

Demystifying Soybean Production and Marketing: Our Experience in Laos

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Editor: Between 1997 and 2009, Kirby Rogers worked as part of a team to establish an agriculture-based business called Natural Products (NPI) in Bokeo, Laos. Much of this effort involved promoting soybean as a local cash crop as well as developing related milling and marketing channels. During the 2011 ECHO Asia Agriculture and Community Development Conference, Kirby provided a plenary presentation titled, "Business-Based Development and Completing Broken Economic Chains in Developing Countries." Information from that presentation is shared here.

In this article, I do not want to give a "wiki history" of the soybean plant, nor a science-based explanation of its properties, nor an economic review of soybean markets. Instead, I will share a more personal look at this plant and how it has directly impacted the lives of many Lao people.

Since this story concerns agricultural development as well, I want to introduce some of the strategies we learned while introducing soybean production to remote locations within Laos. However, I will start at the ending. There are now scores of villages planting soybeans in several locations across northern Laos, producing thousands of tons of soy per year.

Three crucial objectives related to crop introduction

My development philosophy related to crop introduction that was formed during this time can be summarized in these three key objectives: 1) market-driven development; 2) value-added processing; and 3) in-country production....from the start.



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Dry season soybean growing in rice paddy

Whenever I consider a potential new crop, I use the previous mantra as a filter and to help answer the following basic questions: Is there an easy market for the crop? Might it be profitable enough to be interesting to the farmer? How many uses does the crop have in society? Can it be used for personal use? Can value be added within the country of production, or is it generally going to be sold as a raw commodity? The more thoroughly these questions can be answered, the easier will be the introduction of a new plant into an agricultural system.

Other things that need to be considered when trying to establish a new crop in a society relate to the production side. These issues include seed sourcing, how the new crop fits into the current agriculture system, ease of weed control, plant care (including application of water and nutrients), drying of products, and storage and quality control issues, as well as how to sell the crop. This brings us back to the three previously stated objectives related to crop introduction:

Crop introduction should be market driven – Before the introduction of a new crop, first and foremost there must be a market through which to sell the harvest. Many plants grow well, but unless there is a market for the product, no one will plant that crop again after the first harvest. In the case of soybeans in northern Laos, Vietnamese, Chinese and Thai traders were competing to market the crop abroad. Their competition drove up the price as well as the farmers' interest to plant soybeans. On a small scale, there already existed a domestic market in Laos that was quickly filled. Restaurant people would buy soybeans to sprout for traditional soups.

The tofu and soymilk sellers would also buy and store soybeans for their yearly needs. As a side note, these people were willing to pay several times more per kilo than the foreign bulk buyers because they had a very lucrative market for their products.

Value-added crops are a plus – Soybeans are easily value-added at either a household or industrial level. Globally, there exists a huge industry for soy oil and meal production. And in Asia, soybeans are value-added and used in many ways at the local level: sprouted and grilled, or made into a soy sauce, soy milk and tofu. So there is a well-established, nearly insatiable food and feed market for soy.

Aim for in-country processing – The vast majority of Laos' soybean crop ends



up in foreign countries with the product re-imported as soy sauce, cooking oil and animal feed. However, I hope someday to produce Lao cooking oil and use the soy meal domestically as a protein source in animal feed.

Again, I am focusing on marketing because it is a very important part of development. The market is the driving force for acceptance of the crop in a society's agricultural system. If there is not a profit-driven reason to plant a cash crop, more than likely the crop will not be widely accepted. Fortunately, within Laos, soybean easily meets objectives related to market demand as well as adding value and in-country processing. Just as important, its biological characteristics help make soybean a suitable crop for the region.

Soybean: A versatile crop

Soybeans are not only marketable, but versatile, able to adapt to a changing environment. Most plants will respond to outside influences like water availability, sunlight and nutrient competition. But due to their photosensitivity, soybeans might be considered more proactive in their approach by modifying themselves to

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Soy milling facility in Laos

match their environment, even more so than day neutral crops like buckwheat and certain varieties of rice. Day neutral plants flower after attaining a particular development stage or age, or due to environmental stimuli such as exposure to certain temperatures.

