Research Seminars

System Analyses for Sustainable Agricultural Production and Livelihoods of Smallholders: Complementary Approaches and Case studies in Southwestern Burkina Faso

14 and 16 February 2017, ICARDA Office, Amman, Jordan

Systems Analysis in Coping with Smallholder Diversity: Functional Types of Agricultural Livelihood Systems in Ioba Province, Burkina Faso

Boundia Thiombiano, Institute of Rural Development, UPB

Quang Bao Le, DSIRP, ICARDA

CGIAR RESEARCH PROGRAM ON Dryland Systems

ICARDA Science for Better Livelihoods in Dry Areas

ETH Eidgenössische Technische Hochschule Zürich Swiss Federal Institute of Technology Zurich

UPB

Why is typology a matter?

- **Generalization of case-specific findings** (scaling-out and/or -up): Providing a context for application of knowledge/findings in general
  - Medical tests in mice will be applied to who? Why?

- **Relevant sampling**: Providing a context for relevant, cost-effective sampling
  - How to have a minimal sample size to represent best the study population?

- Better **targeting** in policy and management

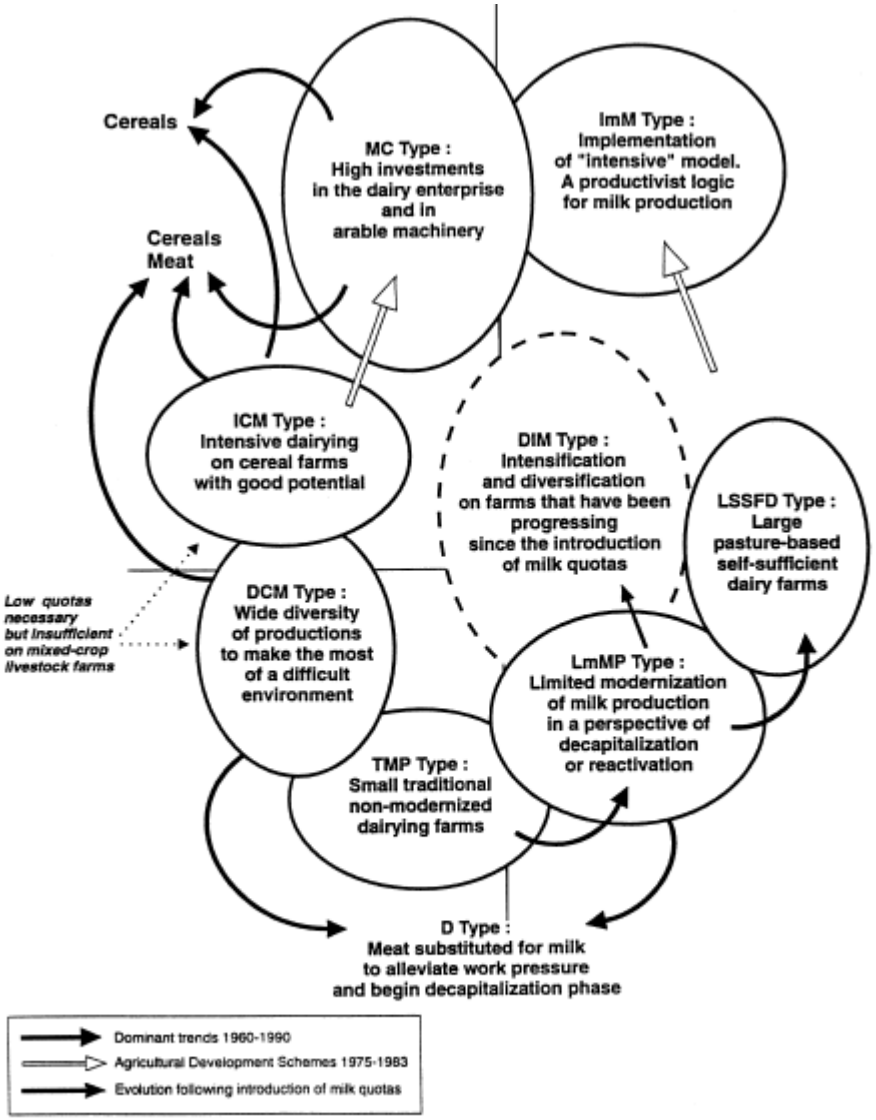
- **Functional typology** of a human system **reflects** its **context, goal/preference, structure**, hence frames its behavior.

