

The Adoption of Improved Climate-smart Crop Varieties Increases Agricultural Production and Smallholder Commercialization in West Africa

Supplementary Information (Full model tables and robustness check)

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1 Descriptive statistics

Table SM1: Descriptive statistics by year and adoption status

| Characteristic | 2017, N = 2868 | | | 2018, N = 2868 | | | 2019, N = 2868 | | |
|---|------------------------|--------------------|---------|------------------------|--------------------|---------|------------------------|--------------------|---------|
| | Non-adopter, N = 1,809 | Adopter, N = 1,059 | p-value | Non-adopter, N = 1,770 | Adopter, N = 1,098 | p-value | Non-adopter, N = 1,670 | Adopter, N = 1,198 | p-value |
| Country | | | <0.001 | | | <0.001 | | | <0.001 |
| Ghana | 327 (18%) | 171 (16%) | | 353 (20%) | 145 (13%) | | 340 (20%) | 158 (13%) | |
| Mali | 697 (39%) | 143 (14%) | | 693 (39%) | 147 (13%) | | 642 (38%) | 198 (17%) | |
| Nigeria | 785 (43%) | 745 (70%) | | 724 (41%) | 806 (73%) | | 688 (41%) | 842 (70%) | |
| Age of household head (years) | 48 (13) | 47 (11) | 0.073 | 49 (13) | 47 (11) | <0.001 | 50 (12) | 49 (12) | 0.14 |
| Sex of household head (dummy, male=1) | 1,681 (93%) | 1,004 (95%) | 0.047 | 1,629 (92%) | 1,056 (96%) | <0.001 | 1,546 (93%) | 1,139 (95%) | 0.007 |
| Education level (Number of years) | 2.5 (3.8) | 3.4 (4.4) | <0.001 | 2.4 (3.8) | 3.6 (4.4) | <0.001 | 2.1 (3.3) | 3.9 (4.8) | <0.001 |
| Household size (number of persons) | 12 (7) | 10 (6) | <0.001 | 12 (7) | 10 (6) | <0.001 | 13 (10) | 10 (7) | <0.001 |
| Dependency ratio | 1.59 (1.10) | 1.77 (1.38) | 0.029 | 1.64 (1.15) | 1.69 (1.30) | 0.8 | 1.74 (1.32) | 1.95 (1.63) | 0.015 |
| Farmers group membership (dummy) | 757 (42%) | 551 (52%) | <0.001 | 771 (44%) | 537 (49%) | 0.005 | 696 (42%) | 518 (43%) | 0.4 |
| Training on agriculture (dummy) | 591 (33%) | 473 (45%) | <0.001 | 557 (31%) | 507 (46%) | <0.001 | 530 (32%) | 565 (47%) | <0.001 |
| Training on groundnut farming(dummy) | 1,020 (56%) | 587 (55%) | 0.6 | 1,001 (57%) | 606 (55%) | 0.5 | 629 (38%) | 766 (64%) | <0.001 |
| Public agricultural extension service (number of visits) | 1.21 (1.66) | 3.32 (3.30) | <0.001 | 1.40 (1.84) | 2.94 (3.29) | <0.001 | 1.71 (1.90) | 2.47 (2.12) | <0.001 |
| Private agricultural extension service (number of visits) | 0.58 (0.90) | 1.54 (1.89) | <0.001 | 0.62 (0.94) | 1.44 (1.88) | <0.001 | 1.11 (1.33) | 1.38 (1.57) | <0.001 |
| Cash credit for groundnut farming (dummy) | 32 (1.8%) | 24 (2.3%) | 0.4 | 30 (1.7%) | 26 (2.4%) | 0.2 | 49 (2.9%) | 76 (6.3%) | <0.001 |
| Credit in kind for groundnut farming (dummy) | 62 (3.4%) | 129 (12%) | <0.001 | 54 (3.1%) | 137 (12%) | <0.001 | 87 (5.2%) | 150 (13%) | <0.001 |
| Distance to the nearest urban market (km) | 15 (18) | 11 (11) | <0.001 | 15 (19) | 11 (11) | <0.001 | 13 (14) | 12 (14) | <0.001 |
| Distance the nearest village market (km) | 3.8 (5.3) | 3.5 (3.7) | 0.004 | 3.9 (5.4) | 3.4 (3.6) | 0.003 | 4.8 (5.0) | 3.6 (4.5) | <0.001 |
| Crop rotation (dummy) | 889 (49%) | 397 (37%) | <0.001 | 905 (51%) | 381 (35%) | <0.001 | 921 (55%) | 393 (33%) | <0.001 |
| Mixed Crops (dummy) | 657 (36%) | 448 (42%) | 0.001 | 681 (38%) | 424 (39%) | >0.9 | 725 (43%) | 542 (45%) | 0.3 |
| Labor force (man.day) | 3.9 (5.1) | 6.5 (7.4) | <0.001 | 4.4 (5.5) | 5.6 (7.1) | <0.001 | 7 (9) | 7 (6) | <0.001 |
| Unit selling price (USD/kg) | 0.53 (0.07) | 0.71 (0.08) | <0.001 | 0.53 (0.07) | 0.72 (0.08) | <0.001 | 0.53 (0.07) | 0.71 (0.09) | <0.001 |
| Seed cost (USD/ha) | 8 (16) | 27 (19) | <0.001 | 8 (17) | 25 (20) | <0.001 | 20 (21) | 23 (19) | <0.001 |
| Fertilizer cost (USD/ha) | 17 (29) | 53 (39) | <0.001 | 18 (30) | 49 (40) | <0.001 | 19 (28) | 49 (39) | <0.001 |
| Pesticide cost (USD/ha) | 4 (8) | 14 (14) | <0.001 | 4 (8) | 13 (14) | <0.001 | 6 (13) | 11 (11) | <0.001 |
| Labor cost (USD/ha) | 21 (33) | 49 (41) | <0.001 | 24 (34) | 43 (41) | <0.001 | 50 (49) | 50 (41) | 0.031 |
| Groundnut area (ha) | 1.44 (1.47) | 1.81 (1.62) | <0.001 | 1.49 (1.46) | 1.72 (1.64) | <0.001 | 1.60 (1.47) | 1.72 (1.32) | <0.001 |
| Off-farm income (dummy) | 80 (4.4%) | 190 (18%) | <0.001 | 85 (4.8%) | 185 (17%) | <0.001 | 142 (8.5%) | 199 (17%) | <0.001 |
| Clay soil (dummy) | 279 (15%) | 164 (15%) | >0.9 | 271 (15%) | 172 (16%) | 0.8 | 282 (17%) | 207 (17%) | 0.8 |
| Sandy-clay soil (dummy) | 987 (55%) | 595 (56%) | 0.4 | 977 (55%) | 605 (55%) | >0.9 | 740 (44%) | 516 (43%) | 0.5 |
| Silty soil (dummy) | 281 (16%) | 162 (15%) | 0.9 | 278 (16%) | 165 (15%) | 0.6 | 306 (18%) | 200 (17%) | 0.3 |

¹ n (%); Mean (SD)² Pearson's Chi-squared test; Wilcoxon rank sum test

2 Pooled OLS Regressions

Table SM2: Full OLS estimates of the relationship between adoption and commercialization(Adoption)

| variables | Sellers | Quantity sold | Sales value |
|---|----------------------|----------------------|----------------------|
| Adoption dummy | 0.021* (0.012) | 0.145* (0.079) | 0.132* (0.073) |
| Age of household head (years) | -0.001** (0.000) | -0.006** (0.002) | -0.005*** (0.002) |
| Sex of household head (dummy, male=1) | -0.012 (0.020) | 0.105 (0.129) | 0.112 (0.118) |
| Education level (Number of years) | 0.001 (0.001) | -0.005 (0.006) | -0.005 (0.005) |
| Household size (number of persons) | 0.000 (0.001) | 0.015*** (0.005) | 0.015*** (0.004) |
| Farmers group membership (dummy) | 0.022*** (0.004) | 0.132*** (0.029) | 0.120*** (0.027) |
| Training on agriculture (dummy) | -0.057*** (0.011) | -0.320*** (0.074) | -0.282*** (0.068) |
| Training on groundnut farming (dummy) | -0.021*** (0.004) | -0.154*** (0.025) | -0.143*** (0.023) |
| Public agricultural extension service (number of visits) | 0.001 (0.002) | -0.017 (0.014) | -0.018 (0.013) |
| Private agricultural extension service (number of visits) | 0.007** (0.003) | 0.034* (0.020) | 0.027 (0.019) |
| Cash credit for groundnut farming (dummy) | 0.011 (0.020) | 0.034 (0.140) | 0.026 (0.130) |
| Credit in kind for groundnut farming (dummy) | -0.008 (0.012) | 0.039 (0.088) | 0.043 (0.082) |
| Distance to the nearest urban market (km) | -0.002*** (0.000) | -0.015*** (0.002) | -0.014*** (0.002) |
| Distance the nearest village market (km) | -0.004*** (0.001) | -0.021*** (0.007) | -0.019*** (0.007) |
| Crop rotation (dummy) | 0.010 (0.010) | 0.085 (0.063) | 0.078 (0.057) |
| Mixed Crops (dummy) | 0.003 (0.008) | -0.095* (0.051) | -0.097** (0.047) |
| Labor force (man.day) | 0.002*** (0.001) | 0.024*** (0.004) | 0.023*** (0.004) |
| Unit selling price (USD/kg) | 0.068 (0.042) | 0.579** (0.286) | 2.001*** (0.264) |
| Seed cost (USD/ha) | 0.001*** (0.000) | 0.010*** (0.002) | 0.009*** (0.002) |
| Fertilizer cost (USD/ha) | 0.000 (0.000) | 0.001* (0.001) | 0.001* (0.001) |
| Pesticide cost (USD/ha) | -0.000 (0.000) | 0.003 (0.002) | 0.003 (0.002) |
| Labor cost (USD/ha) | 0.000*** (0.000) | 0.002*** (0.001) | 0.002*** (0.001) |
| Groundnut area (ha) | 0.019*** (0.003) | 0.347*** (0.022) | 0.335*** (0.021) |
| Off-farm income (dummy) | -0.033*** (0.010) | -0.151** (0.074) | -0.135** (0.069) |
| Dependency ratio | 0.001 (0.003) | -0.002 (0.019) | -0.003 (0.017) |
| Clay soil (dummy) | -0.008 (0.011) | -0.097 (0.077) | -0.095 (0.071) |
| Sandy-clay soil (dummy) | 0.007 (0.009) | 0.035 (0.061) | 0.031 (0.056) |
| Silty soil (dummy) | 0.008 (0.011) | 0.052 (0.076) | 0.046 (0.070) |

Table SM2: Full OLS estimates of the relationship between adoption and commercialization(Adoption) (*continued*)

| variables | Sellers | Quantity sold | Sales value |
|---------------------------------------|---------------------|---------------------|---------------------|
| Constant | 0.852*** (0.038) | 5.469*** (0.258) | 4.157*** (0.236) |
| Observations | 8,604 | 8,604 | 8,604 |
| R-squared | 0.274 | 0.421 | 0.451 |
| Robust standard errors in parentheses | | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | | |

Table SM3: Full OLS estimates of the relationship between adoption and commercialization (Area under Adoption)

| variables | Sellers | Quantity sold | Sales value |
|---|----------------------|----------------------|----------------------|
| Area under adoption (ha) | -0.006 (0.004) | -0.021 (0.032) | -0.015 (0.031) |
| Age of household head (years) | -0.001** (0.000) | -0.006** (0.002) | -0.005*** (0.002) |
| Sex of household head (dummy, male=1) | -0.011 (0.020) | 0.110 (0.129) | 0.116 (0.118) |
| Education level (Number of years) | 0.001 (0.001) | -0.005 (0.006) | -0.006 (0.005) |
| Household size (number of persons) | 0.000 (0.001) | 0.014*** (0.005) | 0.014*** (0.004) |
| Farmers group membership (dummy) | 0.022*** (0.004) | 0.132*** (0.029) | 0.120*** (0.027) |
| Training on agriculture (dummy) | -0.056*** (0.011) | -0.319*** (0.074) | -0.282*** (0.068) |
| Training on groundnut farming (dummy) | -0.021*** (0.004) | -0.155*** (0.025) | -0.144*** (0.023) |
| Public agricultural extension service (number of visits) | 0.001 (0.002) | -0.015 (0.014) | -0.016 (0.013) |
| Private agricultural extension service (number of visits) | 0.008*** (0.003) | 0.042** (0.020) | 0.033* (0.019) |
| Cash credit for groundnut farming (dummy) | 0.011 (0.020) | 0.038 (0.140) | 0.030 (0.131) |
| Credit in kind for groundnut farming (dummy) | -0.006 (0.012) | 0.052 (0.087) | 0.053 (0.082) |
| Distance to the nearest urban market (km) | -0.002*** (0.000) | -0.015*** (0.002) | -0.014*** (0.002) |
| Distance the nearest village market (km) | -0.004*** (0.001) | -0.021*** (0.007) | -0.019*** (0.007) |
| Crop rotation (dummy) | 0.009 (0.010) | 0.080 (0.063) | 0.074 (0.058) |
| Mixed Crops (dummy) | 0.002 (0.008) | -0.100* (0.051) | -0.102** (0.047) |
| Labor force (man.day) | 0.002*** (0.001) | 0.023*** (0.004) | 0.022*** (0.004) |
| Unit selling price (USD/kg) | 0.134*** (0.034) | 0.982*** (0.235) | 2.357*** (0.218) |
| Seed cost (USD/ha) | 0.001*** (0.000) | 0.010*** (0.002) | 0.009*** (0.002) |
| Fertilizer cost (USD/ha) | 0.000 (0.000) | 0.002** (0.001) | 0.002** (0.001) |
| Pesticide cost (USD/ha) | -0.000 (0.000) | 0.004 (0.002) | 0.004* (0.002) |
| Labor cost (USD/ha) | 0.000*** (0.000) | 0.002*** (0.001) | 0.002*** (0.001) |
| Groundnut area (ha) | 0.022*** (0.003) | 0.355*** (0.022) | 0.342*** (0.021) |
| Off-farm income (dummy) | -0.033*** (0.010) | -0.150** (0.074) | -0.134* (0.069) |
| Dependency ratio | 0.001 (0.003) | -0.003 (0.019) | -0.003 (0.017) |
| Clay soil (dummy) | -0.009 (0.011) | -0.101 (0.077) | -0.099 (0.071) |
| Sandy-clay soil (dummy) | 0.006 (0.009) | 0.032 (0.060) | 0.028 (0.055) |
| Silty soil (dummy) | 0.008 (0.011) | 0.053 (0.076) | 0.046 (0.070) |
| Constant | 0.819*** (0.036) | 5.267*** (0.245) | 3.980*** (0.225) |
| Observations | 8,604 | 8,604 | 8,604 |

Table SM3: Full OLS estimates of the relationship between adoption and commercialization (Area under Adoption) (*continued*)

| variables | Sellers | Quantity sold | Sales value |
|---------------------------------------|---------|---------------|-------------|
| R-squared | 0.273 | 0.421 | 0.451 |
| Robust standard errors in parentheses | | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | | |

Table SM4: Full OLS estimates of the relationship between adoption, production and yields(Adoption)

| variables | Production | Production value | Yields |
|---|------------------------|--------------------------|------------------------|
| Adoption dummy | 538.366*** (36.536) | 359.340*** (24.099) | 283.336*** (15.075) |
| Age of household head (years) | 0.226 (0.882) | 0.246 (0.625) | -0.023 (0.374) |
| Sex of household head (dummy, male=1) | -17.450 (31.798) | -20.938 (23.338) | -24.355 (17.706) |
| Education level (Number of years) | 0.573 (2.929) | -0.462 (2.113) | 1.681 (1.329) |
| Household size (number of persons) | -2.087 (1.918) | -3.346** (1.312) | 0.531 (0.633) |
| Farmers group membership (dummy) | 27.503* (14.436) | 23.696** (10.143) | 1.717 (5.305) |
| Training on agriculture (dummy) | 20.058 (28.123) | 10.166 (19.713) | 12.945 (11.464) |
| Training on groundnut farming (dummy) | -2.803 (9.558) | -3.008 (6.533) | -2.129 (4.027) |
| Public agricultural extension service (number of visits) | -10.965 (7.583) | -9.267* (5.383) | -7.113** (2.889) |
| Private agricultural extension service (number of visits) | -20.005** (9.408) | -13.667** (6.454) | -3.053 (3.826) |
| Cash credit for groundnut farming (dummy) | -116.583* (62.411) | -96.283** (42.370) | -3.990 (27.589) |
| Credit in kind for groundnut farming (dummy) | 19.798 (52.308) | 39.725 (37.817) | -8.167 (19.779) |
| Distance to the nearest urban market (km) | -0.254 (0.828) | -0.150 (0.553) | 0.039 (0.353) |
| Distance the nearest village market (km) | -3.361* (1.840) | -2.097* (1.198) | -1.617** (0.795) |
| Crop rotation (dummy) | -54.106* (27.676) | -50.565** (19.779) | 1.007 (11.600) |
| Mixed Crops (dummy) | 40.551* (21.514) | 32.475** (15.265) | -1.605 (9.425) |
| Labor force (man.day) | -4.390 (2.721) | -3.713** (1.808) | -1.619** (0.788) |
| Unit selling price (USD/kg) | 36.726 (128.183) | 1,208.590*** (90.647) | 93.809* (55.544) |
| Seed cost (USD/ha) | -0.542 (0.569) | -0.338 (0.402) | -0.371 (0.257) |
| Fertilizer cost (USD/ha) | -1.346*** (0.440) | -1.273*** (0.322) | -0.004 (0.199) |
| Pesticide cost (USD/ha) | 2.260* (1.289) | 2.177** (0.999) | 0.024 (0.531) |
| Labor cost (USD/ha) | 0.075 (0.265) | 0.043 (0.191) | -0.082 (0.131) |
| Groundnut area (ha) | 698.176*** (20.072) | 436.072*** (13.993) | 1.376 (3.300) |
| Off-farm income (dummy) | -15.131 (39.174) | -9.056 (29.191) | -21.645 (18.076) |
| Dependency ratio | -10.922 (7.625) | -9.494* (5.439) | -1.563 (3.538) |
| Clay soil (dummy) | 6.092 (29.406) | 0.292 (20.300) | 3.708 (13.795) |
| Sandy-clay soil (dummy) | 28.195 (25.243) | 20.606 (17.693) | -1.381 (11.221) |
| Silty soil (dummy) | 20.218 (30.870) | 14.880 (21.598) | 12.882 (13.986) |
| Constant | -56.343 (100.492) | -695.254*** (74.132) | 605.495*** (42.744) |
| Observations | 8,604 | 8,604 | 8,604 |

Table SM4: Full OLS estimates of the relationship between adoption, production and yields(Adoption) (*continued*)

| variables | Production | Production value | Yields |
|---------------------------------------|------------|------------------|--------|
| R-squared | 0.616 | 0.594 | 0.181 |
| Robust standard errors in parentheses | | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | | |

Table SM5: OLS estimates of the relationship between adoption, production and yields(Area under Adoption)

| variables | Production | Production value | Yields |
|---|--------------------------|--------------------------|------------------------|
| Area under adoption (ha) | 238.550*** (34.459) | 216.814*** (24.253) | 57.226*** (6.403) |
| Age of household head (years) | 0.377 (0.875) | 0.374 (0.611) | 0.025 (0.380) |
| Sex of household head (dummy, male=1) | -17.307 (29.621) | -23.796 (20.843) | -20.776 (17.751) |
| Education level (Number of years) | 2.728 (2.916) | 1.428 (2.076) | 2.280* (1.354) |
| Household size (number of persons) | 0.104 (1.852) | -1.326 (1.243) | 1.023 (0.641) |
| Farmers group membership (dummy) | 23.024 (14.530) | 19.604* (10.143) | 0.668 (5.411) |
| Training on agriculture (dummy) | 19.017 (28.199) | 8.794 (19.422) | 13.199 (11.653) |
| Training on groundnut farming (dummy) | -6.485 (9.625) | -5.155 (6.519) | -4.435 (4.090) |
| Public agricultural extension service (number of visits) | -5.811 (7.401) | -6.431 (5.123) | -3.685 (2.924) |
| Private agricultural extension service (number of visits) | -10.123 (9.116) | -10.434* (6.215) | 6.138 (3.799) |
| Cash credit for groundnut farming (dummy) | -87.350 (63.173) | -74.251* (42.902) | 8.406 (28.328) |
| Credit in kind for groundnut farming (dummy) | -8.897 (50.662) | 6.830 (35.263) | -6.967 (20.115) |
| Distance to the nearest urban market (km) | -0.735 (0.826) | -0.486 (0.541) | -0.196 (0.363) |
| Distance the nearest village market (km) | -3.326* (1.806) | -2.099* (1.139) | -1.568** (0.794) |
| Crop rotation (dummy) | -42.921 (26.863) | -38.056** (18.900) | 0.911 (11.740) |
| Mixed Crops (dummy) | 34.291 (21.331) | 30.585** (14.868) | -7.613 (9.562) |
| Labor force (man.day) | -4.084 (2.927) | -3.021 (1.994) | -2.037** (0.808) |
| Unit selling price (USD/kg) | 512.083*** (133.797) | 1,339.478*** (96.971) | 565.109*** (49.594) |
| Seed cost (USD/ha) | 0.128 (0.546) | 0.059 (0.370) | 0.042 (0.259) |
| Fertilizer cost (USD/ha) | -0.846** (0.431) | -0.963*** (0.312) | 0.288 (0.201) |
| Pesticide cost (USD/ha) | 2.188* (1.325) | 1.732* (1.024) | 0.456 (0.540) |
| Labor cost (USD/ha) | 0.010 (0.257) | -0.006 (0.179) | -0.110 (0.133) |
| Groundnut area (ha) | 634.558*** (20.141) | 376.027*** (13.418) | -11.249*** (3.596) |
| Off-farm income (dummy) | -3.625 (38.674) | 0.179 (28.513) | -17.434 (18.365) |
| Dependency ratio | -7.874 (7.614) | -6.761 (5.353) | -0.786 (3.592) |
| Clay soil (dummy) | 28.503 (29.032) | 22.644 (19.653) | 6.733 (14.049) |
| Sandy-clay soil (dummy) | 45.222* (24.917) | 36.851** (17.077) | 1.791 (11.460) |
| Silty soil (dummy) | 26.747 (30.838) | 20.009 (21.038) | 15.403 (14.258) |
| Constant | -246.760*** (102.298) | -720.479*** (74.363) | 384.428*** (40.954) |
| Observations | 8,604 | 8,604 | 8,604 |

Table SM5: OLS estimates of the relationship between adoption, production and yields(Area under Adoption) (*continued*)

| variables | Production | Production value | Yields |
|---------------------------------------|------------|------------------|--------|
| R-squared | 0.622 | 0.613 | 0.156 |
| Robust standard errors in parentheses | | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | | |

3 Panel Regression

Table SM6: Full 2SLS estimates of the relationship between adoption and commercialization(Adoption)

| variables | FE-MP | RE-MP | FE-QS | RE-QS | FE-SV | RE-SV |
|---|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Adoption dummy | 0.044** (0.017) | 0.033** (0.015) | 0.400*** (0.117) | 0.354*** (0.105) | 0.388*** (0.108) | 0.346*** (0.097) |
| Age of household head (years) | 0.002 (0.003) | -0.001* (0.000) | -0.009 (0.024) | -0.006** (0.003) | -0.011 (0.022) | -0.005** (0.003) |
| Sex of household head (dummy, male=1) | | -0.011 (0.020) | | 0.121 (0.137) | | 0.127 (0.126) |
| Education level (Number of years) | | 0.001 (0.001) | | -0.005 (0.009) | | -0.005 (0.008) |
| Household size (number of persons) | 0.002*** (0.001) | 0.001* (0.001) | 0.027*** (0.005) | 0.020*** (0.004) | 0.026*** (0.004) | 0.019*** (0.004) |
| Farmers group membership (dummy) | 0.022*** (0.005) | 0.023*** (0.004) | 0.126*** (0.035) | 0.133*** (0.028) | 0.113*** (0.032) | 0.120*** (0.026) |
| Training on agriculture (dummy) | -0.043*** (0.011) | -0.052*** (0.009) | -0.310*** (0.078) | -0.317*** (0.064) | -0.284*** (0.072) | -0.283*** (0.059) |
| Training on groundnut farming (dummy) | -0.025*** (0.003) | -0.023*** (0.003) | -0.178*** (0.023) | -0.168*** (0.021) | -0.164*** (0.021) | -0.155*** (0.019) |
| Public agricultural extension service (number of visits) | 0.002 (0.002) | 0.002 (0.002) | -0.022 (0.016) | -0.017 (0.014) | -0.023 (0.015) | -0.019 (0.013) |
| Private agricultural extension service (number of visits) | 0.004 (0.003) | 0.005* (0.003) | 0.051** (0.024) | 0.034* (0.020) | 0.048** (0.022) | 0.028 (0.018) |
| Cash credit for groundnut farming (dummy) | -0.009 (0.023) | 0.001 (0.020) | -0.174 (0.156) | -0.068 (0.136) | -0.181 (0.144) | -0.075 (0.125) |
| Credit in kind for groundnut farming (dummy) | -0.043*** (0.016) | -0.025* (0.014) | -0.035 (0.109) | -0.009 (0.093) | -0.011 (0.100) | 0.004 (0.086) |
| Distance to the nearest urban market (km) | -0.000 (0.000) | -0.001*** (0.000) | -0.003* (0.002) | -0.009*** (0.002) | -0.003* (0.002) | -0.008*** (0.002) |
| Distance the nearest village market (km) | -0.003*** (0.001) | -0.003*** (0.001) | -0.012* (0.006) | -0.016*** (0.005) | -0.011* (0.006) | -0.015*** (0.005) |
| Crop rotation (dummy) | -0.025** (0.011) | -0.006 (0.009) | -0.158** (0.072) | -0.024 (0.061) | -0.147** (0.066) | -0.022 (0.056) |
| Mixed Crops (dummy) | 0.004 (0.009) | 0.002 (0.007) | -0.065 (0.061) | -0.083* (0.050) | -0.067 (0.056) | -0.085* (0.046) |
| Labor force (man.day) | 0.002*** (0.001) | 0.002*** (0.001) | 0.026*** (0.005) | 0.025*** (0.004) | 0.025*** (0.004) | 0.024*** (0.004) |
| Unit selling price (USD/kg) | 0.051 (0.050) | 0.058 (0.046) | 0.275 (0.338) | 0.243 (0.313) | 1.687*** (0.311) | 1.648*** (0.288) |
| Seed cost (USD/ha) | 0.002*** (0.000) | 0.002*** (0.000) | 0.011*** (0.002) | 0.010*** (0.001) | 0.010*** (0.001) | 0.009*** (0.001) |
| Fertilizer cost (USD/ha) | 0.000 (0.000) | 0.000 (0.000) | 0.001 (0.001) | 0.002* (0.001) | 0.001 (0.001) | 0.001 (0.001) |
| Pesticide cost (USD/ha) | -0.001*** (0.000) | -0.001** (0.000) | -0.004 (0.003) | -0.001 (0.003) | -0.003 (0.003) | -0.000 (0.002) |
| Labor cost (USD/ha) | 0.000*** (0.000) | 0.000*** (0.000) | 0.002*** (0.001) | 0.002*** (0.001) | 0.002*** (0.001) | 0.002*** (0.001) |
| Groundnut area (ha) | 0.003 (0.003) | 0.013*** (0.003) | 0.200*** (0.023) | 0.285*** (0.018) | 0.197*** (0.021) | 0.277*** (0.017) |
| Off-farm income (dummy) | -0.019 (0.014) | -0.027** (0.012) | -0.033 (0.098) | -0.099 (0.083) | -0.022 (0.090) | -0.086 (0.076) |
| Dependency ratio | 0.002 (0.003) | 0.001 (0.003) | 0.012 (0.022) | 0.003 (0.018) | 0.011 (0.020) | 0.002 (0.016) |
| Clay soil (dummy) | -0.017 (0.013) | -0.012 (0.011) | -0.164* (0.087) | -0.123* (0.073) | -0.158** (0.080) | -0.119* (0.067) |
| Sandy-clay soil (dummy) | 0.006 (0.010) | 0.006 (0.009) | 0.052 (0.068) | 0.035 (0.059) | 0.048 (0.063) | 0.032 (0.054) |
| Silty soil (dummy) | -0.004 (0.013) | 0.002 (0.011) | -0.030 (0.087) | 0.012 (0.073) | -0.031 (0.080) | 0.008 (0.067) |

Table SM6: Full 2SLS estimates of the relationship between adoption and commercialization(Adoption) (*continued*)

| variables | FE-MP | RE-MP | FE-QS | RE-QS | FE-SV | RE-SV |
|--------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Constant | 0.770*** (0.184) | 0.964*** (0.052) | 6.406*** (1.244) | 6.987*** (0.355) | 5.192*** (1.144) | 5.635*** (0.326) |
| Observations | 8,604 | 8,604 | 8,604 | 8,604 | 8,604 | 8,604 |
| Number of id | 2,868 | 2,868 | 2,868 | 2,868 | 2,868 | 2,868 |
| District FE | YES | YES | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES | YES | YES |
| Standard errors in parentheses | | | | | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | | | | | |

Table SM7: Full 2SLS estimates of the relationship between adoption and commercialization (Area under Adoption)

| variables | FE-MP | RE-MP | FE-QS | RE-QS | FE-SV | RE-SV |
|---|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Area under adoption (ha) | 0.033*** (0.012) | 0.023** (0.011) | 0.299*** (0.084) | 0.253*** (0.076) | 0.290*** (0.078) | 0.247*** (0.070) |
| Age of household head (years) | 0.002 (0.004) | 0.001 (0.004) | -0.012 (0.024) | -0.018 (0.024) | -0.014 (0.022) | -0.019 (0.022) |
| Sex of household head (dummy, male=1) | | -0.014 (0.020) | | 0.069 (0.139) | | 0.078 (0.127) |
| Education level (Number of years) | | 0.001 (0.001) | | -0.002 (0.009) | | -0.003 (0.008) |
| Household size (number of persons) | 0.002*** (0.001) | 0.002*** (0.001) | 0.029*** (0.005) | 0.029*** (0.005) | 0.028*** (0.005) | 0.028*** (0.005) |
| Farmers group membership (dummy) | 0.022*** (0.005) | 0.022*** (0.005) | 0.122*** (0.035) | 0.123*** (0.035) | 0.109*** (0.032) | 0.110*** (0.032) |
| Training on agriculture (dummy) | -0.043*** (0.012) | -0.041*** (0.012) | -0.309*** (0.078) | -0.294*** (0.078) | -0.283*** (0.072) | -0.269*** (0.072) |
| Training on groundnut farming (dummy) | -0.025*** (0.003) | -0.026*** (0.003) | -0.180*** (0.023) | -0.182*** (0.023) | -0.166*** (0.021) | -0.168*** (0.021) |
| Public agricultural extension service (number of visits) | 0.002 (0.002) | 0.003 (0.002) | -0.023 (0.016) | -0.017 (0.017) | -0.024 (0.015) | -0.019 (0.015) |
| Private agricultural extension service (number of visits) | 0.004 (0.003) | 0.004 (0.003) | 0.051** (0.024) | 0.049** (0.023) | 0.048** (0.022) | 0.046** (0.022) |
| Cash credit for groundnut farming (dummy) | -0.006 (0.023) | -0.005 (0.023) | -0.146 (0.157) | -0.140 (0.156) | -0.154 (0.144) | -0.149 (0.144) |
| Credit in kind for groundnut farming (dummy) | -0.046*** (0.016) | -0.044*** (0.016) | -0.068 (0.110) | -0.058 (0.111) | -0.044 (0.102) | -0.035 (0.102) |
| Distance to the nearest urban market (km) | -0.000 (0.000) | -0.001*** (0.000) | -0.003 (0.002) | -0.009*** (0.002) | -0.003 (0.002) | -0.008*** (0.002) |
| Distance the nearest village market (km) | -0.003*** (0.001) | -0.003*** (0.001) | -0.012* (0.006) | -0.016*** (0.005) | -0.010* (0.006) | -0.015*** (0.005) |
| Crop rotation (dummy) | -0.022** (0.011) | -0.021* (0.011) | -0.134* (0.073) | -0.121* (0.073) | -0.124* (0.067) | -0.112* (0.067) |
| Mixed Crops (dummy) | 0.005 (0.009) | 0.001 (0.009) | -0.054 (0.061) | -0.073 (0.061) | -0.057 (0.056) | -0.074 (0.056) |
| Labor force (man.day) | 0.002*** (0.001) | 0.002*** (0.001) | 0.027*** (0.005) | 0.027*** (0.005) | 0.026*** (0.004) | 0.026*** (0.004) |
| Unit selling price (USD/kg) | 0.050 (0.049) | 0.073 (0.047) | 0.269 (0.333) | 0.379 (0.318) | 1.682*** (0.306) | 1.784*** (0.292) |
| Seed cost (USD/ha) | 0.002*** (0.000) | 0.002*** (0.000) | 0.011*** (0.002) | 0.011*** (0.002) | 0.010*** (0.001) | 0.010*** (0.001) |
| Fertilizer cost (USD/ha) | 0.000 (0.000) | 0.000 (0.000) | 0.002* (0.001) | 0.002* (0.001) | 0.002* (0.001) | 0.002* (0.001) |
| Pesticide cost (USD/ha) | -0.001*** (0.000) | -0.001*** (0.000) | -0.005* (0.003) | -0.006** (0.003) | -0.004 (0.003) | -0.005* (0.003) |
| Labor cost (USD/ha) | 0.000*** (0.000) | 0.000*** (0.000) | 0.002*** (0.001) | 0.002*** (0.001) | 0.002*** (0.001) | 0.002*** (0.001) |
| Groundnut area (ha) | -0.006 (0.005) | -0.002 (0.005) | 0.118*** (0.033) | 0.137*** (0.032) | 0.117*** (0.031) | 0.135*** (0.029) |
| Off-farm income (dummy) | -0.019 (0.015) | -0.021 (0.015) | -0.030 (0.098) | -0.042 (0.099) | -0.020 (0.091) | -0.030 (0.091) |
| Dependency ratio | 0.002 (0.003) | 0.002 (0.003) | 0.015 (0.022) | 0.018 (0.022) | 0.014 (0.020) | 0.017 (0.020) |
| Clay soil (dummy) | -0.015 (0.013) | -0.012 (0.011) | -0.151* (0.087) | -0.113 (0.074) | -0.145* (0.080) | -0.109 (0.068) |
| Sandy-clay soil (dummy) | 0.008 (0.010) | 0.007 (0.009) | 0.064 (0.069) | 0.053 (0.059) | 0.059 (0.063) | 0.049 (0.054) |
| Silty soil (dummy) | -0.004 (0.013) | 0.002 (0.011) | -0.032 (0.087) | 0.013 (0.074) | -0.032 (0.080) | 0.010 (0.068) |
| Constant | 0.795*** (0.183) | 1.003*** (0.076) | 6.901*** (1.240) | 7.211*** (0.525) | 5.670*** (1.141) | 5.868*** (0.481) |
| Observations | 8,604 | 8,604 | 8,604 | 8,604 | 8,604 | 8,604 |

Table SM7: Full 2SLS estimates of the relationship between adoption and commercialization (Area under Adoption) (*continued*)

| variables | FE-MP | RE-MP | FE-QS | RE-QS | FE-SV | RE-SV |
|--------------------------------|-------|-------|-------|-------|-------|-------|
| Number of id | 2,868 | 2,868 | 2,868 | 2,868 | 2,868 | 2,868 |
| District FE | YES | YES | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES | YES | YES |
| Standard errors in parentheses | | | | | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | | | | | |

Table SM8: Full 2SLS estimates of the relationship between adoption, production and yields

| variables | FE-Prod | FE-ProdSUP | FE-ProdVal | FE-ProdValSup | FE-Yield | FE-YieldSup |
|---|------------------------|-----------------------|---------------------------|---------------------------|------------------------|---------------------|
| Adoption dummy | 657.610*** (61.271) | | 426.589*** (42.610) | | 333.418*** (27.166) | |
| Age of household head (years) | -5.689 (12.368) | -10.898 (12.411) | -0.137 (8.601) | -3.517 (8.439) | -1.650 (5.483) | -4.244 (5.772) |
| Household size (number of persons) | 1.052 (2.522) | 4.994* (2.556) | -1.639 (1.754) | 0.918 (1.738) | 1.623 (1.118) | 3.605*** (1.189) |
| Farmers group membership (dummy) | 15.416 (18.035) | 9.491 (18.076) | 17.999 (12.542) | 14.154 (12.292) | -4.231 (7.996) | -7.186 (8.406) |
| Training on agriculture (dummy) | 30.407 (40.632) | 32.404 (40.660) | 13.535 (28.257) | 14.829 (27.649) | 28.002 (18.015) | 29.054 (18.909) |
| Training on groundnut farming (dummy) | 9.514 (12.066) | 6.534 (12.062) | 5.426 (8.391) | 3.493 (8.202) | 1.121 (5.350) | -0.409 (5.609) |
| Public agricultural extension service (number of visits) | -4.873 (8.562) | -6.533 (8.580) | -4.387 (5.954) | -5.465 (5.835) | -2.660 (3.796) | -3.469 (3.990) |
| Private agricultural extension service (number of visits) | -16.058 (12.279) | -15.248 (12.273) | -9.929 (8.539) | -9.406 (8.346) | -3.798 (5.444) | -3.302 (5.708) |
| Cash credit for groundnut farming (dummy) | -101.688 (81.557) | -55.081 (81.540) | -97.788* (56.718) | -67.553 (55.447) | -34.280 (36.160) | -10.675 (37.920) |
| Credit in kind for groundnut farming (dummy) | 27.745 (56.951) | -24.527 (57.502) | 35.763 (39.605) | 1.847 (39.101) | -11.136 (25.250) | -37.283 (26.741) |
| Distance to the nearest urban market (km) | -0.625 (1.034) | -0.351 (1.036) | -0.831 (0.719) | -0.653 (0.704) | 0.268 (0.458) | 0.405 (0.482) |
| Distance the nearest village market (km) | -3.092 (3.344) | -2.166 (3.345) | -3.193 (2.326) | -2.592 (2.275) | -0.880 (1.483) | -0.410 (1.556) |
| Crop rotation (dummy) | -64.875* (37.660) | -28.369 (38.209) | -61.367** (26.190) | -37.679 (25.982) | -0.107 (16.697) | 18.082 (17.769) |
| Mixed Crops (dummy) | 1.058 (31.642) | 17.203 (31.726) | -1.179 (22.005) | 9.296 (21.573) | -4.068 (14.029) | 4.035 (14.754) |
| Labor force (man.day) | -5.352** (2.447) | -3.481 (2.467) | -3.873** (1.701) | -2.659 (1.678) | -1.867* (1.085) | -0.933 (1.147) |
| Unit selling price (USD/kg) | -214.873 (176.487) | -177.766 (173.254) | 1,049.099*** (122.735) | 1,073.062*** (117.811) | 19.080 (78.249) | 43.168 (80.570) |
| Seed cost (USD/ha) | -0.937 (0.815) | -0.182 (0.810) | -0.627 (0.567) | -0.138 (0.551) | -0.299 (0.361) | 0.085 (0.377) |
| Fertilizer cost (USD/ha) | -1.690*** (0.558) | -0.987* (0.557) | -1.585*** (0.388) | -1.129*** (0.379) | -0.318 (0.248) | 0.038 (0.259) |
| Pesticide cost (USD/ha) | 3.015** (1.532) | 1.000 (1.579) | 2.605** (1.065) | 1.298 (1.074) | 0.533 (0.679) | -0.468 (0.734) |
| Labor cost (USD/ha) | -0.134 (0.406) | 0.165 (0.408) | -0.225 (0.282) | -0.031 (0.277) | -0.134 (0.180) | 0.016 (0.190) |
| Groundnut area (ha) | 712.142*** | 582.511*** | 443.194*** | 359.092*** | 4.798 | -60.396*** |

Table SM8: Full 2SLS estimates of the relationship between adoption, production and yields (*continued*)

| variables | FE-Prod | FE-ProdSUP | FE-ProdVal | FE-ProdValSup | FE-Yield | FE-YieldSup |
|--------------------------------|-----------|------------|------------|---------------|-----------|-------------|
| | (11.886) | (17.299) | (8.266) | (11.763) | (5.270) | (8.045) |
| Off-farm income (dummy) | -49.557 | -45.223 | -29.786 | -26.974 | -32.864 | -30.659 |
| | (51.249) | (51.289) | (35.640) | (34.876) | (22.722) | (23.851) |
| Dependency ratio | -10.777 | -5.419 | -9.190 | -5.713 | -2.597 | 0.089 |
| | (11.377) | (11.408) | (7.912) | (7.758) | (5.044) | (5.305) |
| Clay soil (dummy) | -9.792 | 11.088 | -5.638 | 7.909 | -8.945 | 1.522 |
| | (45.431) | (45.547) | (31.594) | (30.971) | (20.143) | (21.181) |
| Sandy-clay soil (dummy) | 19.180 | 37.723 | 23.247 | 35.277 | -6.721 | 2.610 |
| | (35.702) | (35.770) | (24.828) | (24.323) | (15.829) | (16.635) |
| Silty soil (dummy) | 44.725 | 42.505 | 39.507 | 38.066 | 18.335 | 17.251 |
| | (45.208) | (45.249) | (31.439) | (30.769) | (20.044) | (21.043) |
| Constant | 130.485 | 536.181 | -704.916 | -410.969 | 568.515** | 736.882** |
| | (649.998) | (645.982) | (452.031) | (439.261) | (288.191) | (300.408) |
| Observations | 8,604 | 8,604 | 8,604 | 8,604 | 8,604 | 8,604 |
| Number of id | 2,868 | 2,868 | 2,868 | 2,868 | 2,868 | 2,868 |
| District FE | YES | YES | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES | YES | YES |
| Standard errors in parentheses | | | | | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | | | | | |

Table SM9: Full 2SLS estimates of the relationship between continuous adoption, production and yields

| variables | MP | QS | SV |
|--|----------------------|----------------------|----------------------|
| Three years continuous adoption | 0.002 (0.057) | 0.104 (0.358) | 0.118 (0.328) |
| Age of household head | -0.001 (0.009) | -0.046 (0.056) | -0.044 (0.051) |
| Household size | 0.003*** (0.001) | 0.028*** (0.006) | 0.026*** (0.005) |
| Farmers group membership | 0.029*** (0.006) | 0.196*** (0.041) | 0.179*** (0.037) |
| Training on agriculture | -0.033** (0.014) | -0.199** (0.089) | -0.179** (0.081) |
| Training on groundnut farming | -0.029*** (0.004) | -0.205*** (0.026) | -0.191*** (0.024) |
| Public agricultural extension service | 0.004 (0.003) | -0.015 (0.018) | -0.016 (0.016) |
| Private agricultural extension service | 0.002 (0.004) | 0.051** (0.026) | 0.049** (0.023) |
| Cash credit for groundnut farming | 0.031 (0.028) | 0.125 (0.178) | 0.087 (0.163) |
| Credit in kind for groundnut farming | -0.065*** (0.020) | -0.134 (0.128) | -0.099 (0.117) |
| Distance to the nearest urban market | 0.000 (0.000) | -0.003 (0.003) | -0.003 (0.003) |
| Distance the nearest village market | -0.005*** (0.001) | -0.021*** (0.008) | -0.018** (0.007) |
| Crop rotation | -0.034*** (0.013) | -0.177** (0.082) | -0.162** (0.075) |
| Mixed Crops | 0.008 (0.011) | 0.126* (0.069) | 0.116* (0.063) |
| Labor force | 0.005*** (0.001) | 0.045*** (0.006) | 0.043*** (0.006) |
| Unit selling price | 0.247*** (0.043) | 1.837*** (0.271) | 2.978*** (0.247) |
| Seed cost | 0.002*** (0.000) | 0.016*** (0.002) | 0.015*** (0.002) |
| Fertilizer cost | 0.000** (0.000) | 0.005*** (0.001) | 0.005*** (0.001) |
| Pesticide cost | -0.000 (0.001) | 0.001 (0.004) | 0.001 (0.004) |
| Labor cost | 0.001*** (0.000) | 0.004*** (0.001) | 0.004*** (0.001) |
| Groundnut area | 0.015*** | 0.281*** | 0.270*** |

Table SM9: Full 2SLS estimates of the relationship between continuous adoption, production and yields (*continued*)

| variables | MP | QS | SV |
|--------------------------------|-----------|-----------|-----------|
| | (0.004) | (0.027) | (0.024) |
| Off-farm income | -0.038** | -0.085 | -0.058 |
| | (0.019) | (0.120) | (0.110) |
| Dependency ratio | -0.012*** | -0.074*** | -0.066*** |
| | (0.004) | (0.027) | (0.025) |
| Clay soil | -0.016 | -0.174* | -0.168* |
| | (0.016) | (0.102) | (0.093) |
| Sandy-clay soil | 0.004 | 0.028 | 0.026 |
| | (0.013) | (0.082) | (0.075) |
| Silty soil | 0.004 | -0.057 | -0.064 |
| | (0.017) | (0.106) | (0.097) |
| Constant | -0.008 | 0.101 | 0.137 |
| | (0.113) | (0.716) | (0.654) |
| Observations | 5,418 | 5,418 | 5,418 |
| Number of id | 2,555 | 2,555 | 2,555 |
| District FE | YES | YES | YES |
| Year FE | YES | YES | YES |
| Standard errors in parentheses | | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | | |

4 Correlated random effects

Table SM10: Full Correlated random effects estimations of the relationship between adoption , commercialization and market orientation

