Assessment of Multi-species Fodder Bank Cropping Systems to Improve on Farm Protein Production, Food Security, and Ecological Resilience

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Livestock are an integral component of small- and medium-scale farms in many countries around the world for both subsistence purposes and as a means for income. In places where land is too marginal, steep, or exposed, or where climatic conditions don’t otherwise allow the production of other cash crops, livestock such as cattle, pigs, and chickens can be an important source of both food and income. However, the nutritional requirements of these animals often cannot be met by the available marginal pastures. Typically, farmers purchase bags of concentrated animal feed which include grain, protein, and various necessary minerals and nutrients. This feed can create a substantial financial burden on families living on extremely small margins. Situations are not uncommon where the price of feed matches or outpaces the final live weight value of the animal being sent to market. This can lead to pastures being over utilized, eroded, and compacted. This can lead to further deforestation in an effort to create more available pasture, which in time can also be compromised and lose productivity. Likewise animals can suffer from imbalanced diets and malnutrition.

Conversely integrated diversified farming systems that appropriately manage livestock can be regenerative for soil processes and highly productive while healthy for the animals. Strategies to produce a tighter, more efficient on-farm nutrient cycle and reduce off-farm inputs vary from composting, vermi-composting (worm castings), biodigestors, and various different agroforestry practices such as silva-pastoral systems, alley crops, live fences, and fodder banks. Many of these practices are complimentary and overlap somewhat in principle, if not practice. The focus of this investigation was specifically on the use of tree and shrub species as fodder.

But what is a fodder crop? Fodder is any food that is fed to an animal, as opposed to forage which is food that the animal goes out and finds on its own (such as grass in a pasture). Fodder banks are areas devoted to the production of high quality, nutrient-dense animal fodder. They vary from single strata monocultures to multi -strata diverse systems. The reasons for cultivating them vary somewhat from farm to farm and climate to climate. In tropical regions where there is a long and distinct dry season these fodder banks can produce feed in times when there otherwise isn’t any. In some cases, farmers are using them simply to reduce the amount of feed concentrate they have to purchase. Other farmers have completely eliminated the use of feed concentrate by substituting it entirely with a diverse mix of fodder crops. Often fodder crops are trees and shrubs which are cut back after short durations (one to three months) to ground level, knee height, or sometimes even higher. They can be nitrogen fixers such as many of the trees in the legume family. They can also be other fast growing, easily regenerating, and often highly nutritious species.

In the course of this preliminary investigation I attempted to locate several different farms using fodder cropping methods that varied in soil quality, altitude, and production parameters in both Colombia and Costa Rica. These countries were chosen as I am familiar with Colombia and have contacts there who were able to guide me to likely locations. Also, Costa Rica is the home of CATIE, the Central American Tropical Agricultural Research Center, which was an excellent springboard for finding farms utilizing fodder cropping techniques.

One species I was particularly interested in delving into is white mulberry (Morus alba). This plant, of all the fodder crops commonly utilized in the tropics has the very unique attribute of also being cold hardy in temperate climates such as we have in North America. I have worked with many varieties of this species in previous research in the northeastern U.S. and know it to be an outstandingly productive tree in a wide variety of conditions. For these reasons and the fact that its leaves contain very large ratios of protein (20-24 percent), it is the cornerstone of the longstanding Asian silkworm industry. In fact, this is largely why it was introduced to North and South America many years ago. Although no silkworm industries ever truly prospered on either of these continents, the plant was readily adopted as an excellent fodder crop in the tropics. The same, paradoxically, cannot be said for North America. White mulberry, the native red mulberry (Morus rubra), and their genetically crossed hybrids have not been utilized to any real degree as a fodder crop in the United States. Why this is true is one lingering question that I was hoping to perhaps gain some clarity on while in South America. In fact we have no real tradition of utilizing any trees as short rotation coppices for fodder biomass the way both Europeans and farmers in many paleo and neo-tropical countries have done for centuries.

In an effort to survey different types of fodder cropping systems in Costa Rica and Colombia I visited seven farms, four in Colombia and three in Costa Rica. Provided below is a chart giving some of the quick stats on the different farms. There were several clear take-home messages from this survey. Firstly, not a lot of farms are widely adopting fodder banks as a form of system resiliency building, food security, and insulation from market volatility. The reasons for this remain unclear but it seems likely that there are initial economic hurdles to establishing them, there are questions regarding labor costs, there is a lack of clear systemic information regarding how to manage them, and there is cultural bias against planting trees in pastures. Secondly, many of the farms which have adopted fodder banking as a strategy are utilizing many of the same species such as mulberry, nacadero, and boton de oro. However, the methods for use, management, and cultivation vary quite a bit. For instance Cien Años is using mulberry exclusively as a cut and carry fodder grown under quite heavy forest canopy, while they are using boton de oro as a direct forage in situ in the pastures. Nowhere else did I see boton being used that way, although all the other farms are using it as a cut-and-carry.

There is also a variety of opinions on “the best” fodder crops. Climate and soil conditions are a couple of the key factors in decision making. Mulberry provides a very high quality fodder and is fairly shade tolerant but requires good fertilization and a bit more time to regenerate (about 60 days versus 35-50 for boton). Nacadero requires more time than either of the other two but is more shade tolerant. Boton is more forgiving of low pH soils and is very fast to regenerate but provides a less nutritious fodder than mulberry or nacadero. It seems that personal preference plays a role as well. The two different farms in the Turrialba area of Costa Rica at roughly the same altitude are focusing on two different species. Loma Bonita is very focused on mulberry with 11 ha of it currently in production (far more than any other fodder cropping system I have seen to date). Finca Integral de Guayabo is much more focused on nacadero. However they both, as do all of the farms visited except one, value diversity and are not planting monocultures of any one fodder crop. The one farm which is doing so had a range of these typical fodder crops but has removed them and moved to a system utilizing only one cut-and-carry fodder grass to compliment the small grazing paddocks and the stack of feed concentrate bags in the barn. The reasons given for abandoning the polyculture fodder bank were that it was not producing enough biomass/area. However, this farm is attempting to raise more than 30 cows on less than 5 hectares. Clearly, fodder banks, like any system, have their limits. Outlining just what those limits are will be vital for appropriate management strategies to be developed and for successful further adoption of the systems by other farmers.

What remains to be seen, and fodder (so to speak) for further research is:

* + the extent to which labor and input costs change with such a system
	+ the change in life cycle footprint of reducing purchased feed and increasing on farm fodder production
	+ impacts on soil carbon storage
	+ impacts on whole farm system biodiversity
	+ impacts on animal health (I was told anecdotally, for example, that the cattle fed high protein forage have much fewer problems with garapata insects)
	+ the requisite agroecological management skills necessary in order to optimize a fodder bank cut and carry system
	+ potential geographic extent to which multi-species fodder crops can play a role in diversifying agroecological landscapes
	+ the reasons for adoption or non-adoption of this system by neighboring farms.

This last one is perhaps the question which overarches all the others. Under what conditions and parameters is it worth it for a farmer to adopt such a system? Under what parameters would it be worth it (economically and ecologically) and yet the farmer still wouldn’t adopt such as system? What are the social mechanisms that would help advance adoption? Difficulties in studying these systems, like any diverse system, arise in the complexity of having polycultures be utilized non-uniformly across heterogeneous landscapes. However, that they are being utilized successfully in such a way highlights their flexibility as agroecological systems and their value as components of building agroecological resilience.