- **Understand and/or model systems transitions**: Change in types (qualitative change)

Source: Le et al. (in prep.)

Example: farm types and transitions

Source: Landais (1998)



Graphic representation of a dairy farm typology for the Haute-Marne Department, 1987 (Source: Perrot, 1991).

Type and typology

- A **type** is an abstract generic model which define the characteristic features of a series of objects.

- The term '**typology**' designates both:
  - **The science of type elaboration**, designed to help analyze a complex reality and order objects which, and
  - **The system of types** resulting from this procedure

- E.g. Plant taxonomy is kind of typology

Type and typology

- A **type** is an abstract generic model which define the characteristic features of a series of objects.

- The term '**typology**' designates both:
  - **The science of type elaboration**, designed to help analyze a complex reality and order objects which, and
  - **The system of types** resulting from this procedure

- E.g. Plant taxonomy is kind of typology

Functional typology

- To be meaningful, systems of different types must be **functional, i.e. responsive differently**, to environmental/contextual change regarding the defined objectives

- E.g. Different plant species respond differently to pollution and drought.

- E.g. Labor-rich and labor-less households adopt differently an introduced waste recycling technology.

Methods system typology analysis

Method	Advantage	Disadvantage
Expert opinions	• Fast, cost-effective	• Risk of bias
Participatory rankings	• Fast, cost-effective • Participatory potential	• Difficult to include multi-criteria • Difficult to model type change
Step-wise/decision-tree classification	• Combine qualitative and quantitative criteria • Work with small sample size • Participatory potential • Easy to implement in simulation	• Difficult to know 'key' discriminates among many criteria • May be low contextual robustness
Parametric multivariate statistics	• Capture key discriminates • Easy to implement in simulation	• Less capable to capture many qualitative criteria • Not work well with small sample size

Source: Le et al. (in prep.), Le & Feitosa (2012)

Case Study in South Western Burkina Faso

The present case study in Ioba Province, Burkina Faso, demonstrates the key role of functional typology for system analysis of smallholder livelihoods in drylands areas