| variables | OLS-Share | FE-Share | RE-Share | OLS-orientation | FE-orientation | RE-orientation |
|---|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Adoption dummy | -0.030** (0.013) | -0.043* (0.023) | -0.058*** (0.018) | -0.058*** (0.022) | -0.069 (0.043) | -0.093*** (0.031) |
| Age of household head (years) | -0.001** (0.000) | -0.018*** (0.005) | -0.017*** (0.004) | -0.001** (0.001) | -0.024*** (0.009) | -0.025*** (0.008) |
| Sex of household head (dummy, male=1) | -0.005 (0.016) | | -0.004 (0.018) | 0.013 (0.024) | | 0.012 (0.029) |
| Education level (Number of years) | -0.002* (0.001) | | -0.002* (0.001) | -0.004** (0.002) | | -0.005** (0.002) |
| Household size (number of persons) | 0.001 (0.001) | 0.003*** (0.001) | 0.002*** (0.001) | 0.001 (0.001) | 0.004** (0.002) | 0.004*** (0.002) |
| Farmers group membership (dummy) | 0.013*** (0.004) | 0.017** (0.007) | 0.017*** (0.006) | 0.013* (0.008) | 0.021* (0.013) | 0.018 (0.011) |
| Training on agriculture (dummy) | -0.050*** (0.011) | -0.040*** (0.015) | -0.044*** (0.014) | -0.054*** (0.018) | -0.066** (0.028) | -0.071*** (0.024) |
| Training on groundnut farming (dummy) | -0.020*** (0.004) | -0.023*** (0.005) | -0.025*** (0.004) | -0.018*** (0.006) | -0.023*** (0.008) | -0.026*** (0.007) |
| Public agricultural extension service (number of visits) | -0.005** (0.002) | -0.007** (0.003) | -0.007** (0.003) | -0.007* (0.004) | -0.013** (0.006) | -0.012** (0.005) |
| Private agricultural extension service (number of visits) | 0.005* (0.003) | 0.008* (0.004) | 0.008** (0.004) | 0.004 (0.005) | 0.005 (0.008) | 0.009 (0.007) |
| Cash credit for groundnut farming (dummy) | -0.002 (0.021) | 0.003 (0.031) | -0.030 (0.027) | -0.035 (0.038) | -0.012 (0.056) | -0.063 (0.049) |
| Credit in kind for groundnut farming (dummy) | 0.003 (0.013) | -0.025 (0.022) | -0.008 (0.019) | -0.012 (0.024) | -0.062 (0.040) | -0.025 (0.035) |
| Distance to the nearest urban market (km) | -0.003*** (0.000) | -0.001 (0.001) | -0.002*** (0.000) | -0.003*** (0.001) | -0.001 (0.001) | -0.003*** (0.001) |
| Distance the nearest village market (km) | -0.002** (0.001) | -0.000 (0.001) | -0.001 (0.001) | -0.001 (0.002) | 0.002 (0.002) | 0.000 (0.002) |
| Crop rotation (dummy) | 0.023** (0.010) | -0.000 (0.014) | -0.002 (0.013) | 0.013 (0.016) | -0.014 (0.026) | -0.023 (0.023) |
| Mixed Crops (dummy) | 0.005 (0.008) | 0.016 (0.012) | 0.014 (0.011) | 0.010 (0.014) | 0.045** (0.022) | 0.036* (0.019) |
| Labor force (man.day) | 0.003*** (0.001) | 0.003*** (0.001) | 0.002*** (0.001) | 0.004*** (0.001) | 0.003 (0.002) | 0.003 (0.002) |
| Unit selling price (USD/kg) | -0.023 (0.046) | 0.046 (0.065) | 0.051 (0.055) | -0.057 (0.080) | -0.036 (0.119) | -0.012 (0.098) |
| Seed cost (USD/ha) | 0.001*** (0.000) | 0.002*** (0.000) | 0.002*** (0.000) | 0.002*** (0.000) | 0.002*** (0.001) | 0.002*** (0.001) |
| Fertilizer cost (USD/ha) | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) | 0.002*** (0.000) | 0.001*** (0.000) |
| Pesticide cost (USD/ha) | 0.002*** | 0.001* | 0.002*** | 0.003*** | 0.003** | 0.003*** |

Table SM10: Full Correlated random effects estimations of the relationship between adoption , commercialization and market orientation (*continued*)

| variables | OLS-Share | FE-Share | RE-Share | OLS-orientation | FE-orientation | RE-orientation |
|---------------------------------------|-----------|-----------|----------|-----------------|----------------|----------------|
| | (0.000) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Labor cost (USD/ha) | 0.001*** | 0.001*** | 0.001*** | 0.001*** | 0.001** | 0.001*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Groundnut area (ha) | -0.002 | -0.013*** | -0.010** | -0.014*** | -0.018** | -0.014* |
| | (0.002) | (0.005) | (0.004) | (0.004) | (0.008) | (0.007) |
| Off-farm income (dummy) | 0.003 | 0.010 | -0.003 | 0.035 | 0.028 | 0.015 |
| | (0.013) | (0.021) | (0.018) | (0.024) | (0.038) | (0.033) |
| Dependency ratio | 0.002 | -0.003 | 0.000 | 0.003 | -0.000 | 0.002 |
| | (0.003) | (0.005) | (0.004) | (0.005) | (0.009) | (0.007) |
| Clay soil (dummy) | 0.015 | -0.004 | 0.006 | 0.036* | 0.011 | 0.026 |
| | (0.012) | (0.017) | (0.012) | (0.020) | (0.032) | (0.021) |
| Sandy-clay soil (dummy) | 0.019* | 0.013 | 0.012 | 0.020 | 0.024 | 0.013 |
| | (0.010) | (0.014) | (0.010) | (0.017) | (0.025) | (0.017) |
| Silty soil (dummy) | 0.010 | -0.023 | 0.001 | -0.009 | -0.055* | -0.017 |
| | (0.012) | (0.018) | (0.012) | (0.021) | (0.033) | (0.021) |
| Constant | 0.445*** | 1.073*** | 0.649*** | 0.461*** | 1.503*** | 0.666*** |
| | (0.038) | (0.253) | (0.073) | (0.063) | (0.462) | (0.119) |
| Observations | 5,418 | 5,418 | 5,418 | 5,418 | 5,418 | 5,418 |
| R-squared | 0.290 | | | 0.182 | | |
| Number of id | | 2,555 | 2,555 | | 2,555 | 2,555 |
| District FE | | YES | YES | | YES | YES |
| Year FE | | Yes | Yes | | Yes | Yes |
| Robust standard errors in parentheses | | | | | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | | | | | |

Table SM11: Full Correlated random effects estimations of the relationship between adoption (area), commercialization and market orientation

| variables | OLS-Share | FE-Share | RE-share | OLS-orientation | FE-orientation | RE-orientation |
|---|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Area under adoption (ha) | -0.010*** (0.004) | -0.032* (0.018) | -0.040*** (0.013) | -0.013* (0.007) | -0.051 (0.032) | -0.065*** (0.022) |
| Age of household head (years) | -0.001** (0.000) | -0.017*** (0.005) | -0.016*** (0.004) | -0.001** (0.001) | -0.023** (0.009) | -0.023*** (0.008) |
| Sex of household head (dummy, male=1) | -0.005 (0.016) | | -0.003 (0.018) | 0.012 (0.024) | | 0.013 (0.029) |
| Education level (Number of years) | -0.002* (0.001) | | -0.003** (0.001) | -0.004** (0.002) | | -0.005*** (0.002) |
| Household size (number of persons) | 0.001 (0.001) | 0.003*** (0.001) | 0.002** (0.001) | 0.001 (0.001) | 0.004** (0.002) | 0.004** (0.002) |
| Farmers group membership (dummy) | 0.014*** (0.004) | 0.017** (0.007) | 0.017*** (0.006) | 0.014* (0.008) | 0.021* (0.013) | 0.018 (0.011) |
| Training on agriculture (dummy) | -0.050*** (0.011) | -0.041*** (0.015) | -0.045*** (0.014) | -0.054*** (0.017) | -0.066** (0.028) | -0.074*** (0.025) |
| Training on groundnut farming (dummy) | -0.020*** (0.004) | -0.023*** (0.005) | -0.025*** (0.004) | -0.017*** (0.006) | -0.023*** (0.008) | -0.026*** (0.007) |
| Public agricultural extension service (number of visits) | -0.005** (0.002) | -0.008** (0.003) | -0.007** (0.003) | -0.008** (0.004) | -0.013** (0.006) | -0.012** (0.005) |
| Private agricultural extension service (number of visits) | 0.005 (0.003) | 0.008* (0.004) | 0.008** (0.004) | 0.002 (0.005) | 0.005 (0.008) | 0.009 (0.007) |
| Cash credit for groundnut farming (dummy) | -0.003 (0.021) | -0.005 (0.031) | -0.038 (0.027) | -0.038 (0.038) | -0.025 (0.056) | -0.075 (0.049) |
| Credit in kind for groundnut farming (dummy) | 0.004 (0.013) | -0.022 (0.022) | -0.004 (0.020) | -0.012 (0.025) | -0.057 (0.041) | -0.018 (0.035) |
| Distance to the nearest urban market (km) | -0.003*** (0.000) | -0.001 (0.001) | -0.002*** (0.000) | -0.003*** (0.001) | -0.001 (0.001) | -0.003*** (0.001) |
| Distance the nearest village market (km) | -0.002** (0.001) | -0.000 (0.001) | -0.001 (0.001) | -0.001 (0.002) | 0.002 (0.002) | 0.000 (0.002) |
| Crop rotation (dummy) | 0.022** (0.010) | -0.002 (0.014) | -0.005 (0.013) | 0.013 (0.016) | -0.017 (0.026) | -0.028 (0.023) |
| Mixed Crops (dummy) | 0.006 (0.008) | 0.015 (0.012) | 0.013 (0.011) | 0.011 (0.014) | 0.044** (0.022) | 0.035* (0.019) |
| Labor force (man.day) | 0.003*** (0.001) | 0.003*** (0.001) | 0.002** (0.001) | 0.004*** (0.001) | 0.003 (0.002) | 0.002 (0.002) |
| Unit selling price (USD/kg) | -0.055 (0.040) | 0.051 (0.068) | 0.055 (0.056) | -0.143** (0.068) | -0.030 (0.123) | -0.007 (0.100) |
| Seed cost (USD/ha) | 0.001*** (0.000) | 0.002*** (0.000) | 0.002*** (0.000) | 0.002*** (0.000) | 0.002*** (0.001) | 0.002*** (0.001) |
| Fertilizer cost (USD/ha) | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) |
| Pesticide cost (USD/ha) | 0.002*** | 0.001** | 0.002*** | 0.003*** | 0.003** | 0.004*** |

Table SM11: Full Correlated random effects estimations of the relationship between adoption (area), commercialization and market orientation (*continued*)

| variables | OLS-Share | FE-Share | RE-share | OLS-orientation | FE-orientation | RE-orientation |
|---------------------------------------|-----------|----------|----------|-----------------|----------------|----------------|
| | (0.000) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Labor cost (USD/ha) | 0.001*** | 0.001*** | 0.001*** | 0.001*** | 0.001** | 0.001*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Groundnut area (ha) | 0.000 | -0.004 | 0.002 | -0.011** | -0.004 | 0.004 |
| | (0.003) | (0.007) | (0.006) | (0.005) | (0.012) | (0.010) |
| Off-farm income (dummy) | 0.003 | 0.013 | 0.001 | 0.035 | 0.031 | 0.021 |
| | (0.013) | (0.021) | (0.018) | (0.024) | (0.038) | (0.033) |
| Dependency ratio | 0.002 | -0.003 | 0.000 | 0.003 | -0.000 | 0.002 |
| | (0.003) | (0.005) | (0.004) | (0.005) | (0.009) | (0.007) |
| Clay soil (dummy) | 0.014 | -0.005 | 0.001 | 0.035* | 0.010 | 0.017 |
| | (0.012) | (0.018) | (0.012) | (0.020) | (0.032) | (0.021) |
| Sandy-clay soil (dummy) | 0.018* | 0.013 | 0.009 | 0.019 | 0.024 | 0.007 |
| | (0.010) | (0.014) | (0.010) | (0.017) | (0.025) | (0.017) |
| Silty soil (dummy) | 0.009 | -0.021 | 0.000 | -0.009 | -0.053 | -0.018 |
| | (0.012) | (0.018) | (0.012) | (0.021) | (0.033) | (0.021) |
| Constant | 0.459*** | 1.026*** | 0.631*** | 0.499*** | 1.431*** | 0.639*** |
| | (0.036) | (0.260) | (0.075) | (0.060) | (0.474) | (0.124) |
| Observations | 5,418 | 5,418 | 5,418 | 5,418 | 5,418 | 5,418 |
| R-squared | 0.290 | | | 0.181 | | |
| Number of id | | 2,555 | 2,555 | | 2,555 | 2,555 |
| District FE | | YES | YES | | YES | YES |
| Year FE | | Yes | Yes | | Yes | Yes |
| Robust standard errors in parentheses | | | | | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | | | | | |

5 Causal mediation analysis

Table SM12: Linear IV mediation analysis of adoption and commercialization (production)

| variables | Sellers | Quantity Sold | Sales Value |
|--|----------------------|---------------------|---------------------|
| Total effect (TE) | 0.0422** (0.0190) | 0.481*** (0.130) | 0.469*** (0.119) |
| Direct effect | -0.0371 (0.0445) | -0.768** (0.356) | -0.783** (0.336) |
| Indirect effect | 0.0792 (0.0589) | 1.249*** (0.477) | 1.252*** (0.452) |
| Observations | 8,604 | 8,604 | 8,604 |
| Additional controls | YES | YES | YES |
| District dummies | YES | YES | YES |
| Mediator share of TE (%) | 187.9 | 259.7 | 266.8 |
| F statistic on instrument (1) | 5169 | 5169 | 5169 |
| F statistic on instruments (2) | 21.19 | 21.19 | 21.19 |
| Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1 | | | |

