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Influence of Agricultural Extension, Education on the Adoption of Sustainable Horticultural Crop Production, Landscape Planning and Livestock Management in Ekiti State, Nigeria

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Abstract: *Whether smallholder farmers take up sustainable production practices depends largely on what they are told, how they are taught and how well they can use what they learn. This paper looks at the roles of agricultural extension and farmer education in the adoption of sustainable horticultural crop production, landscape planning and livestock management in Ekiti State, Nigeria. A cross-sectional survey is planned for the main study; for this conference draft, a simulated dataset of 120 smallholder farmers is used to show how the analysis would be carried out. Frequencies and percentages describe the respondents, an adoption index records the proportion of relevant practices a farmer uses regularly, and a chi-square test checks whether extension contact is associated with adoption level. In the simulated data, 90.0% of farmers had at least primary education, 53.3% had regular extension contact and 56.7% were high adopters. Compost or organic-manure use was the most common horticultural practice (70.0%), while vaccination and other preventive health care led among livestock practices (67.5%). High adoption was found among 71.9% of farmers with regular extension contact but only 39.3% of those with limited or no contact ($\chi^2(1, N = 120) = 12.918$, $p < .001$; Cramér's $V = .328$, a moderate effect). The illustration suggests that regular, practical extension that suits farmers' educational levels could raise adoption, but real field data are needed before any conclusion is drawn about farmers in Ekiti State.*

Keywords: agricultural extension, farmer education, technology adoption, sustainable horticulture, landscape planning, livestock management, Ekiti State

Introduction

Smallholder farming households in Ekiti State, like those across southwestern Nigeria, contend with uneven rainfall, declining soil fertility, pests and diseases, expensive inputs and little access to credit. Vegetables, fruit trees, ornamentals and other tree crops, along with poultry, goats, sheep and pigs, supply food and income and help households spread their risks. How long these enterprises remain useful depends on how carefully land, water and animals are looked after, so farms need practices that stay productive while protecting soil, water, biodiversity and animal health.

This paper deals with three groups of practices. **Sustainable horticultural crop production** includes composting, mulching, intercropping, improved planting materials and integrated pest management. **Landscape planning** means laying out farm and homestead land so that crops, trees, water and animals work together, for example through soil and water conservation, water-saving irrigation and trees planted along boundaries and among crops. **Livestock management** includes disease prevention, better housing, balanced feeding, sound breeding, controlled grazing, waste handling and record keeping.

Awareness of a practice does not guarantee its use. Two sources of knowledge matter most. Agricultural extension passes new information to farmers, shows them how to apply it and follows up with advice, and it can help farmers fit technologies to local conditions instead of handing out uniform recommendations (Anderson & Feder, 2007). Education, whether formal or informal, shapes how easily farmers read instructions, keep records, work out costs and decide if a new practice is worthwhile (Lockheed et al., 1980). The two may reinforce each other, since identical advice can be received very differently by farmers with different amounts of schooling.

Most existing studies examine a single practice or enterprise. Yet farmers in Ekiti State usually run crops, trees and animals on the same holding, so this paper considers horticultural, landscape and livestock practices together. Its objectives are to:

- describe the socioeconomic characteristics of the farmers, including education;
- assess how far the farmers are reached by agricultural extension;
- determine how widely selected sustainable horticultural, landscape-planning and livestock practices are adopted;
- test the association between extension contact and overall adoption level; and
- in the field study, test the association between education and adoption level, and the joint influence of extension and education.

Two null hypotheses guide the field study. **H_o1:** extension contact is not significantly associated with adoption level. **H_o2:** farmers' level of education is not significantly associated with adoption level. This draft illustrates the test of H_o1 only; H_o2 and the combined effect of extension and education can be examined only with field data.

Literature Review and Conceptual Framework

Sustainable agricultural production

Sustainable agriculture keeps production going while safeguarding natural resources and farmers' livelihoods. Pretty (2008) emphasises technologies that draw on ecological processes, local knowledge and collective action and reduce reliance on non-renewable inputs. On smallholder farms no single technology achieves this; a combination of practices that support one another and fit local environmental and economic conditions is usually required.

