# Adoption potential of two wheel tractor drill technology in the lowland rice growing areas of Cambodia – An economic analysis

**Rajinder P Singh**[1], Jack Desbiolles[2], Seng Vang[3], Som Bunna[3], Roat Men[3], Chea sovandina[4], Chuong Sophal[5], Bob Martin[6] and Neil Coombes[1]

[1]NSW Department of Primary Industries, Wagga Wagga, NSW
[2]University of South Australia, Mawson Lakes, SA
[3]Cambodian Agri. Research & Development Institute, Phnom Per
[4]General Directorate of Agriculture, Phnom Penh, Cambodia
[5]Royal University of Agriculture, Phnom Penh, Cambodia
[6]ASR Cambodia, Battambang province, Cambodia

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# Cambodia: Rice production

- = over 80% of cropping area and 50% of agriculture sector output.
- 75% is from rain-fed systems, grown in the monsoon season.
- Potential to grow 3 rice crops annually - Early wet season (EWS), Main wet season (MWS) and Dry Season (DS)

## Key constraints

**Small fragmented farm sizes and no land titles**

- 60% <1 ha, 80% fragmented into 2 or more parcels

**Low income and capacity to invest**

- 50-60% farmers earn <$100 per year

**No easy access to loans, huge borrowing costs**

- Only 25% borrow cash, paying on average 3% monthly interest

**Lack of knowledge, skills and extension support**

- 30-40% apply chemicals but under mostly informal private sector advice

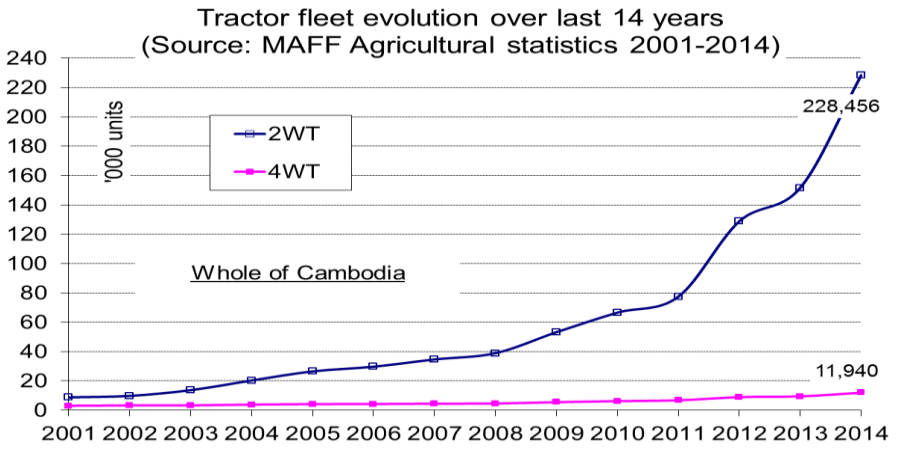
**Big gaps between crop yields in research trials and farmer fields**

- Essential to optimise input use and reduce yield gaps

# Rice crop establishment trends

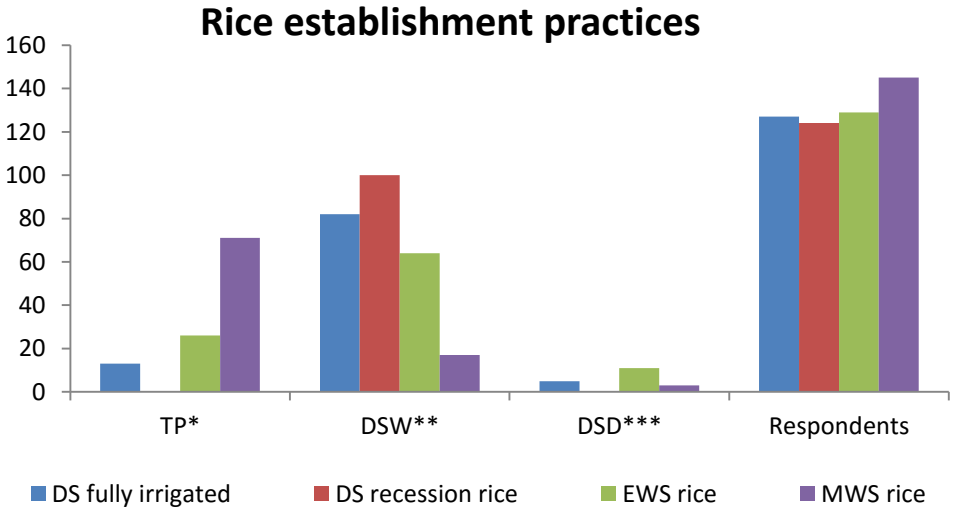
## Current trends:

