

## Can we define the term ‘farming systems’? A question of scale

### Existing definitions

One commonly used definition of a farming system is that of Dixon *et al* (2001):

‘...a population of individual farm systems that have broadly similar resource bases, enterprise patterns, household livelihoods and constraints, and for which similar development strategies and interventions would be appropriate. Depending on the scale of the analysis, a farming system can encompass a few dozen or many millions of households.’

I find this definition unsatisfactory because it plays down the rich diversity of farms and livelihoods that are found at all levels of analysis, from the village upwards across almost all parts of the world.

In searching for a better option, I was surprised to find that most of the relevant texts were remarkably silent on this issue. Ruthenberg (1980), in *Farming Systems in the Tropics*, provides a classification of farming systems, but no definition. Even the wealth of literature on farming systems research fails to give a clear definition (for example, Collinson, 2000a; Darnhofer *et al*, 2012). The term ‘farming system’ is used both as a compound noun and as an adjective (Ison, 2012). Some definitions equate the farming system to a farm system or a ‘unit of production’ (Norman and Gilbert, 1981); ‘a unique and reasonably stable arrangement of farming enterprises that a household manages’ (Shaner *et al*, 1982). Part of the difficulty is that some use the term ‘farming system’ interchangeably with ‘system of farming’, so farming systems are ‘systems with the goal of producing biomass’ (Biggs, 1995), ‘an approach’ (Turner and Brush, 1987) or ‘a resource management strategy’ (Lal and Miller, 1990).

### Systems analysis

Since joining Wageningen University in 2001, I have worked with many other scientists from Africa and elsewhere to apply the tools of systems analysis to deepen our understanding of smallholder farming in Africa (Giller *et al*, 2006, 2011). Our overall goals are to understand the constraints farmers face and explore possible development pathways. In this approach to systems analysis, a system is defined as a ‘group of parts [subsystems] that are interacting according to some kind of process’ (Odum, 1983) or ‘a limited part of reality that contains interrelated elements’ (de Wit, 1993). Systems analysis recognizes five elements of a system: the boundary, the inputs, the outputs, the subsystems (or components) and the internal structure (how the subsystems are

interrelated and interact). A critical step in systems analysis is to place the boundary accurately, such that the system is influenced by its environment, but has no direct influence on that environment (for example, see Spedding, 1979; and Leffelaar, 1999). Furthermore, the rule of parsimony, or ‘Ockham’s Razor’, applies: it is important to identify only the key subsystems and their interrelationships to avoid being drowned in unnecessary complexity. A good systems diagram provides the basis for analysis, which can be done using static tools, such as nutrient and cash balances or optimization models, or dynamic tools such as simulation models. When applied to agriculture, systems analysis can help to identify (in)efficiencies and constraints; to compare existing farming practices and strategies; and to explore possible futures by asking ‘what if?’ questions. The limits of our knowledge about the behaviour of complex systems and possible changes in the biophysical and economic environment lead us to ‘explore’ possible futures (van Ittersum *et al*, 1998) rather than to predict the future. Systems analysis can thus help us to identify and understand emergent properties, synergies and trade-offs that may influence future trajectories (Groot and Rossing, 2011). Building on the tradition of C.T. de Wit, systems analysis is now firmly embedded in research and teaching at Wageningen University.

I find the systems hierarchy approach (Ruthenberg, 1976; Fresco and Westphal, 1988) a useful conceptualization when applied to agriculture. Ruthenberg (1976) states that ‘classes of similarly structured farms... are classified as belonging to a certain “farming system”’. Fresco and Westphal (1988) avoid the term farming system and define a ‘farm system’<sup>1</sup> as:

‘... a decision making unit comprising the farm household, cropping and livestock systems, that transform land, capital (external inputs) and labour (including genetic resources and knowledge) into useful products that can be consumed or sold’.

While the boundary of an arable farm as a physical unit is usually distinct, does the farm system include only cropped land or also land that could be cropped? Boundaries are often blurred for livestock farms, particularly when livestock graze freely on common land. Such cases demand an approach focused at the level of the village, ‘terroir’ or even region (for example, Rufino *et al*, 2011). Further, what comprises the boundary of a farm as an economic unit? Given the importance of off-farm income, whether from casual labour, local employment of household members or remittances, should the unit of analysis include only household members ‘eating from the same pot’? Rural–urban connections that arise from circular migration may operate over vast distances, often crossing national boundaries, and can be key to investments both on- and off-farm (Painter *et al*, 1994; Andersson, 2001, 2006).

### Analysing patterns

So is *farming systems analysis* of the type we do at Wageningen University possible without a good definition of a farming system? Our work has focused on the development of the NUANCES framework, through which we combine information generated through surveys, participatory analyses, experimentation and modelling to *describe* the current state of the system, *explain* how it functions, *explore* possible alternative interventions and scenarios and *design* alternative configurations (Giller *et al*, 2011). Our approach builds on the rich toolbox for participatory learning and analysis that emerged from farming systems research (for example, Dorward *et al*, 1998; Defoer, 2002) and combines this with farm household and broader

system modelling. The identification of repeating patterns across different regions provides the basis for a comparative approach. Patterns emerge at different scales. Within farms, patterns arise due to similar management, such as the allocation of animal manures and fertilizers to particular fields that results in gradients of declining soil fertility with distance from the homestead (Tiftonell *et al*, 2005b; Zingore *et al*, 2007a). Patterns of farms, farming livelihoods and production objectives can be used to structure farm typologies (Tiftonell *et al*, 2005a; Zingore *et al*, 2007b; Tiftonell *et al*, 2010). Such typologies can be particularly useful when combined with analyses of different rural household strategies (such as Dorward's 'hanging in', 'stepping up' and 'stepping out' (Dorward *et al*, 2008) and different 'rural worlds' in terms of engagement of rural households in markets (Vorley, 2002; Seville *et al*, 2011). The diversity within and among farms highlights the need to move away from broad recommendations and towards a more tailored or situated development approach. Given the likelihood (and inevitability) of local adaptation by farmers of technologies, it seems more appropriate to offer a 'basket of options' based on principles rather than specific recommendations. This led us to coin the term 'best fits', in contrast to 'best bets', to recognize the importance of context and local adaptation. Thus technologies or approaches to farming have to fit within a 'socio-ecological niche' (Ojiem *et al*, 2006).

### A new definition?

So how do these considerations inform my search for a better definition of farming systems? The reason I find the Dixon *et al* (2001) definition unsatisfactory is because I think of a farming system as a level in a hierarchy above farm systems. Their definition appears to equate the farming system to a 'recommendation domain' (Collinson, 2000b). Yet if we recognize the diversity of farm systems and their interactions, how can a farming system 'encompass... many millions of households'? In my mind, the term 'farming systems' cannot easily be applied to vast areas of continents.

Perhaps we should replace their first sentence with:

'A farming system is defined as a population of individual farm systems that may have widely differing resource bases, enterprise patterns, household livelihoods and constraints.'

Rather than seeing a farming system as a single recommendation domain, we could state that:

'The farm systems exhibit varying degrees of interdependency and interact in use of common property resources. The diversity of farm enterprises requires that development strategies, interventions and policies need to be tailored to their different needs and opportunities.'

At the end of this analysis I have still failed to find a good definition of farming systems. I'm still searching!

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## Note

- <sup>1</sup> In a later paper (Stomph *et al*, 1994), these ideas were developed to describe a hierarchy of land use systems.

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