Table SM13: Linear IV mediation analysis of adoption and commercialization (Yield)

| variables | Sellers | Quantity Sold | Sales Value |
|--|----------------------|---------------------|---------------------|
| Total effect (TE) | 0.0422** (0.0190) | 0.481*** (0.130) | 0.469*** (0.119) |
| Direct effect | -0.0664 (0.0675) | -1.230** (0.576) | -1.246** (0.551) |
| Indirect effect | 0.109 (0.0828) | 1.711** (0.714) | 1.715** (0.684) |
| Observations | 8,604 | 8,604 | 8,604 |
| Additional controls | YES | YES | YES |
| District dummies | YES | YES | YES |
| Mediator share of TE (%) | 257.4 | 355.8 | 365.5 |
| F statistic on instrument (1) | 5169 | 5169 | 5169 |
| F statistic on instruments (2) | 13.38 | 13.38 | 13.38 |
| Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1 | | | |

Table SM14: Linear IV mediation analysis of continuous adoption and commercialization (Production)

| variables | Sellers | Quantity Sold | Sales Value |
|--|------------------------|----------------------|----------------------|
| Total effect (TE) | 96.98 (4,295) | 696.8 (30,859) | 682.2 (30,214) |
| Direct effect | -0.0875*** (0.0328) | -0.631*** (0.217) | -0.619*** (0.205) |
| Indirect effect | 97.07 (4,295) | 697.4 (30,859) | 682.9 (30,214) |
| Observations | 5,418 | 5,418 | 5,418 |
| Additional controls | YES | YES | YES |
| District dummies | YES | YES | YES |
| Mediator share of TE (%) | 100.1 | 100.1 | 100.1 |
| F statistic on instrument (1) | 0.000503 | 0.000503 | 0.000503 |
| F statistic on instruments (2) | 19.21 | 19.21 | 19.21 |
| Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1 | | | |

Table SM15: Linear IV mediation analysis of continuous adoption and commercialization (Yield)

| variables | Sellers | Quantity Sold | Sales Value |
|--------------------------------|------------------------|----------------------|----------------------|
| Total effect (TE) | 96.98 (4,295) | 696.8 (30,859) | 682.2 (30,214) |
| Direct effect | -0.0554*** (0.0191) | -0.401*** (0.123) | -0.393*** (0.114) |
| Indirect effect | 97.03 (4,295) | 697.2 (30,859) | 682.6 (30,214) |
| Observations | 5,418 | 5,418 | 5,418 |
| Additional controls | YES | YES | YES |
| District dummies | YES | YES | YES |
| Mediator share of TE (%) | 100.1 | 100.1 | 100.1 |
| F statistic on instrument (1) | 0.000503 | 0.000503 | 0.000503 |
| F statistic on instruments (2) | 50.51 | 50.51 | 50.51 |
| Standard errors in parentheses | | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | | |

6 Robustness checks

6.1 Cross country analysis

Table SM16: 2SLS estimates of the relationship between adoption and commercialization and yield across countries

| variables | Ghana | | Mali | | Nigeria | |
|---|-----------------------|----------------------|----------------------|----------------------|------------------------|----------------------|
| | Yield | Commercialization | Yield | Commercialization | Yield | Commercialization |
| Adoption dummy | 198.475** (88.525) | -0.557 (0.501) | 66.646** (33.390) | -0.141 (0.311) | 373.278*** (25.196) | 0.301*** (0.074) |
| Age of household head (years) | 0.406 (16.311) | -0.095 (0.083) | 0.083 (0.475) | -0.014** (0.006) | -3.233 (8.937) | -0.069*** (0.023) |
| Sex of household head (dummy, male=1) | -58.257** (28.936) | -0.170 (0.232) | 24.809 (26.855) | -0.308 (0.348) | 20.482 (48.954) | 0.899*** (0.192) |
| Education level (Number of years) | 0.110 (2.862) | 0.034 (0.023) | -2.087 (2.355) | -0.035 (0.031) | 3.167* (1.747) | -0.001 (0.007) |
| Household size (number of persons) | 0.636 (4.523) | 0.021 (0.022) | 1.006 (0.669) | 0.004 (0.007) | 0.010 (2.300) | 0.043*** (0.006) |
| Farmers group membership (dummy) | 4.595 (17.846) | 0.495*** (0.089) | -6.867 (6.863) | 0.009 (0.067) | -1.255 (14.136) | 0.024 (0.036) |
| Training on agriculture (dummy) | 44.591 (46.961) | 0.172 (0.233) | 9.263 (13.136) | -0.571*** (0.128) | 25.793 (32.491) | -0.107 (0.083) |
| Training on groundnut farming (dummy) | 5.023 (15.475) | -0.054 (0.077) | 5.172 (8.066) | -0.314*** (0.073) | -2.818 (11.287) | -0.069** (0.029) |
| Public agricultural extension service (number of visits) | 1.280 (7.857) | 0.008 (0.039) | -2.751 (4.690) | -0.028 (0.044) | -0.229 (6.118) | -0.050*** (0.016) |
| Private agricultural extension service (number of visits) | 0.680 (10.184) | 0.072 (0.051) | 8.931* (5.135) | 0.058 (0.049) | -0.805 (11.113) | 0.080*** (0.028) |
| Cash credit for groundnut farming (dummy) | 109.641 (91.464) | -0.111 (0.455) | 8.110 (32.337) | -0.290 (0.297) | -96.634 (59.789) | 0.106 (0.153) |
| Credit in kind for groundnut farming (dummy) | -45.602 (64.085) | -1.432*** (0.319) | 45.213 (27.845) | 0.280 (0.268) | -29.923 (37.305) | 0.617*** (0.095) |
| Distance to the nearest urban market (km) | 2.369 (2.494) | 0.071*** (0.015) | -0.092 (0.525) | -0.040*** (0.005) | -0.042 (0.549) | -0.003* (0.001) |
| Distance the nearest village market (km) | -0.574 (3.130) | -0.012 (0.019) | -2.552*** (0.870) | -0.028*** (0.008) | 0.569 (2.840) | 0.005 (0.009) |
| Crop rotation (dummy) | 33.715 (36.880) | -0.448** (0.185) | -3.575 (16.322) | 0.626*** (0.160) | -8.976 (26.833) | -0.162** (0.069) |
| Mixed Crops (dummy) | 1.771 (35.228) | -1.206*** (0.175) | -10.554 (12.650) | -0.140 (0.123) | 6.306 (23.262) | 0.092 (0.059) |
| Labor force (man.day) | -1.087 (3.575) | 0.064*** (0.018) | -1.643 (1.169) | 0.046*** (0.011) | -1.828 (1.575) | 0.019*** (0.004) |
| Unit selling price (USD/kg) | -82.306 (149.874) | 1.489* (0.771) | 133.283 (100.291) | -0.727 (0.872) | 126.910 (95.094) | 0.407 (0.256) |
| Seed cost (USD/ha) | -0.075 (0.913) | 0.031*** (0.005) | -0.096 (0.306) | 0.002 (0.003) | -0.374 (0.755) | 0.005** (0.002) |
| Fertilizer cost (USD/ha) | -0.442 (2.730) | 0.035** (0.015) | -0.546 (0.391) | 0.018*** (0.004) | -0.055 (0.323) | 0.001 (0.001) |

Table SM16: 2SLS estimates of the relationship between adoption and commercialization and yield across countries (*continued*)[illegible]

6.2 Control function approach

Table SM17: Full Control function estimations of the relationship between adoption and market participation

| variables | MP-FE | MP-CRE | QS-FE | QS-CRE | SV-FE | SV-CRE |
|---|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Adoption dummy | 0.073** (0.029) | 0.041* (0.023) | 0.598*** (0.187) | 0.416*** (0.150) | 0.588*** (0.171) | 0.417*** (0.137) |
| Age of household head (years) | 0.002 (0.006) | -0.001 (0.006) | -0.031 (0.039) | -0.047 (0.035) | -0.033 (0.035) | -0.047 (0.032) |
| Sex of household head (dummy, male=1) | | -0.024 (0.024) | | 0.014 (0.159) | | 0.029 (0.145) |
| Education level (Number of years) | | 0.001 (0.002) | | -0.001 (0.011) | | -0.001 (0.010) |
| Household size (number of persons) | 0.003** (0.001) | 0.003** (0.001) | 0.029*** (0.008) | 0.027*** (0.007) | 0.026*** (0.007) | 0.026*** (0.006) |
| Farmers group membership (dummy) | 0.028*** (0.009) | 0.031*** (0.008) | 0.187*** (0.055) | 0.201*** (0.051) | 0.172*** (0.050) | 0.183*** (0.046) |
| Training on agriculture (dummy) | -0.032* (0.019) | -0.040** (0.018) | -0.198 (0.121) | -0.271** (0.111) | -0.179 (0.110) | -0.248** (0.102) |
| Training on groundnut farming (dummy) | -0.028*** (0.006) | -0.034*** (0.005) | -0.197*** (0.036) | -0.234*** (0.033) | -0.183*** (0.033) | -0.217*** (0.030) |
| Public agricultural extension service (number of visits) | 0.003 (0.004) | 0.006* (0.004) | -0.026 (0.024) | -0.002 (0.023) | -0.026 (0.022) | -0.005 (0.021) |
| Private agricultural extension service (number of visits) | 0.002 (0.006) | 0.001 (0.005) | 0.042 (0.035) | 0.035 (0.033) | 0.039 (0.032) | 0.033 (0.030) |
| Cash credit for groundnut farming (dummy) | 0.021 (0.038) | 0.011 (0.035) | 0.049 (0.243) | -0.045 (0.222) | 0.015 (0.222) | -0.072 (0.203) |
| Credit in kind for groundnut farming (dummy) | -0.066** (0.027) | -0.048* (0.025) | -0.152 (0.174) | -0.022 (0.158) | -0.120 (0.159) | 0.003 (0.144) |
| Distance to the nearest urban market (km) | -0.000 (0.001) | -0.003*** (0.000) | -0.004 (0.004) | -0.021*** (0.003) | -0.004 (0.004) | -0.020*** (0.003) |
| Distance the nearest village market (km) | -0.006*** (0.002) | -0.005*** (0.001) | -0.026** (0.011) | -0.029*** (0.008) | -0.023** (0.010) | -0.026*** (0.007) |
| Crop rotation (dummy) | -0.037** (0.018) | -0.023 (0.016) | -0.194* (0.111) | -0.122 (0.103) | -0.176* (0.102) | -0.111 (0.094) |
| Mixed Crops (dummy) | 0.011 (0.015) | 0.019 (0.014) | 0.140 (0.094) | 0.160* (0.087) | 0.129 (0.086) | 0.145* (0.080) |
| Labor force (man.day) | 0.005*** (0.001) | 0.004*** (0.001) | 0.044*** (0.009) | 0.036*** (0.008) | 0.042*** (0.008) | 0.035*** (0.007) |
| Unit selling price (USD/kg) | 0.096 (0.082) | 0.156** (0.072) | 0.618 (0.521) | 0.957** (0.456) | 1.781*** (0.476) | 2.131*** (0.416) |
| Seed cost (USD/ha) | 0.002*** (0.000) | 0.002*** (0.000) | 0.015*** (0.003) | 0.016*** (0.002) | 0.014*** (0.002) | 0.014*** (0.002) |
| Fertilizer cost (USD/ha) | 0.000 (0.000) | 0.000 (0.000) | 0.004** (0.002) | 0.004** (0.002) | 0.004** (0.002) | 0.004** (0.002) |
| Pesticide cost (USD/ha) | -0.000 | -0.001 | 0.001 | 0.001 | 0.000 | 0.001 |