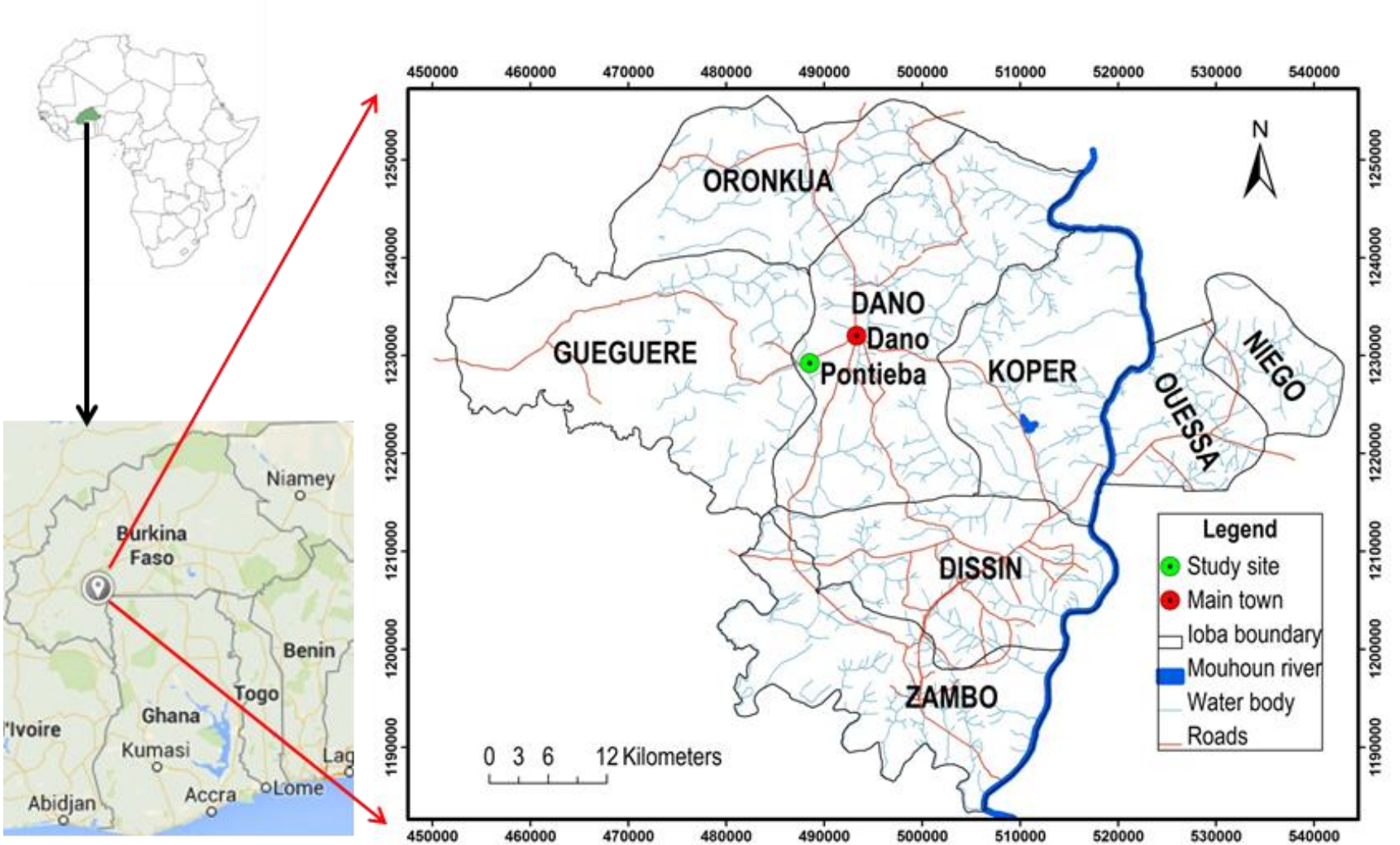
The objectives of the study were to:

i. identify main agricultural livelihoods system types (ALS) in the village of Pontieba;

ii. analyze crop choice decision making by main ALS types and;