In horticulture, compost and mulch build soil organic matter and hold moisture, intercropping spreads income and makes fuller use of land, and integrated pest management blends cultural, biological and carefully targeted chemical control. In livestock keeping, vaccination and other preventive care, suitable housing, balanced feeding and good waste handling protect animal welfare and avoid needless losses. Whether a practice is suitable still depends on the circumstances of each farm.

Landscape planning on smallholder farms

Landscape planning sees the farm as one connected system, not as separate plots and pens. Where crops, trees, water points, animal houses and manure heaps are placed influences erosion, water supply, microclimate and nutrient flows across the whole farm. Contour planting, vegetative barriers, boundary trees and well-designed irrigation layouts are usually set up once and pay off over many years, but they demand labour and land at the start. Farmers are thus likely to want technical guidance and demonstrations first, which makes landscape planning a natural subject for extension support and a reason to study it together with crop and livestock practices.

Agricultural extension and technology adoption

The diffusion-of-innovations view treats adoption as a sequence in which a farmer becomes aware of an innovation, develops interest, weighs its relevance, tries it where possible and then decides whether to keep using it (Rogers, 2003). Extension agents can assist at every step by supplying information, running demonstrations and helping farmers judge a technology's advantages, fit and complexity. Information and communication technologies can extend this reach, although their benefit depends on whether farmers have access and the skills to use them (Aker, 2011).

Reviews indicate that extension works better when advice is well delivered, farmers learn from it effectively and the technology suits local conditions (Takahashi et al., 2020). Farmer field schools and other group-based, participatory methods have improved knowledge and uptake in some settings (Davis et al., 2012), and access to extension and membership of farmer groups have been associated with greater adoption (Wossen et al., 2017). In Nigeria, smallholders' adoption of soil and water conservation in Kwara State was linked to personal, socioeconomic and institutional factors, among them formal training and technical support (Iyilade et al., 2020).

Education and adoption

Education can affect adoption in several ways. Better-schooled farmers generally find it easier to read labels and leaflets, follow written advice, keep records and work out costs and returns, and they may grasp new ideas faster and be more willing to experiment (Lockheed et al., 1980). Even so, education is only one determinant. Farm size, labour, credit, attitudes to risk and market access also count (Feder et al., 1985), and a farmer who understands a practice may still be unable to use it because of cost, water shortage, insecure tenure or lack of inputs. Extension and education should therefore be studied together and alongside these other factors.

Conceptual framework

The study assumes that extension and education affect adoption through three pathways:

- **Information pathway:** raising awareness and understanding of sustainable practices;
- **Skills pathway:** building ability through training, demonstrations and follow-up, with education influencing how readily advice is understood and applied; and
- **Risk-reduction pathway:** helping farmers compare the benefits, costs and requirements of a practice before committing resources.

The expected relationship is:

Extension contact and education → improved knowledge, skills and confidence → adoption of sustainable horticultural, landscape-planning and livestock practices

Resources, market conditions, farm characteristics and other socioeconomic factors may strengthen or weaken this relationship.

Materials and Methods

Study area

The study was carried out in Ekiti State, southwestern Nigeria, which comprises sixteen Local Government Areas in three senatorial districts: Ekiti North, Ekiti Central and Ekiti South. Farming is the chief occupation in most rural communities, where horticultural crops, tree crops and small-scale livestock are widespread. Communities were selected so that all three districts were represented, and each farm's location was recorded by GPS during fieldwork.

Research design and sampling procedure

A cross-sectional survey was conducted. The target population was smallholder farmers in Ekiti State who grow horticultural crops, keep livestock or do both.

A multistage sampling procedure was used. The three senatorial districts served as strata, with Local Government Areas chosen in each. Farming communities were then selected within those areas with the help of the Ekiti State agricultural development authorities and farmer organisations, and eligible farmers in each community were listed. Respondents were finally drawn using a probability method suited to the sampling frame.

Status of the present data

The results presented in this draft are based on **synthetic aggregate data for 120 hypothetical farmers**, which were used only to demonstrate the presentation and statistical analysis. They were framed as a single-community illustration (Ilogbo-Ekiti, Ido-Osi Local Government Area) and do not describe the farming population of Ilogbo-Ekiti or of Ekiti State.