- Rapid adoption of 2 wheel tractors (2WT)
- Shift from transplanting to direct seeding (broadcasting), requiring low labour and achieving fast crop establishment




## Seed broadcasting limitations include:

- high seed rate
- high loss to predation
- non-uniform crop establishment
- high weed burden




## Seed drill technology

Opportunities investigated for mechanising dry direct seeding of rice with seed drill operated by a 2WT

Benefits include: labour and seed savings, easier weeding and greater yield potential

# Objectives

1. Estimate the net $ benefits of adoption of seed drill technology

2. Assess the true ownership costs and quantify realistic contract rates

3. Identify the key issues limiting adoption of seed drill technology

4. Identify key recommendations for drill adoption and maximise its economic benefits for an inclusive farm sector growth

Example 2WT operated seed drills


# Methodology

Using a partial budgeting approach, economic analysis was undertaken, within a benefit cost framework and using @Risk software to measure the present value of benefits, costs and net benefits from the on-farm adoption of the technology.

Criteria: Net Present Value (*NPV*) of benefits

Financial benefits include:

- Benefits to the owner-operator **(= 'Full adopters')**
- Benefits to farmers using technology by contract hiring **(= 'Partial adopters')**

Key considerations:

- Accounting period of 20 years
- Discount rate = 24%
- Contract hiring rate = US$33 / ha
- Cost of machine - US$650

*Sources of data:*

- *Research and farmers field trials; farmer survey (n=600); Farmer Focus Groups; farmer/contractor interviews and expert opinions*

# 4 selected scenarios of seed drill usage and impact

EWS: Early Wet Season ; DS: Dry Season ; MWS: Main Wet Season

**Scenario 1**: *Upper baseline scenario (high demand for contract servicing)*

The farmer direct drills rice in both EWS and DS on his 2 ha farm, as well as 0.5ha in MWS only (= an average 25% proportion due to monsoon rain limitations). Additionally, the farmer contract services over 10 ha each in EWS and DS, and 25% pro-rata in MWS.

NB: drilled rice grain yield = farmer practice grain yield (e.g. Likely transition phase)

**Scenario 2:** As per scenario 1, but:
>> drilled rice yield = 1.1 x farmer practice grain yield <<

**Scenario 3:** *Lower baseline scenario (low/no demand for contract servicing)*

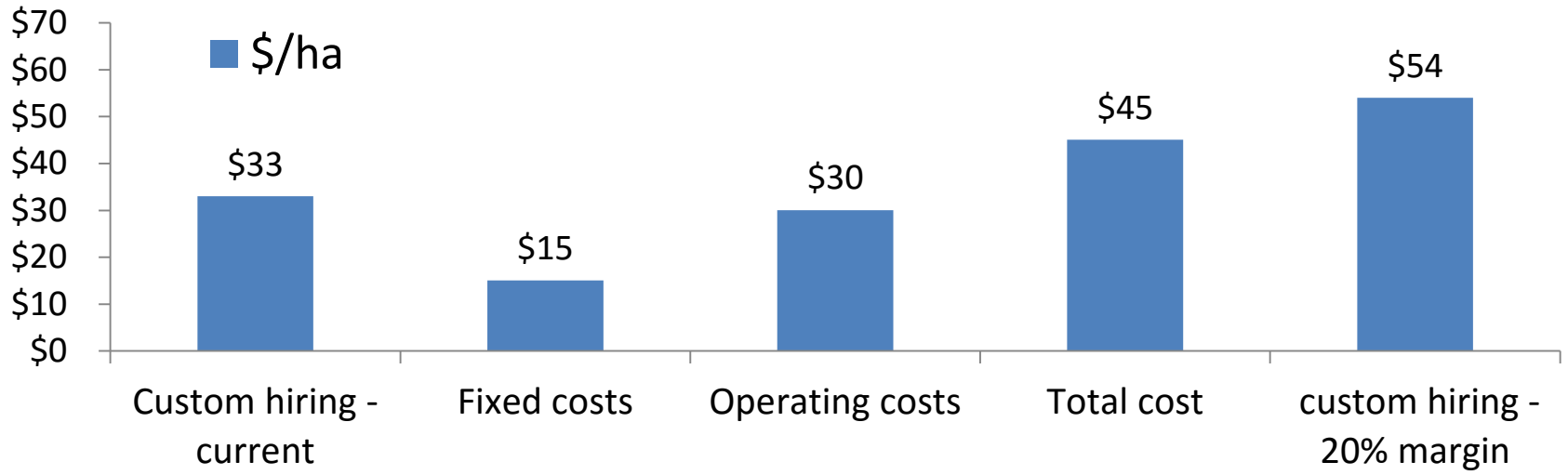
The farmer direct drills rice on his own 2 ha farm only, and the machine is not used for contract work: >> drilled rice grain yield = farmer practice grain yield <<

