Integrating Crops and Livestock through Direct Seeding on Vegetal Cover in Vietnam

Husson O [2]. (Husson@cirad.fr); *Chabanne A.*[2] (Chabanne@cirad.fr), *Ha Dinh Tuan*[1] (vacb@netnam.org.vn), *Lecomte P.*[2] (philippe.lecomte@cirad.fr), *Martin C.*[2] (cedric-martin@fpt.vn), *Castella J.C.* [3 and 4] (j.castella@ird.fr), *Tivet F.* [2] (Florent.tivet@cirad.fr) and *Séguy L.*[2] (seguy@cirad.fr)

Key words: Direct seeding on vegetal cover, crops/livestock integration, forages, Vietnam

1 Introduction

In the mountainous areas of northern Vietnam, the increasing population pressure, the changes in land tenure and the economic reforms at the beginning of the 1990's led to the return to traditional slash-and-burn cultivation practices and to a fast development of livestock herd. However, competition for natural resources led to a downward spiral of rapid forest degradation, soil compaction caused by over-grazing, decreasing crop yields, crop damages by animals, and fodder shortage and sanitary problems for the livestock leading to a high mortality (Eguienta *et al.*, 2002). The development of livestock herd was stopped at the end of the decade, although it was of major economic interest at farm level. Making crop production sustainable on these sloping land, and preserving natural resources was not possible without solving the problem of forage availability for animals. It is in this context that the SAM project (Moutain Agrarian Systems, funded by the French Ministry of Foreign Affairs and conducted by VASI[1], CIRAD[2], IRD[3] and IRRI[4]) started experiments on direct seeding techniques with permanent vegetal cover, introducing in 1998 legumes and grasses as cover crops with, as primary objective, to improve and protect the soil. These plants were rapidly seen by farmers as a potential source of forage and the research programme harnessed opportunities to integrate food and feed productions through these techniques. Technical references were set at field level. Integration of technical and economical aspects were tackled at farm level and tools were developed to facilitate changes in local institutions that would scale-up promising results obtained at field level to the watershed or village level.

2 Establishing technical references at field level

Experiments were conducted to assess the performances of various cropping systems based on no tillage direct seeding on permanent vegetal cover. The experimental set up was designed in order to produce references for the main local soil conditions (from very degraded and acid ferralitic soils to richer brown soil developed on limestone), and for various social environments (ethnic groups, grazing regulation, etc.). At the same time, technical references on possible forages production were set, at field level, for alternative systems in which forages were one component.

2.1 Systems based on mid-term forage production (to restore soil structure and fertility before cultivation)

On the various soil types and preceding vegetation types (shrubs, degraded pasture, young forest), 8 grasses and 2 legume species are being compared, with and without fertilisation. Biomass production is measured every month and feeding value is assessed through Near Infra-Red Spectrometry analysis.

Preliminary results show:

- the low productivity of most species during the dry and cold season,
- the high biomass production of Brachiaria species, even on degraded soil, without fertilisation and their rather good feeding value,

---

[1] Vietnam Agricultural Science Institute, Hanoi, Vietnam

[2] Centre de Coopération Internationale en Recherche Agronomique pour le Développement, France

[3] Institut de Recherche pour le Développement, France

[4] International Rice Research Institute, The Philippines

- the complementarity between grasses and legumes: higher biomass production of grass forages balanced by a high feeding value of legumes

2.2 Systems based on crop production with partial forage uptakes at specific periods

Experiments aimed at improving crop production through direct seeding techniques are all based on the maximisation of the biomass production all over the year. This is achieved by combining different parts of the toposequence through:

(i) cultivation in the lowland of species able to grow during unfavourable periods (dry, and/or cold season) such as oats (cultivated in winter, it produces over 2.5 t/ha of dry matter in January and February, the forage shortage is at the highest) partially grazed it is then used as a mulch for rice cultivation in rainfed paddy fields,

(ii) on the hillsides sorghum can be grown at the end of the rainy season and *Brachiaria ruziziensis* produces over 12 t/ha of dry matter in the first three months of the rainy season when rains are unreliable. It can be used in cut and carry for animal feeding, the regrowth being then used as a mulch for upland rice or maize cultivation; and

(iii) associations or relay intercropping of a main crop (rice, maize, cassava) with grasses (especially *Brachiaria sp*.) or legumes (*Stylosanthes guyanensis, Arachis pintoï*)

As all these species also are excellent forages, providing it is carefully managed to leave sufficient residual cover, part of the biomass produced during these unfavourable periods, can be used for animal feeding, when fodder availability is low and needs are high. In addition, hedgerows between fields can be planted with grasses (Bana Grass, Elephant Grass) or legumes shrubs or trees *(Calliandra calothyrsus, Flemingia macrophylla, Gliricidia sepium,* etc.) which are used as forages. Finally, crop residues can be processed to increase their conservation and their feeding value. Experiments showed that rice straws treated with urea can be conserved for 20 to 45 days (and then used for animal feeding in winter time) while their proteic value is increased.

