**Table 1.** Input and output summary statistics for 25 rice producing provinces in Cambodia, 2012-2015

| Variable | 2012 | | 2013 | | 2014 | | 2015 | |
|---|---|---|---|---|---|---|---|---|
| | Mean | S.E. | Mean | S.E. | Mean | S.E. | Mean | S.E. |
| Output | | | | | | | | |
| *Rice quantity*[1] *(tons)* | 290,808 | 52,994 | 329,872 | 60,296 | 391,150 | 80,437 | 315,270 | 57,785 |
| Inputs | | | | | | | | |
| *Land*[2] *(hectares)* | 134,629 | 23,192 | 144,944 | 25,893 | 212,785 | 56,497 | 145,685 | 26,699 |
| *Labor*[3] *(persons)* | 168,703 | 27,044 | 163,805 | 26,208 | 160,163 | 25,683 | 155,159 | 24,486 |
| *Fertilizer*[4] *(tons)* | 74,061 | 13,236 | 75,027 | 13,300 | 160,043 | 13,436 | 79,038 | 13,618 |
| *Pesticide*[5] *(tons)* | 45,116 | 9,610 | 47,926 | 10,021 | 52,205 | 10,596 | 56,117 | 11,047 |
| *Machinery*[6] *(units)* | 10,196 | 1,937 | 12,213 | 2,135 | 14,569 | 2,394 | 16,762 | 2,675 |

Source: Measured by Ms. Excel 2016 using combined datasets of RGC [32, 33]. "S.E." = Standard Error.

[1] *Rice quantity* was the total provincial un-milled rice production output quantity, measured in tons

[2] *Land* input was the total area of rice actually harvested within the year (included both in wet and dry season), measured in hectares

[3] *Labor* input measured as total farmers in the province with rice farming as primary occupation, unit in persons

[4] *Fertilizer* input was total amount of chemical and organic fertilizers' quantity using by total rice families in the province, unit in tons

[5] *Pesticide* input measured as total amount of chemical and organic poisons for insects and grass's quantity using by total rice families in the province, unit in tons

[6] *Machinery* measured the capital investment on agricultural machineries was the total amount of tractors, walking tractors (koryons), and rice transplanting machines existing in the provincial territory, unit in units