iii. examine the nutrient adoption behavior of the ALS types

Study area and site



RESEARCH PROGRAM ON Dryland Systems

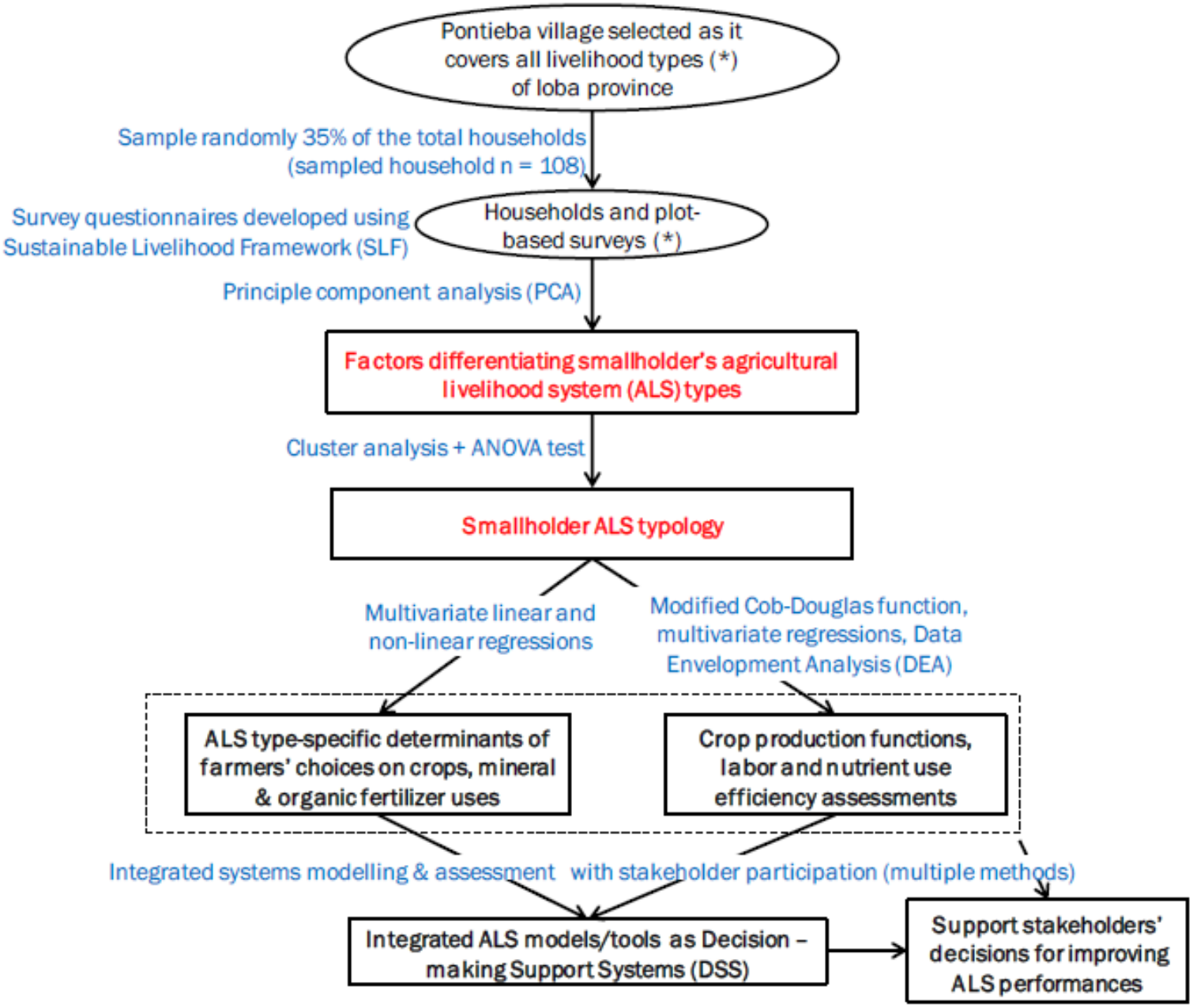
CGIAR

ICARDA
Science for Better Livelihoods in Dry Areas

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

UPB

Sampling method



Agricultural livelihood variables

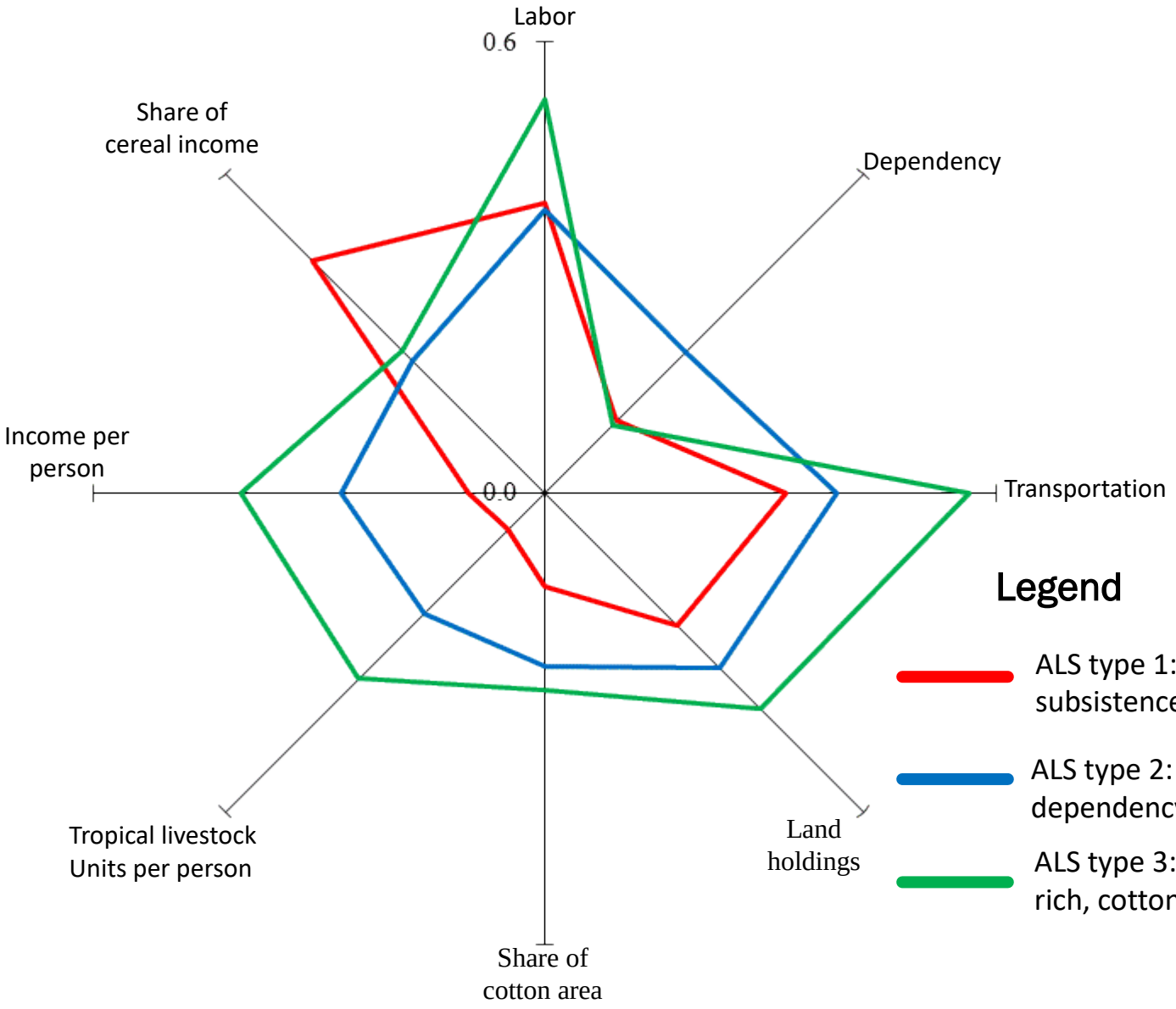
Livelihood asset	*Variable*	*Variable definition*	*Source*[a]
Human	$H_{HEADAGE}$	Household head age (year-old)	D
	$H_{MEANAGE}$	Average age of the household members	C
	H_{LABAGE}	Average age of the household labour	C
	H_{HEDUYR}	Number of years of classic education of household head	C
	H_{NBEDUC}	Number of educated members in the household	C
	H_{SIZE}	Household size (no. of people in the household)	D
	H_{LABOUR}	Number of workers of the household (labour)	C
	H_{DEPEND}	Dependency ratio of the household	C
Physical	$H_{DMARKET}$	Distance to important market (Main town) from household house	D
	H_{DROAD}	Distance to permanent road from household house (m)	R
	$H_{VEHICLE}$	Number of transportation means (bicycle and motorbike) possessed by the household	C
	$H_{BULLOCK}$	Number of bullock possessed by the farm	D
Natural	$H_{HOLDINGS}$	Farm land holdings (ha)	D
	$H_{HOLDINGCP}$	Farm land holdings per capita (ha/person)	C
	$H_{FALLOWCP}$	Farm fallow land per capita (ha/person)	C