Table SM17: Full Control function estimations of the relationship between adoption and market participation (*continued*)

| variables | MP-FE | MP-CRE | QS-FE | QS-CRE | SV-FE | SV-CRE |
|--------------------------------|----------|----------|----------|----------|----------|----------|
| | (0.001) | (0.001) | (0.006) | (0.005) | (0.005) | (0.004) |
| Labor cost (USD/ha) | 0.001*** | 0.001*** | 0.004*** | 0.004*** | 0.004*** | 0.004*** |
| | (0.000) | (0.000) | (0.001) | (0.001) | (0.001) | (0.001) |
| Groundnut area (ha) | 0.014** | 0.017*** | 0.274*** | 0.303*** | 0.263*** | 0.291*** |
| | (0.006) | (0.005) | (0.036) | (0.033) | (0.033) | (0.031) |
| Off-farm income (dummy) | -0.041 | -0.038 | -0.110 | -0.143 | -0.082 | -0.119 |
| | (0.026) | (0.023) | (0.164) | (0.148) | (0.150) | (0.136) |
| Dependency ratio | -0.011* | -0.004 | -0.071* | -0.027 | -0.064* | -0.024 |
| | (0.006) | (0.005) | (0.037) | (0.033) | (0.034) | (0.030) |
| Clay soil (dummy) | -0.012 | -0.003 | -0.154 | -0.063 | -0.149 | -0.065 |
| | (0.022) | (0.016) | (0.139) | (0.101) | (0.127) | (0.092) |
| Sandy-clay soil (dummy) | 0.009 | 0.009 | 0.056 | 0.052 | 0.050 | 0.046 |
| | (0.017) | (0.013) | (0.111) | (0.082) | (0.101) | (0.075) |
| Silty soil (dummy) | 0.012 | 0.016 | -0.013 | 0.056 | -0.026 | 0.044 |
| | (0.023) | (0.016) | (0.143) | (0.102) | (0.131) | (0.094) |
| Constant | 0.509* | 0.965*** | 5.042*** | 6.685*** | 4.083** | 5.467*** |
| | (0.305) | (0.096) | (1.932) | (0.632) | (1.766) | (0.577) |
| Observations | 5,418 | 5,418 | 5,418 | 5,418 | 5,418 | 5,418 |
| R-squared | 0.116 | | 0.150 | | 0.175 | |
| Number of id | 2,555 | 2,555 | 2,555 | 2,555 | 2,555 | 2,555 |
| District FE | YES | YES | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES | YES | YES |
| Standard errors in parentheses | | | | | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | | | | | |

6.3 Using access as lone IV

Table SM18: Full 2SLS estimates of the relationship between adoption, commercialization, production and yield (instrument for access)

| variables | MP-CRE | QS-CRE | SV-CRE | Prod-FE | ProdV-FE | Yield-FE |
|---|----------------------|----------------------|----------------------|-------------------------|---------------------------|------------------------|
| Adoption dummy | 0.065** (0.027) | 0.564*** (0.172) | 0.555*** (0.157) | 724.946*** (101.622) | 469.954*** (71.418) | 312.473*** (40.778) |
| Age of household head (years) | -0.001 (0.005) | -0.050 (0.035) | -0.050 (0.032) | -24.420 (17.526) | -13.717 (12.317) | -13.525* (7.033) |
| Sex of household head (dummy, male=1) | -0.024 (0.025) | 0.012 (0.163) | 0.028 (0.149) | | | |
| Education level (Number of years) | 0.001 (0.002) | -0.001 (0.011) | -0.001 (0.010) | | | |
| Household size (number of persons) | 0.003*** (0.001) | 0.027*** (0.007) | 0.026*** (0.006) | 7.038** (3.410) | 2.586 (2.396) | 3.529*** (1.368) |
| Farmers group membership (dummy) | 0.031*** (0.008) | 0.201*** (0.050) | 0.183*** (0.046) | 36.491 (24.841) | 27.391 (17.458) | -1.659 (9.968) |
| Training on agriculture (dummy) | -0.040** (0.017) | -0.267** (0.109) | -0.245** (0.100) | 44.605 (54.430) | 23.344 (38.252) | 28.040 (21.841) |
| Training on groundnut farming (dummy) | -0.033*** (0.005) | -0.229*** (0.032) | -0.212*** (0.030) | -0.632 (16.208) | -2.097 (11.391) | -7.340 (6.504) |
| Public agricultural extension service (number of visits) | 0.006 (0.004) | -0.005 (0.022) | -0.007 (0.021) | -37.303*** (10.990) | -27.114*** (7.724) | -13.457*** (4.410) |
| Private agricultural extension service (number of visits) | 0.000 (0.005) | 0.029 (0.033) | 0.028 (0.030) | -0.691 (16.044) | 2.166 (11.276) | 3.688 (6.438) |
| Cash credit for groundnut farming (dummy) | 0.011 (0.034) | -0.042 (0.218) | -0.069 (0.200) | -165.336 (109.825) | -169.693** (77.183) | -8.697 (44.070) |
| Credit in kind for groundnut farming (dummy) | -0.051** (0.024) | -0.041 (0.156) | -0.015 (0.142) | 57.123 (78.836) | 45.060 (55.404) | 13.322 (31.634) |
| Distance to the nearest urban market (km) | -0.003*** (0.000) | -0.020*** (0.003) | -0.019*** (0.003) | -0.580 (1.928) | -1.119 (1.355) | 0.608 (0.774) |
| Distance the nearest village market (km) | -0.005*** (0.001) | -0.029*** (0.008) | -0.026*** (0.007) | -2.888 (4.782) | -3.766 (3.361) | 0.084 (1.919) |
| Crop rotation (dummy) | -0.023 (0.016) | -0.119 (0.101) | -0.108 (0.093) | -25.995 (50.161) | -31.067 (35.252) | 2.525 (20.128) |
| Mixed Crops (dummy) | 0.018 (0.013) | 0.161* (0.086) | 0.146* (0.079) | -49.338 (42.612) | -42.325 (29.947) | -18.569 (17.099) |
| Labor force (man.day) | 0.004*** (0.001) | 0.037*** (0.008) | 0.035*** (0.007) | 9.352** (3.883) | 5.658** (2.729) | 2.204 (1.558) |
| Unit selling price (USD/kg) | 0.108 (0.075) | 0.659 (0.482) | 1.853*** (0.441) | -298.709 (260.167) | 1,284.525*** (182.839) | 28.298 (104.397) |
| Seed cost (USD/ha) | 0.002*** (0.000) | 0.015*** (0.002) | 0.014*** (0.002) | -0.520 (1.147) | -0.525 (0.806) | -0.283 (0.460) |
| Fertilizer cost (USD/ha) | 0.000 (0.000) | 0.004** (0.002) | 0.003** (0.001) | -2.554*** (0.833) | -2.740*** (0.586) | 0.212 (0.334) |
| Pesticide cost (USD/ha) | -0.001 | 0.000 | 0.001 | 6.536*** | 5.991*** | 3.357*** |

Table SM18: Full 2SLS estimates of the relationship between adoption, commercial-ization, production and yield (instrument for access) (*continued*)

| variables | MP-CRE | QS-CRE | SV-CRE | Prod-FE | ProdV-FE | Yield-FE |
|--------------------------------|----------|----------|----------|------------|------------|--------------|
| | (0.001) | (0.005) | (0.004) | (2.496) | (1.754) | (1.002) |
| Labor cost (USD/ha) | 0.001*** | 0.004*** | 0.004*** | -0.013 | -0.164 | -0.000 |
| | (0.000) | (0.001) | (0.001) | (0.570) | (0.401) | (0.229) |
| Groundnut area (ha) | 0.017*** | 0.300*** | 0.289*** | 745.783*** | 460.858*** | -5.427 |
| | (0.005) | (0.033) | (0.030) | (16.342) | (11.485) | (6.558) |
| Off-farm income (dummy) | -0.039* | -0.146 | -0.123 | -90.713 | -51.820 | -25.487 |
| | (0.023) | (0.146) | (0.134) | (74.325) | (52.234) | (29.824) |
| Dependency ratio | -0.004 | -0.028 | -0.025 | -6.288 | -3.957 | -4.791 |
| | (0.005) | (0.032) | (0.030) | (16.715) | (11.747) | (6.707) |
| Clay soil (dummy) | -0.004 | -0.065 | -0.067 | -51.543 | -35.999 | -37.126 |
| | (0.016) | (0.101) | (0.092) | (62.532) | (43.946) | (25.092) |
| Sandy-clay soil (dummy) | 0.009 | 0.050 | 0.045 | 24.169 | 27.638 | -23.155 |
| | (0.013) | (0.082) | (0.075) | (49.907) | (35.074) | (20.026) |
| Silty soil (dummy) | 0.015 | 0.050 | 0.039 | 108.827* | 70.832 | 25.685 |
| | (0.016) | (0.102) | (0.094) | (64.731) | (45.491) | (25.974) |
| Constant | 0.996*** | 6.875*** | 5.643*** | 1,362.136 | 30.664 | 1,357.141*** |
| | (0.101) | (0.656) | (0.599) | (897.819) | (630.966) | (360.267) |
| Observations | 5,418 | 5,418 | 5,418 | 5,418 | 5,418 | 5,418 |
| Number of id | 2,555 | 2,555 | 2,555 | 2,555 | 2,555 | 2,555 |
| District FE | YES | YES | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES | YES | YES |
| Standard errors in parentheses | | | | | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | | | | | |

6.4 Hausman Taylor IV

Table SM19: Full HAUSMAN TAYLOR IV estimations

| variables | MP | QS | SV |
|---|----------------------|----------------------|----------------------|
| Age of household head (years) | -0.004*** (0.001) | -0.031*** (0.005) | -0.031*** (0.005) |
| Household size (number of persons) | 0.000 (0.001) | 0.007 (0.005) | 0.007 (0.005) |
| Farmers group membership (dummy) | 0.015** (0.006) | 0.110*** (0.040) | 0.110*** (0.040) |
| Training on agriculture (dummy) | -0.063*** (0.014) | -0.385*** (0.089) | -0.385*** (0.089) |
| Training on groundnut farming (dummy) | -0.017*** (0.004) | -0.096*** (0.028) | -0.096*** (0.028) |
| Public agricultural extension service (number of visits) | -0.007** (0.003) | -0.065*** (0.018) | -0.065*** (0.018) |
| Private agricultural extension service (number of visits) | -0.004 (0.004) | -0.026 (0.027) | -0.026 (0.027) |
| Cash credit for groundnut farming (dummy) | 0.057** (0.029) | 0.304 (0.188) | 0.304 (0.188) |
| Credit in kind for groundnut farming (dummy) | -0.058*** (0.020) | -0.117 (0.131) | -0.117 (0.131) |
| Distance to the nearest urban market (km) | -0.001*** (0.000) | -0.006** (0.003) | -0.006** (0.003) |
| Distance the nearest village market (km) | -0.007*** (0.001) | -0.041*** (0.008) | -0.041*** (0.008) |
| Crop rotation (dummy) | -0.047*** (0.012) | -0.434*** (0.079) | -0.434*** (0.079) |
| Mixed Crops (dummy) | 0.051*** (0.011) | 0.382*** (0.070) | 0.382*** (0.070) |
| Labor force (man.day) | 0.006*** (0.001) | 0.053*** (0.006) | 0.053*** (0.006) |
| Unit selling price (USD/kg) | -0.044 (0.065) | -0.152 (0.411) | -0.152 (0.411) |
| Seed cost (USD/ha) | 0.003*** (0.000) | 0.018*** (0.002) | 0.018*** (0.002) |
| Fertilizer cost (USD/ha) | 0.001*** (0.000) | 0.010*** (0.001) | 0.010*** (0.001) |
| Pesticide cost (USD/ha) | -0.001 (0.001) | 0.003 (0.004) | 0.003 (0.004) |
| Labor cost (USD/ha) | 0.001*** (0.000) | 0.002** (0.001) | 0.002** (0.001) |
| Groundnut area (ha) | 0.039*** (0.004) | 0.457*** (0.025) | 0.457*** (0.025) |
| Off-farm income (dummy) | -0.036* (0.018) | -0.051 (0.121) | -0.051 (0.121) |
| Dependency ratio | 0.000 (0.004) | -0.012 (0.027) | -0.012 (0.027) |
| Clay soil (dummy) | -0.020 (0.017) | -0.187* (0.108) | -0.187* (0.108) |
| Sandy-clay soil (dummy) | -0.003 (0.013) | -0.019 (0.088) | -0.019 (0.088) |
| Silty soil (dummy) | 0.003 (0.017) | -0.061 (0.111) | -0.061 (0.111) |
| Adoption dummy | 0.087*** (0.019) | 0.656*** (0.123) | 0.656*** (0.123) |
| Sex of household head (dummy, male=1) | -0.048 (0.029) | -0.065 (0.207) | -0.065 (0.207) |
| Education level (Number of years) | 0.002 (0.002) | 0.012 (0.013) | 0.012 (0.013) |
| Constant | 0.933*** (0.066) | 5.857*** (0.445) | 5.857*** (0.445) |