Variables and measurement

The survey used a structured questionnaire to collect:

- age, sex, marital status and years of farming experience;
- highest level of formal education, adult-literacy or farmer-training courses attended, and ability to read and write in English or Yoruba;
- horticultural and livestock enterprises, farm size, labour and production resources;
- frequency and type of extension contact, and participation in demonstrations, training and farmer-group meetings; and

- awareness, trial and continued use of each sustainable practice.

For analysis, practices were grouped into horticultural crop production and landscape planning (reported together as 'sustainable horticulture' in Table 2) and livestock management (reported as 'animal production'). In Table 2, soil and water-conservation measures, water-efficient irrigation and agroforestry or boundary tree planting are the landscape-planning practices.

In this illustration, extension exposure was split into **regular contact** and **limited or no contact** over the previous 12 months, and a farmer counted as an adopter of a practice if it was reportedly used regularly. The adoption index for farmer *i* was computed as:

$$AI_i = (\text{Number of applicable practices regularly adopted by farmer i} \div \text{Total number of practices applicable to farmer i}) \times 100$$

Farmers scoring 60% or more were classed as high adopters and those below 60% as low adopters.

Data analysis

Respondent characteristics, extension exposure and practice-level adoption were summarised with frequencies and percentages. A chi-square test of independence assessed the association between extension contact and adoption level at the 5% significance level, and Cramér's V gauged its strength; the Pearson statistic was used without continuity correction. In the field study the same approach would be applied to education level, followed by multivariable models (see Discussion).

Results

All results in this section come from simulated data for 120 hypothetical farmers and do not describe actual farmers in Ilogbo-Ekiti.

Socioeconomic characteristics

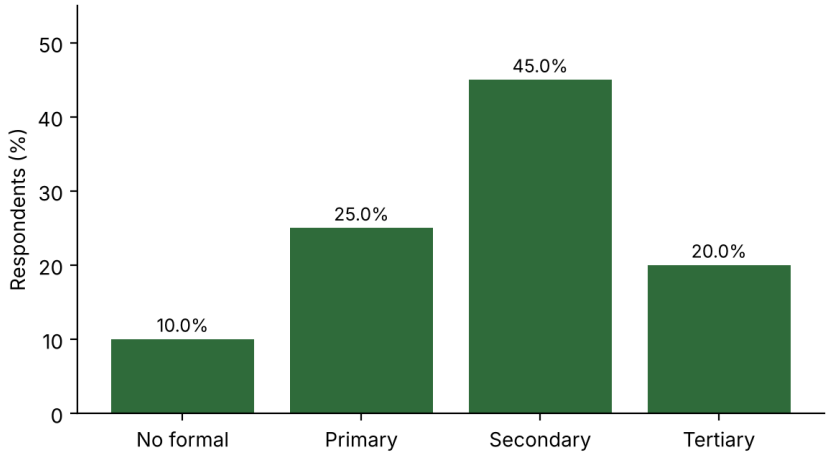
The simulated sample was 60.0% male and 40.0% female. Most respondents were between 31 and 60 years old. Ninety percent had at least primary education, and 60.0% had more than 10 years of farming experience.

Table 1: Simulated socioeconomic characteristics of respondents

Characteristic	Category	Frequency	Percentage (%)
Sex	Male	72	60.0
Sex	Female	48	40.0
Age	≤30 years	18	15.0
Age	31–40 years	30	25.0
Age	41–50 years	36	30.0
Age	51–60 years	24	20.0
Age	Above 60 years	12	10.0
Education	No formal education	12	10.0
Education	Primary	30	25.0
Education	Secondary	54	45.0
Education	Tertiary	24	20.0
Farming experience	≤5 years	18	15.0
Farming experience	6–10 years	30	25.0
Farming experience	11–20 years	42	35.0
Farming experience	Above 20 years	30	25.0
Total		**120**	**100.0**

Source: Simulated data, 2026.

