

PROJECT SUMMARY

TITLE OF PROJECT: Farmer-centred agroforestry research and development in eastern China: methods for optimising tree spatial arrangement and fodder value.

R NUMBER: R5398

RNRRS PROGRAMME: Forestry

PROGRAMME MANAGER: OFI

SUB-CONTRACTOR: Silsoe College

RNRRS PROGRAMME PURPOSE: The use of trees within farming systems, including community and farm woodlots, optimised.

RNRRS PRODUCTION SYSTEM: Semi arid

COMMODITY BASE: Tree fodder, sawn timber

BENEFICIARIES: Resource-poor farmers

TARGET INSTITUTIONS: Chinese Academy of Forestry, research and extension departments.

GEOGRAPHIC FOCUS: China

START DATE: 01/11/1992 **FINISH DATE:** 31/03/1996

TOTAL COST: £232,496

1. Project purpose:

Under the pre-1978 "collective" agricultural system in China, official encouragement for farmers to plant paulownia (mainly *Paulownia elongata*) led to the species being adopted for agroforestry over some 2 million hectares of the North Central Plain. The tree is very fast growing and casts only light shade. It is a source of versatile timber and the foliage is suitable for winter animal feed. However, inadequate knowledge on between-row spacing has resulted in low intercrop productivity with disputes among farmers, and little is known of the nutritional value of the fodder. Furthermore, the change to an "individual responsibility system" in which farmers are the decision makers on how their land is managed has made the need for sound guidance more urgent so that **improved understanding of social and economic interactions between people, animals, trees and crops can be incorporated in land use strategies and promoted.**

2. Outputs:

The overall project objective was **to adapt research on agroforestry to improve the management and productivity of paulownia and poplar-based agroforestry systems in eastern China.** The specific objectives were:

- 1) to adapt and develop ecophysical and agronomic models to optimise yield in agroforestry with emphasis on the understorey;
- 2) to adapt and develop methods for assessing fodder value of tree species within the context of farming systems.

3. Contribution of outputs to project goal:

The project achieved the objectives set out in 2 above, thus contributing to the **optimisation of the use of trees within farming systems.**

A socio-economic survey confirmed that paulownia-wheat intercropping is favoured by both farmers and local authorities. Present land-use policies, however, result in the farming of small parcels of land, which creates management problems and does not encourage investment. There is a need for alternative summer crops, preferably ones that combine shade tolerance with high value.

A review of existing agroforestry models suggested that empirical models, such as SIBU and SOLID, were more suitable than detailed ecophysical models. Field data were used to develop a series of regression equations within a broad model structure to express:

- diameter at breast height (used as an index of tree growth) as a function of tree age;
- light transmissivity as a function of distance across the alley for different spacings and ages of trees;
- understorey wheat yield as a function of distance across the alley for different spacings and ages of trees;
- understorey wheat yield as a function of light transmissivity.

The model was validated and found to predict reasonably well the trends in light transmissivity and understorey wheat yield across the alley with 95 per cent of the observed values falling within a range of one standard deviation of the predicted value. Applications of the model to current farming systems in north central China indicated that tree rows should be 30-40 m apart to give maximum wheat yield. If maximum tree growth is the aim the distance between rows should be reduced to 20-25 m, which causes only a small decline in wheat yield. The model is

applicable to trees aged 1 to 11 years old at spacings between 5 x 10 and 5 x 50 m

The *in-vitro* gas production method of assessing anti-nutritive compounds in tree fodders was simplified to make it more generally applicable. A second test, the Comet Assay, was used as a cytotoxicity test for anti-nutritive compounds in tree fodders fed to monogastrics. Manuals that describe both methods were prepared for use in China. Application of the methods indicated that paulownia leaves have a nutritional level in terms of crude protein and digestible energy that is close to that of wheat bran. The main anti-nutritive compounds were found to be iridoid glucosides belonging to the aucubin group. Phosphorus and lysine are limiting factors that keep pig growth rates below potential. Paulownia leaf can be safely used in place of wheat bran for up to 20 per cent of the ration given to pigs of over 50 kg liveweight, provided that the diet is supplemented with phosphorus, such as 100 g per day of steamed bone meal or burnt bone.

Some 90 per cent of the farmers and all extension workers attending a workshop understood the agroforestry model and thought it useful. In another workshop, farmers who had participated in feeding trials agreed with the main findings on using paulownia as fodder for pigs and were willing to take part in further trials to improve practices.

4. Dissemination products:

See PROREC output.

5. Follow-up:

The methods developed for *in-vitro* gas production and the Comet Assay will be adopted at the Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, Beijing. Interest in the methods has also been shown by other research centres in China.