and alternative structures

Staffing. A lesson I teach myself over and over. Training is different than running a farm. It is ambitious to think a single farmer-trainer can do all things, including curriculum and lesson planning, administrative tasks, and farm planning, all "on the fly", in Bhutan. A program should staff up to include an Assistant in the field, and/or more help on the administrative end. An assistant can also reduce the number of people needing the attention of the trainer at a time. This will improve the quality of his or her attention.

Affiliation. The DSP is an interesting organization. It has a unique mission and exists outside of the usual civil service; it is clearly loyal to the King, its budget falls under His Majesty's Secretariat, and it has an unusual degree of responsiveness - it can be much more nimble than other government ministries and agencies. It has grown quickly and over the course of three trainings became slightly
more bureaucratic, or perhaps organized is another way to put it, increasing staff to handle increases in workload.

I very much enjoyed working with and representing the Desuung Skilling Program. My personal feelings aside, I am do wonder if a program can be more successful working in partnership, or even independently, of the DSP.

One conflict I ran into, and reported on several occasions, was of payment of bills outstanding. I found the DSP to be very slow to pay for items bought on credit or to reimburse those who make purchases.

It was important to me that we operate the farm the way a real farmer might – organizing purchases but also buying supplies as needed in order to make timely repairs and improvements. Farming, like many small enterprises, does not always keep to well-schedule plans and budgets; we need fuel, repairs, parts, and labor on short notice (and usually before harvest and sale of our product). Maintaining relationships with vendors is useful and sometimes critical.

We worked mostly with small businesses, local vendors, or individuals closely associated with our trainings (that is we often paid upfront and expected reimbursement). We occasionally purchased items or services from government organizations. Small businesses are exposed to late payments in a way the government often is not, and they would extend credit to us because of the reputation of the Desuung program and its affiliation with the King. We have – and rely on – personal relationships with these vendors, and it becomes difficult to continue to do business with them as needed.
My experience was that payments were often not made until sufficient pressure had been put on individuals, or not made at all (one vendor is has not been paid for services rendered in October 2022). This is uncomfortable for everyone involved.

I suspect that these agriculture trainings spend differently than most other trainings, and this is common with farming enterprises affiliated with institutions and organizations. More control of an approved budget, flexibility with how payments are made, and a system of accounting that fits an agricultural program would all benefit the program. It is not clear this is possible with a government-administered program.

On the other hand, this may not be a significant enough issue to suggest a different relationship with DSP. As an independent farmer in the U.S., I am accustomed to working at my own pace, through a developed agricultural private sector and with a reliable and responsive civil service. I was fortunate to have strong partners in Bhutan that provided resources, experience, and attention to our program. Where Bhutan is a country with established hierarchies, chains of commands, and rigid structures in place, and the slow bureaucracy\(^\text{18}\) and "proper channels" can be constraining, the DSP was able to advance the training's needs quickly and efficiently. We can hope that civil service catches up with the efficiency of the DSP.

\(^{18}\)In February 2021 the King delivered to the people of Bhutan a *kasho* (Royal Edict) establishing a Civil Service Reform Council to provide recommendations for restructuring civil service. The last two years have already yielded dramatic changes, including hundreds of early retirements, in an effort to improve the effectiveness of government to provide services equally to citizens (Keunsel Online, 2021).
Alternative structures. Alternative organizational models include using a non-profit organization to manage a training program or working with a group of farmers to develop a training program within an organized cooperative structure.

**Collectivism and Cooperation.** That said, it may be advisable not to focus too much on social aspects of how trainees might organize themselves and whether they will form collaboratives and cooperatives in the long run. Dendup (2018, see above) explained that the 2001 Cooperative Act of Bhutan, and its 2009 amendment, formalized the governments support for cooperative and community efforts. This is not something anyone but farmers themselves seem to be able to control. As one experienced foreigner explains, Bhutanese have their own complex cultural forms of organization. Bhutanese farmers can be pretty self-sufficient and autarkic, occasionally collaborating on farm tasks with neighbors. They tend to pick up and select what they deem useful and what works and leave the rest (Anonymous, personal communication, 2022).

This should not be surprising, but like many foreign experts I had hoped what seems like a good idea to me would be quickly adopted. It has been tried before: introducing cooperative- or community-ownership of equipment, for example. I saw many power-tillers and tractor implements broken and unused, in part because no one would take ownership. Historically, things like this have rarely been owned by a community. Instead, individuals would own and others might borrow. One might suggest and even model alternative forms of ownership but should acknowledge that some ideas may not be adopted in the Bhutanese context. Instead, it may make sense to focus on fostering traditional relationships, building on not interfering with local forms of organization.
Crop and Livestock Predation is very real and very different than in North America. Farmers widely say that the number one challenge with farming in Bhutan is predation by wild and domestic animals. This includes elephants, monkeys, wild boar, bear, jaguars, deer, semi-feral dogs, smaller critters, and birds; as well as free-ranging livestock, mainly cows. With many small farms near conservation areas, human-wildlife conflict is a complex issue and requires new policy ideas and also technologies; as does, perhaps, crop-livestock predation. Only very few communities seem to insist that the owner of the grazing animal is responsible for damage to crops; rather than responsibility to control animals and fence them in, farmers are expected to fence other people's animals out. This may be partly due to traditional grazing rights afforded to herders. Cows and dogs both cause damage to crops, even in greenhouses. Small farms can lose a lot of their crops in a short time and the trainees learned good lessons about fence design, maintenance, and vigilance. Farmers in Bhutan really need more robust strategies to protect crops; farmers often take turns staying up all night in the field to scare off animals. This adds to the poor perception of farming viability and contentment.

Tools & Machinery. There are still large gaps (in yield, productivity, and profitability) in strategies to modernize agricultural production. There are justifiable and economic reasons farmers make the decisions they do. But there are also strategies that can make a dramatic difference in productivity per unit time or energy spent, making some work more comfortable and efficient. With a shrinking world of ideas, there are many tools and innovations from other contexts worth trying in Bhutan. This might include seeding technologies, long-handled tools, and equipment for 2WT and 4WT. There is also a large gap between the expectation that modern agriculture can make farming more attractive and the tools available in Bhutan to make that so. If these systems can be affordable and
attractive enough to implement, it may help learners go from trainee to satisfied farmer who chooses to continue in agriculture.

The AMC has experimented with some of these technologies in the last thirty-five years, and some, such as polyhouses, have been shown to improve productivity since the late 1960s (Dorji and Penjore, 2011). It is not clear to me why they are still underutilized. If I were farming in Bhutan, I would particularly want to improve:

1. Potting mixes and nursery procedures: We found that seedling survival increased dramatically when using cell- or tray-based transplants grown in potting mix instead of traditional bed-based transplants. Transplanting shock is much more difficult to manage in the latter system. Modern nursery materials can be expensive for farmers in Bhutan (materials such as plastic cells and pots) and options are limited. Common recommendations for potting soil include native soil. Including high quality compost in potting mix recipes might improve seedling quality and uniformity. This might also help develop a market for (or on-farm production of) organic soil amendments like compost, vermicompost, and biochar. Adoption rates for new practices like these can be low. Such high value uses that can show promise in a single season might be an entry point for the use of on-farm resources.

2. Direct seeding: manual seeding can be cumbersome as scale increases, and time consuming in succession-based cropping systems (where consuming time compounds over many seedings; these management-intensive systems are like singing in canon). Timely planting can also improve productivity: delays or long planting seasons can affect yields (varieties often come with trade-offs like higher yield over longer seasons); likewise, farmers can plant more in tight planting windows.
Even simple seeding machines like a push- or pull-seeder can be effective and can also make it easier to make cultivation easier and more effective.

3. Light, long-handled, and tractor-mounted cultivation tools: many Bhutanese deal with weeds when they are large enough to pull by hand, and cultivation is then more difficult and time consuming. It is much more cost-effective to take a multi-dimensional approach to weed management. Tools that make it comfortable to work shallowly and kill weeds when they are in the white-thread stage, or near it, can be key to this strategy.

Such cultivation can be adapted to 2WT and 4WT by integrating more precise seeding operations. We can develop raised or permanent bed systems that can be maintained with both kinds of tractor. Some of the 2WTs available in Bhutan preclude this work, and others may need modifications to do so. I think farmers can get more out of the mechanized equipment, giving them more value for their price. We can consider how this equipment compliments other equipment (manual) suitable for small-scale farms.

4. Cold storage options: the government of Bhutan is currently constructing several large cold storage facilities in strategic locations. Despite a few of such options available in some progressive farming areas (Paro, Thimphu, Phuentsholing), Bhutanese have not yet made best use of them. This is a somewhat complicated phenomenon, and it might be valuable to better understand why so. There may be options for further distributed cold storage networks (on-farm or small shared units) to reduce post-harvest loss and increase quality at the marketplace.
5. Soil health by developing best practices for the use of cover crops and reducing tillage. Bhutanese soils are often observably in poor health. Cover crops can improve biological functioning, physical structure, and nutrient cycling, supporting plant health and improving crop quality and quantity. Useful cover crop species should be identified for different agro-ecological zones and cropping systems, seed produced or acquired, and practices and tools developed for their management.

We began to address this in Training Three. I like the approach we started to take by cultivating problem-solving skills: learning to be self-aware; identifying points of inefficiency; exploring how others solve similar problems or innovating new ideas for oneself; developing and evaluating prototypes and refining designs; and continuing the process. Not everyone is “naturally” innovative, but self-awareness and problem-solving can be learned skills. More attention should be given to how to do this.

Human-centered design (HCD) might help inform this process (though an expanded definition of HCD may actually include the process we used). Wyche, Olson, and Karanu, (2019) used HCD to redesign hand tools in Kenya. HDC is a three-phased process: understanding, ideation, and evaluation. Working with groups of farmers and metalworkers, they asked the farmers to draw their "ideal weeding tool." After groups presented their ideas to each other, they were given tools from North America to interact with and then collected their reactions: wheel hoes, stirrup (hula or oscillating) hoes, and 2-headed (forked) jembes. These tools are like the hoes that I also brought from the U.S. The metal workers then make prototypes of the tools based on the farmers' drawings and comments. Later, the farmer groups took the tools home to use and then were surveyed for their reactions. There was general preference for the new tools because they were easier to use, made work go faster, and were more comfortable.
Wyche, Olson, and Karanu used this information to understand how local conditions relate to design as well as to develop useful tools. But – they worked with experienced farmers. Trainees may not have the experience to contribute fully to a tool development project. When we began using long-handled hoes at the training farm, inexperienced trainees were not able to articulate what they liked about them until after their more experienced peers, or I, shared our own reactions. We can at least appreciate the activity for that contribution to their learning process.

**Water**

Water! Stuff of life. There is so much potential to grow crops in the winter, for example, and it can be done efficiently using drip irrigation, targeted use of overhead, and even, if necessary, flood. But – it must be reliable. I cannot recommend planting vegetables without reliable irrigation water. Developing and maintaining reliable water systems must be a priority for the government, and managing those resources must involve all stakeholders in a given watershed or water system. I know this is a complex and challenging issue in Bhutan. It is also vital to development in the agriculture sector and food security in the country.

**Access to Capitals, and Challenges to Start-Ups**

There are many barriers or frictions to entry for young adults. Access to natural capital (land and healthy soil), finance and credit, and labor are challenges in most countries, and Bhutan is no exception. Landholdings are small, fragmented, and often in poor condition. Many young adults might choose to return home where they have a support network and can live with fewer expenses, but where land may still be under the control of elders or far-flung and hard to manage.
In recent years the RGB has initiated policies to make land and credit available. Anecdotal evidence suggests that these ideas were initiated “top-down;” there is conversation about entrepreneurship from older generations, but I also heard tell that it is hard to actually get the support (see Box D for thoughts about entrepreneurship). Young adults are also cautious about taking out large loans, if they can get them, to start an agricultural business. As they say, it takes money to make money. It is true that young people sometimes have high expectations about making money quickly and easily; it can take patience and persistence to build a business. But high interest rates (often starting at 15%) and collateral requirements also worry them. As they say, it often takes money to make money.