Figure 1: Education level of respondents

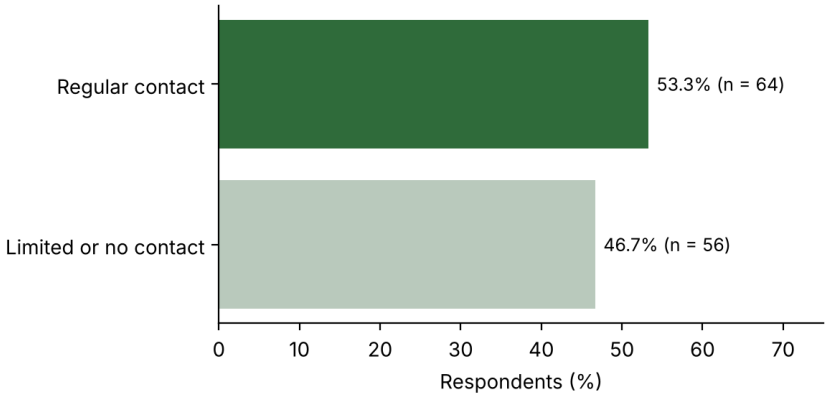


Simulated data, 2026 · drawn from Table 1

Exposure to extension services

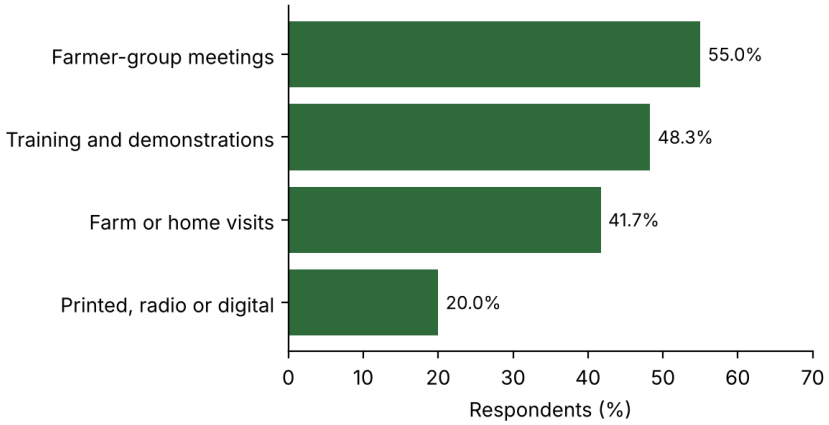
Sixty-four respondents (53.3%) had regular extension contact, and 56 (46.7%) had limited or no contact. Farmer-group meetings were the most frequently reported extension channel (55.0%), followed by training and demonstrations (48.3%), farm or home visits (41.7%), and printed, radio or digital information (20.0%). These percentages come from multiple responses and so do not total 100%.

Figure 2: Extension contact status of respondents



Simulated data, 2026 · 120 hypothetical respondents

Figure 3: Extension channels reported by respondents



Simulated data, 2026 · 120 hypothetical respondents

Adoption of sustainable practices

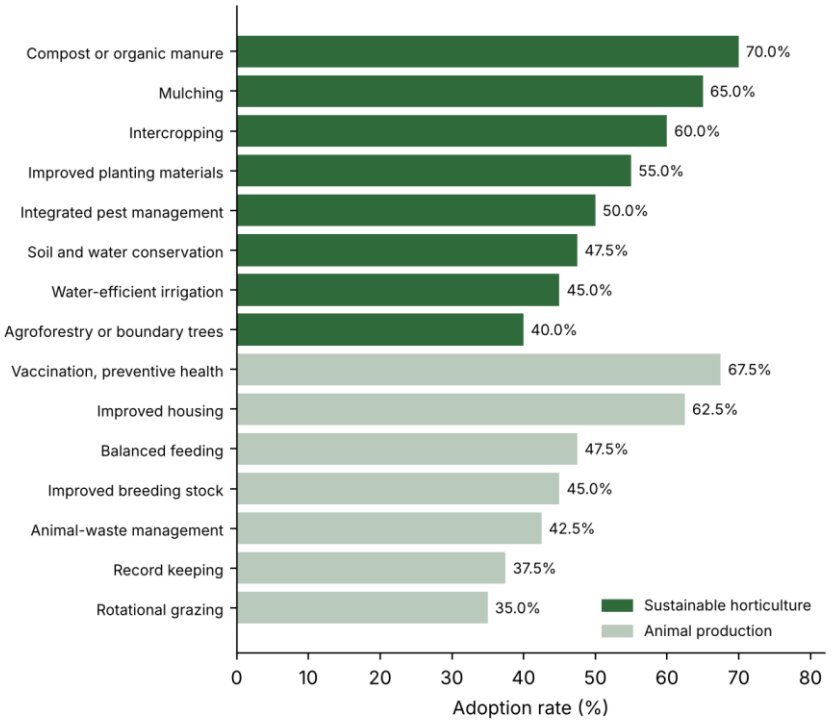
Overall, 68 respondents (56.7%) were high adopters and 52 (43.3%) were low adopters. Compost or organic-manure application had the highest simulated horticultural adoption rate, and agroforestry or boundary tree planting the lowest. Among animal-production practices, preventive healthcare ranked highest, while rotational grazing and record keeping ranked lowest.

