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Policy brief

A farming systems framework for targeting investment in Africa

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The livelihoods of African smallholder farmers are extremely diverse, reflecting the variety of natural resources and agricultural services available to farm families. These resources generally encompass different types of farmed and fallow land as well as water resources and common property resources, including grazing areas, forest and ponds. Farms are characterized by their specific farm resource endowments and family circumstances (history, preferences and projects). To produce food and meet multiple other household goals, farmers make decisions to manage resources and have various interdependent activities in crop, livestock and tree production, gathering as well as processing, marketing and off-farm work. The functioning of any individual farm system is also strongly influenced by the larger farm environment which is made up of social relations, economic opportunities, market arrangement, political incentives and the bio-physical context. Taking a systems approach helps to capture the complexity of smallholder agriculture and household logic for system improvement.

Capturing the diversity of farming systems for planning

Despite remarkable growth in some African economies in recent years, poverty and widespread chronic hunger persist on the continent. Yet these challenges are not distributed uniformly. In fact there are a number of hotspots, often in areas of high population density, slow economic growth and land degradation. Likewise, the enormous diversity of natural characteristics (including terrain, soils, water and climate) and socio-cultural patterns of human settlements has induced many different farming systems, each with its own agricultural land use rationale and organization.

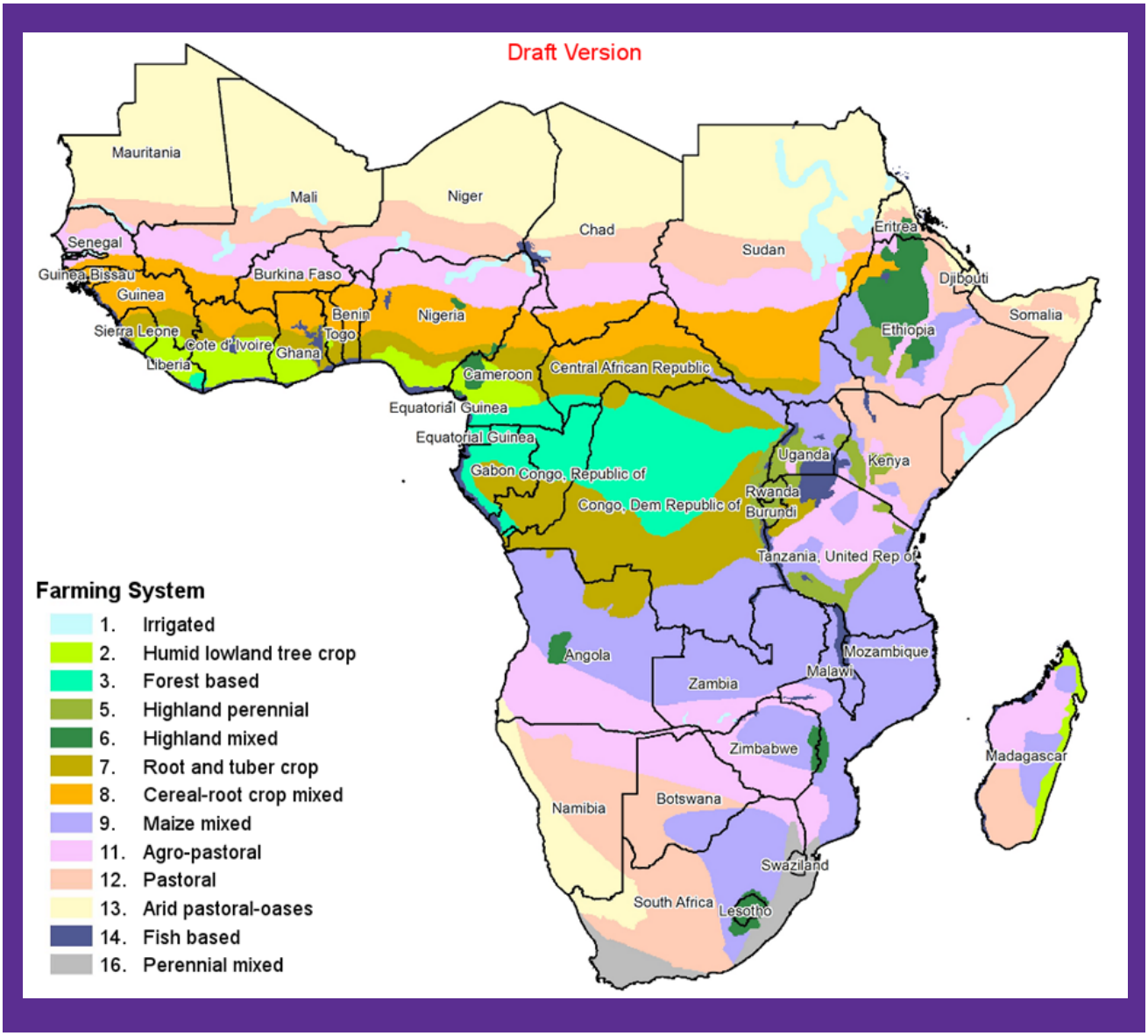
Historically, a large body of farming systems applications has been directed towards adoption of improved technology. In contrast, a new initiative updating Dixon et al.'s (2001) analysis for sub-Saharan Africa applies a farming systems framework to framing strategies and priorities for intervention toward the reduction of poverty and food insecurity (Garrity, Dixon and Boffa 2012).

