Applied Geography for Sustainable Living

Eye on the World

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Applied Geography Education: the path to a more sustainable future.

SLU Global at the Swedish University of Agricultural Sciences (SLU) and the Swedish International Agriculture Network Initiative (SIANI), with support from the Swedish International Development Cooperation Agency (Sida) organized and held Agri4D. This free online three-day conference brought together researchers, policy makers, and practitioners. The conference aimed to view the current knowledge frontier, connect science to policymaking and practice, and spark new collaborations. They addressed six topics:

Topic 1 - Justice in Food Governance
Topic 2 – Towards Improved Food and Nutrition Security from Smallholder-inclusive Food Systems
Topic 3 – Agroecology
Topic 4 – Closing the loop – making food systems circular
Topic 5 – Innovation & Innovative Approaches
Topic 6 – Build resilience to vulnerabilities, shocks, and stresses

From the conference website:

"More than 800 million people in the world are undernourished, despite the growing scientific knowledge and decades of international aid. Natural resource conflicts, climate change and the COVID-19 pandemic rapidly push more people into poverty and hunger. At the same time, obesity is an increasing health problem in almost all countries in the world. While the majority of existing food systems are drivers of biodiversity loss, greenhouse gas emissions and water insecurity, they also provide livelihoods to a majority of people.

Just and resilient food systems can contribute to all Sustainable Development Goals (SDGs). At this year's Agri4D conference, we ask the participants to specifically address the core question: 'How can we shape sustainable and just food systems resilient to the new realities of changing climates, ongoing transformations in food production, supply and demand, health threats and pandemics?"

Applied Geography for Sustainable Living contends people today are so disconnected from Nature they do not understand their negative environmental impact. This contributes to their inaction.

Some statements appearing in the popular press confuse readers.

How much food is produced by whom? "It is often claimed that smallholder farmers produce 70%

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or even 80% of the world's food. This claim has even been made by the United Nations Food and Agriculture Organization (UN FAO).

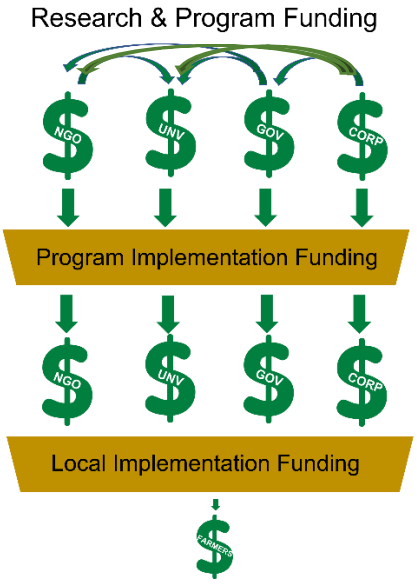
It has been a linchpin for agricultural and development policies. But it is wrong. Recent studies suggest that this figure is too high: smallholder farmers produce around one-third of the world's food, less than half of what these headlines claim.

A key problem is that some use the terms 'family farms' and 'smallholder farms' interchangeably. Family farms do produce around 80% of the world's food. These farms can be of any size and should not be confused with smallholder," says Hannah Ritchie.

[**Note**: At Agri4D 2021, small farms and smallholders were defined as owning/farming 3 hectares or less (>3.7 acres).] Global statistics may be attention grabbing but are of little practical use as the issues of food production, distribution, hunger, and malnutrition are not uniformly distributed over the globe. The complexity is confounded by differences of wealth, access to information, and geo-politics (to mention a few).

How much food is wasted and lost each year? "Roughly one third of the food produced in the world for human consumption every year— approximately 1.3 billion tonnes— gets lost or wasted, according to an FAO-commissioned study. "In the United States, food waste is estimated at between 30–40 percent of the food supply. This figure, based on estimates from USDA's Economic Research Service of 31 percent food loss at the retail and consumer levels, corresponded to approximately 133 billion pounds and $161 billion worth of food in 2010."

The numbers / statistics are confusing because of combining the terms "lost or wasted." In the first statement the 1/3 amount is tallied as "lost or wasted." In the second, they mention "food loss" at the retail and consumer level. Some researchers consider losses as occurring at the production/post-production stages of the food supply chain. Wastes occur at the retail and consumer levels. This leads them to frame the problems and solutions differently. Also, these types of "global" or "total" numbers mask the problems. The factors driving the losses and wastes are not uniform around the world.

