

Chicken-bamboo farming in Southern China

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Agroforestry systems are being promoted in many developing countries as they provide timber, poles for construction, and fuel wood, while at the same time they have the potential to protect the soil from erosion and improve its fertility. However, many agroforestry systems are very much focused on the vegetative component, excluding the potential interaction with livestock and the interests of the farmer. This article describes a recently developed agroforestry system with an animal component, situated in a hilly region of Southern China. The system is analysed and the economic, social and ecological benefits are highlighted.



Photo: L. Jianbo

In the chicken-bamboo system the chickens are allowed to roam freely during part of the day.

Integrating forestry and livestock

Large parts of the hilly areas in Southern China are planted with bamboo forests. These forests help to enhance soil and water conservation and provide economic benefits from the sale of bamboo poles and edible bamboo shoots. Many farmers in Southern China own chickens and they usually let the animals roam in the open, for example in vegetable gardens, orchards, and grasslands. Usually farmers keep only small numbers of chickens. Recently the demand for chicken meat from free-roaming animals has increased and market prices have risen. This has provided the farmers with an incentive to increase the number of chickens and try to raise them in the forest areas. Interested farmers received assistance from scientists in technical matters, e.g. breed selection and disease control and together they made a plan of action, which resulted in an innovative system that combines chicken rearing with bamboo growing. Together with

interested farmers, scientists of the Agro-Ecology Institute of Zhejiang University and the Agricultural Bureau of Chunan county, Zhejiang Province, have set up a small number of pilot farms to study the chicken-bamboo system and develop it further.

One of the pilot farms belongs to Mr Hong Zhiwen, who was contacted through a local agricultural extension office. His bamboo farm is located in a watershed in Zhejiang province, an area with a semi-humid sub-tropical climate, with an average annual temperature of 17 °C, mean annual rainfall of 1430 mm, and an average relative humidity of 75 percent. His farm, about 1.7 ha, is covered mainly with redsheath bamboo (*Phyllostachys incarnate*), early garden bamboo (*Phyllostachys propinqua*) and Mao bamboo (*Phyllostachys heterocyda*). In 2000 Mr Hong obtained a bank loan to purchase chickens, and at present he owns about 20 groups of 300 - 500 chickens each, which are allowed to roam in turns in the bamboo forest.

Building and managing the system

Before buying the chickens, Mr Hong built four poultry houses on his farm, each with a size of 200 m², and situated in a quiet, well-aerated area protected from wind, rain and predators. When constructing the poultry houses, care was taken to keep them simple and cheap. The 1.8-metre walls were built with soil or bamboo, and the roofs covered with couch grass. The floors of the poultry houses were raised and made of bamboo rods that facilitate easy management. Newly-hatched chicks were bought and allowed to range freely in the field when they reached 25 days of age in summer, 40 days in spring and autumn, and about 50 days in winter. The chickens are divided in groups and allowed to range in turns. This is done to avoid overcrowding, which can damage the ground cover and cause soil erosion. Special care is taken not to expose chickens to rapid weather fluctuations which may cause sickness. Very hot conditions during summer are also avoided by releasing the chickens in the early morning. Mr Hong feeds his chickens twice a day, providing them with a ration of maize grains, paddy and soybean before their discharge in the morning and another in the evening. When they are in the bamboo forest, the chickens feed on grass, weeds, insects and earthworms.

Mr Hong has not made major changes in the management of his bamboo plants since he introduced the chickens. He keeps his bamboo in good health and maintains a density of 1.5 - 3 bamboo plants per square metre. However, as part of the chicken-bamboo agroforestry system, Mr Hong introduced specific forage crops which are randomly planted in the bamboo forest. They include clover (*Trifolium* spp.), alfalfa (*Medicago sativa*) and a number of cruciferous plant species (belonging to the cabbage and mustard family). He also decided to carry out soil and water management practices by planting along contour lines, establishing vegetation along the stream to retain the soil and building a dam to obtain a water reservoir.

The animal and plant components in the system are complementary. The chickens feed on insects, weeds, grasses and forage crops. Chicken excreta are directly deposited in the forest, making the soil more fertile which benefits the plants in the system. The bamboo and the vegetation cover supplied by the clover, alfalfa and cruciferous plants enhance the conservation of the soil and contribute to water conservation.