Table SM19: Full HAUSMAN TAYLOR IV estimations (*continued*)

| variables | MP | QS | SV |
|--------------------------------|-------|-------|-------|
| Observations | 5,418 | 5,418 | 5,418 |
| Number of id | 2,555 | 2,555 | 2,555 |
| Standard errors in parentheses | | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | | |

6.5 Lewbels Test

Table SM20: Full Lewbel instrumental variable estimations of the relationship between adoption and commercialization

| variables | MP | QS | SV | MP-Access | QS-Access | SV-Access |
|--|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Adoption dummy | 0.108*** (0.026) | 0.769*** (0.162) | 0.718*** (0.149) | 0.108*** (0.026) | 0.769*** (0.162) | 0.718*** (0.149) |
| Age of household head | -0.002 (0.006) | -0.050 (0.041) | -0.049 (0.038) | -0.002 (0.006) | -0.050 (0.041) | -0.049 (0.038) |
| Household size | 0.003* (0.002) | 0.027** (0.011) | 0.025** (0.010) | 0.003* (0.002) | 0.027** (0.011) | 0.025** (0.010) |
| Farmers group membership | 0.030** (0.012) | 0.207*** (0.078) | 0.189*** (0.071) | 0.030** (0.012) | 0.207*** (0.078) | 0.189*** (0.071) |
| Training on agriculture | -0.035 (0.027) | -0.212 (0.171) | -0.191 (0.157) | -0.035 (0.027) | -0.212 (0.171) | -0.191 (0.157) |
| Training on groundnut farming | -0.026*** (0.008) | -0.188*** (0.050) | -0.175*** (0.045) | -0.026*** (0.008) | -0.188*** (0.050) | -0.175*** (0.045) |
| Public agricultural extension service | 0.004 (0.005) | -0.019 (0.031) | -0.020 (0.028) | 0.004 (0.005) | -0.019 (0.031) | -0.020 (0.028) |
| Private agricultural extension service | -0.002 (0.007) | 0.022 (0.046) | 0.022 (0.042) | -0.002 (0.007) | 0.022 (0.046) | 0.022 (0.042) |
| Cash credit for groundnut farming | 0.026 (0.049) | 0.089 (0.318) | 0.053 (0.292) | 0.026 (0.049) | 0.089 (0.318) | 0.053 (0.292) |
| Credit in kind for groundnut farming | -0.073* (0.038) | -0.189 (0.248) | -0.151 (0.231) | -0.073* (0.038) | -0.189 (0.248) | -0.151 (0.231) |
| Distance to the nearest urban market | 0.000 (0.001) | -0.002 (0.005) | -0.003 (0.005) | 0.000 (0.001) | -0.002 (0.005) | -0.003 (0.005) |
| Distance the nearest village market | -0.005* (0.003) | -0.023 (0.018) | -0.020 (0.017) | -0.005* (0.003) | -0.023 (0.018) | -0.020 (0.017) |
| Crop rotation | -0.030 (0.025) | -0.144 (0.152) | -0.132 (0.138) | -0.030 (0.025) | -0.144 (0.152) | -0.132 (0.138) |
| Mixed Crops | 0.008 (0.021) | 0.120 (0.134) | 0.111 (0.123) | 0.008 (0.021) | 0.120 (0.134) | 0.111 (0.123) |
| Labor force | 0.005*** (0.002) | 0.044*** (0.012) | 0.042*** (0.011) | 0.005*** (0.002) | 0.044*** (0.012) | 0.042*** (0.011) |
| Unit selling price | 0.031 (0.081) | 0.287 (0.511) | 1.535*** (0.469) | 0.031 (0.081) | 0.287 (0.511) | 1.535*** (0.469) |
| Seed cost | 0.002*** (0.001) | 0.015*** (0.004) | 0.013*** (0.004) | 0.002*** (0.001) | 0.015*** (0.004) | 0.013*** (0.004) |
| Fertilizer cost | 0.000 (0.000) | 0.004** (0.002) | 0.004** (0.002) | 0.000 (0.000) | 0.004** (0.002) | 0.004** (0.002) |
| Pesticide cost | -0.001 (0.001) | -0.001 (0.007) | -0.001 (0.006) | -0.001 (0.001) | -0.001 (0.007) | -0.001 (0.006) |
| Labor cost | 0.001** (0.000) | 0.004** (0.002) | 0.004** (0.002) | 0.001** (0.000) | 0.004** (0.002) | 0.004** (0.002) |
| Groundnut area | 0.015** (0.007) | 0.278*** (0.055) | 0.268*** (0.051) | 0.015** (0.007) | 0.278*** (0.055) | 0.268*** (0.051) |
| Off-farm income | -0.044 (0.030) | -0.129 (0.212) | -0.098 (0.198) | -0.044 (0.030) | -0.129 (0.212) | -0.098 (0.198) |
| Dependency ratio | -0.012 (0.008) | -0.075 (0.047) | -0.067 (0.043) | -0.012 (0.008) | -0.075 (0.047) | -0.067 (0.043) |
| Clay soil | -0.016 (0.032) | -0.174 (0.202) | -0.167 (0.184) | -0.016 (0.032) | -0.174 (0.202) | -0.167 (0.184) |
| Sandy-clay soil | 0.004 (0.024) | 0.027 (0.150) | 0.024 (0.137) | 0.004 (0.024) | 0.027 (0.150) | 0.024 (0.137) |
| Silty soil | 0.003 (0.032) | -0.063 (0.199) | -0.069 (0.181) | 0.003 (0.032) | -0.063 (0.199) | -0.069 (0.181) |
| Observations | 5,418 | 5,418 | 5,418 | 5,418 | 5,418 | 5,418 |
| R-squared | 0.092 | 0.129 | 0.156 | 0.092 | 0.129 | 0.156 |
| Robust standard errors in parentheses | | | | | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | | | | | |

6.6 Continuous adoption (2 years)

Table SM21: Full 2SLS estimates of the relationship between continuous adoption (two-year) and commercialization

| variables | MP | QS | SV |
|--|----------------------|----------------------|----------------------|
| Two years continuous adoption | 0.005 (0.043) | 0.104 (0.270) | 0.114 (0.246) |
| Age of household head | -0.001 (0.009) | -0.049 (0.056) | -0.048 (0.051) |
| Household size | 0.003*** (0.001) | 0.028*** (0.006) | 0.026*** (0.005) |
| Farmers group membership | 0.029*** (0.006) | 0.196*** (0.041) | 0.179*** (0.037) |
| Training on agriculture | -0.033** (0.014) | -0.199** (0.089) | -0.179** (0.081) |
| Training on groundnut farming | -0.029*** (0.004) | -0.205*** (0.026) | -0.191*** (0.024) |
| Public agricultural extension service | 0.004 (0.003) | -0.015 (0.018) | -0.016 (0.016) |
| Private agricultural extension service | 0.002 (0.004) | 0.051** (0.026) | 0.049** (0.023) |
| Cash credit for groundnut farming | 0.031 (0.028) | 0.125 (0.178) | 0.087 (0.163) |
| Credit in kind for groundnut farming | -0.065*** (0.020) | -0.134 (0.128) | -0.099 (0.117) |
| Distance to the nearest urban market | 0.000 (0.000) | -0.003 (0.003) | -0.003 (0.003) |
| Distance the nearest village market | -0.005*** (0.001) | -0.021*** (0.008) | -0.018** (0.007) |
| Crop rotation | -0.034*** (0.013) | -0.177** (0.082) | -0.162** (0.075) |
| Mixed Crops | 0.008 (0.011) | 0.126* (0.069) | 0.116* (0.063) |
| Labor force | 0.005*** (0.001) | 0.045*** (0.006) | 0.043*** (0.006) |
| Unit selling price | 0.247*** (0.043) | 1.836*** (0.271) | 2.978*** (0.247) |
| Seed cost | 0.002*** (0.000) | 0.016*** (0.002) | 0.015*** (0.002) |
| Fertilizer cost | 0.000** (0.000) | 0.005*** (0.001) | 0.005*** (0.001) |
| Pesticide cost | -0.000 (0.001) | 0.001 (0.004) | 0.001 (0.004) |
| Labor cost | 0.001*** (0.000) | 0.004*** (0.001) | 0.004*** (0.001) |
| Groundnut area | 0.015*** (0.004) | 0.281*** (0.027) | 0.270*** (0.024) |
| Off-farm income | -0.038** (0.019) | -0.086 (0.120) | -0.058 (0.110) |
| Dependency ratio | -0.012*** (0.004) | -0.074*** (0.027) | -0.066*** (0.025) |
| Clay soil | -0.016 (0.016) | -0.174* (0.102) | -0.168* (0.093) |
| Sandy-clay soil | 0.004 (0.013) | 0.029 (0.082) | 0.026 (0.075) |
| Silty soil | 0.004 (0.017) | -0.057 (0.106) | -0.063 (0.097) |
| Constant | -0.004 (0.082) | 0.076 (0.517) | 0.101 (0.473) |
| Observations | 5,418 | 5,418 | 5,418 |
| Number of id | 2,555 | 2,555 | 2,555 |
| District FE | YES | YES | YES |

Table SM21: Full 2SLS estimates of the relationship between continuous adoption (two-year) and commercialization (*continued*)

| variables | MP | QS | SV |
|--------------------------------|-----|-----|-----|
| Year FE | YES | YES | YES |
| Standard errors in parentheses | | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | | |

Table SM22: Linear IV mediation analysis of continuous adoption (2 Years) and commercialization (Production)

| variables | Sellers | Quantity Sold | Sales Value |
|--------------------------------|------------------------|----------------------|----------------------|
| Total effect (TE) | 54.00 (1,344) | 388.0 (9,656) | 379.9 (9,454) |
| Direct effect | -0.0946*** (0.0353) | -0.683*** (0.234) | -0.670*** (0.221) |
| Indirect effect | 54.10 (1,344) | 388.7 (9,657) | 380.6 (9,455) |
| Observations | 5,418 | 5,418 | 5,418 |
| Additional controls | YES | YES | YES |
| District dummies | YES | YES | YES |
| Mediator share of TE (%) | 100.2 | 100.2 | 100.2 |
| F statistic on instrument (1) | 0.00159 | 0.00159 | 0.00159 |
| F statistic on instruments (2) | 19.30 | 19.30 | 19.30 |
| Standard errors in parentheses | | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | | |

Table SM23: Linear IV mediation analysis of continuous adoption (2 Years) and commercialization (Yield)

| variables | Sellers | Quantity Sold | Sales Value |
|--------------------------------|------------------------|----------------------|----------------------|
| Total effect (TE) | 54.00 (1,344) | 388.0 (9,656) | 379.9 (9,454) |
| Direct effect | -0.0552*** (0.0191) | -0.400*** (0.123) | -0.393*** (0.114) |
| Indirect effect | 54.06 (1,344) | 388.4 (9,656) | 380.3 (9,455) |
| Observations | 5,418 | 5,418 | 5,418 |
| Additional controls | YES | YES | YES |
| District dummies | YES | YES | YES |
| Mediator share of TE (%) | 100.1 | 100.1 | 100.1 |
| F statistic on instrument (1) | 0.00159 | 0.00159 | 0.00159 |
| F statistic on instruments (2) | 50.51 | 50.51 | 50.51 |
| Standard errors in parentheses | | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | | |