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A mixed farming system for the reconversion process in the Caribbean: How to do the necessary research? Which strategies?

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Context

Doing research in mixed crop and animal systems (or mixed farming systems, **MFS**) is nowadays imperative. However, research institutions often continue using conventional methods that are actually far away from the vision and strategy that MFS requires. This work succinctly describes our point of view about how professionals and research institutions from the agricultural sectors must advance in projects for MFS development during the imminent environmental-agricultural reconversion process. Based on our own experience, we focus the context in the Caribbean settings.

The shortage of available arable land in the Small and Large Antilles, Caribbean, justifies the enhancement, expansion and development of integrated MFS, which at the same time could mean positive and economic benefits in the promotion of a sustainable and environmentally friendly agriculture. Reasons for this statement are geographical (islandness, smallness), natural (vulnerability, vagaries of climate), economic (expansion of tourist and service sector with related increase in land pressure), and social (increase of conscience and resistance to conventional systems through the rescue of rural traditions and practices, and/or subsistent agriculture from the poorest rural sector). Agricultural production in the Caribbean emphasizes sugarcane, bananas/plantains, coconuts, coffee, cocoa, citrus, roots and tubers (cassava, sweet potato, taro and yam), beans, maize, and other fruit plantations like pineapple, papaya, guava, avocado or mangoes. These productions, according to their nature, seasonality and extension, give a wide availability and quality of authentic primary products. Their crop residues, agro industrial by-products and other non-conventional feeds are useful to be used in integrated feeding systems with a holistic vision for the livestock production sector. The result is a wide spectrum of alternatives across the region where sugarcane and banana/plantain are the backbone of the agriculture sector. These islands also have a rich stock of well adapted native domestic animal breeds (i.e., Creole cattle, pigs, goats, hair sheep, rabbits, rustic hens, etc.) that facilitate the planning of multi-production systems with rational use of their own local and natural resources.

Approach and Methods

Strategies:

(1) *From the individual to the collective: Leading research with institutional concepts and perception based on the integrative and holistic way of thinking*
This is the first step. Professional community and agents have to be first convinced about the rationality and necessity of 'new' solutions for facing the future. "Old wine in new bottles?" One thing is clear: agricultural processes during the 'Green Revolution Era' provoked a great part of the current problems we are suffering from nowadays (e.g., soil erosion, loss of biodiversity, monoculture…). Thus, such work styles are no longer adequate. However, urbanization and world population growth continues and some key questions arise like the following: How to feed them?. The answers are as multiple as local particular conditions we can find. We have a great challenge and a great responsibility. How do we do this?

(2) *Theoretical evaluation of MFS and functioning in space and time: Modeling tools*
On each location, on each farm, firstly, we have to 'design on the paper' what is it possible to do, with what tools, what are the main advantages and disadvantages of the context we are dealing with, and what is the main production purpose or objective to keep in mind? Based on these aspects, a 'Theoretical Model, **TM**' must be designed. This should take into account criteria, ambitions and points of view from each social member (from the farmer to the politician). A convinced group of experts must lead the process. The dynamic must be collective, dialectic and pragmatic. Predictive modeling tools may help in the quality and rigour of research processes. Estimation of different options (scenarios) in space and time must be performed. Multi- and inter- disciplinary research: a key, difficult but possible and necessary! We have a lot of work on that. We have to enjoy it, convinced that we are doing the right thing at the right time. That is the challenge.

(3) *Practical evaluation of a 'Model system' in space and time: a 'Pilot' system under controlled experimental conditions*
Once we have designed the best TM to get a project started, an immediate step is to start 'building' our system under real conditions (field). If not completely, at least one portion of the experimental institutional fields must be converted into a 'Pilot MFS'. This would allow the convergence of each member of the staff with their competencies from a multi-criterion approach. The system must start to validate each aspect of the TM in time and space. A priority order must be first defined and stated. The team coordination is essential

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as well as the scientific leadership. The 'Pilot' must serve as a physical tool to demonstrate to visitors, farmers and unconvinced people. This phase (validation) must be accompanied by new theoretical statements also producing new research questions or hypotheses.

(4) Using the farmer's leadership: detecting and monitoring evolution of successful practical cases

Simultaneously, the leadership of local individual farmers and societies must be identified. They should be in the same line of the more scientific approach. 'Model real farm' processes must also be conceived for evaluating their dynamics in space and time. Constant feedback with these real farms is essential.

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Livestock farming systems and conditions of sustainability in Cuba, the case of small ruminant production

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Introduction

Beginning at the end of the 1990's, the Cuban agricultural sector implemented a sustainable animal production (SAP) program for developing new livestock farming systems to reach food security at the country level. The main statements of SAP (Funes-Monzote *et al.*, 2009) are to reduce the environmental impact, to increase the use of local resources (food, feeds, herbs and genotypes) and to promote an integrated approach of the production system (mixed farming system, MFS). Thus, the Cuban experience could be shared with other tropical regions. Given the high efficiency of small ruminant (SR) production under the Caribbean conditions (Alexandre *et al.*, 2010), it appears interesting to study the SR systems and assess the conditions of their sustainability. A study has been carried out in 2 regions of Cuba on SR systems of production and their integration to the natural environment.

Materials and Methods

Thirty-four farmers were questioned (more than 360 questions*modalities) upon the crops, the different flocks, husbandry practices for SR (reproductive, feeding and health management). The use of different plant species for human consumption, animal use (feeding and sanitary practices) or other function was determined. The importance of diseases and pathogens is also described. All the data allow determining indexes of biodiversity and some criteria of sustainability according to Cammaert and Palacios (2006). A functioning typology of the different SR systems was implemented as described by Alexandre (2008). The indexes of biodiversity (species and diseases) and the criteria of sustainability were assessed at the sub-group level.

Results and discussion

The different groups of SR breeders were discriminated according to their main economic activity at the farm level and/or the area exploited by the animals (Table 1). The first group (A, 12%) was made up of farmers where crop production is preponderant (pasture surfaces ranging

Table 1 *Main description of the SR systems in Cuba, type of plant species exploited and indexes of biodiversity and sustainability*

Type	Species: total number	Food: % of total	Feeds: % of total	Food/feeds: % of food+feeds	Vegetables and roots: % of food	Forages: % of feeds	Diseases + parasites	Index of biodiversity and sustainability
Crop farmers	29.5	73	55	22	34	25	4.1	2.06
Livestock farmers								
Pig	21.6	63	61	19	28	31	3.2	2.13
Cattle	21.8	50	61	9	2	29	4.2	2.15
SR breeders								
Small unit	21.9	66	58	19	18	31	4.3	2.26
Large unit	20.0	49	64	12	8	39	5.0	2.16
Public areas	21.8	51	65	14	20	36	4.8	2.40

Diseases + parasites (number of pathogens); Index of biodiversity and sustainability adapted from Cammaert and (2006) score from 1 = good to 3 = very bad.

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