Box D. Entrepreneurship

I am skeptical of the attention given to "entrepreneurship" by governments and institutions like the World Bank (World Bank, 2021). First, it is not always clear how an author defines or intends to use the word, neither in the literature (Santiago and Roxas, 2015) nor in public discourse. Does it refer to any kind of economic activity or business literacy, or only innovative ones? Is innovation context specific or is it meant to be innovative and lucrative universally? How do we measure entrepreneurship or success related to entrepreneurship? I think the term is often confused with business or financial literacy; that is, encouraging individuals to think of their farms as a business, where resources like money, energy, and nutrients flow in and out. Regardless, governments and institutions seem to effectively be placing the burden of overcoming dysfunctional markets directly on individuals - in this case on farmers. Or, onto someone else, an "agri-preneur" who will add value to primary economic activity, essentially: farmer cultivates land, agri-preneur finds opportunities to make more from the output. But markets don't usually account for the benefits of farming "well" (and they also externalize most downstream problems related to farming practices). The entrepreneurial system usually involves the use of off-farm inputs such as tractors, fertilizers, seeds, packaging, etc. Then, even if the farmer earns more income, he or she is still often at the mercy of a marketplace they have little control over. I am curious if farmers can improve their quality of life, and if farming can be an attractive profession to younger generations, whether they enter the entrepreneurial ecosystem or not. Can a farmer afford in Bhutan an iPhone? Jan Douwe van der Ploeg, Ben White, Henry Bernstein, and Harriet Friedmann seem to say on one hand there are peasants and there are those who farm in an entrepreneurial system; on the other hand, they might say (and to repeat myself now) that being peasant has shifted from being a "destiny to being a choice" (Bernstein et al, 2018). But here I am, recommending tools, business plans, greenhouses, and succession sowing as ways to make more money.
Profitability, Proofs of Concepts.

Finally, there are policies and infrastructures that may require government attention. For example, there is a cost-share program to provide young, entering farmers in Dagana kits of equipment.\(^{19}\) I have three trainees who are eligible and very interested in the program. But the cost share is prohibitive.

Can we develop and verify a plan to earn the cost-share money in a reasonable length of time? A 90,000-Ngultrum (nu) greenhouse still costs the entering farmer 17,000 nu. At 1 kg cabbage per m\(^2\), a market price of 50 nu per kg and an expense of 36 nu\(^{20}\) per kg, one would need to grow and sell 517 m\(^2\) cabbage to pay the cost-share.

Then, in one season, how can we maximize profit potential in a greenhouse? Greenhouses, which were provided free to farmers for years, are often used for home consumption. But they can be highly productive growing spaces, as we learned from our experience in Phobjikha. Yield and quality can be significantly higher in the house; there may be untapped commercial potential in each. A mini-tiller might cost 300,000 nu with a 60,000-nu cost-share. Could we earn 60,000 nu in one season in a greenhouse?

A modest greenhouse tomato yield in the US is 45 kg/m\(^2\), which might give us 1,500 kg in a 100 m\(^2\) greenhouse. At an off-season market price, thanks to using the greenhouse, of 100 nu/kg, less 50 nu/kg cost of production, the greenhouse might earn 75,000 nu in a year, enough to pay the mini-tiller cost-share. We need to do a lot of work to get that production, but it might be possible with practice.

\(^{19}\)Greenhouse, drip irrigation, mini-tiller, tarpaulins for water storage ponds at an 80/20 cost-share.

\(^{20}\)MoAF’s 2020 ag statistics estimate a national average.
This kind of plan should be verified, and best practices identified, but it provides a blueprint that might be valuable to entering farmers. An established training farm can do the work to make such maps and encourage their use.
Conclusion

"If the land is to be used well, the people who use it must know it well, must be highly motivated to use it well, must know how to use it well, must have time to use it well, and must be able to afford to use it well."

Wendell Berry

The King is investing in the future of Bhutan by providing trainings intended to develop skills and engage youth in meaningful work. Because of changing cultural dynamics and poor perceptions of farming, it can be a hard sell. With the right mix of pedagogy, curriculum, and attention paid to the mind, the body, and the heart, agricultural education for young adults may find success inspiring either one's choice to farm or pride and contentment in one's destiny to farm.

These three trainings provided valuable experience to learn from and improve on. A logical next step will be to develop a robust training program housed at a more permanent location, where a farm can be established, and productive systems installed. We can grow and sell crops and model good practices. We can develop tools and systems that make the most out of resources available in Bhutan. We can assist farmers to make plans and start businesses, and to sustain those businesses. As summarized in the previous chapter, we can do a good job preparing young farmers and even cultivating inspiration to take up the hoe. A more permanent training site can be identified and developed.

We need models of successful farms, and we need them to be visible to young people, to change their perception of what farming can be like. Perhaps the first few graduates start their own farms,
demonstrate what is possible, and they start a pandemic of the “farming bug.” In a country as small as Bhutan, this is conceivable.

These activities may not be enough if the environment in Bhutan is not sufficiently supportive of farmers, though. I don’t have answers for how to do that, but I have made a few observations that deserve attention.

**Liberalize access to organic inputs**

Despite the government’s intention for the entire country to farm organically, it is very difficult to find any organic inputs. The Department of Agriculture has tight control over what materials are available and they can be accessed. Once a product is granted permission to be imported, it is still difficult to get it. A grower has to be shown a list and tell their local extension agent what products they want in August in order to get it in February for the following year. Without any exposure to new materials, though, they might not ever try something new. I recommend either some degree of liberalization to make it easier to buy and try organic inputs, or more resources should be provided to the appropriate agencies to speed up assessments and approvals for new products. This might include mineral fertilizers and certified organic pesticides (especially biopesticides like Bt, Spinosad, and Neem oil). Pure neem oil and karanja oil can and should be produced domestically.

**Organic matter matters**

By my estimate, farmers apply only 10-20% the manure or compost they should in order to improve their soils and support good crop yields (most apply 2-2.5 tons per acre, I recommend 10-20 tons/acre). Manure and compost are key ingredients to healthy soil. They are also bulky and expensive to ship, especially in the quantities that would be needed to make dramatic improvements.
I traveled to Gelephu with two trainees to attend the Stakeholders Consultation Workshop on organic fertilizer production and marketing in December 2022. I offered the NSSC Program Director my thanks and a few thoughts as a farmer and outsider looking in. In Bhutan organic fertilizers refers mainly to composts. The government is in a challenging situation; it wants a private sector to grow and thrive, but there is not enough of a consumer market to support it. If the government wants to improve the agricultural sector, it should focus on how to support farmers, who should be the market for organic matter.

But, because farmers are unaware or unwilling to pay for compost, compost producers are looking for markets in the few institutions that do landscaping or considering exporting to India. Do NOT export organic matter. This would be a desperate move; organic matter is one of a country’s most precious resources. Better the government buys it and distributes it than to sell it out of country. The government should focus on how to support farmers as a market for organic matter (compost).

How do we do that? Perhaps it is time to be bold. The goal is not the use of organic fertilizers but improving agriculture and livelihoods through soil health. This means more organic matter and fewer chemicals. Set a bold target of improving organic matter content in soils by 2% in the next ten years. Be willing to incentivize farmers for this (or other beneficial) outcomes. Educate; make 2025 the Year of Soils. Make a big deal of it; use public service announcements, advertise online, get articles in the newspaper, add lessons to curricula in every school grade. Things like this take a generation to change (a good example is “littering” in the United States in the 1980s) but blitz the public and farmers. Start a competition between villages to increase organic matter (or water storage, for that matter) the most.
Try to instill a sense of value of soil health. This is often something very personal. It is easiest to start with young and beginning farmers.

**Develop systems and practices for adaptation and soil health**

But the country will need to be ready with good examples of what to do. There is still a lot to learn with respect to improving soil health in the Bhutanese context. Two under-researched subjects in Bhutan: the use of cover crops and reducing tillage. Cover crop species should be identified, trialed, and selected for performance in the various agro-ecological zones. Best practices to developed around management, especially within the cropping systems and the tools that are readily available in Bhutan. There is a lot of work to do to find and fine-tune reduced-tillage systems. Both of these strategies may well require new tooling to make work well and be attractive practices to adopt in Bhutan.

It may seem like there are more pressing systems to research. But the value of improving soil health (using cover crops and reducing tillage are two keyways to do this) will likely become pressing itself, to help farmers adapt to climate changes, poor soil health and crop production, and the need for food security. Research programs like these can run parallel to current priorities and should be started immediately.

**Animals for Plants**

Another issue related to organic matter is the decline in animal husbandry. The trend toward vegetarianism in Bhutan is so inspiring in many ways. I want to raise the idea that animals can be an important part of good farming. Livestock can be a vital component of nutrient recycling and source of manure. By-products of animal processing, such as blood meal, bone meal and char, and feather meal, can also be excellent food for soil and plants. This might be a missed opportunity.
Religious leadership is said to have become much more conservative in recent decades, their position on vegetarianism and animal welfare has increased pressure on Bhutanese farmers to export production to Hindu citizens in the south, or (because the quality of meat is often safer and better coming from Indian processors) to India. Meanwhile, many Bhutanese still eat meat and eggs – they just don’t want to have anything to do with producing it. At the same time, as young people leave the countryside, those who remain keep fewer animals. We need more animals moving through and cycling through the landscape, not less.

**Stones for Bread**

Mineral soil amendments are barely on the radar in Bhutan. Minerals can help fix nutrient deficiencies in soil and can jumpstart the process of improving soil health, especially when used with other organic practices like cover cropping and adding manure and compost. Rock dusts include lime, dolomite, and gypsum, for which there are mines in Bhutan, and also rock phosphate, granite and basalt dusts, silicates like alumino-silicates and calcium-silicates, and more. They might be used at 50-1,000 kg per acre, and are applied at very fine particle size, which increases surface area for bacteria to work on the material. The minerals used in agriculture are often the “fines” or leftover dust when mines crush stone for other uses. This suggests that mines can operate for industry and agriculture both.

At this time, it is very difficult to find information related to mining geology and production. This opportunity is ripe. Perhaps the Ministry of Agriculture and Forests can collaborate with the Department of Geology and Mines.

**Innovation Grants?**
Research and development still play an important role in agricultural development. Yet farmers don’t seem very engaged in research in Bhutan. I wonder if farmers can play a bigger role in R&D; driving research priorities rather than being driven to adopt practices and technologies.

In fact, perhaps that innovation could happen on farms themselves. The Sustainable Agriculture Research and Education (SARE) program in the US has been a major source of support for farmer-led research and development in sustainable and organic agriculture. Subsistence farming has the smallest of risk margins. Would farmers in Bhutan pursue grant money to innovate?

Reform civil service

One reason young people don’t avail themselves of credit opportunities may be dysfunction in civil service. Working through the system can be difficult without connections to expedite the process. I recently heard a story about a young Bhutanese who began studying at a prestigious university in the US. During his first years there he became interested in the local food movement that has blossomed in the Northeast US. When the COVID pandemic began he decided to leave university, return home, and start a farm business. He spent a year trying to navigate the bureaucracy to get required permits and access capital to build a small dairy processing facility. Eventually he gave up and returned to the US to finish his degree. Civil service reform could be a helpful step for farmers if it succeeds.

And reconsider how credit might work

More importantly, young people are hesitant to take on such large debt to get started in a business with so many uncertainties. I mentioned in the last chapter that I have three young farmers who are eligible for an 80/20 cost share. The 20% they are responsible seems to be quite a lot to ask of them. Can we adapt policies like these? I wonder if there are creative ways to provide make the program work better
for these young, unemployed youth. For example, perhaps a special fund for beginning farmers is started with money from hydroelectric, tech, or crypto-mining projects. What if instead of standard financing terms a beginning farmer is given some amount of money, say 100,000 nu (1 lakh) as a no- or truly-low-interest, non-recourse loan for a down payment on capital expenses. Then, the farmer would have 5-10 years to establish a commercial operation before starting to pay it off. Or portions of the loan might be written off over time as the farm proves itself and the farmer stays in the business, earning a majority of their income from the farm. I would be interested in a scenario like this!

**Deal with the border**

Finally, one of the biggest challenges for Bhutan’s farmers to sell locally is competition from India. Road improvements work both ways, connecting farmers with markets, but also markets with rural residents. How can Bhutanese products compete with cheap imports?