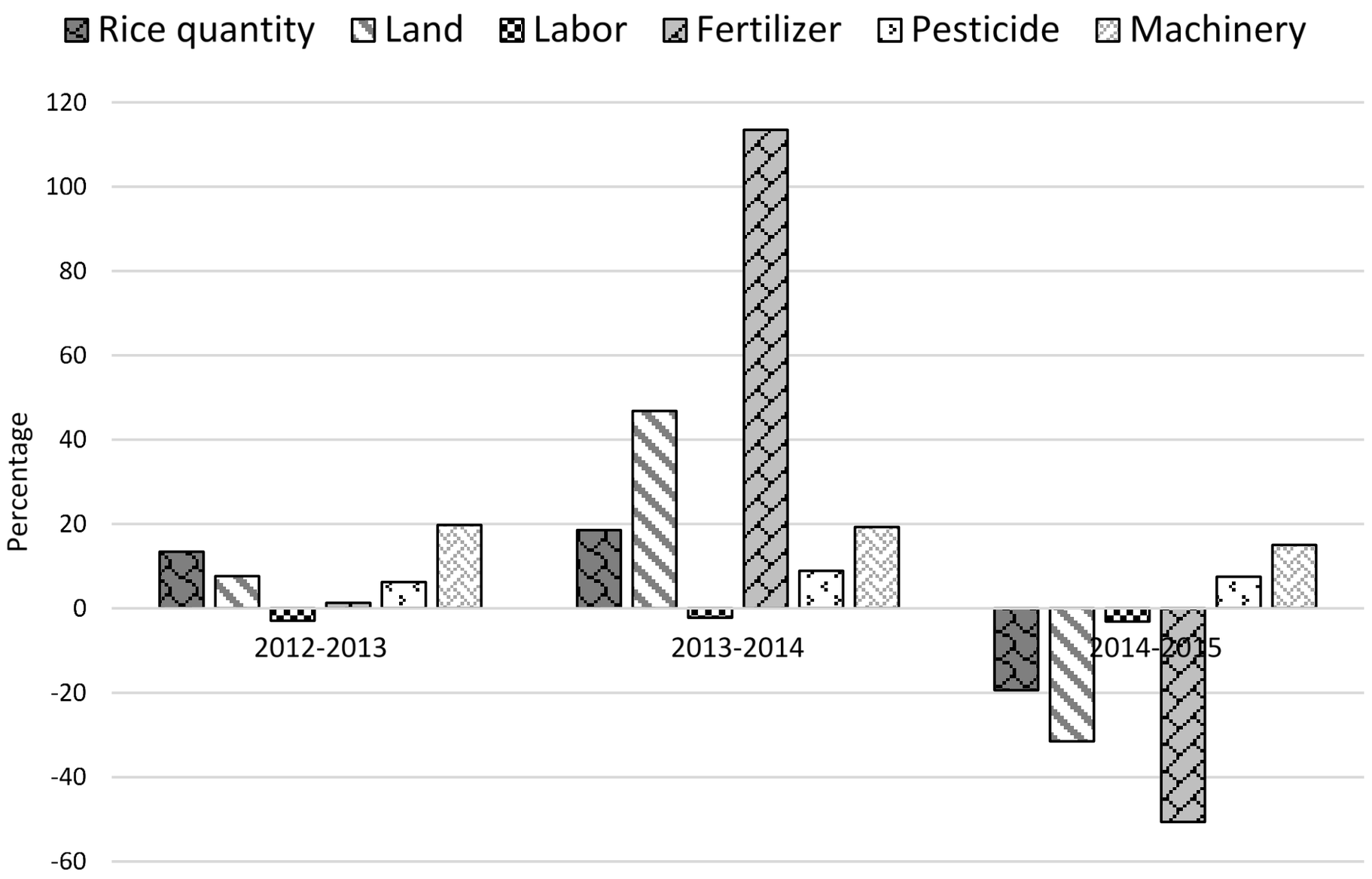


**Figure 1.** Percentage changes in input and output statistics for 25 rice producing provinces in Cambodia for the periods 2012-2013, 2013-2014, and 2014-2015

**Table 2** Descriptive statistics of factors affecting the efficiency of rice production in Cambodia, 2012-2015

| Variable | 2012 | | 2013 | | 2014 | | 2015 | |
|---|---|---|---|---|---|---|---|---|
| | Mean | S.E. | Mean | S.E. | Mean | S.E. | Mean | S.E. |
| *Disaster*[1] | 18.86 | 12.34 | 5.16 | 1.12 | 30.98 | 26.37 | 5.20 | 1.16 |
| *Irrigation*[2] | 21.70 | 3.49 | 22.75 | 3.52 | 19.94 | 3.58 | 22.64 | 3.54 |
| *Production technique*[3] | 3.04 | 0.48 | 2.79 | 0.47 | 2.74 | 0.42 | 2.44 | 0.37 |
| *Distant info-source*[4] | 14.92 | 1.53 | 14.86 | 1.22 | 14.67 | 1.14 | 15.01 | 1.20 |
| *Supporting staffs*[5] | 0.11 | 0.03 | 0.10 | 0.02 | 0.09 | 0.02 | 0.09 | 0.02 |
| *Dry-season prod.*[6] | 68.47 | 5.72 | 58.76 | 6.33 | 65.12 | 5.89 | 64.91 | 6.43 |
| *Small-land farmers*[7] | 41.80 | 3.17 | 40.99 | 3.43 | 40.35 | 3.45 | 39.76 | 3.67 |

Source: Measured by Ms. Excel 2016 using combined datasets of RGC [32, 33]. "S.E." = Standard Error.

[1] *Disaster* measured as percentage of rice land damaged by floods, droughts, and insects to total rice actual harvested land within the year

[2] *Irrigation* measured as percentage of provincial paddy land having or benefit from irrigation systems as well as paddy land located near water sources to total provincial cultivated land within the year.

[3] *Production technique* measured as percentage of families cultivating rice under the SRI system to total rice cultivated families

[4] *Distant to information sources* measured as average distance from village center to the center of district/khan (in kilometers)

[5] *Agricultural supporting staffs* measured as percentage of agricultural staffs included both government officers and NGOs staffs (working on agricultural plans or projects) to total rice farmers existing in the province

[6] *Dry-season production* measured as percentage of paddy land actually harvested during dry season to the total available cultivated land for rice cultivation during dry season

[7] *Small-land farmers* measured as percentage of families having paddy land smaller than one hectare altogether with families having no paddy land to total rice families (i.e. families cultivating rice)