However, because soybeans are photosensitive, they will adapt themselves to better match their environment according to night length. If a soy plant of a determinate variety senses that night length is increasing, it will essentially hurry through its vegetative stage so that it can get to the seed-producing stage more quickly. On the other hand, if night length is decreasing, a determinate soy plant will extend the vegetative state; thereby growing larger. So the plant height of the same variety of soybean can differ greatly according to date of planting.

This ability of soybean can be used to a farmer's advantage. Some who want to maximize total crop yield (both biomass and seed) would plant during periods of decreasing night length. But those who plant their soybeans during periods of increasing night length, before the start of a cold season, will harvest a lesser yield but higher quality seed. Soybean's photosensitivity also affects seeding requirements. For example, since the individual plant size will be smaller during periods of increasing night length, you may choose to plant more seeds per area [Ed: For reference, a reported rate of soybean seed planted in the Chiang Mai province of Thailand is 16.4 kg/rai or 102.2 kg/ha or 91.2 lb/acre].

Another aspect of soybean photosensitivity means that each variety is adapted to a specific night length that relates directly to its time of flowering and setting seed. Therefore soybean seeds of particular varieties cannot easily be transported and planted too far across the north-south gradient without essentially "confusing" the plant, causing the crop to flower at the wrong time. However, soybean varieties can be moved and planted almost anywhere in an east-west direction along roughly the same latitude [Ed: For this reason, the ECHO Asia Seed Bank does not offer soybean varieties, as it would be very difficult to stock suitable types for the wide range of latitudes in the region].

Like many other legumes, soybeans fix nitrogen for their own use, having the ability to create nodules on their roots that host a nitrogen-fixing bacteria called *Rhizobium japonicum*. In a symbiotic relationship, the bacteria get a nice oxygen-free environment along with plenty of nutrients and the soybean plants benefit from the excess nitrogen that the bacteria give off. So soybeans create their own nitrogen source in a nitrogen-limiting system. This nitrogen-producing ability has uses related to fertilization rates and crop rotations. For instance, we found that soybeans planted in dry season paddy fields increased yields in the following rice crop by more than 10 percent [Ed: Under good conditions, soybean can fix at least 100 kg N/ha or 89 lbs. N/acre]. Soybeans also enhance soil tilth, causing the soil to be much more workable following the bean crop. Farmers comment on how easy it is to till the soil after raising a crop of soybeans.

It may be necessary to inoculate (i.e. introduce the necessary strain of nitrogen-fixing bacteria) when introducing soybeans into a new area. However, we have found that wherever we have introduced soybeans, there were already natural bacteria present for the soy plants to use. To check whether or not soybeans have been "infected" by the beneficial bacteria, simply pull up a mature plant to see if nodules have formed on the roots. If nodules are found, cut a nodule open to see whether its interior is red. If the interior is red, then it is producing nitrogen.

Soybeans are good competitors against weeds in their quest for sunlight. If the rate of planting is correct [Ed: Soybean planting distances may range from 30 to 75 cm (12-30 in.) between rows and 20 to 30 cm (8-12 in.) between hills], then it is necessary to weed soybeans only once during the season. But if soil preparation is done correctly, it often is not necessary to weed even once. We found that our best results for weed control in a paddy field resulted when we retained the residual rice cover and planted into the straw and stubble. This slowed the weeds and gave the soybeans a head start. If the soybeans are given enough head start, they can shade out the other plants (the straw and stubble offered another benefit as well, as explained in the next paragraph). One way to verify the correct rate of planting is to check that when the soybean plants reach maturity, only about 3-5 percent of the sunlight will reach the ground. This is because the big horizontal leaves of the soybeans will capture most of the sunlight.

Soybeans have some insect pests, the most challenging being the soybean stem fly (*Melanagromyza sojae*). The soybean stem fly lays eggs in the stem of the soy plant. After hatching, the fly larva eats the center of the plant. If adult flies find the soybean plant when it is still young and small, their larvae can eat enough of the inside of the stem to stunt the plant or even to kill it. I think planting soybean in rice stubble helps to hide young plants long enough to give them a head start on the flies. Some other soybean pests exist, but none with the potential to cause as much damage as the soybean stem fly.