**Oh, and figure out how everyone can get more money**

Ultimately, the biggest issues may be structural not technical. Most governments wrestle with how to balance low prices for consumers and high prices for farmers. Bhutan’s farmers may need good prices for farming to be attractive to people who might want to farm if the living is acceptable. If citizens make more money, they might be willing to spend more money – to the benefit of farmers selling domestically. Young people are leaving Bhutan not just because they aren’t attracted to farming, but because society rewards people based on connections rather than merit, and because they don’t see opportunities to make a sufficient living in general.
Lastly

I received a text message a few days ago from a young woman in Dagana who completed trainings two and three. "I am planning to start a farm." Yes! This made me so happy to read. That intention to enter and, I hope, a full life choosing to continue, is one measure of a successful training.

The next day I received a text from a young man from the first training. He is smart, capable, one of two post-secondary graduates (from Bhutan's College of Natural Resources). "I have done all my documentation and now awaiting medical clearance to lodge the visa to Australia. I am pursuing a "bachelor’s in business." No! Another talented person leaving Bhutan.

But also, Yes! This young man plans to study in Australia, make money, and return to Bhutan to start an agricultural supply business. He knows he needs capital to do that. This may be part of his journey back to the farm or rural community.

The future of farming in places like Bhutan isn’t clear. I’m hopeful the future will happen in the hears and lives of individuals, regardless of current events and political economy. We do the best we can given the world around us. I think there is desire to farm. It might be strong and clear, it may need to be drawn out. Is there a best way to do that? We may have to get dirty to find out.
BIBLIOGRAPHY


De-suung Skilling Program  
*Building Skill Set, Transforming Mindset, Pursuing Excellence*

- **Background**  
The De-suung Skilling Program (DSP) is a series of short-term trainings in various fields, which will be imparted to unemployed Bhutanese youths with varying degree of educational qualification over the next two years. These youths have all undergone the De-suung Training Program, which is a valued-based personal development program intended to encourage active citizenry in the process of nation-building. Built upon the spirit of volunteerism, ethics, community service, integrity and civic responsibility, they volunteer to serve during disaster operations, participate in charitable activities and social services.

The trainings will be provided by public agencies, private institutes as well as international experts and trainers. Depending on the courses, some skilling programs will be conducted in existing training institutes while others will be conducted in available infrastructure or establishments, which will be equipped with facilities needed for the courses. In some cases, youths may also be sent for training in institutions abroad based on need-assessment, future potential for employment or to serve as trainers, and on opportunities available based on merit and aptitude.

The focus of these programs will be to ensure high quality and impactful short-terms trainings that are aligned to leading international standards. Its strength lies in bringing in foreign talent, skills and technology. It will complement the efforts of the Royal Government’s technical and vocational education programs.

The trainings will be followed by field experiences associated with business and entrepreneurial entities. It is expected that the trainings will eventually lead to engagement of youths in meaningful economic activities such as self-employment and entrepreneurship. The formulation and implementation of DSP is overseen by a Steering Committee.

- **Training Design**  
The following are the types of possible training-design.

  a. Short-term training (2-6 months) for fresh cohorts of out-of-school youth without prior skills. Duration is not strictly defined and can be adjusted based on training content and module.

  b. Short-term up-gradation course for youths who already have fundamentals of theoretical learning/training. If courses proposed by foreign trainers require basic prior learning, they will
have to indicate the levels necessary in specific fields. For such courses, DSP can either identify youths with prior learning or impart them before the proposed courses commence.

c Some skilling will be On-the-Job Training. Youths will be engaged in projects ranging from one to six months. The duration is again not specific and can be adjusted based on the programs and projects. Trainers will impart skilling on-site by being with youths at the projects.

d Trainings should include both theoretical learnings and practical skills with greater focus on the latter.

e Trainings can be reproduced for subsequent cohorts depending on success of the initial training and also demand from youths.

f In some cases, trainings will be followed by engagement in National Service projects to provide youths with opportunities to enhance their skills further and test them in actual projects.

- **Areas for Skilling Programs**
Based on a survey of unemployed De-suups, the following skilling areas have received top preferences. Demands and market potentials also affirm the need for such skills. Hence, DSP will initially focus trainings in these areas and explore expert trainers from abroad specializing in these fields. Other courses and skilling areas will also be explored subsequently.

<table>
<thead>
<tr>
<th>#</th>
<th>Industry / Sector</th>
<th>Programs/skills</th>
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</table>
| 1 | Construction, building and property | Masonry  
Laying tiles and marbles  
Carpentry (buildings)  
False ceiling  
Plumbing  
Electrical house wiring  
Industrial wiring  
Fabrication (aluminium & steel)  
**Cabinetry & furniture** |
| 2 | Information, Communications & Technology (ICT) | Networking  
Digital Marketing (E-commerce)  
Web Design and Development  
Robotics and Animation |
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<td>Cyber Security</td>
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<td>Software and App Development</td>
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<td>Game Design and Development</td>
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<td>3</td>
<td>Culinary Arts</td>
<td>Fast foods (pizza, burger, hot dogs, etc)</td>
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<td>Asian Cuisine (Thai, Korean, Chinese etc)</td>
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<td>Bakery and pastry</td>
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<td>Chocolatier</td>
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<td>4</td>
<td>Mechanical and electro-technology</td>
<td>Home-appliance repair</td>
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<td>Mobile phone &amp; computer repairs</td>
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<td>Sound &amp; lighting</td>
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<td>Green jobs and Environmental Studies</td>
<td>Solar photovoltaic (PV): design, installation and servicing</td>
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<td>Solar hot water heating system installation &amp; servicing</td>
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<td>6</td>
<td>Agriculture</td>
<td>Food-packaging</td>
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<td>Tofu-making</td>
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<td>Horticulture</td>
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<td>Floriculture</td>
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<td>7</td>
<td>Hairdressing</td>
<td>Hairdressing and makeup artist</td>
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<td>8</td>
<td>Arts and Crafts</td>
<td>Ceramics (including lacquering)</td>
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<td>Costume jewelry</td>
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<td>Pottery</td>
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<td>9</td>
<td>Rerefrigeration and Air Conditioning</td>
<td>Rerefrigeration and Air Conditioning (RAC) installation &amp; servicing</td>
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<td>10</td>
<td>Tailoring (Stitching and alterations)</td>
<td>Suits, western garments, field uniforms and para-military uniforms</td>
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- **Information Requested from Potential Foreign Experts and Trainers**

The following are the broad areas that DSP seeks information from foreign trainers/training institutes and organizations who are interested to come to Bhutan to impart trainings.

- Tentative and broad curriculum or module of the courses highlighting training objectives and deliverables or outcomes.
• Regional or global standards to which the courses are aligned.

• Duration for the training. **It can range anywhere from one to six months.**

1 Please note that trainers may have to teach either half or full of Saturdays depending on the course modules. Sundays will be free.

2 Generally, teaching time will be between 9 am to 5 pm with an hour’s lunch break between 1-2 pm.

• Number of months or years that experts and trainers can stay in Bhutan to impart trainings.

• Optimum of number of trainees (trainer to trainee ratio) to ensure that the training is focused and impactful.

• Tentative date/month of arrival in Bhutan.

• Tentative timeline to commence the training program.

• Training materials and facilities which are needed based on proposed modules. DSP will procure the materials and build facilities, wherever necessary.

• **Medium of Instructions**
  Generally, courses for DSPs will all be delivered in English. Hence, we expect foreign experts and trainers to have competencies to teach in English.

• **Allowances**
  On its part, DSP will offer the following to the foreign trainers and experts.
  
  • Round-trip airfare (economy),
  • Insurances for travelling to and from Bhutan,
  • Monthly training fee (**DSP requests experts/trainers to indicate their expectations**),
  • Lodging/accommodation in Bhutan,
  • Travel within Bhutan,
  • Cover costs of mandatory 21-day quarantine in Bhutan (the duration of quarantine may be revised),
  • 50% of monthly remuneration during quarantine period.
• **Counterparts**
The Bhutanese counterpart for foreign trainers and experts will be the DSP Steering Committee. Depending on the areas of training to be imparted, an official of the DSP will serve as the focal person for the trainers.

• **Formal Engagement**
The engagement of foreign experts and trainers will be formalized upon signing a contract agreement reflecting the broad terms of engagement mentioned above.

• **Contacts**
For more information or clarification, kindly contact the following officials of the De-suung Skilling Program:

  i  Sonam Kinga ([sonamkinga@ns.bt](mailto:sonamkinga@ns.bt))
  ii Tashi Wangchuk ([tashiw@bsb.gov.bt](mailto:tashiw@bsb.gov.bt))
  iii Pema Wangdi ([pemaw@moea.gov.bt](mailto:pemaw@moea.gov.bt))
  iv Penjor ([penjor@gnhc.gov.bt](mailto:penjor@gnhc.gov.bt))
De-suung Skilling Program: Horticulture and Agriculture Training

1. About Michael Snow
2. Urban/Peri-Urban Horticultural Training: from Start-up to Sale
3. Winter Vegetable Production
4. List of other possible trainings

About Michael Snow
I grew up in a Midwestern U.S. city and was bit by the “bug” as I finished school. I have been farming and training others the twenty years since, growing a wide variety of organic vegetables, including potatoes and garlic, fruits, grains (even upland rice!), and animals. I have worked in several different climates in the U.S. and abroad (most recently as a Farmer-to-Farmer trainer in Nepal and Myanmar), and at different scales: using hand tools and in greenhouses on less than an acre up to 35 acres of fruit and vegetables and 300 acres of pasture for animals, using 4-wheel tractors and appropriately scaled equipment. I love growing food, and selling it, too: I sell directly to customers and through local wholesale channels. I have also processed produce into value-added products like jams, sauces, and ready-to-eat meals.

In 2009, I co-founded a learning and social network for young farmers and their trainees in the Maryland-Virginia region of the U.S. and has also been involved in sustainable (organic) research and education. I recently completed studies in Agriculture and Rural Development at Cornell University in New York State. I grew up expecting to be a teacher and have in fact taught in the classroom as well as the farm: science and geography in high school (secondary school) and middle (primary) school.

Training youth in agricultural vocations is not just about learning skills and developing work ethic, but also about building a collaborative community of peers to work with and learn with. I believe you can learn anything in a farm or garden. It should be fun! And meaningful. And profitable. I hope trainees get the same bug I have.

“The ultimate goal of farming is not the growing of crops, but the cultivation and perfection of human beings.”
Masanobu Fukuoka, Japanese farmer

Availability in 2022: 2-12 months, beginning April/May 2022
1 Urban/Peri-Urban Horticultural Training: From Start-up to Sale

Productivity
Stewardship
Joy

Highlights:
- Six-month training (2 months intensive) and support, 3 x cohorts (starting every 2 months)
- Trainees will work together as a young farmer cooperative or collective
- Members of each cohort will be selected to mentor and help train following cohorts.
- Mike will partner with 1-2 in-country agricultural extension agents, who are expected to improve and continue trainings after Mike leaves.

Introduction:
Agriculture is not just a job; it can be a meaningful way of life. This training is intended to cultivate appreciation for agriculture and to give youth a runway to learn to grow and sell food as a livelihood. It is designed to develop a cadre of dedicated, creative farmers, to empower them with horticultural, business, and critical thinking skills, and to associate growing crops with important personal and group development.

Broad themes cultivated include production skills, business planning, post-harvest handling, marketing, and farm community building. This will be a hands-on training that includes formal training, fieldwork, farm visits, and teamwork. We will encourage trainees to find their own interests and specialize if they wish to. We will encourage them to develop an eye for new business opportunities.

A critical aspect of the training will be to develop a sense of pride and joy in growing food, and a network of peers to support each other materially and socially. Trainees will be cultivated to mentor others.

I recommend half of trainees are female, half are male.