	$H_{CULTLANDCP}$	Farm cultivated land per capita (ha/person)	C
	$H_{SHFALLOW}$	Share of fallow area in land holdings (%)	C
	$H_{SHCOTTON}$	Share of cotton area in land holdings (%)	C
	$H_{SHCEREAL}$	Share of cereals area in land holdings (%)	C
	$H_{SHMFCRP}$	Share of marketable food crops area in land holdings (%)	C
	H_{TLUCP}	Tropical livestock unit per capita (TLU/capita)	C
	H_{TLUHA}	Tropical livestock unit per ha of cultivated land (TLU/ha)	C

Agricultural livelihood variables

Livelihood asset	Variable	Variable definition	Source[a]
Financial	$H_{GROSSINC}$	Household annual gross income (FCFA)	C
	$H_{GROSSINCCP}$	Household annual gross income per capita (FCFA/capita)	C
	$H_{SHREMITINC}$	Share of remittance income in household annual gross income (%)	C
	$H_{SHNFINC}$	Share of Off-farm income in household annual gross income (%)	C
	$H_{SHLIVESTINC}$	Share of livestock income in household annual gross income (%)	C
	$H_{SHCOTINC}$	Share of cotton income in household annual gross income (%)	C
	$H_{SHCERINC}$	Share of cereals income in household annual gross income (%)	C
	$H_{SHMFCRPINC}$	Share of marketable food crops income in household annual gross income (%)	C

Note: [a] D = Direct extracted from the questionnaire; C = Compound information calculated based on information coded in the questionnaire; R = Extracted from map reading.