Soybeans can be threshed by hand. We know farmers who thresh seeds from the pods with a stick and then winnow with a large, wide flat basket. They can prepare hundreds of kilograms of seed this way. Alternatively, the same beater-arm type threshers that the farmers use for their rice can also be used for soybeans.

Sourcing soybean seed can be difficult, especially if an area has never grown soybean before. There are businesses abroad that sell soybeans that are adapted to certain latitudes and climates, but their services can be expensive. For a cheaper source, look for other soybean producers or seed retailers in nearby areas with more developed markets, in roughly the same latitude and climate as your own.

Soybean seed can be saved, since plants are self-pollinated, enabling the variety to stay true. There are several tricks to saving seed in tropical environments. First, dry the soybean to be used as seed in the shade; usually two or three days of shade drying are enough. Growers should be aware that soybeans can be infected with purple seed stain disease, caused by the fungus *Cercospora kikuchii*. Infected soybean can be eaten, but should not be used for seed as the fungus affects germination. Any purple seeds must be selected out by hand. [Ed: With regard to the prevention of purple seed stain disease, the University of Florida recommends the following practices: 1) use disease-free seed; 2) use crop rotation with grass crops; 3) plow under crop residues; 4) control weeds, which increase moisture retention on leaves; 5) use a seed treatment, as it can reduce inoculum of several seed-borne diseases; 6) use resistant varieties where available; 7) seed treatment fungicide use is recommended for seed lots with a high percentage of infected seed; 8) harvest soybeans as soon as they mature, since leaving soybeans in the field beyond maturity results in a poorer quality bean or seed and can be counterproductive to other control measures used earlier].

Once you have selected your seed stock store the seeds in a cool, dry place. Also, try to keep insects away. Some people use insecticide-dipped cloth to store their seeds. I have also heard of people sealing metal canisters with wax to make them air tight. In Laos, as we can plant soybean during two seasons a year, we essentially keep the crop continually in production, allowing for regular access to new seed.

In the areas where we introduced soybeans, some hill tribes had historically planted soybeans for their own use. The entrepreneurs saw an opportunity and started producing soybean seeds in the hill fields during the rainy season to sell to the lowland paddy farmers to plant in their irrigated fields during the dry season. Their marketing efforts ruined my seed sales, but they are still producing seed soybeans to this day.

Along those lines, any new crop has to fit into the farmers' current agriculture system. Planting, harvesting or other labor-intensive work related to the new crop cannot come at the same time as other main crops. However, if farmers are already familiar with crops similar to the new crop, introduction of the new crop will be easier. Usually, there are a few entrepreneurs in every group who are willing to take a chance on a new idea. It will be these individuals who will help lead the others towards accepting a new crop.

In our context, soybeans normally cannot yield as much profit per area as corn. So unless other factors come into play, such as improved soil fertility, soybeans will be relegated to marginal ground or seasons when and/or where corn cannot be planted. Such areas include paddy fields where there is not enough water for either dry season rice or corn. However, there is usually enough water for a dry season soybean crop. Dry season soybean in the paddy fields offers a great rotation; a legume crop following a grass crop. Some of the Lao soy farmers have not used extra fertilizers of any kind, although others have supplemented with green manures and chemical fertilizers. Thus far, we have observed no nutrient mining in the more than 10 years that the farmers have used this system.

Some hill tribe farmers started planting soybeans instead of more lucrative opium and corn, for a couple of reasons. One farmer was tired of walking all day to his hidden, remote opium fields so he decided to plant legal soybeans instead of illegal opium. He also chose soybeans over corn, even though he had previously earned somewhat more from his corn crop. Because soybeans were actually worth more per kilogram than corn, he reasoned that for the same income, he did not have to carry as many bags of soy from the mountain fields as corn.

I will close with two main points summarizing our promotion of soybean as a cash crop in Laos:

1. Soybeans are an adaptive crop, and you will need to understand many variables in their growth pattern before you can gain maximum yields.
2. A market-driven system seems to be a self-motivating system. It did not take a lot of convincing to begin soybean production in the areas we selected. Once the farmers knew the crop, the market and the amount of inputs (cost and labor), they just needed to decide if it was worth their effort.

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