Table 1. Inputs and outputs of the chicken-bamboo farm during 2000 - 2002 (US\$/ha)

	2000	2001	2002
Basic input			
- Poultry house	740	740	370
- Land preparation	990	494	
Bamboo input			
- Labour	49	74	99
Chicken input			
- Young chicks	990	2175	2965
- Feed	4942	10873	14827
- Labour	1483	1483	1483
Total input	9194	15839	19744
Outputs			
- Bamboo	670	1074	1236
- Chicken	10503	23106	31508
Total outputs	11173	24180	32744
Net outputs	1979	8341	13000
Benefit/cost ratio	1.21	1.53	1.66

The cost of the forage crop inputs are negligible; costs of health care of chickens (vaccines) are included in cost of young chicks.

Analysis of the system

The design of the chicken-bamboo farming system leads to a complementary and multi-level utilization of resources. The system produces bamboo, bamboo shoots and chicken meat, while improving or maintaining the soil fertility and preventing water and soil erosion, thus achieving significant social, economic and ecological benefits.

Economic benefits

The average annual income from bamboo grown with minimal management before the introduction of the chickens was estimated to be less than 10 000 Chinese Yuan per hectare (approximately US\$1 240). Table 1 shows that the net income obtained from the chicken-bamboo farm is well above the income from the production of bamboo before the introduction of the chickens. It also shows an increasing trend over three consecutive years. The output/input ratio also increased during the period. The net income per chicken was calculated to be approximately US\$0.70.

Ecological benefits

Animal and plant production systems that were originally separate have been integrated in the chicken - bamboo system, allowing for better nutrient recycling. The chicken excreta enriches the soil of the bamboo plantation. The chickens also loosen up the soil surface while searching for food. This enhances the decomposition of organic matter and increases the amount of available nutrients in the soil. Soil analysis showed that the content of nitrogen, phosphorus and potassium significantly increased, even though no fertilizers have been used. The analysis

also showed that the organic matter content of the soil increased by approximately 70 percent, while the number of earthworms is now more than three times greater than before chickens were introduced into the system. Total earthworm mass also increased (Table 2). Soil erosion is kept in control because of the soil conservation measures that have been taken.

Social benefits

By introducing an animal component into the bamboo forest system the land is used more efficiently, allowing farmers to harvest plant and animal products from the same land. Since the animal and plant components are complementary they also produce better as compared to systems based only on bamboo or chickens. The system is more intensive and requires continuous and higher labour inputs during the whole year. This is a positive development because it allows for increasing employment opportunities for growing numbers of unemployed people in the rural areas. At present, the diets of those living in China's countryside are still lacking in animal protein, and the quality of the available meat may be low because of poor treatment of the animals. Breeding chickens in the bamboo forest increases the availability of good quality meat. The chickens roam freely and receive nutritious feed supplements consisting of a variety of grains.

Conclusion

This experience shows that small animals can be successfully introduced into agroforestry systems and that there are many advantages to this. Farmers can reap substantial economic benefits that will be a very important incentive to adopt such systems. The chicken-bamboo system is feasible for big and small-scale farmers alike.

The chicken-bamboo system is evolving and there is room for improvements. One of the components worth studying is earthworms. Active breeding of earthworms to develop a chicken-bamboo-forage-earthworm system might carry additional ecological and economic benefits, but this practice needs to be studied in detail. There should be active involvement of the farmers when developing such technological innovations and improved production systems in order to guarantee that they correspond to the farmers' needs.

Continued institutional support of farmers is required to achieve wider implementation of the chicken-bamboo system. One area which requires attention is the development of an efficient marketing system for chicken meat. Market demand for chicken meat exists, but farmers face difficulties in selling their produce. The support of local governments and farmer organizations is required to improve this situation. ■

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Table 2. Comparison of soil characteristics before and after the introduction of the chicken-bamboo system

	Sample depth (cm)	Organic matter (%)	Total nitrogen (%)	Total phosphorus (%)	Total potassium (%)	Amount of earthworms (worms/m ²)	Earthworm mass (g/m ²)
1999	0-15	1.54	0.122	0.067	0.95	88.9	71.93
2002	0-15	2.62	0.171	0.129	1.92	279.7	187.37