Basic training structure:

- 2-month intensive training. Trainees will plant and be responsible to care for plants and infrastructure each day. Part of each day will include hands-on activities: planning, planting, light construction, farm visits. Part of each day will include formal learning and team building exercises.
- Trainees will search for and find a plot of their own to develop into a small farm. They can work alone or in small teams. Trainees will be supported by trainers and by other students.
- Some trainees may take on various other roles in the vegetable value chain: producers, service provider (plants/nursery propagation, fertility and pest management inputs, tools, etc.), cold-storage, marketing, and distribution.
- The group will begin building a shared cold storage center. They will collaborate to aggregate, market, and distribute produce.
- After the first month, trainees will meet weekly at rotating farm-sites. These meetings will be learning and social events.
• After the second month, trainees will meet twice a month, or more, at rotating farm-sites. These meetings will be learning and social events.
• Trainees will make training videos for other farmers and future trainees

Curriculum includes:
• Introduction to botany, soil science, and related sciences: what’s a farmer need to know?
• Business planning and budgeting: thinking about workflow, cash flow, labor, and material needs.
• Organic Farming and Stewardship – Big Picture and little picture
• Site selection and farm design
• Horticultural skills: plant production, seeding and planting, cultivating, ergonomics, efficiency, plant care
• Fertility and nutrient management: assessing plant health, choosing fertilizers and soil amendments, and how, when, and where to apply them.
• Crop Protection: pest and disease management - scouting for pests, identification, choosing interventions (Integrated Pest Management), application and safety: how, when, and where to apply controls
• Irrigation: water sources, types of irrigation, how, when, and where to irrigate
• Tools, Equipment, and Technology selection, use, maintenance
• Harvest and Post-harvest Management
• Food Safety
• Marketing, Maintaining Customer Relationships, and Communication Skills
• Distribution
• Value-added Products
• Adapting to climate change, natural disasters, and economic shocks
• Taking care of yourself: Nutrition and Farm safety
• Work skills and expectations: how to be efficient, observant, and reliable
• Training Trainers

Facilities and Materials:
1 Farm plot or vacant lot in or near city limits. The group will build a training farm together, using materials readily available.
2 A small stipend, grant, or loan for each trainee to start their enterprise.
3 Site for cold-storage and access to a shared vehicle (truck or van) for pick up and distribution of produce.
4 One or more customers who will agree to purchase produce from the youth cooperative. This may be hotels, restaurants, embassies, or a school or health clinic/hospital.

Outcomes:
3 Small group of dedicated young urban/peri-urban farmers
4 Cooperative or network of farmers growing, harvesting, storing, marketing, and distributing produce together
5 Cooperative or network to provide material and social support for each other
6 Pride, joy and meaning in growing food for community and for income
TRAINING: Winter Vegetable Production

Low-input, passive production

Winter hardy vegetables

Greenhouse construction skills

Highlights:
- Young farmers will be trained to plant and harvest vegetables for winter harvest, and to build and manage season extension structures such as hoophouses and greenhouses.
- Three types of structures will be built: varying degrees of cost, management, and maintenance.
- Trainees will be expected to help other horticulture trainees to build their own structures.
- Greenhouse-building specialists can provide valuable and profitable services to other farmers.

Introduction:
This workshop will provide formal training in winter vegetable production suitable to a local climate. There are two groups of winter vegetable production: hardy crops that require few inputs, and intensive crops that require significant inputs of time, energy, and materials. Both can be profitable with good management and good markets. This program will focus on hardy crops and production systems that are accessible (not expensive) and that will provide experience that is critical to gain prior to high-input production. Trainees are expected to have farm experience or be in the Horticulture Training Program. We will focus on budgeting, selecting crops, the planning and timing of planting, cultivation, pest control, winter harvest, and seasonal protection (structures and other techniques).

I recommend half of trainees are female, half are male.

Basic training structure:
Winter productions requires advanced planning. A first series of workshops (total 1 x week, but can be part-time) will begin in spring, ideally before the summer season becomes busy. These will involve formal learning, hands-on activities, and field trips.

During the summer, Mike will work with a small team of either Horticulture trainees or dedicated greenhouse construction trainees to build several demonstration structures: one very low cost, one moderate cost, and one more permanent. We will focus on passive production techniques (rather than high tech solutions that require energy inputs to maintain warm temperatures): many crops will be planted before winter but harvested then.

The construction team will be expected to the either train or provide (paid) services to other farmers, constructing several simple structures at trainee farms during the summer/fall. Trainees will return to the demonstration farm in late summer to begin planting the winter crops. They will visit weekly to observe changes and conditions in each structure. The cohort will visit other farms

*This could also be done as several 2-week intensive “design-build” in multiple locations with follow-up visits
Trainees in the Horticulture program will grow and prepare plants during the summer to plant for winter harvest.

**Curriculum includes:**
- g Winter agronomy: light, temperature, and plant growth
- h Planning: seeding and planting early for winter harvest
- i Winter troubleshooting: pest and disease control, cold-season harvest, irrigation
- j Food safety
- k Storage and distribution
- l Marketing, customer relations, and communication skills
- m Design and construction of simple greenhouse structures
- n Work skills

**Facilities and Materials:**
1. Demonstration site within or near city/town limits (the same as the Horticultural Training site).
2. A small stipend, grant, or loan for each trainee to build a basic greenhouse structure
3. Building materials, permits

**Outcomes**
1. 3 demonstration structures of different design
2. Successful winter harvests and sales
3. Knowledge accumulation for all
4. Network of winter producers and extension agents
5. Future research and development needs

**2 Other trainings and assessments can be arranged:**

<table>
<thead>
<tr>
<th>Organic Agriculture</th>
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<tbody>
<tr>
<td>Potatoes, garlic, other vegetables</td>
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<tr>
<td>Small fruit: strawberries, melons, brambles, blueberries, and other bush crops</td>
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<tr>
<td>Maize and cereals</td>
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<tr>
<td>Green manure-cover crops (GMCC), crop rotation, reduced tillage (Conservation Agriculture). Trials and evaluations.</td>
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<td>Integrated crop-livestock systems, including integrated rice-duck-fish systems</td>
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<td>Organic Certification</td>
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<th>Farm Efficiency, Tools and Equipment</th>
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<td>Scaling Up: getting bigger and more efficient</td>
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<td>Tools and Equipment for small- and medium-size farms (appropriate technologies)</td>
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<td>Tool and equipment maintenance</td>
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<td>Animal exclusion: “hard” fence, electric fence, living fences, bird scares, and guard animals</td>
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<tr>
<td>Farm- and community-scale water management systems – focus on water harvest and storage</td>
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<td>Value chain: post-harvest, storage, marketing and distribution</td>
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<tr>
<td>Post-harvest handling: cold storage, processing, and food safety</td>
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<td>Value chain development for integrated systems</td>
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<th>Other</th>
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<tr>
<td>Orchard pruning</td>
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<td>Pesticide application and fertility management (organic and conventional)</td>
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<td>Young farmer networking</td>
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De-suung Skilling Program: Horticulture and Agriculture Training

1. About Michael Snow  
2. Horticultural Training: from Start-up to Sale  
3. 6-month timeline  
4. List of other possible trainings

**About Michael Snow**

I grew up in a Midwestern U.S. city and was bit by the farming “bug” as I finished school. I have been farming and training others the twenty years since, growing a wide variety of organic vegetables, including potatoes and garlic, fruits, grains (even upland rice!), and animals. I have worked in several different climates in the U.S. and abroad (most recently as a Farmer-to-Farmer trainer in Nepal and Myanmar), and at different scales: using hand tools and in greenhouses on less than an acre up to 35 acres of fruit and vegetables and 300 acres of pasture for animals, using 4-wheel tractors and appropriately scaled equipment. I love growing food, and selling it, too: I sell directly to customers and through local wholesale channels. I have also processed produce into value-added products like jams, sauces, and ready-to-eat meals.

In 2009, I co-founded a learning and social network for young farmers and their trainees in the Maryland-Virginia region of the U.S. and has also been involved in sustainable (organic) research and education. I recently completed studies in Agriculture and Rural Development at Cornell University in New York State. I grew up expecting to be a teacher and have in fact taught in the classroom as well as the farm: science and geography in high school (secondary school) and middle (primary) school.

Training youth in agricultural vocations is not just about learning skills and developing work ethic, but also about building a collaborative community of peers to work with and learn with. I believe you can learn anything in a farm or garden. It should be fun! And meaningful. And profitable. I hope trainees get the same bug I have.

> “The ultimate goal of farming is not the growing of crops, but the cultivation and perfection of human beings.”
> 
> Masanobu Fukuoka, Japanese farmer

Availability in 2022: 2-9 months, beginning April/May 2022
Horticultural Training: From Start-up to Sale

<table>
<thead>
<tr>
<th>Productivity</th>
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<td>Stewardship</td>
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<td>Joy</td>
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**Highlights:**
- Six-month training (3 months intensive) and support, 2 x cohorts (starting every 3 months)
- Trainees will learn and work together
- Trainees will gain experience with variety of farming techniques and tools, and construction of basic farm infrastructure
- Members of each cohort will be selected to mentor and help train following cohorts.
- Mike will partner with 1-2 in-country agricultural extension agents, who are expected to improve and continue trainings after Mike leaves.

**Introduction:**
Agriculture is not just a job; it can be a meaningful way of life. This training is intended to cultivate appreciation for agriculture and to give youth a runway to learn to grow and sell food as a livelihood. It is designed to develop a cadre of dedicated, creative farmers, to empower them with horticultural, business, and critical thinking skills, and to associate growing crops with important personal and group development.

Broad themes cultivated include production skills, business planning, post-harvest handling, marketing, and farm community building. This will be a hands-on training that includes formal training, fieldwork, farm visits, and teamwork. Trainees will gain experience using a variety of tools and materials, and also greenhouse construction. We will encourage trainees to find their own interests and specialize if they wish to. We will encourage them to develop an eye for new business opportunities, including providing services for other farmers (e.g. greenhouse construction or equipment contracting).

A critical aspect of the training will be to develop a sense of pride and joy in growing food, and a network of peers to support each other materially and socially. Trainees will be cultivated to mentor others.

I recommend half of trainees are female, half are male.

**Basic training structure:**
- 3-month intensive training. Trainees will plant and be responsible to care for plants and infrastructure each day. Part of each day will include hands-on activities: planning, planting, light construction, farm visits. Part of each day will include formal learning and team building exercises.
- Trainees will search for and find a plot of their own to develop into a small farm. They can work alone or in small teams. Trainees will be supported by trainers and by other students.
- Some trainees will be encouraged to take on various other roles in the vegetable value chain: producers, service provider (plants/nursery propagation, fertility and pest management inputs, tools, etc.), cold-storage, marketing, and distribution.
• The group will find or begin building a shared produce storage center. They may collaborate to aggregate, market, and distribute produce.
• After the first month, trainees will meet weekly at rotating farm-sites. These meetings will be learning and social events.
• Trainees will make training videos for other farmers and future trainees
• After the second month, trainees will meet twice a month, or more, at rotating farm-sites. These meetings will be learning and social events (this assumes trainees live within a reasonable distance to training center).

Curriculum includes:
• Introduction to botany, soil science, and related sciences: what’s a farmer need to know?
• Business planning and budgeting: thinking about workflow, cash flow, labor, and material needs; where to find financing; how to write a business plan.
• Organic Farming and Stewardship – Big Picture and little picture
• Site selection and farm design
• Horticultural skills: plant production, seeding and planting, cultivating, ergonomics, efficiency, plant care
• Fertility and nutrient management: assessing plant health, choosing fertilizers and soil amendments, and how, when, and where to apply them.
• Crop Protection: pest and disease management - scouting for pests, identification, choosing interventions (Integrated Pest Management), application and safety: how, when, and where to apply controls
• Irrigation: water sources, types of irrigation, how, when, and where to irrigate
• Tools, Equipment, and Technology selection, use, maintenance
• Harvest and Post-harvest Management
• Food Safety
• Marketing, Maintaining Customer Relationships, and Communication Skills
• Distribution
• Value-added Products
• Winter harvest: planning and planting for winter vegetable harvest, hoop house/ greenhouse construction.
• Adapting to climate change, natural disasters, and economic shocks
• Taking care of yourself: Nutrition and Farm safety
• Work skills and expectations: how to be efficient, observant, and reliable
• Training Trainers

Facilities and Materials:
5 Farm plot for demonstration farm. The group will build a training farm together, using materials readily available. 1-2 hectares (2-5 acres)
6 A small stipend, grant, or loan for each trainee to start their enterprise, equipment purchase, and/or greenhouse construction.
7 Access to:
   o hand tools (for field work and for building projects) and seeders
   o nursery supplies for seedling production,
   o water source for irrigation, and irrigation supplies (we will build an irrigation system),
   o clean/new sprayers (manual and/or motorized),
o seed, fertilizers, and other production materials,
o motorized equipment (2-wheel tractors, seeder, harvest equipment)
o building materials (and any permits required) for small sheds, greenhouses/hoop houses, simple cold storage, etc.

8 Site for cold storage
9 Transportation for trainer and for group field trips
10 One or more customers who will agree to purchase produce from the youth cooperative. This may be hotels, restaurants, embassies, or a school or health clinic/hospital.

Outcomes:
7 Small group of dedicated young farmers growing, harvesting, storing, marketing, and distributing produce
8 Farmers’ network to provide material and social support for each other
9 Pride, joy and meaning in growing food for community and for income
10 3 season-extension structures of different design
11 Future research and development needs

SIX MONTH TRAINING DETAIL

Trainees: 15 trainees that have similar background with respect to farming – either all having farm experience or all having no farm experience. Trainees should live within commuting distance to training site. If the training is town/village/region specific, each trainee should have access to their own land to farm on.

Co-leader: 1 x teacher, extension agent, or farmer should work with me at least 3 days a week (or full-time) during each training. This person can then be a resource and provide additional training after international trainer (M. Snow) returns home.

Budget (subject to change)

<table>
<thead>
<tr>
<th>Cost (NA unless USD)</th>
<th>Category</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>80,000 NA per acre</td>
<td>Production expenses</td>
<td>Estimate based on “Cost of Production for Field and Horticulture Crops in Bhutan 2020” (<a href="https://www.doa.gov.bt/cost-of-production/">https://www.doa.gov.bt/cost-of-production/</a>)</td>
</tr>
<tr>
<td></td>
<td>Irrigation materials</td>
<td>Water for nursery and irrigation for farm site</td>
</tr>
<tr>
<td></td>
<td>Greenhouse and other building project materials</td>
<td>Design and build cost-effective season-extension structures</td>
</tr>
<tr>
<td></td>
<td>Post-harvest and storage materials</td>
<td>Design and build cost-effective storage using appropriate/locally available technology</td>
</tr>
<tr>
<td></td>
<td>Fencing/predation control</td>
<td>If necessary</td>
</tr>
<tr>
<td></td>
<td>Transportation: truck/van/bus</td>
<td>and group meals on Field Trips</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>Educational supplies (paper, pencils, markers, projector, copies), misc</td>
</tr>
<tr>
<td>10%</td>
<td>Contingency</td>
<td>In case of unexpected problems</td>
</tr>
<tr>
<td></td>
<td>Co-leader</td>
<td>If available</td>
</tr>
</tbody>
</table>

| US$                 | International trainer                        | I would like to live at the training farm, or nearby with a farming family. |

| Total               |                                              |                                                                       |

114
<table>
<thead>
<tr>
<th>Week</th>
<th>Agenda</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1, Q2</td>
<td>Quarantine</td>
</tr>
</tbody>
</table>
| 1, 2 | In-country preparation and resource assessment:  
- Visits to relevant Department of Agriculture centers and resources (ARDC, ADP, AED - AMC and CMU), agricultural service providers, successful/innovative farmers and value-chain enterprises. Also local markets and material suppliers.  
- Visit each trainee at their home/farm. |
| 3 | Curriculum: introduction to training; farm safety and farmer health; farm plan 1; business management 1; marketing 1  
Activities: classroom setup, seeding 1, nursery project 1: water/irrigation  
Field Trips: farm visit; market; supply |
| 4 | Curriculum: vegetable production basics: seed selection, seed starting, botany, nursery work; climate and nutrient cycles; farm infrastructure 1  
Activities: nursery build; seeding 2; field prep 1  
Field Trips: farm visit, service provider, extension services (e.g. ARED) |
| 5 | Curriculum: soils, soil health, cultivation; irrigation  
Activities: field irrigation; tools and equipment, seeding 3  
Field Trips: farm visit; equipment supplier; blacksmith/welder; AMC/CMU |
| 6 | Curriculum: vegetable health; weed and pest management; harvest and post-harvest; storage  
Activities: cultivation; pest control; field work; harvest; seeding  
Field Trips: farm visits; extension services (e.g. ADP) |
| 7 | Curriculum: finding and assessing land; farm infrastructure 2; marketing 1;  
Activities: land search; farm design; field work; harvest; seeding; sales  
Field Trips: land search – trainees look for farm sites |
| 8 | Curriculum: whole farm design; farm design workshopping; business management 2; marketing 2  
Activities: trainee farm design workshopping; field work; harvest; seeding 6; sales  
Field Trips: trainee sites in groups |
| 9 | Curriculum: season extension, winter production; education and professional development – how to learn and get help; legal issues/requirements  
Activities: training infrastructure projects; field work; harvest; seeding; sales  
Field Trips: trainee sites, TBD |
| 10 | Curriculum: alternative crops; livestock; business management 3; value-added products; next steps  
Activities: finish projects as needed; field work; harvest; seeding; sales  
Field Trips: TBD |
| 11 | Curriculum: winter vegetable production  
Activities: greenhouse build; field work; harvest; seeding; sales |
<table>
<thead>
<tr>
<th>Week</th>
<th>Activity</th>
</tr>
</thead>
</table>
| 12   | Field Trips: TBD  
Curriculum: winter vegetable production  
Activities: greenhouse build; field work; harvest; seeding; sales |
| 13   | Field Trips: TBD  
Curriculum: winter vegetable production; catch-all topics  
Activities: finish projects |
| 14   | Field Trips:  
Curriculum: Next steps, catch-all topics  
Activities: finish projects  
End training 1 |
| 15   | Instructor rest, review  
Prepare for 2nd training  
Visit Trainees group 2 |
| 16   | Farmer Training 2, see weeks 3-14 |
| 17   | Farmer Training 2, see weeks 3-14 |
| 18   | Farmer Training 2, see weeks 3-14 |
| 19   | Farmer Training 2, see weeks 3-14 |
| 20   | Farmer Training 2, see weeks 3-14 |
| 21   | Farmer Training 2, see weeks 3-14 |
| 24   | Farmer Training 2, see weeks 3-14 |
| 23   | Farmer Training 2, see weeks 3-14 |
| 24   | Farmer Training 2, see weeks 3-14 |
Farmer Training 2, see weeks 3-14

Farmer Training 2, see weeks 3-14

Farmer Training 2, see weeks 3-14

Debrief; in-country travel?

3 Materials

Teaching Materials:
- Paper – notebook/s for each trainee
- Paper – loose (printer paper)
- Flip Charts (or roll of large “mural” paper)
- Pens, Pencils, Markers, Colors
- Access to a printer and copy machine?
- Masking or Painter’s Tape

Facilities:
- Farm plot for demonstration farm. 1-2 hectares (2-5 acres)
- Sheltered classroom space
- Power and Wifi at training site?
- Kitchen facilities for group lunches/meals (we will make lunches for ourselves)
- Water access for washing hands, washing produce, and for irrigation

Tools and Equipment:
- Common hand tools (for field work and for building projects) and seeders
- Motorized equipment (2-wheel tractors, seeder, harvest equipment)
- 4-wheel tractor if possible
- 2 x clean/new sprayers (manual and/or motorized)
- Irrigation supplies – we will build an irrigation system together. Drip irrigation for 1-2 acres. Sprinklers for 1 acre (or a line of at least 400’) if possible
- Seed, fertilizers, and other production materials – details to follow
- Building materials for:
  - Small sheds,
  - Sheltered classroom space
  - Greenhouses/hoop houses,
  - Cold storage room
Soil tests – is there a soil testing laboratory? If not, okay!

**Transportation**
- For trainer
- For group field trips

**Market / Customers**
One or more customers who will agree to purchase produce from the youth cooperative. This may be hotels, restaurants, embassies, or a school or health clinic/hospital. If not an obvious customer, we will find customers as a group.

### 4 Other trainings and assessments can be arranged:

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organic Agriculture</strong></td>
<td>Potatoes, garlic, other vegetables</td>
</tr>
<tr>
<td></td>
<td>Small fruit: strawberries, melons, brambles, blueberries, and other bush crops</td>
</tr>
<tr>
<td></td>
<td>Maize and cereals</td>
</tr>
<tr>
<td></td>
<td>Green manure-cover crops (GMCC), crop rotation, reduced tillage (Conservation Agriculture). Trials and evaluations.</td>
</tr>
<tr>
<td></td>
<td>Integrated crop-livestock systems, including integrated rice-duck-fish systems</td>
</tr>
<tr>
<td><strong>Farm Efficiency, Tools and Equipment</strong></td>
<td>Organic Certification</td>
</tr>
<tr>
<td></td>
<td>Scaling Up: getting bigger and more efficient</td>
</tr>
<tr>
<td></td>
<td>Tools and Equipment for small- and medium-size farms (appropriate technologies)</td>
</tr>
<tr>
<td></td>
<td>Tool and equipment maintenance</td>
</tr>
<tr>
<td></td>
<td>Animal exclusion: “hard” fence, electric fence, living fences, bird scares, and guard animals</td>
</tr>
<tr>
<td></td>
<td>Farm- and community-scale water management systems – focus on water harvest and storage</td>
</tr>
<tr>
<td><strong>Value chain: post-harvest, storage, marketing and distribution</strong></td>
<td>Value chain development for integrated systems</td>
</tr>
<tr>
<td></td>
<td>Post-harvest handling: cold storage, processing, and food safety</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>Orchard pruning</td>
</tr>
<tr>
<td></td>
<td>Pesticide application and fertility management (organic and conventional)</td>
</tr>
<tr>
<td></td>
<td>Young farmer networking</td>
</tr>
</tbody>
</table>
APPENDIX 4: Amended Proposal for Training #2

Proposal
DSP Horticulture Training 2
Autumn 2022

Dates
10 September 2022 – 15 December 2022

# Trainees:
10-15 (hard cap at 15)
Recommend roughly half male, half female.

Prerequisites:
- Successful completion of previous horticultural trainings (DSP or other, ie CNR or RDTC?) + Trainer Recommendation
- Or real, on-farm production experience
- Questionnaire or interview, to include plans for individual or small group enterprise
*Can we review candidates?

Location: see below
Option 1: Gup P’s farm, Wangdi
Option 2: Yangchen’s Homestay/Happiness Field Village Homestay, Punakha
Option 3: Zomlingthang, Punahkha

<table>
<thead>
<tr>
<th>Wangdi:</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Close to ARDC</td>
<td><em>Water/Irrigation may be more complicated</em></td>
</tr>
<tr>
<td>6 Respected member of community, visible to other farmers</td>
<td><em>Paddy/wetland only</em></td>
</tr>
<tr>
<td>7 Housing available, tentatively</td>
<td><em>Distraction of town?</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Punakha 1: Yangchen’s Homestay</th>
<th>Punakha 1: Yangchen’s Homestay</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 Wetland/paddy and dryland/4WT fields</td>
<td>o Further from ARDC (though still accessible)</td>
</tr>
<tr>
<td>7 4WT, 2WT both in good working order</td>
<td>p Farm is committed to organic practices and inputs – fewer options for nutrient management and pest control</td>
</tr>
<tr>
<td>8 Riverside location, irrigation easier to develop if necessary</td>
<td></td>
</tr>
<tr>
<td>9 3 x Polyhouses on-site and ready to construct – excellent opportunity</td>
<td></td>
</tr>
<tr>
<td>10 Further but still accessible to ARDC</td>
<td></td>
</tr>
<tr>
<td>11 Quiet location, group may be more focused and “together”</td>
<td></td>
</tr>
<tr>
<td>12 Housing available on-site</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Punakha 2: Zomlingthang</th>
<th>Punakha 2: Zomlingthang</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Wetland/paddy and dryland fields</td>
<td>□ Housing at DSP Camp is not ideal – expert <em>strongly</em> recommends housing on-site</td>
</tr>
<tr>
<td>□ 2 x existing polyhouses on-site</td>
<td>□ No equipment – need powertiller, tractor</td>
</tr>
<tr>
<td>□ Access to commercial kitchen, reliable power, and water</td>
<td></td>
</tr>
<tr>
<td>□ Irrigation on-site, easy to increase capacity</td>
<td></td>
</tr>
<tr>
<td>□ Further but still accessible to ARDC</td>
<td></td>
</tr>
</tbody>
</table>
**Instructor’s Note:** I am concerned that trainees may be required to live at the DSP camp near Punakha. I cannot stress enough how valuable it is for trainees to live on-site, together. Agriculture is not a 9-5 career – it sometimes requires long days, flexible schedules (e.g. meals early or late in order to finish while weather permits), immediate attention to repairs, pests, and other unscheduled occurrences… and the ability to be at the farm evenings or early mornings to observe

They should live, study, and work together during training. Agriculture can also be lonely work, farmers isolated from each other in many ways. I firmly believe it is important to develop camaraderie among these trainees – they may well collaborate and support each other in important ways in the future.

**Location Recommendation:** All three locations are excellent training sites. Each has some advantage and disadvantage relative to the others. I recommend **Punakha Site 1: Yangchen Homestay** as the most promising. It offers:

- A diverse land-base with both paddy/wetland (currently in rice) and flat, open dryland – ideal for training with common tools like 2WT (powertiller) and 4WT (tractor).
- 3 x polyhouses on-site, ready to construct (no cost to DSP). Excellent training opportunity for trainees.
- Existing tunnel for initial nursery
- Irrigation infrastructure – will be less expensive to develop for training purposes
- Housing on-site

**Phobjikha Training Site**

Our intention in Phobjikha (current training) has been to grow crops for the short term, and to develop a training site that can be used long-term - for training, demonstration, and production. We propose to continue using the Phobjikha training site (at the NSC sub-center). We would travel to Punakha roughly every week for two months to:

1. Harvest field and tunnel crops grown in the summer for sale
2. Complete walipini sunken greenhouse
3. Complete water harvesting and irrigation system
4. Any fieldwork required to bring viable crops to market (e.g. weeding, pest control…)

**Summary**

This in advanced training that will provide farm-based experience and skill-building, as well as support for young farmers to develop their own farm-based/agricultural enterprises. This training will build on a first training by reviewing introductory materials (soil fertility, production basics, cultivation, marketing, etc). Trainees will work collaboratively to bring crops to market, as well as individually or in small groups to research, experiment, or incubate their enterprises.

Where the beginning training focused on basic skills and the development of a challenging site, this training will focus on production, sales, and individual enterprise development.
Three components to the training:

1. Vegetable Production:
The training farm will grow a variety of cool season vegetables for sale under the guidance of the Trainer. Trainees will gain experience in planning, cultivation, harvest, and marketing. A portion of the farm will be dedicated to soil improvement, the rest in crop production.
   - Focus on marketable crops:
     - beans, peas
     - cole crops (broccoli, cauliflower, cabbage, kale)
     - greens (lettuce, spinach, sag)
     - root crops (carrots, beet root, radish, turnip)
     - herbs (bunching onions, coriander, basil, culinary herbs)
   - Market development, sales via:
     - Kaja throm
     - Local restaurants/hotels
     - Evergreen cafeteria (if running this fall)
   - Harvest crops from Phobjikha at beginning of training
   - Post-Harvest Handling, Food Safety, Cold storage

2. Skill Building and Enterprise Development. Individual and Group Projects/Enterprises might include:
   - Mushroom production
   - Production of organic fertilizers and soil amendments: Compost, Vermicompost, Charged biochar, Farm-based microbes, fermented fertilizers
   - Improved irrigation system development
   - Vertical farming or hydroponics in poly tunnel
   - Design and production of cultivation tools
   - Animal integration
   - Seed saving
   - Specific/specialty crop production
   - Group marketing
   - Fruit grafting/Nursery production
   - …

3. Experimentation:
The training program will collaborate with ARDC-Bajo to explore and refine practices that can contribute to off-season vegetable production and food self-sufficiency, particularly in areas of organic soil improvement, off-season production, and tools for field cultivation. May include:
   - Planting dates for continuous cool-season harvest (succession harvest)
   - Nursery production & transplanting tools: potting soils, bed layout for mechanical cultivation
   - Long-handled tools, 2WT tools & implements, 4WT tools & implements
   - Green Manure / Cover Crops
   - Soil fertility and natural pest control: soil amendments, foliar applications, habitat for beneficials, animal integration.
Curriculum Summary:
Likewise, the curriculum may be divided into three sections. It will include and build upon the earlier training curriculum (see bottomi).

Section 1: Review production basics - formal lectures, presentations, small projects; nursery & irrigation planning, set-up, production; tool and power tiller training; enterprise and business planning
Section 2: Enterprise execution – group and individual work on the farm; field work; project implementation. Production topics in more detail.
Section 3: Next steps – support trainees as they plan for next steps: location, improvement, expansion; capital/materials needs and acquisition. Harvest and sale of produce from training farm.
Budget and Materials: See attached spreadsheet.
The budget varies by site. Necessary materials include:

- Irrigation
- Polyhouses x 3
- Wildlife control (fence)
- Access to 2-wheel tractor (powertiller) and 4-wheel tractor
- Please note there is also a line item for shipping charges from the US to Bhutan.

Items Mike would like to ship from the USA – and request the DSP to share shipping charges (Mike to donate the materials themselves). I expect shipping charges to amount to US$400 for 10 kg, or $700 for 25 kg.

One of the challenges we faced in the first training: we ask our trainees to be excited about new tools and technologies that can make agriculture more efficient and comfortable, but then those tools aren’t available. This is a major gap – and this is not about “smart” or digital systems, this is about the real work of cultivation, seeding, and nursery production. These tools don’t have to be expensive or complex, they just need to be available.

I would like to bring several items over from the US to trial and demonstrate. They can then be made here or if necessary imported.

Seed: in collaboration with ARDC-Bajo, several varieties (mostly open-pollinated but also hybrid seed) to compare to those locally available. All seeds come from a reputable source – Johnny’s Selected Seeds (https://www.johnnyseeds.com/) and High Mowing Seeds (https://www.highmowingseeds.com/), both of which sell only certified Non-GMO and disease-free seed.

- Broccoli
- Cabbage – green, red, Chinese
- Carrot
- Cauliflower
- Cucumber
- Greens, Japanese, Spinach
- Herbs
- Lettuce
- Pea
- Cover crop to trial

Tools: several small tools to use as prototype for in-country construction. These tools have made manual labor more efficient and more ergonomic in the US and Europe, and include

- Long-handled cultivating tools (just the business end, not the handles) – several of these, these, and these.
- A spin-seeder for broadcasting seed and fertilizer evenly (this and this)

Several irrigation fitting to demonstrate effectiveness.
Horticultural Training: From Start-up to Sale

Curriculum includes:

- Introduction to botany, soil science, and related sciences: what’s a farmer need to know?
- Business planning and budgeting: thinking about workflow, cash flow, labor and material needs; how to write a business plan.
- Organic Farming and Stewardship – Big Picture and little picture
- Site selection and farm design
- Horticultural skills: plant production, seeding and planting, cultivating, ergonomics, efficiency, plant care
- Fertility and nutrient management: assessing plant health, choosing fertilizers and soil amendments, and how, when, and where to apply them.
- Crop Protection: pest and disease management - scouting for pests, identification, choosing interventions (Integrated Pest Management), application and safety: how, when, and where to apply controls
- Irrigation: water sources, types of irrigation, how, when, and where to irrigate
- Tools, Equipment, and Technology selection, use, maintenance
- Harvest and Post-harvest Management
- Food Safety
- Marketing, Maintaining Customer Relationships, and Communication Skills
- Distribution
- Value-added Products
- Winter harvest: planning and planting for winter vegetable harvest, hoop house/ greenhouse construction.
- Adapting to climate change, natural disasters, and economic shocks
- Taking care of yourself: Nutrition and Farm safety
- Work skills and expectations: how to be efficient, observant, and reliable
- Training Trainers

Facilities and Materials:

1. Farm plot for demonstration farm. The group will build a training farm together, using materials readily available. 1-2 hectares (2-5 acres)
2. A small stipend, grant, or loan for each trainee to start their enterprise, equipment purchase, and/or greenhouse construction.
3. Access to:
   - 3.a hand tools (for field work and for building projects) and seeders
   - 3.b nursery supplies for seedling production,
   - 3.c water source for irrigation, and irrigation supplies (we will build an irrigation system),
   - 3.d clean/new sprayers (manual and/or motorized),
   - 3.e seed, fertilizers, and other production materials,
   - 3.f motorized equipment (2-wheel tractors, 4-wheel tractor, seeder, harvest equipment)
3.g building materials (and any permits required) for small sheds, greenhouses/hoop houses, simple cold storage, etc.

3.h 3 x (5x20) polytunnels

4 Site for cold-storage

5 Transportation for trainer and for group field trips

Outcomes:

a Small group of dedicated young farmers growing, harvesting, storing, marketing, and distributing produce
b Farmers’ network to provide material and social support for each other
c Pride, joy and meaning in growing food for community and for income
d 3 season-extension structures of different design
e Future research and development needs

Materials

Teaching Materials:

- Paper – notebook/s for each trainee
- Paper – loose (printer paper)
- Flip Charts (or roll of large “mural” paper)
- Pens, Pencils, Markers, Colors
- Access to a printer and copy machine?
- Masking or Painter’s Tape

Facilities:

- Farm plot for demonstration farm. 1-2 hectares (2-5 acres)
- Sheltered classroom space
- Power and Wifi at training site
- Kitchen facilities for group lunches/meals (we will make lunches for ourselves)
- Water access for washing hands, washing produce, and for irrigation
- Living quarters, male and female

Tools and Equipment:

- Common hand tools (for farm field work and basic carpentry tools) and seeders
- Motorized equipment (2-wheel tractors, seeder, harvest equipment)
- 4-wheel tractor if possible
- 2 x clean/new sprayers (manual and/or motorized)
- Irrigation supplies – we will build an irrigation system together. Drip irrigation for 1-2 acres. Sprinklers for 1 acre (or a line of at least 400’) if possible
- Seed, fertilizers, and other production materials – details to follow
DSP Horticulture Training 3: Special Projects in Weed Management and Cold Storage
Winter 2022-2023

Dates
22 December 2022 – 14 January 2023 (Mike to confirm end date)

# Trainees: 8
Continuation from Horticulture 3 (Wangdi) training

Prerequisites:
- Horticulture 3, Mid-Altitude Vegetable Production

Location: current Wangdi horticulture site

Trainer: Michael Snow

Summary

6. Special Projects:
   1. Post-harvest handling and cool storage for farmers
   2. Cultivation tools: long-handled tools and 2 Wheel Tractor tools & implements

7. Harvest and Marketing of Horticulture 3 crops (continuation of Horticulture 3)

One of the challenges we face in our first trainings: we ask our trainees to be excited about new tools and technologies that can make agriculture more efficient and comfortable, but then those tools aren’t available. This is a major gap – and this is not about “smart” or digital systems, this is about the real work of cultivation, seeding, and nursery production. These tools don’t have to be expensive, complex, or digital, they just need to be available.

This training will continue the work started in Horticulture 3, harvesting and marketing crops as they mature. It will also focus on several important technological challenges facing farmers in Bhutan: cultivation (weed management) equipment, post-harvest handling and storage, and useful farm-made soil amendments.

Trainees will work in small groups to problem solve one of these major challenges. Collaborating with ARDC-Bajo, the FMCL, and the SuperFABLAB in Thimphu, trainees will approach describe and analyze the problem, researching potential solutions, and prototype practical and appropriate farm tools.
Elaboration
In Horticulture 3 (Mid-latitude Vegetable Production) we have explored irrigation challenges using technologies that are immediately available and accessible by most farmers in Bhutan. Without water, vegetable production is not viable, and while there are still major challenges in terms of consistent water supply (this issue is beyond the farm-level), we have built and trialed a variety of water storage, distribution, and management systems – including several drip, sprinkler, and flood systems.

Major challenges remain, particularly in weed management and post-harvest handling and storage. While we have practiced strategies to make weed management more efficient, there are few-to-no organic (non-chemical) tools for effective cultivation. We have used several tools brought to Bhutan to trial and have had good outcomes. The next step is to choose designs that can be produced in-country, prototype, and troubleshoot production.

Another major issue is a lack of cold storage for crops; more than a third of crops can be lost due to poor storage and handling after harvest. Farmers either lose the crop, take a poor quality to market, or take a crop to market immediately – when they have little leverage over price. While there are several large cold storage facilities being built in Bhutan, a more decentralized approach can help farmers utilize those facilities more effectively. We will build and demonstrate several farm-scale, appropriate cold storage technologies.

The training program will again collaborate with ARDC-Bajo to explore and refine practices that can contribute to profitability, off-season vegetable production and food self-sufficiency. Using resources available via ARDC-Bajo, the FMCL, and technology hubs like the SuperFABLAB in Thimphu, trainees will approach important farm challenges in small groups, naming and analyzing the problem, researching potential solutions, modeling and prototyping useful tools.

While some of the initial Mid-Altitude Veg Production group have other responsibilities after December 21, roughly half wish to continue to develop new techniques and technologies. This training would allow them to see through many of their crops to maturity, market them, and solve important problems they may face as they farm themselves.
APPENDIX 6: Curricula as Covered, Crops Grown, Field Trips for Trainings 1-3

Table 10. Site Information, Training 1, Phobjikha

<table>
<thead>
<tr>
<th>Location</th>
<th>Phobjikha Valley</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geowog</td>
<td>Gangtay</td>
</tr>
<tr>
<td>Dzongkhag</td>
<td>Wangdue Phodrang</td>
</tr>
<tr>
<td>Elevation</td>
<td>2,900 masl</td>
</tr>
<tr>
<td>Precipitation, months</td>
<td></td>
</tr>
<tr>
<td>Temperatures</td>
<td></td>
</tr>
<tr>
<td>Ownership</td>
<td>National Seed Center seed potato farm</td>
</tr>
<tr>
<td>Area</td>
<td>4 acres</td>
</tr>
<tr>
<td>Description</td>
<td>38 fenced acres on the slopes of Phobjikha Valley, the bottom of which is a (protected) RAMSAR wetland site. Slopes of 10 - 15%. Soils are mostly eroded, stoney silt loam with low levels of fertility. The site was fenced for protection from wild boar, jaguar, deer, and bear.</td>
</tr>
<tr>
<td>Living Situation</td>
<td>Farmhouse of Aum Lhakpa and Ap Yanka. Lhakpa and Yanka are farmers in the village of Mol, 1.5 km from the NSC farm. Trainees live in shared rooms (two boys', two girls' rooms) on lower floor of the main farmhouse. Trainer lives on main floor with owners. A second, older farmhouse is used as a kitchen and dining area for trainees and co-trainer.</td>
</tr>
<tr>
<td>Meals</td>
<td>Trainer ate lunch with trainees daily, dinner three times a week. Breakfast daily with hosts, dinner three times a week. Sundays took care of self.</td>
</tr>
<tr>
<td>Co-trainer/s</td>
<td>Tashi Dorji, of ARDC-Bajo (m)</td>
</tr>
<tr>
<td>Trainees, male/female</td>
<td>8 male, 10 female</td>
</tr>
<tr>
<td>Trainees, ages</td>
<td>21 - 35 yo</td>
</tr>
<tr>
<td>Trainees, Dzongkhags</td>
<td>Haa, Mongar, Trashigang, Zhemgang, Chukka, Punakha, Paro, Samse, Luentse, Wangdue Phodrang, Gasa, Dagana, Samdrup Jongkhar</td>
</tr>
<tr>
<td>Key Partners</td>
<td>ARDC-Bajo PD; Gangtay Extension Agent; Wangdue Phodrang Agricultural Development Office; NSC Phobjikha Farm Manager</td>
</tr>
<tr>
<td>Overview &amp; Introduction</td>
<td>Introductions; group rulemaking; overview; conflict resolution</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Site &amp; Soil Assessment</td>
<td>Observational skills; collecting site history; testing &amp; on-farm assessment: soil chemistry, pH, biology, physical characteristics; risk &amp; resource assessments: access, water, air, light, fire, vegetation, wildlife, community</td>
</tr>
<tr>
<td>Production Planning &amp; Materials Needs</td>
<td>Mathematics! Estimating seed, potting soil, fertilizer, space needs for seedling and field production; seed and variety selection; markets; season extension; succession sowing</td>
</tr>
<tr>
<td>Nursery Production &amp; Greenhouse Mgmt</td>
<td>Several methods of seedling production; potting soils; cultural practices (water, temperature, air management); attentiveness; troubleshooting</td>
</tr>
<tr>
<td>Soil Fertility Management</td>
<td>Soil–plant relationships; soil health as the key to plant health, pest and disease management, and crop quality, and productivity; integrated fertility management; amendments and fertilizers sources, rates, calculations; how to choose and properly use chemical fertilizers 4Rs+C; building organic matter with carbon-based inputs; organic soil amendments use and production: compost, vermi-compost, making and charging biochar, bokashi, microorganisms; fermented plant juices, cow urine, stone dusts; mulches; crop rotations; GMCCs</td>
</tr>
<tr>
<td>Water &amp; Nutrient Harvesting</td>
<td>Water storage ponds: ARDC-Bajo PD</td>
</tr>
<tr>
<td></td>
<td>Water Harvesting: Gyan Sagar, Int’l expert</td>
</tr>
<tr>
<td></td>
<td>Built 2 x water storage ponds, 27,000 l each; water &amp; nutrient flows in an agricultural landscape; managing for long-term productivity; rehydrating landscapes for dry periods; managing water in wet periods; introduction to agro-forestry for nutrient management and vegetable production; field and bed layout</td>
</tr>
<tr>
<td>Irrigation: water sources</td>
<td>Water sources; developing sources</td>
</tr>
<tr>
<td>Irrigation: water distribution</td>
<td>Flood, overhead, and drip irrigation; sizing a system; planning and building a distribution system; installing and using sprinkler and drip systems; gravity flow.</td>
</tr>
<tr>
<td>Water Management</td>
<td></td>
</tr>
<tr>
<td>Field Preparation &amp; Fertilization</td>
<td>Hand-building beds; double-digging for improved root penetration; plastic mulch laying and use; power-tiller built beds; no-bed systems</td>
</tr>
<tr>
<td>Erosion Control</td>
<td></td>
</tr>
<tr>
<td>Weed and Pest Management</td>
<td>Cultivation strategies; build and use long-handeded hand tools; Integrated Pest Management; Pest ID; Pick-A-Pest and Pick-A-Disease presentations; scouting and</td>
</tr>
<tr>
<td>Section</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Harvest</td>
<td>Harvest planning and preparation, harvest for local restaurant, shop, and commencement</td>
</tr>
<tr>
<td>Post-Harvest Handling &amp; Food Safety</td>
<td>Introduction to food safety</td>
</tr>
<tr>
<td>Marketing, Sales, and Distribution</td>
<td>Introduction to marketing</td>
</tr>
<tr>
<td>Record Keeping</td>
<td>Importance of record keeping; systems for keeping records; practice keeping records for individual plots</td>
</tr>
<tr>
<td>Greenhouse/Polyhouse Construction</td>
<td>Planning and design; site selection and preparation; build 5 m x 20 m greenhouse; sunken greenhouse (<em>walipini</em>) design</td>
</tr>
<tr>
<td>Tools and Equipment</td>
<td>The right tool for the job; ergonomics and safety; care and maintenance; hand and long-handled cultivation tools; 4 Wheel Tractor training and use</td>
</tr>
<tr>
<td>Trades and Building Skills</td>
<td>Light carpentry</td>
</tr>
<tr>
<td>Goal Setting</td>
<td>Personal goal setting</td>
</tr>
<tr>
<td>Enterprise Budgeting</td>
<td>Introduction, revenues, variable and fixed expenses</td>
</tr>
<tr>
<td>Business Planning &amp; Next Steps</td>
<td>Introduction</td>
</tr>
<tr>
<td>Integrated Crop-Livestock Systems</td>
<td>How animals can be integrated in diversified farms</td>
</tr>
<tr>
<td>Information Resources</td>
<td>Library of books, catalogues, and magazines from US; shared compilation of online resources; topic: how to find information and resources</td>
</tr>
<tr>
<td>Other</td>
<td>On-farm research (one of four saffron trial sites) Introduction to mushroom production; oysters in bag</td>
</tr>
</tbody>
</table>
### Table 12. Crops Grown, Training 1, Phobjikha

<table>
<thead>
<tr>
<th>Direct Seeded</th>
<th>Transplanted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sag</td>
<td>Sag</td>
</tr>
<tr>
<td>Spinach</td>
<td>Spinach</td>
</tr>
<tr>
<td>Beet root</td>
<td>Beet root</td>
</tr>
<tr>
<td>Lettuce</td>
<td>Lettuce</td>
</tr>
<tr>
<td>Coriander</td>
<td>Coriander</td>
</tr>
<tr>
<td>Dill</td>
<td>Dill</td>
</tr>
<tr>
<td>Beans</td>
<td>Broccoli</td>
</tr>
<tr>
<td>Peas</td>
<td>Cabbage</td>
</tr>
<tr>
<td>Carrots</td>
<td>Cauliflower</td>
</tr>
<tr>
<td>Zucchini</td>
<td>Zucchini</td>
</tr>
<tr>
<td>Cucumber</td>
<td>Cucumber</td>
</tr>
<tr>
<td>Flowers</td>
<td>Flowers</td>
</tr>
<tr>
<td>Watermelon</td>
<td>Pumpkin, winter squash</td>
</tr>
<tr>
<td>Radishes</td>
<td>Basil</td>
</tr>
<tr>
<td>Turnip</td>
<td>Chili</td>
</tr>
<tr>
<td>Insectiary species</td>
<td>Tomato</td>
</tr>
</tbody>
</table>

### Field Trips

- AMC Bajo
- ARDC Bajo: biochar production, wood vinegar production, bokashi production
- FMCL Bajo
- FMCL tomato greenhouse, Bajo
- Chimipang Royal Project: horticulture, floriculture, mushrooms
- Gyalsung program farm, Khotokha
- National Post-Harvest Center, Paro
- FMCL Mega-greenhouse demonstration farm, Paro
- National Plant Protection Center, Thimphu
- National Soil Services Center, Thimphu
- Centenary Farmers Market, Thimphu
- Kaja Throm Farmers Market, Thimphu
- Private Agri-supply shores: Sherab Enterprises, Karma One-Stop
- Local hardware stores
- Aum Damchoe's Urban Farm
- Shangri-La Cold Storage
- National Center for Organic Agriculture, Yusipang
- Six Senses Hotel, Gangtay

### Visits hosted

- Ag Machinery Field Day, host for local farmers and Desuups
- ARDC-Bajo Program Director, water storage ponds
- National Seed Center, Director
- Sonam, owner Gangtay Pizza
- Governor, Wangdue Phograng
- Mejii Tashi Dorji (Chairman of National Council)
### Training 2

Table 13. Site Information, Training 2 & 3, Rubesa

<table>
<thead>
<tr>
<th>Location</th>
<th>Rubesa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geowog</td>
<td>Rubesa, near Wangdi dzong</td>
</tr>
<tr>
<td>Dzongkhag</td>
<td>Wangdue Phodrang</td>
</tr>
<tr>
<td>Elevation</td>
<td>1,200 masl</td>
</tr>
<tr>
<td>Precipitation, months</td>
<td></td>
</tr>
<tr>
<td>Temperatures</td>
<td></td>
</tr>
<tr>
<td>Ownership</td>
<td>Gup Phurba Namgay, private owner</td>
</tr>
<tr>
<td>Area</td>
<td>1.5 acre</td>
</tr>
<tr>
<td>Description</td>
<td>Almost entirely wetland (paddy) on steep terrain, 300 m above the Dang chhu. Soils terraced, sandy loam, some large stones but mostly stone free. Soils low in organic matter and fertility. Windy site, one of the only wind turbine sites in Bhutan; strong daily winds beginning late morning and lasting through afternoon. Fields accessible by 2WT.</td>
</tr>
<tr>
<td>Living Situation</td>
<td>Farmhouse of Gup Phurba Namgay and wife. Trainer upstairs with family. Female trainees began the training also with family, then moved into makeshift housing onsite, still separate from the males</td>
</tr>
<tr>
<td>Meals</td>
<td>Trainees began by eating with trainer and hosts; then to cook on their own. Trainer took breakfast himself and with hosts, eventually eating with trainees</td>
</tr>
<tr>
<td>Co-trainer/s</td>
<td>none</td>
</tr>
<tr>
<td>Trainees, male/female</td>
<td>9 male, 7 female</td>
</tr>
<tr>
<td>Trainees, ages</td>
<td>21 - 31</td>
</tr>
<tr>
<td>Trainees, Dzongkhags</td>
<td>Dagana, Trashigang, Tashi Yangste, Mongar, Samtse, Paro, Tsirang, Sarpang, Wangdue Phodrang, Gelaphu</td>
</tr>
<tr>
<td>Key Partners</td>
<td>ARDC-Bajo PD; Wangdue Phodrang Agricultural Development Office</td>
</tr>
<tr>
<td>Table 14. Curriculum Achievements and Activities, Training 2, Rubesa</td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Overview &amp; Introduction</strong></td>
<td>Introductions; group social contract; overview; conflict resolution</td>
</tr>
<tr>
<td><strong>Site &amp; Soil Assessment</strong></td>
<td>Observational skills; collecting site history; testing &amp; on-farm assessment: soil chemistry, pH, biology, physical characteristics; risk &amp; resource assessments: access, water, air, light, fire, vegetation, wildlife, community</td>
</tr>
<tr>
<td><strong>Production Planning &amp; Materials Needs</strong></td>
<td>Mathematics! Estimating seed, potting soil, fertilizer, space needs for seedling and field production; seed and variety selection; markets; season extension; succession sowing</td>
</tr>
<tr>
<td><strong>Nursery Production &amp; Greenhouse Mgmt</strong></td>
<td>Several methods of seedling production; potting soils; cultural practices (water, temperature, air management); attentiveness; troubleshooting</td>
</tr>
<tr>
<td><strong>Soil Fertility Management</strong></td>
<td>Soil-plant relationships; soil health as the key to plant health, pest and disease management, and crop quality, and productivity; integrated fertility management; amendments and fertilizers sources, rates, calculations; how to choose and properly use chemical fertilizers 4Rs+C; building organic matter with carbon-based inputs; organic soil amendments use and production: compost, vermi-compost, making and charging biochar, bokashi, microorganisms; fermented plant juices, cow urine, stone dusts; mulches; crop rotations; GMCCs</td>
</tr>
<tr>
<td><strong>Water &amp; Nutrient Harvesting</strong></td>
<td>Built 2 x water storage ponds, 27,000 l each; water &amp; nutrient flows in an agricultural landscape; managing for long-term productivity; rehydrating landscapes for dry periods; managing water in wet periods; introduction to agro-forestry for nutrient management and vegetable production; field and bed layout</td>
</tr>
<tr>
<td><strong>Irrigation: water sources and basics</strong></td>
<td>Water sources; developing sources</td>
</tr>
<tr>
<td><strong>Irrigation: water distribution</strong></td>
<td>Flood, overhead, and drip irrigation; sizing a system; planning and building a distribution system; installing and using sprinkler and drip systems; installing and using sprinkler and drip systems; gravity flow; booster pumps; install 3 types of available drip irrigation; use of 4 types sprinklers</td>
</tr>
<tr>
<td><strong>Water Management</strong></td>
<td>Water as a shared resource; introduction to management systems &amp; governance; debate and vote on water management structure; formed Water Council of five members: two males, two females, and one Expert-Trainer-Chairman</td>
</tr>
<tr>
<td>Topic</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Field Preparation &amp; Fertilization</td>
<td>Hand-building beds; double-digging for improved root penetration; plastic mulch laying and use; power-tiller built beds; no-bed systems</td>
</tr>
<tr>
<td>Erosion Control</td>
<td>Soil stabilization: used Vetiver grass, Napier grass, and other species to stabilize bare soil made from greenhouse and pond projects</td>
</tr>
<tr>
<td>Weed and Pest Management</td>
<td>Pick-A-Pest and Pick-A-Disease presentations; scouting and monitoring; economic thresholds; IPM; organic and chemical control; pesticide selection by group, use, and safety; traditional weed management methods; plastic mulch; long-handled tools (European and North American); pose question: can we cultivate using power-tillers? what would we need in order to do that? begin experimenting with bed preparation and row marking for cultivation systems</td>
</tr>
<tr>
<td>Harvest</td>
<td>Harvest planning and preparation; several harvests from Phobjikha site as well as Rubesa site</td>
</tr>
<tr>
<td>Post-Harvest Handling &amp; Food Safety</td>
<td>Weighing and recording; food safety; cold storage</td>
</tr>
<tr>
<td>Marketing, Sales, and Distribution</td>
<td>Harvests given to King; sales to trainee mess and weekly at Bajo Sunday market; farmers market practices and strategies; branding and labeling</td>
</tr>
<tr>
<td>Record Keeping</td>
<td>Importance of record keeping; systems for keeping records; practice keeping records for individual plots</td>
</tr>
<tr>
<td>Greenhouse/Polyhouse Construction</td>
<td>Planning and design; site selection and preparation; design and build three greenhouses: 5 m x 20 m greenhouse kit; 4 m x 17 m custom design using locally sourced materials; in-ground greenhouse (walipini)</td>
</tr>
<tr>
<td>Tools and Equipment</td>
<td>The right tool for the job; ergonomics and safety; care and maintenance; hand and long-handled tools; 2-Wheel Tractor training and use</td>
</tr>
<tr>
<td>Trades and craftsmanship</td>
<td>Light carpentry and plumbing; heat plate for waterline joints</td>
</tr>
<tr>
<td>Goal Setting</td>
<td>Personal goals; budgeting living expenses and financial goals</td>
</tr>
<tr>
<td>Enterprise Budgeting</td>
<td>Revenues, variable and fixed expenses</td>
</tr>
<tr>
<td>Business Planning &amp; Next Steps</td>
<td>Capital expenses, labor, overhead, cash flow; template for written business plan</td>
</tr>
<tr>
<td>Integrated Crop-Livestock Systems</td>
<td>How animals can be integrated in diversified farms</td>
</tr>
<tr>
<td>Information Resources</td>
<td>Library of books, catalogues, and magazines from US; shared compilation of online resources; topic: how to find information and resources</td>
</tr>
<tr>
<td>Other</td>
<td>On-farm research (one of four saffron trial sites)</td>
</tr>
<tr>
<td></td>
<td>Introduction to mushroom production; small trial</td>
</tr>
<tr>
<td></td>
<td>Pruning and Grafting</td>
</tr>
</tbody>
</table>
Table 15. Crops Grown, Training 2 & 3, Rubesa

<table>
<thead>
<tr>
<th>Direct Seeded</th>
<th>Transplanted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beans</td>
<td>Broccoli</td>
</tr>
<tr>
<td>Peas</td>
<td>Cabbage</td>
</tr>
<tr>
<td>Carrots</td>
<td>Chinese Cabbage</td>
</tr>
<tr>
<td>Beet root</td>
<td>Cauliflower</td>
</tr>
<tr>
<td>Radishes and Turnips</td>
<td>Garlic</td>
</tr>
<tr>
<td>Spinach</td>
<td>Onions and leeks</td>
</tr>
<tr>
<td>Lettuce and salad crops</td>
<td>Lettuce</td>
</tr>
<tr>
<td>Sag and Asian greens</td>
<td>Sag and Asian greens</td>
</tr>
<tr>
<td>Coriander</td>
<td>Coriander, basil, fennel</td>
</tr>
<tr>
<td>Cucumber</td>
<td>Cucumber</td>
</tr>
<tr>
<td>Zucchini</td>
<td>Zucchini</td>
</tr>
<tr>
<td>Flowers</td>
<td>Flowers</td>
</tr>
<tr>
<td>Insectary plants</td>
<td>Quinoa</td>
</tr>
<tr>
<td></td>
<td>Maize</td>
</tr>
<tr>
<td></td>
<td>Amaranth</td>
</tr>
</tbody>
</table>

Table 16. Cover Crop Trials, Training 2 & 3, Rubesa

<table>
<thead>
<tr>
<th>Cover Crop</th>
<th>Cover Crop Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>Grass</td>
</tr>
<tr>
<td>Millet</td>
<td>Grass</td>
</tr>
<tr>
<td>Mustard</td>
<td>Mustard</td>
</tr>
<tr>
<td>Radish</td>
<td>Mustard</td>
</tr>
<tr>
<td>Sag</td>
<td>Mustard</td>
</tr>
<tr>
<td>Lupine</td>
<td>Legume</td>
</tr>
<tr>
<td>Fava (broad) bean</td>
<td>Legume</td>
</tr>
<tr>
<td>White pole bean</td>
<td>Legume</td>
</tr>
<tr>
<td>Soybean, small</td>
<td>Legume</td>
</tr>
<tr>
<td>Soybean, large</td>
<td>Legume</td>
</tr>
<tr>
<td>Clover, red</td>
<td>Legume</td>
</tr>
<tr>
<td>Buckwheat, sweet</td>
<td>Forb</td>
</tr>
<tr>
<td>Buckwheat, bitter</td>
<td>Forb</td>
</tr>
<tr>
<td>Phacelia</td>
<td>Forb</td>
</tr>
<tr>
<td>Mixtures</td>
<td>Several mixtures</td>
</tr>
</tbody>
</table>
**Field Trips**

National Seed Center, Gangtay/Phobjikha, site of first training. Several trips there.

AMC Bajo

ARDC Bajo: biochar, wood vinegar, and bokashi production; pruning & grafting

FMCL Bajo

FMCL tomato greenhouse, Bajo

National Post-Harvest Center, Paro

FMCL Mega-greenhouse demonstration farm, Paro

National Plant Protection Center, Thimphu

National Soil Services Center, Thimphu

Centenary Farmers Market, Thimphu

Kaja Throm Farmers Markets, Paro and Thimphu

DSP Culinary Arts Kitchen, Thimphu

Private Agri-supply shores: Sherab Enterprises, Karma One-Stop

Local hardware stores

Super FABLAB, Thimphu Technology Park

Aum Damcho's Urban Farm, Thimphu

Arit Drukzay kiwi farm, Punakha

Shangri-La Cold Storage, near Thimphu

National Center for Organic Agriculture, Yusipang

Wangdi dzong

Stakeholders Consultation Workshop on organic fertilizer production and marketing, Gelephu, with two trainees

**Training 3**

Table 17. Site Information, Training 3, Rubesa

<table>
<thead>
<tr>
<th>Location</th>
<th>Rubesa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geowog</td>
<td>Rubesa, near Wangdi dzong</td>
</tr>
<tr>
<td>Dzongkhag</td>
<td>Wangdue Phodrang</td>
</tr>
<tr>
<td>Elevation</td>
<td>1,200 masl</td>
</tr>
<tr>
<td>Precipitation, months</td>
<td></td>
</tr>
<tr>
<td>Temperatures</td>
<td></td>
</tr>
<tr>
<td>Ownership</td>
<td>Gup Phurba Namgay, private owner</td>
</tr>
<tr>
<td>Area</td>
<td>1.5 acre</td>
</tr>
<tr>
<td>Description</td>
<td>Almost entirely wetland (paddy) on steep terrain, 300 m above the Dang Chhu. Soils terraced, sandy loam, some large stones but mostly stone free.</td>
</tr>
<tr>
<td>Living Situation</td>
<td>Private farmhouse. Trainer with hosts. Trainees in barracks.</td>
</tr>
<tr>
<td>Meals</td>
<td>Trainees began by eating with trainer and hosts; then to cook on their own. Trainer took breakfast himself and with hosts, eventually eating with trainees</td>
</tr>
<tr>
<td>Co-trainer/s</td>
<td>none</td>
</tr>
<tr>
<td>Trainees, male/female</td>
<td>5 male, 5 female</td>
</tr>
<tr>
<td>Trainees, ages</td>
<td>21 - 31</td>
</tr>
<tr>
<td>Trainees, Dzongkhags</td>
<td>Dagana, Trashigang, Tashi Yangste, Mongar, Samtse, Paro, Tsirang, Sarpang, Wangdue Phodrang, Gelaphu</td>
</tr>
<tr>
<td>Key Partners</td>
<td>ARDC-Bajo PD; Wangdue Phodrang Ag Dev Office; FMCL</td>
</tr>
</tbody>
</table>