**Table 3**. Parameter estimates of SFA model

| Variables | Coefficient | Standard Error | t-ratio |
|---|---|---|---|
| *Constant* | -1.1869 * | 0.6189 | -1.9178 |
| *Ln(land)* | 0.6796 *** | 0.2475 | 2.7458 |
| *Ln(labor)* | 0.0775 | 0.3279 | 0.2364 |
| *Ln(fertilizer)* | 0.9245 ** | 0.4664 | 1.9820 |
| *Ln(pesticide)* | -1.8588 *** | 0.3565 | -5.2139 |
| *Ln(machinery)* | 1.8642 *** | 0.2629 | 7.0914 |
| *t* | 0.0573 | 0.0369 | 1.5529 |
| *Land x Labor* | 0.0420 ** | 0.0197 | 2.1339 |
| *Land x Fertilizer* | -0.0771 * | 0.0429 | -1.7966 |
| *Land x Pesticide* | 0.1680 *** | 0.0309 | 5.4381 |
| *Land x Machinery* | -0.1210 *** | 0.0241 | -5.0263 |
| *Labor x Machinery* | -0.0585 ** | 0.0271 | -2.1577 |
| $t^2$ | 0.0013 | 0.0068 | 0.1888 |
| *Gamma* ($\gamma$) | 1.0000 *** | 0.0001 | 13,538.2280 |
| *Sigma-squared* ($\sigma^2$) | 0.0336 *** | 0.0062 | 5.3882 |
| Log likelihood function | | | 75.7787 |

Source: Estimated by FRONTIER 4.1c. * indicates significant at 10%, ** significant at 5%, and *** at 1%.

**Table 4** Input elasticities of rice production in Cambodia, 2012-2015

| Year | Ln(land) | Ln(labor) | Ln(fertilizer) | Ln(pesticide) | Ln(machinery) |
|---|---|---|---|---|---|
| 2012 | 0.9898 | 0.0465 | 0.0569 | 0.0317 | -0.1701 |
| 2013 | 0.9816 | 0.0340 | 0.0559 | 0.0339 | -0.1709 |
| 2014 | 0.9694 | 0.0248 | 0.0537 | 0.0386 | -0.1729 |
| 2015 | 0.9632 | 0.0156 | 0.0551 | 0.0356 | -0.1687 |