From a targeting perspective, a farming system is defined as a population of farm households that have broadly similar resource and livelihood patterns, as well as constraints and opportunities, and for which similar development strategies and interventions would be appropriate. Often, such systems share broadly similar agro-ecological and market access conditions. Given the diversity of African agriculture, targeting agricultural and rural development efforts to specific farming systems can improve the effectiveness of those investments.

Spatial delineation methodology

Fourteen farming systems were classified using spatial data on agro-ecological and socio-economic variables as well as expert knowledge of more than 100 key informants (Figure 1; Table 1). An iterative expert-driven process was applied to refine their spatial definition as initially provided by Dixon et al. (2001). Length of growing period (LGP) was used as the primary classifier. LGP is a fundamental component of agro-ecological zones that includes climate, soils and landform and is a surrogate for farm natural resource endowments (Figure 2). Several additional classifiers were also successively considered for system delineation including travel time to market, population density, crop and livestock distribution, elevation (for example in the case of highland systems), and environmental criteria such as soil type for the tree crop system.

The major sources of spatial data were IFPRI's Harvest Choice, FAO's and IIASA's Global Agro-ecological Zones databases and CIESIN for population. When available, crop distribution and farming systems maps developed by national or regional projects, as well as sensor-based data on bi-modal seasonal patterns were consulted. The revision of farming system boundaries was undertaken by a multidisciplinary team for each of the 14 farming systems and a total of over 60 scientists and development professionals with in-depth knowledge of Africa. Statistics were sourced from FAOSTAT, as well as UN and World Bank. The year 2010 was selected as the base year. Where the spatial data layers referred to earlier years, linear extrapolations were used to estimate 2010 figures and anchored to FAOSTAT country and regional statistics. Household surveys from the World Bank were also used. The relative importance of the predominant crops found in each farming system is highlighted in Table 2. It confirms a reasonable correspondence with rainfed crops that are potentially most adapted to prevailing environmental conditions in each system.