**Scenario 4:** As per Scenario 3, but

>> drilled rice yield = 1.1 x farmer practice grain yield <<

# True costs of drill seeding

- Calculated cost of drill seeding where a farmer-owner is working as a part-time contractor (10 ha in EWS and DS, and 25%  in MWS)




- The current custom hiring rates are:
  - 9% higher than the overhead costs
  - 27% lower than the true total cost and
  - 61% lower than the preferred custom hiring rates (built on its true costs+20% profit)

| | |
|---|---|
| - Breakeven area (ha/annum) – based on the current custom hiring rate | 190 ha |
| - Breakeven area based on the preferred custom hiring rate | 27 ha |

# Economics of drill seeding

| 20 year accounting period | Scenario 1 *(= yield)* | Scenario 2 *(+10% yield)* | Scenario 3 *(= yield)* | Scenario 4 *(+10% yield)* |
|---|---|---|---|---|
| Custom hiring $33/ha | | | | |
| | NPV of benefits (US$) | | | |
| Full adopters | -$702 | $777 | -$774 | $987 |
| Partial adopters | $1,727 | $9,475 | - | - |
| Total benefits | $1,025 | $10,252 | -$774 | $987 |
| | | | | |
| Custom hiring $54/ha | | | | |
| Full adopters | $1,240 | $2,718 | -$774 | $987 |
| Partial adopters | -$215 | $7,533 | - | - |
| Total benefits | $1,025 | $10,252 | -$774 | $$897 |

Probability distribution of risk parameters

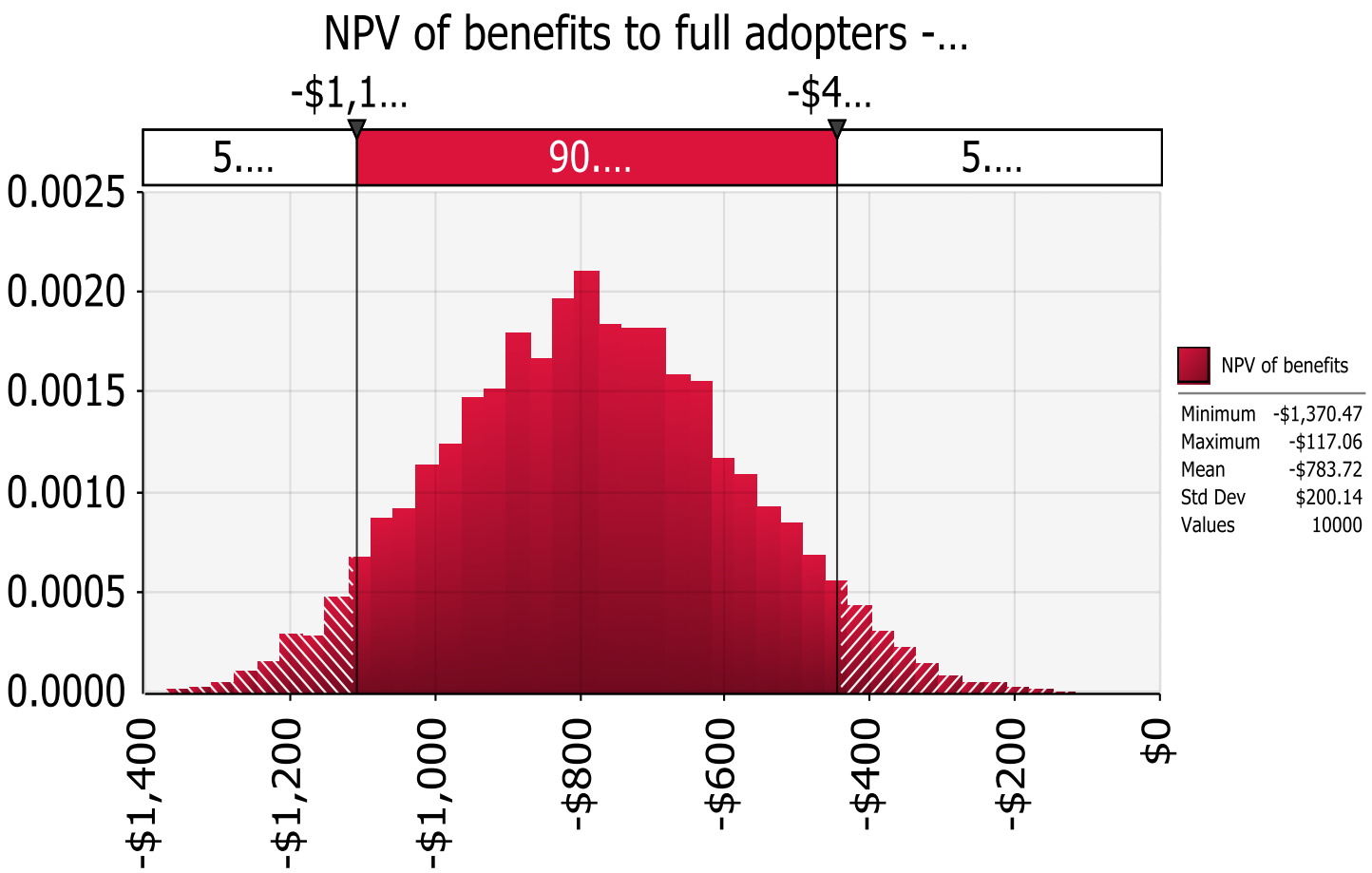
| | | Parameters of distributions | | | |
|---|---|---|---|---|---|
| Uncertain inputs | | Distribution | Parameter 1 | Parameter 2 | Parameter 3 |
| Cost of machine ($,US) | $650 | Pert | $600 | $650 | $750 |
| Contract rate ($/ha) | $33 | Triang | $28 | $33 | $38 |
| Discount rate (% / annum) | 24% | Pert | 18% | 24% | 36% |
| Value of labour saved ($/day) | $5 | Pert | $0 | $5 | $8 |

Scenario 1 (S1)

Machinery used on own-farm

Machinery contract hired

No yield improvement



# Conclusions

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- Financial benefits from adoption of drill seeding can be quite high but only where farmers are able to achieve higher grain yields.
  - Field evidence to date points to the possibility of achieving 10% yield increase, in particular with adequate training, extension support and operational care.
- Contract hiring at current rate is not profitable to a **full adopter**
  - It covers operating cost but only a minor proportion of overheads
- Contract hiring at current rate leads to significant financial benefits to a **partial adopter**.
  - A higher custom rate would need to rely on a consistent yield gain to be attractive
- A custom hiring rate based on the true technology ownership costs with some targeted assistance to partial adopters would;

- make it more attractive for seed drill owners to work as part-time contractors
- enable small farmers to take advantage of the technology
- be more likely to lead to widespread adoption and inclusive economic growth

# Conclusions

...(2/2)

## INDUSTRY savings from technology adoption: A simple analysis

E.g. Net area sown to rice: 100,000 ha (= 3.3% of rice cropping area in Cambodia)

| | *Lower baseline scenario* (No contract servicing) | vs | *Upper baseline scenario* (10 Ha contract servicing) |
|---|---|---|---|
| No of drills required | 50,000 | | 8,333 |
| Capital cost ($650/drill): | $32.5 M | | $5.4 M |
| Return on investment for industry (best case: 10% yield gain) | *US$775 / drill* | | *US$10,252 / drill* |
| 20 year benefits: | $38.8 M | | $85.4 M |
| Net benefit to industry: | $6.3 M | | $80.0 M |

- Access to mechanisation via contract servicing provides a very significant net benefit to industry.
- Much easier to provide mechanical, R&M, extension and policy support for its successful adoption
- Financial incentives targeted to support partial adopters would allow a greater contract rate to be implemented, making drill ownership more attractive to would be contractors
- Balancing the economic profitability between full and partial adopters seems key to promoting an inclusive rice industry development in Cambodia.

# Thank you