Table 2: Simulated adoption of sustainable horticultural and animal-production practices

Practice	Adopters	Adoption rate (%)
Sustainable horticulture		
Compost or organic-manure application	84	70.0
Mulching	78	65.0
Intercropping or mixed cropping	72	60.0
Improved or disease-resistant planting materials	66	55.0
Integrated pest management	60	50.0
Soil and water-conservation measures	57	47.5
Water-efficient irrigation	54	45.0
Agroforestry or boundary tree planting	48	40.0
Animal production		
Vaccination and preventive health measures	81	67.5
Improved housing and ventilation	75	62.5
Balanced feeding or improved feed formulation	57	47.5
Selection of improved breeding stock	54	45.0
Proper animal-waste management	51	42.5
Production and health record keeping	45	37.5
Rotational or controlled grazing	42	35.0

Source: Simulated data, 2026. Respondents could adopt multiple practices.

Figure 4: Adoption rate of each sustainable practice



Simulated data, 2026 · 120 hypothetical respondents; drawn from Table 2

Extension contact and adoption level

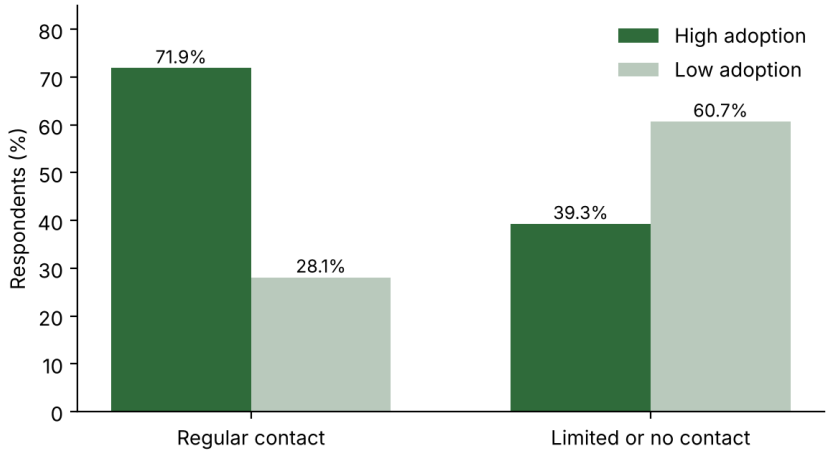
High adoption was more common among respondents with regular extension contact (71.9%) than among those with limited or no contact (39.3%).

Table 3: Simulated cross-tabulation of extension contact and adoption level

Extension contact	High adoption	Low adoption	Total
Regular contact	46 (71.9%)	18 (28.1%)	64
Limited or no contact	22 (39.3%)	34 (60.7%)	56
Total	**68 (56.7%)**	**52 (43.3%)**	**120**

Percentages in parentheses are row percentages. Source: Simulated data, 2026.

Figure 5: Adoption level by extension contact



Simulated data, 2026 · drawn from Table 3

The test result was:

$$\chi^2(1, N = 120) = 12.918, \quad p < .001, \quad V = .328$$

Within this simulated analysis the null hypothesis is rejected. Cramér's V indicates a moderate association.

Discussion

The simulated results illustrate how regular contact with extension services may go hand in hand with wider adoption of sustainable practices. Demonstrations, group meetings and farm visits allow farmers to watch a technology working, put questions to the extension worker and get help setting it up. This agrees with the extension literature, which regards learning, access to information and locally suitable advice as central to agricultural innovation (Anderson & Feder, 2007; Takahashi et al., 2020), and with evidence that participatory, group-based methods can strengthen uptake (Davis et al., 2012).

