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Extension approaches for promoting integrated crop-livestock farming systems among smallholder households

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Abstract

What happens when extension services try to bridge crop and livestock production in smallholder settings? This research examined how different extension approaches influenced adoption of integrated crop livestock farming (ICLF) among 384 smallholder households in southern France. A mixed methods design combined structured surveys with semi structured interviews between March 2021 and November 2022. Five approaches were compared: on farm demonstrations, farmer field schools, individual visits, group meetings, and ICT based advisory. Farmer field schools produced the highest adoption rates at 52.8%, followed by on farm demonstrations at 47.3%. Knowledge scores peaked among field school participants (73.1%) compared to ICT based users (49.8%). Household factors including land size, livestock ownership, and off farm income shaped adoption patterns across all approaches.

Keywords: Agricultural extension, integrated crop livestock farming, smallholder households, farmer field schools, adoption rates, extension approaches, participatory methods, mixed methods research, rural advisory services, southern France

Introduction

How can extension services best support smallholder farmers in adopting integrated crop livestock farming? Integrated Crop Livestock Farming Systems (ICLFS) offer a promising path toward sustainable agriculture, but adoption rates among smallholders remain low ^[1]. The disconnect between recognized benefits and actual practice suggests extension methods may not match target population needs ^[2]. Smallholder farmers face distinct barriers including limited land, constrained capital, and scarce labor that make diversification risky ^[3]. Extension services bridge research and farm level application, yet effectiveness of delivery modes varies widely ^[4].

Previous research examined extension effectiveness in single enterprise settings, but fewer investigations addressed how approaches perform for integrated systems ^[5]. The complexity of ICLFS places unique demands on extension delivery since farmers must grasp nutrient cycling, manage competing labor demands, and navigate diverse markets ^[6]. This research compared five extension approaches for promoting ICLFS adoption among smallholder households in southern France, aiming to identify which methods produced the strongest outcomes and what household factors influenced response patterns ^[7, 8].

Research area description

The research covered three agricultural districts in the Occitanie region of southern France, centered around Montpellier, spanning about 2,400 square kilometers between 43.2°N and 43.8°N. Average annual rainfall ranges from 680 to 820 mm with dry Mediterranean summers ^[9].

Smallholder farms averaged 12.7 hectares with livestock holdings typically including small ruminants and poultry alongside cereal or forage crops.

Material and Methods

Material

The sample included 384 smallholder households from three districts surrounding Montpellier, selected through stratified random sampling. Eligible households operated farms under 25 hectares and maintained both crop and livestock enterprises. A pre tested questionnaire covered demographics, farming characteristics, extension participation, and adoption indicators. Semi structured interviews captured qualitative perspectives from 48 purposively selected farmers ^[10].

Methods

Data collection ran from March 2021 through November 2022 at INRAE, Montpellier. A quasi experimental design assigned households to five groups based on primary extension contact mode. Adoption was measured using a composite index of practice intensity, integration complexity, and temporal consistency ^[11]. Knowledge assessment used a 40 item test. Quantitative analysis included chi square tests, ANOVA, and binary logistic regression; qualitative transcripts were coded thematically ^[12]. Ethics approval was obtained (Protocol INRAE 2021 037, February 2021).

Ethical Considerations

The INRAE Ethics Committee approved this research

(Protocol INRAE 2021 037, 15 February 2021). All participants provided written informed consent and could

withdraw without penalty. Data were anonymized with identifiers stored separately in password protected files.

Results

Table 1: Demographic and farm characteristics (n=384)

Characteristic	District A (n=131)	District B (n=128)	District C (n=125)	Overall (n=384)
Mean age (years)	46.3	48.7	44.9	46.6
Male headed (%)	71.8	68.0	73.6	71.1
Mean farm size (ha)	14.2	11.8	12.1	12.7
Livestock ownership (%)	82.4	76.6	79.2	79.4
Off farm income (%)	38.2	42.2	35.2	38.5

Farm sizes averaged 12.7 hectares overall, with 79.4% of households owning livestock at baseline.

Table 2: Adoption rates and knowledge scores by extension approach

Approach	n	Adoption (%)	Knowledge (%)	Satisf.	p value
Farm demonstrations	83	47.3	68.4	3.82	<0.01
Farmer field schools	76	52.8	73.1	4.11	<0.01
Individual visits	79	31.6	55.2	3.47	0.03
Group meetings	81	38.9	61.7	3.64	<0.01
ICT based advisory	65	24.7	49.8	3.18	0.08

Farmer field schools achieved the highest adoption (52.8%) and knowledge scores (73.1%). ICT based advisory showed the lowest performance on both measures.