2.3 Systems based on tree production with forages as permanent vegetal cover

In orchards or in industrial tree plantations (rubber, cinnamon, etc.), legumes such as *Arachis pintoï* and *Stylosanthes Guyanensis* proved well adapted to protect and improve the soil, while producing high quality forages. Grasses (*Brachiaria sp., Paspalum atratum, Panicum maximum,* etc.) also can be grown the first years after plantation, before the trees have closed their canopy.

3 Crop-livestock integration at farm level

Technical and economic factors beyond farmers' adoption of direct seeding techniques were studied along four successive steps:

1. Elaboration of a farming system typology (Eguienta *et al*., 2002), in order to identify and to understand farmers' strategies, especially regarding animal husbandry. This helped adapting the innovative food-feed systems to specific target groups.
2. Participatory development by farmers and researchers of a common representation of the village land use systems . A model with compartments was designed (Martin *et al*., 2003), each compartment representing land units being proportional to its relative area in the whole village territory.
3. Farmers were able to simulate feeding improvement scenarios for their animals (Martin *et al.*, 2003): They first locate their agricultural resources on the compartment model, drawn on a paper sheet. On the basis of technical information provided by the research team, farmers then choose the systems they are the most interested in, and simulate how much fodder they would produce. For each system, the number of animals fed is given per surface unit, as well as the optimal production period. This information is then reported on a table, which enables the user to estimate how many heads can be fed by a given system, during which period of the year. In an iterative process, farmers can so simulate the areas devoted to forage production, select the

systems the most fitted to their own situation and objectives, in order to insure sufficient forage production to feed their herd.

4. In a last step, real-scale on-farm trials were set-up with farmers, to test in real situation the various systems they had simulated. Farmers appreciation of the various systems and species is then an important feed-back for researchers. Farmers' preferences went to forage production/fertility restoration with species like *Brachiaria ruziziensis, Panicum maximum, Paspalum atratum, Brachiaria decumbens* ; winter cereals like oats, barley and wheat, and treatment of rice straws with urea.

4 Crops - livestock integration at village level

Since the end of the collectivisation period, and mainly because of common rule allowing free grazing by animal after crop harvests, cattle feeding is for a large part based on use of common natural resources (communal grazing areas or forests). However, fodder shortage led individual farmers to increase forage production in their own fields after fencing.

Based on diagnoses at various scales and MAS (multi-agents simulation) coupled to a role game and a GIS (Geographic Information System), we developed a method for participatory simulation of landscape evolution under various hypotheses of local institutions and economic situations (Castella et al, 2002). Together with the compartment model, these tools were used to facilitate the emergence of negotiation platforms on natural resource management . For example, it made it possible to initiate discussions among local stakeholders on options for increasing forage production at farm level on the basis of experimental results. Two main options received attention from farmers and local authorities: improvement or reclamation of collective pasture land, and surveillance of animals in groups, either on collective pastures or on collective management of forages produced in individual fields of farmers organized in groups.

5 Conclusions

Direct seeding techniques, based on soil improvement by cultivation of species having strong root systems and the ability to produce a high biomass even on degraded soils also produce forages which can partially be used for animal feeding. In return, use of manure with direct seeding techniques improves the performances of the cropping systems. Thus, the whole farming system benefits from these techniques: food and feed systems performances are increased, while use of the farm resources are optimised (soil preservation or even improvement, reduction of bottlenecks in labour force use).

The possibilities of integration between livestock and crops given by these techniques makes them more attractive to farmers than innovation supposed to improve only one of the components of a farm. Thus, in northern Vietnam, inclusion of forages production in the cropping systems is clearly a synergetic mean for the adoption of direct seeding systems by farmers.

SAM project results do not only apply to northern Vietnam situations. The tools and the approach developed here, and the main guidelines to build up direct seeding systems integrating animals can be used in a wide range of situations all over the world (as in Madagascar, Cameroon) integration between crops and livestock is most often the key issue in many Southern countries.

References:

Castella J.C., Tran Ngoc Trung, Tronche N.R. and Boissau S.; 2002: "Participatory characterization of agrarian dynamics in Bac Kan. The SAMBA-GIS method: combination of multi-agents models, role plays, and GIS". In: "Scaling-up innovative approaches in agricultural development", 23-27 09/2002 , Hanoi, Vietnam.

Eguienta E.; Martin C.; Lecomte P.; Husson O. and Castella J.C. ; 2002: "Crop-livestock interactions in northern Vietnam: Issues, diversity of farmers' responses and alternatives for sustainable integration of animals in upland agricultural systems", in: "Doi Moi in the Mountains:

Land use changes and farmers' livelihood strategies in Bac Kan Province, Vietnam", Castella J.C. and Dang Dinh Quang Editors, The Agricultural Publishing House, Hanoi, Vietnam, P. 221-247

Martin C., Castella J.C., Hoang Lan Anh, Eguienta Y., Tran Trong Hieu; 2003 "A participatory simulation to facilitate farmers' adoption of livestock feeding systems based on conservation agriculture in the Vietnam uplands" accepted for publication in *International Journal of Agricultural Sustainability*, 19 p.