Smallholders' agricultural livelihood types



Legend

- ALS type 1: Poor, landless and subsistence-based farms
- ALS type 2: Medium-income, high-dependency, cotton-and livestock-turned
- ALS type 3: Better-off, land-and labour-rich, cotton-and livestock-turned

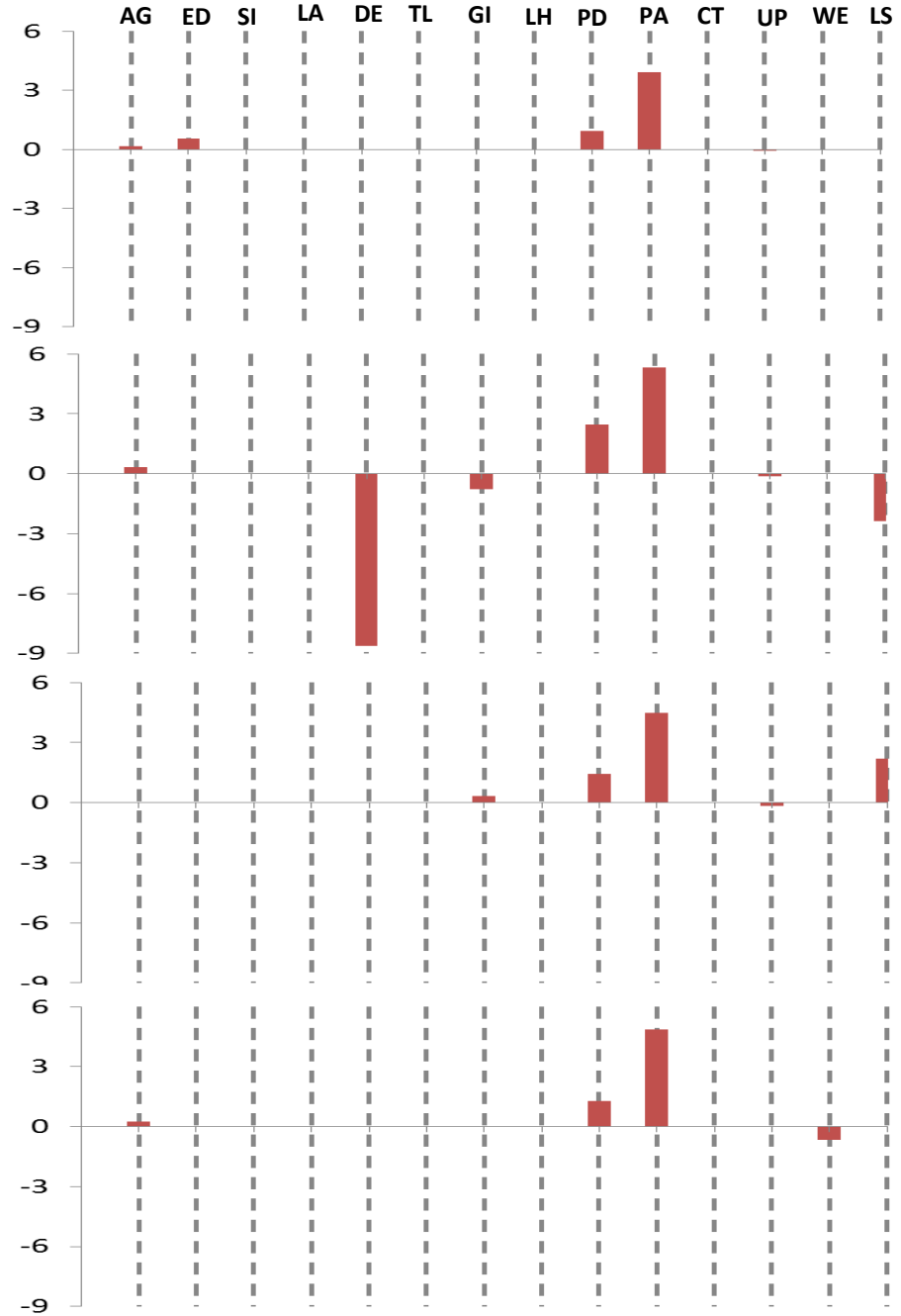
Tested ALS type-specific and common behavior: crop choices