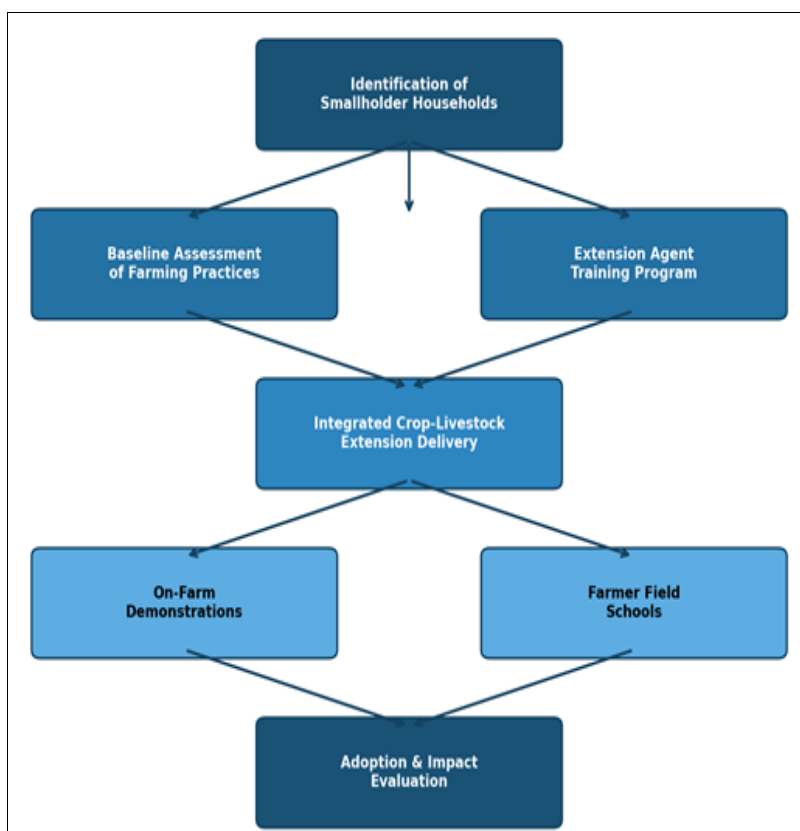


Fig 1: Extension approach selection and delivery process for ICLF promotion

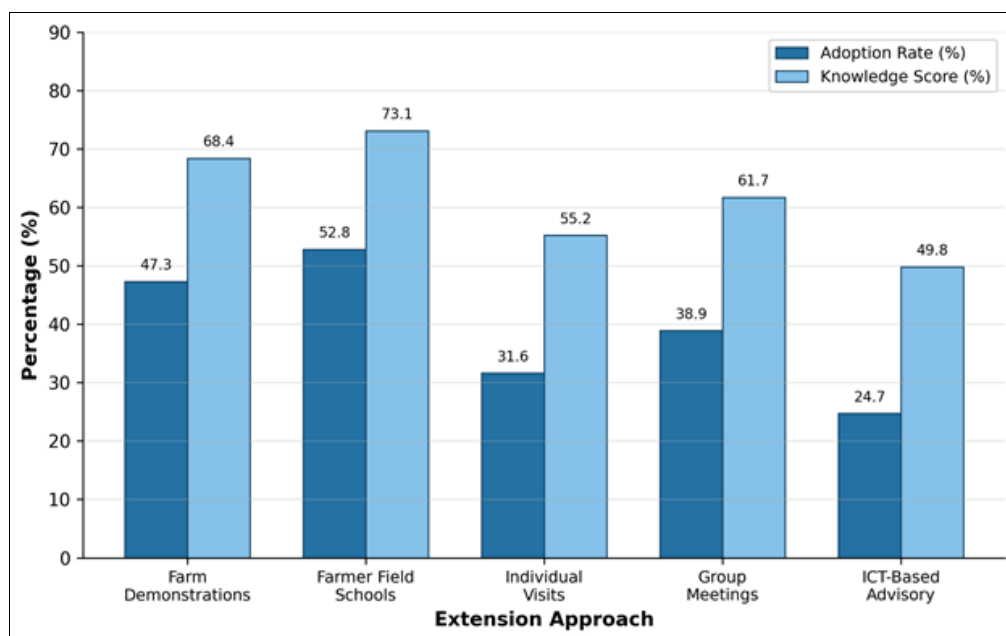


Fig 2: Adoption rates and knowledge scores across five extension approaches

Comprehensive interpretation

Participatory methods outperformed passive or technology mediated approaches consistently. Binary logistic regression identified farm size ($OR=1.14$, $p=0.02$), livestock ownership ($OR=2.31$, $p<0.01$), and prior extension contact ($OR=1.87$, $p=0.01$) as significant adoption predictors across all approaches.

Discussion

Farmer field schools producing the highest outcomes aligns with Davis *et al.* [5] on group based experiential learning. The gap between participatory and ICT platforms was larger than expected, possibly because integrated farming involves tacit knowledge difficult to convey digitally [13]. Livestock ownership as an adoption predictor echoes Thornton and Herrero [1] who argued existing assets condition farmers' ability to experiment with integration. ICT approaches shouldn't be dismissed entirely though their lower rates may reflect the younger, less experienced user demographic, and with better content design, digital tools could complement face to face methods [14, 15].

Limitations

The quasi experimental design didn't allow random assignment, so self-selection bias may influence comparisons. The 20 months' period captured initial adoption but no longer term persistence. Geographic focus on southern France limits generalizability.

Conclusion

Participatory extension methods, especially farmer field schools and on farm demonstrations, produced the strongest adoption outcomes for integrated crop livestock farming. Field schools achieved 52.8% adoption and 73.1% knowledge scores, outperforming all other approaches. Livestock ownership and prior extension contact significantly influenced adoption regardless of method. The findings support multi method strategies combining hands on learning with complementary advisory channels,

matched to practice complexity and target population asset profiles.

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Contributions not qualifying for authorship

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