The contrast between practices is equally telling. Composting, mulching and preventive animal health care showed relatively high simulated adoption; they slot into everyday farm routines and need little extra land or money. Water-efficient irrigation, agroforestry and controlled grazing, which belong to landscape planning and grazing management, showed lower adoption. These may call for equipment, take time to establish, compete for land or be technically harder, so they probably need more hands-on extension than simple, cheap practices. The low uptake of record keeping may reflect doubts about its usefulness, too little training or literacy barriers, which is where education and extension plainly overlap.

The simulated sample covered a range of schooling: 45.0% had secondary education, 20.0% tertiary education and 10.0% none. Such variation matters for how extension is delivered in real farming communities. Farmers with little schooling may benefit most from demonstrations, pictures, messages in their own language and learning by doing, whereas better-educated farmers can make use of written guides, record books and digital sources. Whether education reinforces or replaces extension contact cannot be settled from these simulated tables and is a key question for the field study.

Extension contact should not be read automatically as the cause of higher adoption. Innovative or better-off farmers may be more likely to seek out extension and also more able to adopt what is recommended. Education, income, credit, farm size and group membership could therefore confound a simple two-variable comparison, as the adoption framework of Feder et al. (1985) suggests.

An empirical study should accordingly supplement the chi-square test with multivariable methods. Binary logistic regression could identify predictors of high adoption, including extension contact, education level and their interaction, and Poisson or negative binomial regression could model the number of practices adopted. Fitting separate models for horticultural, landscape-planning and livestock practices would avoid treating them as interchangeable.

Conclusion and Recommendations

This conference draft sets out a framework for studying how agricultural extension and education influence the adoption of sustainable horticultural crop production, landscape planning and livestock management in Ekiti State. The simulated results show a positive and statistically significant link between regular extension contact and high adoption, with a moderate effect size. They are not, however, evidence about the real study population, and the effect of education remains untested.

In plain words: in this example, farmers who met extension workers often were far more likely to use good farming practices than those who rarely or never did. Cheap and easy practices, such as making compost, covering the soil with mulch and vaccinating animals, were the most common. Practices that need more money, land or know-how, such as water-saving irrigation, planting trees on farm boundaries and moving animals between grazing plots, were the least common. Farm visits and interviews with real farmers are still needed to confirm this for Ekiti State, and to learn how much a farmer's schooling matters.

Subject to confirmation by field research, the following recommendations are made:

- **Make extension more practical:** give priority to demonstrations, farm visits and follow-up support instead of depending only on the passing on of information.
- **Fit the message to the farmer:** use pictures, Yoruba-language messages and hands-on training for farmers with little schooling, and written guides and digital tools for those able to use them.

- **Support farmer education:** link extension with adult-literacy and farmer-training programmes, and with the polytechnics and university in Ado-Ekiti, so that farmers gain basic skills in record keeping and farm planning.
- **Focus on practices with low uptake:** offer targeted training on efficient irrigation, boundary tree planting and other landscape-planning measures, controlled grazing, animal-waste management and record keeping.
- **Work through farmer groups:** encourage group learning and farmer-to-farmer demonstrations, and make sure women, young people and farmers with little extension access are included.
- **Ease resource constraints:** pair training with suitable credit, access to inputs and technologies that local farmers can afford.
- **Join up crop, landscape and livestock advice:** show how compost making, manure management and the recycling of suitable crop residues connect, and how to lay out a farm so that crops, trees, water and animals support one another.
- **Evaluate better:** track awareness, trial, continued use and disadoption separately instead of treating adoption as a single event.

Limitations and Requirements for the Empirical Study

The analysis rests on synthetic aggregate data and cannot support conclusions about real farmers. Only extension contact is tested; education is described but not tested against adoption. The two-category adoption measure oversimplifies what may be a gradual or partial process, and the chi-square test does not control for confounding variables. Before this paper is submitted as an empirical conference paper, the authors should:

- carry out the field survey across the three senatorial districts and report the actual sampling and response rates;
- demonstrate the validity and reliability of the instrument;
- secure ethical approval and informed consent;
- test the association between education level and adoption, and the combined effect of extension and education; and
- replace every simulated result with the observed findings.

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