Source: Calculated by Ms. Excel 2016

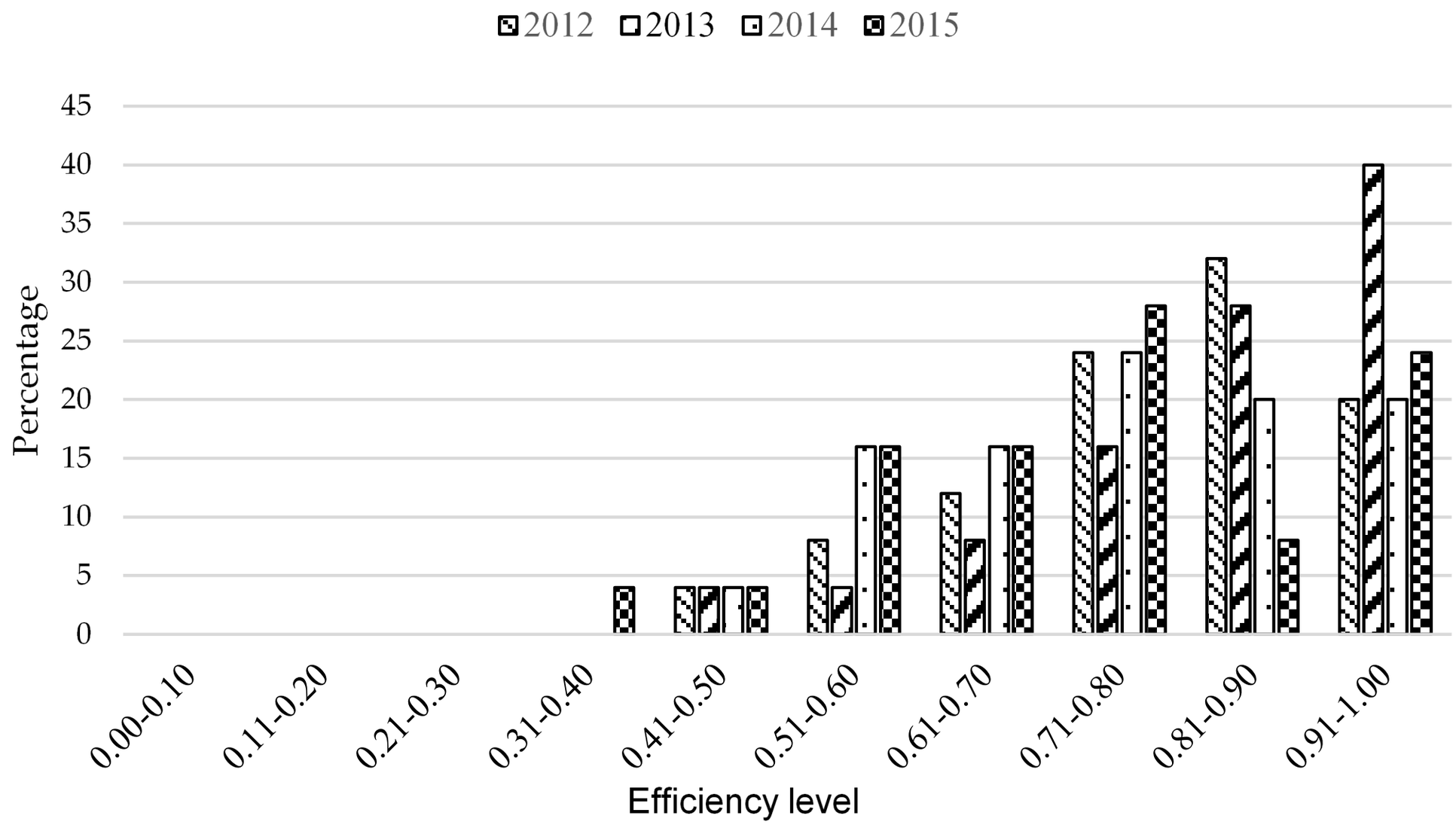


**Figure 2**. Distribution of Technical Efficiency

**Table 5** Regional technical efficiency of rice production in Cambodia, 2012-2015

| Regions | 2012 | | 2013 | | 2014 | | 2015 | | TE Change (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *M* | *S.E.* | *M* | *S.E.* | *M* | *S.E.* | *M* | *S.E.* | 12-13 | 12-14 | 12-15 |
| *Phnom Penh* | 0.83 | 0.00 | 0.84 | 0.00 | 0.81 | 0.00 | 0.61 | 0.00 | 1.2 | -3.4 | -26.5 |
| *Tonle Sap plain*[1] | 0.81 | 0.05 | 0.87 | 0.04 | 0.71 | 0.05 | 0.77 | 0.04 | 6.8 | -12.4 | -5.4 |
| *Mekong plain*[2] | 0.86 | 0.07 | 0.89 | 0.10 | 0.88 | 0.07 | 0.88 | 0.07 | 3.2 | 2.6 | 2.2 |
| *Mekong plateau*[3] | 0.79 | 0.04 | 0.79 | 0.04 | 0.74 | 0.06 | 0.70 | 0.06 | 0.0 | -6.7 | -11.3 |
| *Mountain*[4] | 0.66 | 0.09 | 0.76 | 0.08 | 0.63 | 0.09 | 0.53 | 0.09 | 14.6 | -5.7 | -19.7 |
| *Coastal*[5] | 0.81 | 0.07 | 0.84 | 0.06 | 0.86 | 0.09 | 0.79 | 0.08 | 4.7 | 6.3 | -2.0 |
| Cambodia | 0.80 | 0.03 | 0.84 | 0.03 | 0.76 | 0.03 | 0.74 | 0.03 | 5.4 | -3.9 | -6.9 |

Source: Estimated by FRONTIER 4.1c; "M" = Mean; "S.E." = Standard Error; "12-13" = TE change between 2012 and 2013; "12-14" = TE change between 2012 and 2014; "12-15" = TE change between 2012 and 2015

[1] Tonle Sap plain region included the province of Banteay Meanchey, Battambang, Kampong Chhnang, Kampong Thom, Pailin, Pursat, and Siem Reap. Total area: 61,510 km² (accounted for 34.54% of the total area)

[2] Mekong plain included the province of Kampong Speu, Kandal, Prey Veng, Svay Rieng, and Takéo. Total area: 21,997 km² (12.35%)

[3] Mekong plateau included the province of Kampong Cham, Kratié, Stung Treng, and Tbong Khmoum. Total area: 31,663 km² (17.78%)

[4] Mountain region included the province of Mondulkiri, Ratanakiri, Preh Vihear, and Oddar Meanchey. Total area: 45,016 km² (25.28%)

[5] Coastal region included the province of Kampot, Koh Kong, Kep, and Preah Sihanouk. Total area: 17,237 km² (9.68%)

**Table 6**. Rice production technical inefficiency model parameters estimation

| Variables | Coefficient | Std. Error | t-ratio |
|---|---|---|---|
| *Constant* | 0.9241 *** | 0.1484 | 6.2261 |
| *Disaster* | 0.0003 | 0.0005 | 0.5641 |
| *Irrigation* | -0.0119 *** | 0.0026 | -4.5368 |
| *Production technique* | -0.0841 *** | 0.0283 | -2.9688 |
| *Distant to information sources* | -0.0052 | 0.0060 | -0.8703 |
| *Agricultural supporting staffs* | -0.9530 ** | 0.4032 | -2.3635 |
| *Dry-season production* | -0.0016 | 0.0016 | -1.0549 |
| *Small-land farmers* | -0.0007 | 0.0036 | -0.2056 |

Source: Estimated by FRONTIER 4.1c. * indicates significant at 10%, ** significant at 5%, and *** at 1%.