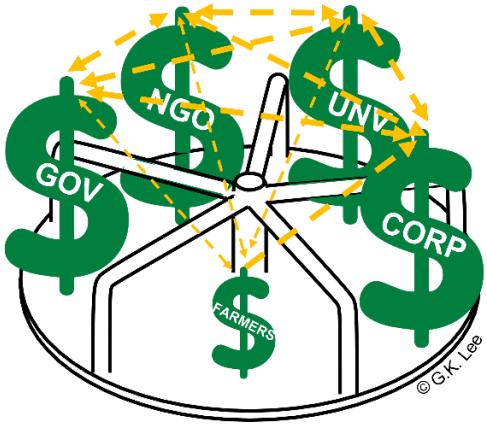


One of the expressed conference goals was to bring science input to bear on policy / decision making. When you consider the decades of warnings from climatologists and epidemiologists and the lack of government and social action, there seems to be little reason for optimism.

From where we sit, the money and power tend to be in urban centers in the hands of a few who are distanced from Nature and small farms. The small food producers are often marginalized, have little to no money and power. They live far from the urban centers with little to no voice in policy or decision making. From my experience in a small rural farming village in Thailand, the diagram on the left shows common money flow paths. Policies and decisions made by the powerful in government and corporations fund research and projects in government, universities, and non-government organizations. Funding for implementation goes

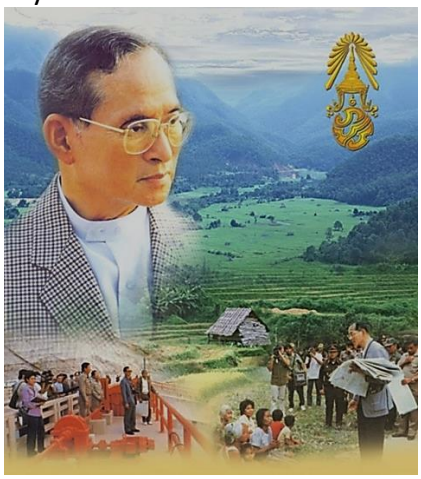
through similar types of groups with very little to small farmers. The questions and laments of many researchers of their difficulty in moving their research results to implementation inspired part of this graphic. Many practitioners expressed frustration at their inability to get funding or access to funding to improve their programs for farmers. [**Editor's Note:** The money flow diagram is our conceptualization and is not based on any hard validated research data.]

Raising small farm income was a common goal for many projects. This usually involved using improved seeds (e.g., seeds promising higher yields, more uniform quality, pest resistance, drought tolerance, etc.) and newer technologies. These tend to involve higher costs. From where we sit, this perpetuates what we call the money-go-round (see diagram on the right). The big money tends to flow between the big four players (Governments, Non-government Organizations, Universities, and Corporations) with smaller amounts going to small Farmers, but more off-farm spending going from small farmers to Corporations.



When small farm income goes up, it is due to planting cash monocrops for export. Chances are their cost of production goes up. This adds to existing debts, and the farmers are still impoverished. Planting, growing, and selling cash crops leaves little land, time, or labor to grow food to feed their families. Planting a cash crop is risky. You cannot predict the harvest. You cannot predict the market price. You cannot predict the costs to get it to market. COVID imposes shortages in farm labor, truck drivers and warehouse workers. The demand for food rises due to retail shortages exacerbated by food not being harvested and getting to markets. Workers are not earning so have less ability to pay for goods and services. It's a downward spiral. In 2002, Clark reported the World Bank, International Monetary Fund (IMF), and World Trade Organization (WTO) have anti-poverty programs in place for many years, yet poverty has increased and not decreased.

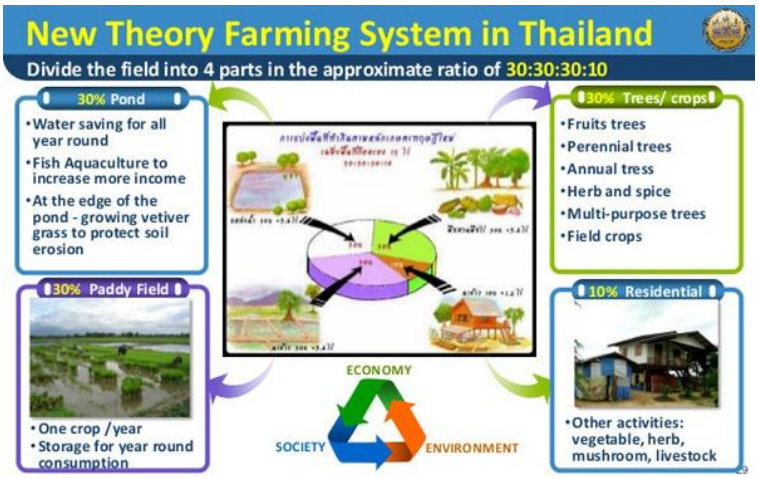
The cash crops tend to be for export. Now some of the small farmers' added income goes to buy imported food which also costs more. When climate change rears its ugly head, the monocrop may lack the genetic diversity to respond to local climate changes. Most programs to increase small farm income only weds them tighter to the money-go-round and a spiraling cycle of debt. The money-go-round favors the big money players. The system pays farmers the lowest possible rate for inputs to a system where others who "add value" make more money.

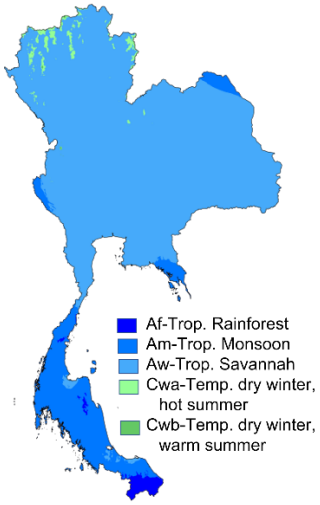


Put Farmers First. The late Thai King Bhumibol Adulyadej proposed the "Sufficiency Economy" for Thailand. This is not a silver bullet. The King cautioned that each farm family had to adapt the model to their circumstances AND to be as "self-sufficient as possible."

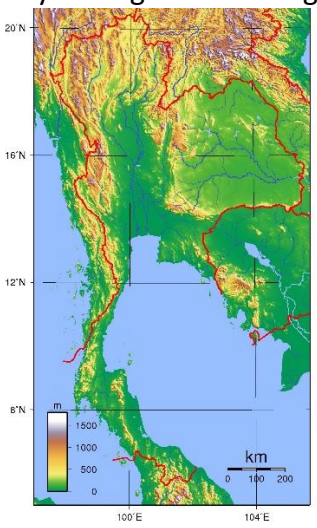
Once small farmers attained food security for their families, surpluses should be sold via local cooperatives to enter the commercial food supply chain. This would increase small farm income by 1) eliminating local farmers competing against each other locally; 2) scaling up local surpluses to sufficient quantities via the cooperative to enter the commercial market. Small farmers would earn more through the co-op than by selling alone. This gets economies of scale work for the small farmers.

The late King Bhumibol Adulyadej traveled throughout the kingdom observing and learning about the conditions of small farmers. The diagram on the right summarizes his ideas for small family farms. Small family farm sufficiency begins with diversity. Diversity of land use (pond, paddy, dry land crops, gardens) and agriculture practices (aquaculture, horticultures, agriculture, and animal husbandry). When small family farms set the priority on food security, the farm has biodiversity reducing the need for agri-chemical pesticides. Many Thai farm families supplement their diets with natural forest products which tend to be native plants. The climate and terrain vary throughout the kingdom (see maps below). The maps suggest it may be possible to adapt the Thai King's method to other lands with similar combinations of climate and terrain.





Köppen-Geiger Map of Thailand, Beck, et al.



Topography of Thailand (0-2,565m AMSL)

F.U.N.D.S. (Funding Farmers Under a No Debt System): The basic plan is consistent with the Thai King's idea of small farm sufficiency. We conceived this idea for the Rural Training Center-Thailand (RTC-TH). It is based on a simple economic idea: It is easier to control the money in your hand as you have no control of the money others may put in your hand. It starts by minimizing or stop spending for off-farm farm inputs of 1) synthetic chemicals, 2) processed feeds, 3) fossil fuels and wood burning, 4) processed hybrid seeds, 5) minimize the use of high-tech machines. These items come from non-local sources. Shipping costs related to fuel prices vary and aren't controlled by farmers. Not buying off the farm keeps money in the family's pocket to 1) pay of existing debt, 2) meet other family expenses (e.g., medical care, education,

Status Quo Farming	F.U.N.D.S.
1) synthetic agri-chemicals	• Comprehensive on-farm recycling of nutrients (CORN) including composting & biochar • Integrated Pest Management (IPM) using local/native species
2) processed feeds	• Grow all livestock feed on farm • Supplement feed with insect protein produced on farm
3) fossil fuels and wood burning	• On-farm Independent Fuel Systems (IFS) • Appropriate / Adaptive technology (e.g., solar, non-food biofuels, micro/pico hydro or wind)
4) processed hybrid seeds	• Native seed collecting • Seed sharing
5) mechanize	• Minimize the use of high-tech machines. • Buy locally made equipment.

items the family needs but cannot produce themselves). Remember, the Thai King said to be as "self-sufficient as possible according to your circumstances." Local bartering should be encouraged before spending money off the farm.

Community-based Education: The speed of change in technology and society is faster than before. And we are now facing climate change, too. Education is a key factor is helping people learn about and adapt to change. Education institutions (schools to universities) are not responding fast enough. Most government institutions are a bureaucratic labyrinth small farmers and small rural communities have great difficulty penetrating.

Rural communities face several challenges brought about by their geography: they are far from the centers of power and money which are key to enjoying the benefits of civilization. The farther away, the fewer benefits they have access to due to: 1) social marginalization (urban – rural divide); 2) poverty; 3) lower quality of education (or little to no chance to get an education); 4) the digital divide (which also limits access to information, education, or remote jobs—if they can afford to buy and have the knowledge to use the technology), to name a few.

Rural communities can take advantage of their circumstances by connecting with researchers and practitioners, but it most likely will start from the outside. Climate change drives interest for research in remote areas. If inhabited at all, these remote areas are often occupied by impoverished, marginalized groups and indigenous people. They tend to live insular lives. Operating on the basis of mutual respect, mutual benefit, outside researchers can use community-based education to 1) improve rural education; 2) access and document indigenous or traditional ecological knowledge (TEK); 3) use community service activities to mobilize local people to help gather observations and data; 4) stimulate local economic development; 5) open the door to higher education for local students.

This is the approach Applied Geography for Sustainable Living will present at the Association of American Geographers 2022 annual meeting. The virtual presentation "Community-based Education to Bring Research Down to Earth: A Concept Paper" is included under the conference theme "Bringing Youth Voices into Community Geography."

The idea is for academic researchers to engage with local schools (elementary to college) to identify local education needs and to incorporate a holistic community-based education program in their research project. By using outdoor, hands-on, interactive, practical examples in place of textbook problems, education is made more relevant and meaningful to students. Aligning the lessons using the GLS Community-based curriculum development model of STEAMING (an enhancement of STEM/STEAM by Integrating Nature and Geography) minimizes or makes it unnecessary to make any changes to a school's curriculum.

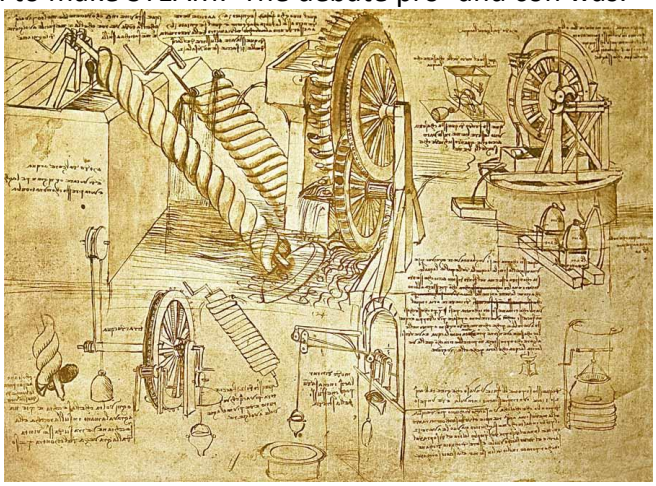
It is uncertain how this will be received in academic circles. This approach is empirically based on more than 20-years of use in the inner city of Los Angeles and rural schools in Thailand.

~~STEM, STEAM~~ → STEAMING!

When I first heard about STEM (Science, Technology, Engineering, and Mathematics), I thought about the "Cold War" (~1947-1991) and Sputnik (1957). There was a national effort to graduate more scientists and engineers than the Russians. I recall my high school years (~early 1960's) having "new" math teaching methods.

Ironically, during WWII, women mathematicians and scientists were hidden from history and rarely acknowledged. They were considered "human computers" using applied mathematics and engineering knowledge and skills in cryptanalysis and ballistics calculations. In the early 60's, a few select women began astronaut training (and were doing well). The program was terminated. But that is another story.

STEM emerged ~2011 as a push to make the US internationally technologically competitive. John Maeda advocated to add Arts to the STEM curriculum to make STEAM. The debate pro- and con was. sometimes heated. But look at the written notes of many inventors, scientists, engineers, etc. and undoubtedly you find sketches, drawings, and diagrams; stark evidence of the "arts." I rest my case.



Sketches from Leonardo da Vinci's notebook.

Applied Geography for Sustainable Living (AppGeog) enhances STEAM by Integrating Nature and Geography. This is implemented through holistic collaborative project-based learning using outdoor community service projects. The projects involve active use of classroom lessons to build a sense of community by focusing on activities to build community emergency preparedness, environmental sustainability, and disaster resilience. Indigenous people and many small family farms live in much closer proximity to Nature than do urban dwellers. With wealth and power concentrated in urban areas, many policies affecting the environment originate here. In many countries, a large segment of the population are farmers. Their lives, the environment, and food producing capacity are negatively impacted by policies in which they have little or no voice in shaping or making.

The importance of "Integrating Nature and Geography" to STEAM is two-fold: 1) to connect people with Nature; and 2) introducing Geography as the fundamental holistic learning template to connect all aspects of human learning activities and knowledge. People living in rural areas live much closer to Nature than do those in the city. The quality of education is lower than in the city. As Sugata Mitra pointed out, in most countries, those who need education the most are impoverished. Teachers don't want to go to teach in those places. Those same places are often the source of trouble.

The table on the right summarizes the general characteristics of STEM, STEAM, and STEAMING. STEM and STEAM can be used outside of formal schools but are most commonly found in schools. STEAMING was intentionally created for outdoor education.

Characteristics	STEM	STEAM	STEAMING
Topics Included	Science	Science	Science
	Technology	Technology	Technology
	Engineering	Engineering	Engineering
	Mathematics	Arts	Arts
		Mathematics	Mathematics
			Integrating
			Nature
			Geography
Location	Traditional schools: Classroom, some outdoors	Traditional schools: Classroom, some outdoors	Non-traditional approach, no formal school needed. (Traditional schools optional): Outdoors, some indoors.
Teachers	Credentials often required	Credentials often required	Community member with knowledge, skills, and who is willing to share
Materials	Textbooks, equipment	Textbooks, equipment	Books (if available); re-purposed, recycled homemade/off-the-shelf equipment
Proof of Learning	Examinations	Examinations	Teach Backs; practical collaborative community service projects

The GLS C-bE STEAMING terms are defined and clarified in the table below.

Oxford Dictionary Definition	GLS C-bE Notes
Science: knowledge about the structure and behavior of the natural and physical world, based on facts that you can prove, for example by experiments.	We use the scientific method of inquiry combine with linear and non-linear systems of logic to guide observations of Nature, the open source for learning.
Technology: scientific knowledge used in practical ways in industry, for example in designing new machines,	We focus on practical ways aimed at sustainability, ecosystem restoration/maintenance, and creating systems compatible with Nature.
Engineering: the activity of applying scientific knowledge to the design, building and control of machines, roads, bridges, electrical equipment, etc.	We focus on applied engineering projects to build local environmental, agricultural sustainability and increased disaster mitigation and resilience.
Arts: the use of the imagination to express ideas or feelings, particularly in painting, drawing or sculpture.	We use of all arts, language, performing, graphics, etc. to support education for environmental awareness, sustainability, and emergency preparedness, prevention, mitigation, resilience, and economic development.
Mathematics the science of numbers and shapes.	We emphasize mathematics as a systematic method to document observations with measurements used throughout the other STEAMING components.
Integrating to combine two or more things so that they work together; to combine with something else in this way.	We abolish the segmented teaching of subjects, but simultaneously integrate them in outdoor, interactive, hands-on project-based lessons aimed at building local community environmental sustainability, disaster preparedness and resilience.
Nature: all the plants, animals and things that exist in the universe that are not made by people.	Nature is the ultimate, freely accessible library and learning resource world-wide.
Geography: the scientific study of the earth's surface, physical features, divisions, products, population, etc.	We use the Geographic Systems Model to simultaneously integrate all life, physical, and social sciences to study and explain the distribution and interrelationship of phenomena on Earth.

This C-bE approach has been field tested and proven in two different situations: inner city urban Los Angeles and rural northern Thailand. The focus in Los Angeles was to give inner city youth an opportunity to visit and do community service in local area natural parks (e.g., county, state, and National Parks) with lessons and skills linked to entry level jobs in the parks. In this effort, we integrated community college student volunteers trained as outdoor youth leaders to assist in training inner city high school students. This was a teach back for the college students. It also allowed college and high school students to engage and discuss post-secondary education opportunities and experiences as many of the inner-city youth had no family members who had gone to college. The photo (below left) shows college and high school student volunteers conducting a GPS survey in a US National Park. A weekend volunteer activity of college and high school students teaching back field survey methods to parents and siblings.

Learning to use a GPS unit to conduct mapping surveys in a National Park.

Inner city high school students teaching back to their families (parents and siblings) and friends

The same C-bE approach was adapted to sustainable agriculture training in rural northern Thailand with an English language training component. Additionally, the program served as a pilot program, the Rural Environmental Education Enhancement Pilot Program (abbreviated as REEEPP, which sounds like reap, alluding to the metaphor of sowing seeds of education to reap the next generation of environmental stewards for protecting biodiversity and advancing sustainable agricultural practices for small rural family farms).

American geography and community volunteers teaching Thai elementary school students to make compost

Thai elementary students teaching back to classmates an applied math exercise to map the school sports field.

Student interest was high, and teachers were pleasantly surprised the low academic achievers were keen to teach back and showed greater interest and ability in contrast to when in a classroom.

Students self-reported having more fun and felt more comfortable learning without anxiety about taking written exams.

A holistic learning experience is closer to regular daily life. For example, if you are in the kitchen helping to prepare a meal, the parent talks about a wide variety of topics in an integrated way. They don't segment the meal preparation into math, language, chemistry, mechanics, etc. The meal preparation instructions involve an integration of verbal, written, and sometimes demonstrated instructions. Measurements can be in precise units or "add a pinch of salt" without separate breakout chemistry or physics lessons.

Collaborative learning is sometimes considered "cheating" in some schools, but in the workplace, it is called teamwork. While some teachers frown on open note/open book exams, most employers have no trouble for workers to consult reference books and notes to assure the job is done correctly. Collaborative work helps hone interpersonal communications. Think about the 1999 loss of the $125 million Mars Climate Orbiter due to a miscommunication between two groups of engineers. One group used English measurements while the other group used metric. Both assumed they were using the same measurement system but never talked with each other to confirm the work they were doing.

STEAMING combined fun collaborative learning to create a environment that simultaneously fostered acquisition and development of both hard and soft skills. Holistic education provided a durable foundation for students.

The Path from Learning to Earning

Pathway from Learning to Earning

1. **Know Yourself:** Identify your true interests.
2. **IT-IS Survey:** Know the relevant technologies matching your interests.
3. **SCANS Lists:** Use the SCANS lists to a) inventory yourself; b) your volunteer activities; c) your job; d) your courses; e) job descriptions of interest.
4. **Study Major:** Your curiosity (from #1-#3) should guide your studies.
5. **Network:** Make contacts aligned with your interests and studies.
6. ***Job Hunt:*** *Find a job that naturally fits you, not a job that you try to fit.*

We advocate the purpose of an education is to develop your mind through critical thinking to make effective decisions and to be a life-long learner to navigate life and adapt to changes. Education can lead to a good paying job. But money is not the primary goal. Being a good decent human being, to do no harm to others, to care and share with others are the higher goals of life.

In order to care and share with others, you need to be in a position to do so. That can mean a number of different things to each person. The basic requisite is to meet your basic survival needs of adequate water, food, shelter, and security.

To attain that basic level of comfort, we suggest people know themselves and find employment doing what they truly love to do. The litmus test for this is simple: you would do that activity whether you were paid or not. So, if you would do it for no pay, BUT they pay you, then your job is NOT work; it's what you love to do anyway.

The diagram shows the steps to finding your dream job. The details are available in the paper "Personal Guide to Go from Learning to Earning." If you are a teacher, please see our paper "Putting the Earn Into Learn: Preparing Students for Work."

All GLS Community-based Education projects incorporate these ideas. Students should become viable community members to make their communities sustainable and resilient.