Note: The map excludes the Urban and Peri-Urban Farming System

Fig 1. The farming systems of Africa

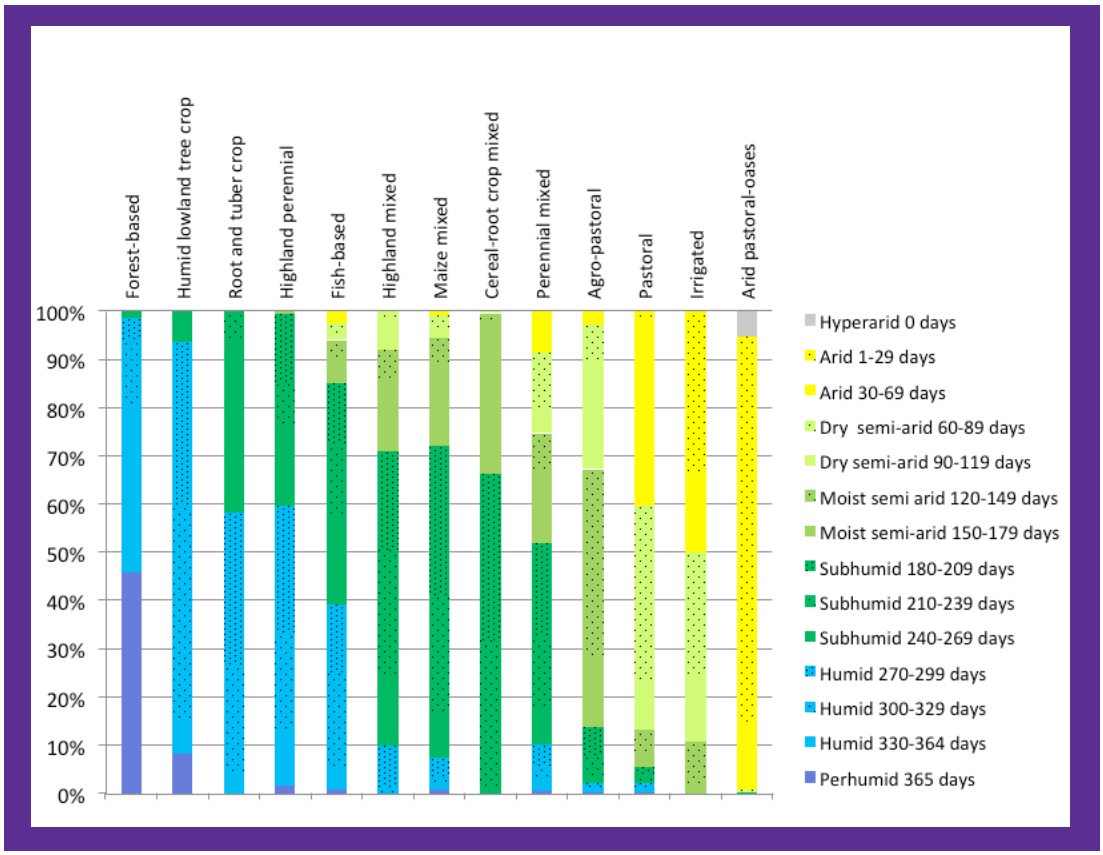


Fig 2. Range of length of growing periods in farming systems (%)

Source: Van Velthuizen et al. 2013

Table 1. Description of the main farming systems

Farming Systems	Market access	Main livelihood source	Defining characteristics
Maize Mixed	Medium	Maize, tobacco, cotton, cattle, goats, poultry, off-farm work	Sub-humid and humid areas, dominated by maize with legumes
Agro-Pastoral	Medium-high	Sorghum, pearl millet, pulses, sesame, cattle, sheep, goats, poultry, off-farm work	Semi-arid areas, mixed sorghum/millet and livestock systems
Highland Perennial	Medium-high	Banana, plantain, enset, coffee, cassava, sweet potato, beans, cereals, livestock, poultry, off-farm work	Moist highland areas with a dominant perennial crop either banana (often with coffee) or enset in Ethiopia
Root and Tuber Crop	Medium	Yams, cassava, legumes, off-farm work	Lowlands, dominated by roots and tubers with no major tree crop, LGP
Cereal-Root Crop Mixed	Medium-high	Maize, sorghum, millet, cassava, yams, legumes, cattle, off-farm work	Two starchy staples alongside roots and tubers
Highland Mixed	Medium	Wheat barley, teff, peas, lentils, broad beans, rape, potatoes, sheep, goats, livestock, poultry, off-farm work	Above 1700 m; LGP, temperate cereals because of altitude
Humid Lowland Tree Crop	High	Cocoa, coffee, oil palm, rubber, citrus, yams, cassava, maize, off-farm work	Where tree crops replaced forest; > 25% source of cash income; Oil palm has local market
Pastoral	Medium	Cattle, camels, sheep, goats, remittances	LGP. Extensive livestock dominant.
Fish-Based	High	Fish, coconuts, cashew, banana, yams, fruit, goats, poultry, off-farm work	Proximity to sea or lake; fish is significant livelihood source
Forest-Based	Low	Subsistence food crops including cassava, maize, beans, coco yam and taro, and off-farm work.	LGP, humid lowland heavily forested areas
Irrigated	High	Rice, cotton, vegetables, rainfed crops, cattle, poultry	Large scale irrigation scheme; mappable; absence of rainfed agriculture
Perennial Mixed	High	Deciduous fruits, tree plantations, sugarcane	High production intensity and commercial orientation
Arid Pastoral and Oasis	Very low	Date palms, cattle, small ruminants and off-farm work, with some scattered irrigated crops and vegetables	LGP, strong hydrological and livestock connection between oases and arid surroundings
Urban-Based	High	Fruit, vegetables, dairy, cattle, goats, poultry, off-farm work	Center or fringes of cities, population density

Table 2. Occurrence of rainfed crops by farming system (%)

	Maize mixed	Agro-pastoral	Highland perennial	Root and tuber crop	Cereal-root crop mixed	Highland mixed	Humid lowland tree crop	Pastoral	Fish-based	Forest- based	Irrigated	Perennial mixed	Arid pastoral-oases
Wheat	2.6	0.7	3.2	0.0	0.0	17.4	0.1	1.6	0.0	0.0	0.2	30.7	0.1
Maize	44.3	11.8	20.8	30.3	16.6	34.5	21.1	12.1	29.1	15.4	6.7	29.4	9.4
Sorghum	7.0	24.5	7.5	6.5	20.3	17.1	2.1	24.0	7.2	0.1	40.2	0.4	16.8
Millet	3.9	26.6	2.8	2.3	10.0	5.4	0.7	38.7	4.8	0.1	29.9	0.6	41.1
White and sweet potato	3.7	1.6	15.3	1.3	1.3	2.0	2.9	1.6	4.9	1.8	0.3	2.3	2.3
Cassava and yam	18.9	9.2	19.5	39.3	26.2	5.7	59.9	4.6	32.9	68.4	2.7	3.0	9.6
Pulses	11.6	16.8	27.6	8.5	12.7	15.1	7.9	11.4	13.8	5.3	10.6	4.3	14.1
Groundnut	6.4	8.6	1.5	8.9	10.4	1.3	3.0	5.6	5.8	6.4	9.3	1.7	6.6
Soybean	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Sugarcane	0.5	0.0	0.8	1.2	0.1	1.2	1.3	0.3	0.8	2.2	0.0	23.6	0.0
Total (10^6ha)**	***17.2***	***46.9***	***5.7***	***6.7***	***18.1***	***3.9***	***3.7***	***9.2***	***1.4***	***1.3***	***3.1***	***0.9***	***0.0***

** Total year 2000 harvested area of: wheat, maize, sorghum, millet, white potato, sweet potato, cassava, yam, pulses, groundnut, soybean or sugarcane

Source: Van Velthuizen et al. 2013

Potential applications

This farming systems classification approach is a generalization of the vast diversity of African agriculture. It represents a pragmatic approach to showing farming system areas in a geographical manner and communicating analytical results to policy makers, research program planners and investors who need relatively large-scale tendencies for planning. Each farming system class, however, has a unique core concept or "central tendency", and each of the categories contains a substantial degree of subsystems heterogeneity. Sharp boundaries between farming systems on the ground rarely exist, and thus the boundaries are actually soft gradations.

This framework combines quantitative biophysical parameters as well as analyses of farming systems which can be closely integrated with livelihood strategies. It can thus be extended into areas such as rural poverty, vulnerability/resilience, nutrition and gender equity, for which a singular commodity or even natural resource management focus would be too limited. As an initial step for dealing with farmer heterogeneity, it can be an effective tool for priority setting and targeting of research, development, policy and investment including site selection and the design, testing and evaluation of interventions.

Further information on the analysis of sub-Saharan African farming systems can be found in the forthcoming book **Farming systems and food security in sub-Saharan Africa: priorities for science and policy**, which will be co-published by Earthscan, FAO, ICRAF, ACIAR and the World Bank

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