Variable	ALS type 1 (n = 151 plots)				ALS type 2 (n = 183 plots)				ALS type 3 (n = 131 plots)			
	Groun.	Rice	Maize	Cotton	Groun.	Rice	Maize	Cotton	Ground.	Rice	Maize	Cotton
Constant												
Household variables												
Age of household head	?	0.1**		**-0.1***	-0.1*	?		**?**	?	?		**?**
Household head education	**0.9****			?	**?**			?	**?**			-0.3*
Household size												
Household labour				?				1.6**				?
Dependency ratio				?				6.5**				?
Tropical Livestock Unit	18.2**			**?**	?			**2.3***	?			**?**
Annual gross income												
Total and holdings												
Plot variables												
Plot distance from homestead			-2.1E-3**	?			-1.8E-3***	-7.1E-4**			-1.3E-3**	?
Plot size	-7.1***	-13.0***	-3.7**		-4.9***	-16.5***	-3.4***			-14.4***	-3.8**	
Previous crop			6.3***		-2.8**	2.6**	2.7***				6.7**	
Plot upslope												
Plot wetness index												
Slope length		?	-0.6**	**?**		-1.2**	-0.8**	**-0.7****		?		**?**
Household access to enabling policy												
Access to credit	2.7**		**?**	?	?		**?**	2.3***	?		**1.9***	?
Fitness and accuracy assessment of the model												
Likelihood ratio test	Chi-2 = 248.58; df=60; p=0.000				Chi-2= 255.69; df=60; p=0.000				Chi-2= 171.86; df=60; p=0.000			

Note: Signs ***, **, and * indicate statistical significance at the 99%, 95%, and 90% levels, respectively.

CGIAR RESEARCH PROGRAM ON Dryland Systems
ICARDA Science for Better Livelihoods in Dry Areas
ETH Eidgenössische Technische Hochschule Zürich Swiss Federal Institute of Technology Zurich
UPB

Tested ALS type-specific and common behavior: adoption of mineral fertilizer uses



Whole sample

Poor, landless and subsistence-based farms

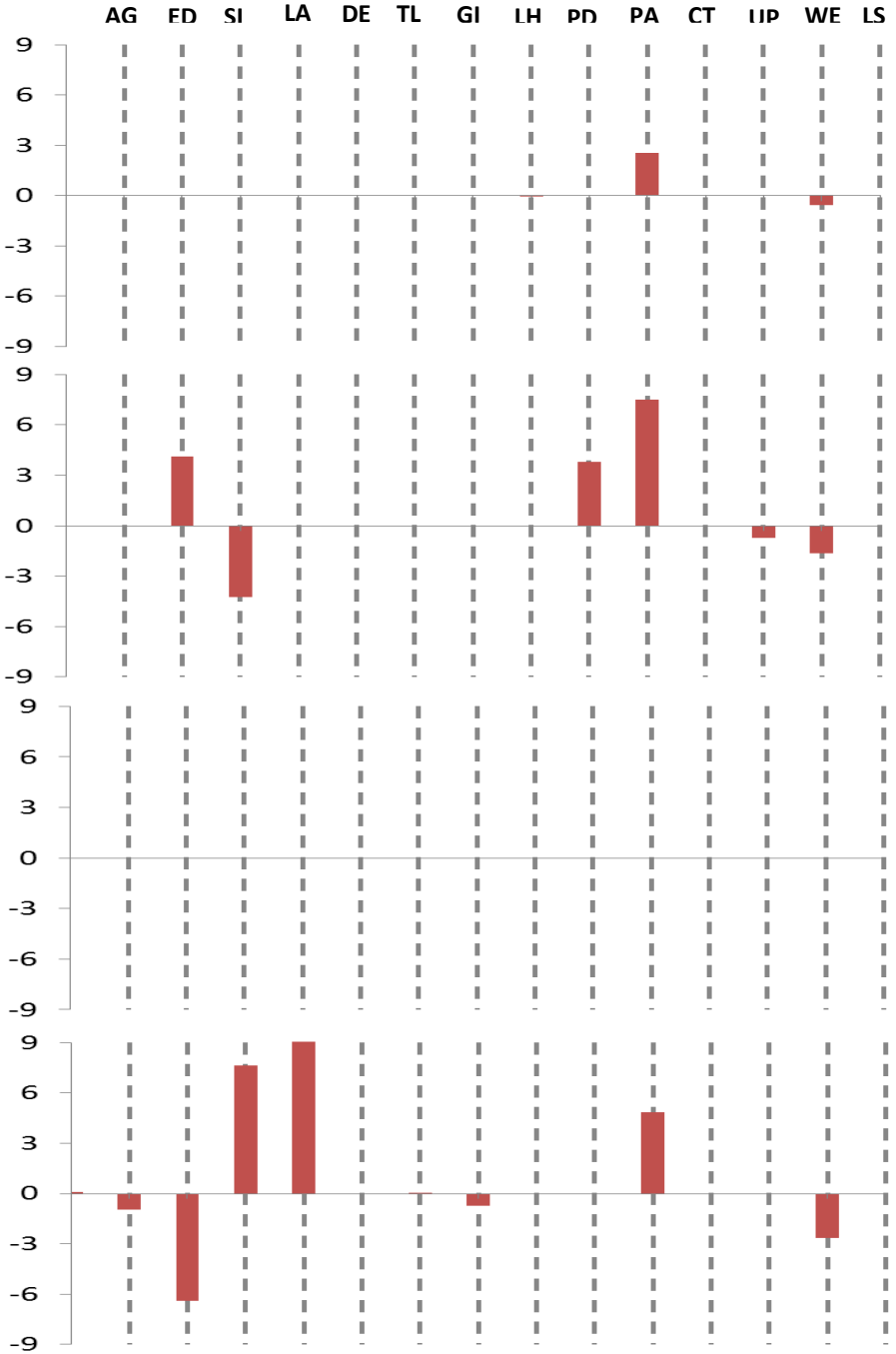
Medium-income, high-dependency, cotton-and livestock-turned

Better-off, land-and labour-rich, cotton- and livestock-turned

Legend

Variable	: Brief definition
AG	: Age of household head
ED	: Education of household head
SI	: Household size
LA	: Labor
DE	: Dependency ratio
TL	: Tropical Livestock Units
GI	: Gross Income
LH	: Land Holdings
PD	: Plot distance from house
PA	: Plot area
CT	: Crop type
UP	: Upslope
WE	: Wetness index
LS	: Slope length

Tested ALS type-specific and common behavior: adoption of combined mineral-organic fertilizer uses



Whole sample

Poor, landless and subsistence-based farms

Medium-income, high-dependency, cotton-and livestock-turned

Better-off, land-and labour-rich, cotton-and livestock-turned

Legend

Variable	: Brief definition
AG	: Age of household head
ED	: Education of household head
SI	: Household size
LA	: Labor
DE	: Dependency ratio
TL	: Tropical Livestock Units
GI	: Gross Income
LH	: Land Holdings
PD	: Plot distance from house
PA	: Plot area
CT	: Crop type
UP	: Upslope
WE	: Wetness index
LS	: Slope length

Concluding remarks

- Strong heterogeneity of studied smallholder farms was observed for both in the decision making for crop grown of plots and for adoption of soil nutrients

- This heterogeneity revealed a livelihood type specific behavior beside the usual common behavior for crop choice and sustainable nutrient management

- These results demonstrate that efficient farming system analysis and transformation in Sub-Saharan African drylands requires accounting for the heterogeneous behavior of smallholder farms