Field Study: Insights into the Performance and Propagation of Direct Seeded Rice (DSR) in Paddy Cultivation

Transforming Agriculture for Small Farmers

THE/NUDGE INSTITUTE

Preface (1/2)

The Nudge Institute (T/NI) seeks to alleviate poverty within our lifetime. The Transforming Agriculture for Small Farmers (TASF) program within T/NI aims to increase income and reduce variability for small and marginal farmers in a financially and environmentally sustainable manner.

Smallholder farmers face a host of barriers to increasing their incomes which includes use of non-scientific practices, the presence of high input and labor costs, lack of good market access, etc[1]. But a major consideration is climate – in our earlier research 63% of smallholder farmers cited climate as their top concern and 70% of them experienced crop loss due to variations in weather[2].

The problem also works in reverse; agriculture is also a major contributor to climate change. It accounts for 18%[3] of greenhouse gas emissions, and this is only going to increase as our population increases, consumption increases and other sources of emissions decrease. It is therefore critical to address the impact of agriculture on climate. Considering the financial constraints faced by small and marginal farmers, it would be unreasonable to anticipate their adoption of agricultural practices that might be environmentally beneficial but could potentially decrease their income or expose them to higher risks.

1 - https://assets-global.website-files.com/62131cb6f0c7fd0ea30abf4b/6322e1e150382383891 98e4a_TASF_Report.pdf - SFBO report
2- https://assets.website-files.com/62131cb6f0c7fd0ea30abf4b/649929f0a79111b462e158cc_Smallholder%20Farmer%20and%20Climate%20Change_Final%20Draft.pdf - SFCC report
3 - Sapkota T.B. et al. (2019). Cost-effective opportunities for climate change mitigation in Indian agriculture.

Preface (2/2)

Hence the team worked with farmers and experts to identify agriculture practices or solutions that are at the intersection of farmer's income increase, consumer health and the environment, and called them "Agri-IKIGAI" solutions[1]. The report highlights 13 "Agri-IKIGAI Solutions" that are good for the environment, consumer and financially beneficial for the farmer. All of these Agri-IKIGAI agricultural practices identified by the team are well researched and established methods, but despite their efficacy, these techniques have seen limited adoption in practical applications.

To encourage the adoption of these practices, the team initiated action research on few of the solutions.

Thus we started the current project, focusing on piloting one of the solutions known as **Direct Seeded Rice (DSR)**. This method involves directly planting paddy using a seed drill, which saves labor cost compared to traditional transplanting (PTR), and requires lesser inputs - less water, and and often leads to better income. It eliminates the need for water flooding, resulting in reduced methane emissions and other benefits.

To definitively demonstrate, through first hand data collection, that adhering to the recommended package of practices (PoP) DSR does not result in reduced yield is crucial for widespread adoption of this technique among farmers.

1 -https://assets.website-files.com/62131cb6f0c7fd0ea30abf4b/64f02eb6fa28e75aaf6880a6_Agri-IKIGAI%20Solutions%20Reports.pdf , "Agri-Ikigai" report

Acknowledgement

Partners

We are grateful to ITC, Dvara, Sehgal Foundation, and WRMS for partnering with us for our study, in their respective implementation areas.

We are thankful to Prabhakar, Vijay, Subhendu, Akhilesh, Dhanesh, and Arunendra, from ITC, Tarun and Pankaj from Dvara, Pawan from Sehgal and Anuj, and Pardeep from WRMS who helped us with our extensive farmer surveys and visits.

We would like to thank Dr. Virendra from DSR Consortium, IRRI, and Arjun, Sangeeta, and other members of Bayer team, and Swati Agarwal of Oak Foundation for their valuable inputs.

Team

Our team comprised of Swathi Krishnamurthy, Ankur Sanghai, Prem Prasad, Abhishek Singh, Harshit Chaubey, Medha Ojha, and Ravi Trivedi.

Objectives of the Study

1. Gather on-ground evidence to evaluate whether **DSR** method of paddy cultivation is financially viable for **marginal & small farmers** under different **agro-climatic conditions**

2. I**dentify challenges** in **adoption**, and the **support required by farmers**

3. **Create a playbook** for Civil Society Organizations (CSOs) highlighting successful methodologies to enable adoption and propagation of the DSR method of paddy cultivation

In order to do this, the TASF team worked with partners who had on-ground presence, and also had a pool of farmers practising DSR method. With one partner, we worked on migrating the farmers from transplantation to DSR in a portion of their field. We conducted a research study to assess the comparative aspects of **paddy yield, input costs of cultivation, and income for DSR farmers in comparison to traditional PTR methods.** Additionally, we documented the **challenges associated with the adoption** of these practices.

Executive Summary (1/5)

Click on the key findings for supporting slides

Our findings and observations are based on the study spanning **3 states**, **9 districts**, **6 agro-climatic zones**, and **4** different **partner organisations** providing varying degrees of support to farmers. Totally, **325** farmers practising **DSR** method, and **161** practising **PTR** method were interviewed.

Data was analysed at each partner organisation level, forming **4 regions** of analysis: **Uttar Pradesh(UP) 1, Uttar Pradesh(UP) 2, Haryana(HR)** and **Madhya Pradesh(MP)[2]** and at an aggregate level[1]. On average, **one-third** of the **farmers** interviewed were **small and marginal**, and **~90%** of the farmers had completely **irrigated** farmland.

The **yield and income** values showed a **huge variation in the 4 different regions** under the study. We feel this is mainly driven by the **suitability of soil and weather for DSR**, and difference in the **level of support provided by the partner organisation**. DSR method requires that a farmer **follow a Package of Practice (PoP)** - using the **right inputs** at the **right time, preparation of land before sowing, irrigation** at the right time, and also follow steps required **to manage weeds.** Failing to do these, farmers have shown **loss in yield.** This is where the support provided by the partner org. is crucial. Additionally, the **soil type, irrigation type, climatic conditions and rainfall** also play a significant role in the DSR method.

1- MP data not included for aggregation since it was found to be an outlier
Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers
2 - UP 1 covers districts Bahraich, Gonda and Gorakhpur. UP 2 covers Prayagraj, Haryana covers Karnal, Kaithal and Sirsa districts, and MP covers Vidisha and Raisen districts

Executive Summary (2/5)

Click on the key findings for supporting slides

Key findings of our study are as follows:

- Over **47%** of **small & marginal** farmers experienced a **higher yield** with DSR compared to the average yield from traditional PTR, while using **similar seed varieties**

- Overall, **small & marginal** farmers experienced an average **2.5% decrease** in yield while **farmers of all land size** experienced an average **7% decrease** in yield using the DSR method as opposed to the PTR method.

    - Of the 4 regions, only **UP 1 showed an increase in yield for DSR** practising farmers. In this region, **60 % small & marginal** farmers experienced a **higher yield** with DSR compared to the average yield from traditional PTR. The **increase in yield was by 9%.** In this region, the partner org. provided high hand holding

    - **MP farmers had the poorest performance with DSR** due to issues with irrigation, weed management, low soil fertility, and overall low hand-holding leading to lack of adherence to PoPs

    - Within regions with same level of partner support, but **different agro climatic zones**, performance of DSR showed a notable variation

    - Overall, irrespective of the landholding size, **at least ~70%** of the farmers following the DSR technique have recorded yield **>=80% of the average PTR yield** (similar seed varieties)**.** Farmers tell us that**,** when the variability of yield is within this range, they feel confident in making the switch because the ease of farming and problems with labour availability is managed better with DSR technique.

- Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers
- MP data not included for aggregation since it was found to be an outlier

Executive Summary (3/5)

Click on the key findings for supporting slides

- Overall, **small & marginal** farmers experienced an average **8% increase** in **net income** while **farmers of all land size** experienced an average **0.5% decrease** in **net income** using the DSR method as opposed to the PTR method. Our study does not include incremental income from govt subsidy or carbon credits based extra income.

- Over **51%** of **small & marginal** farmers experienced a **higher net income** with DSR compared to the average net income from traditional PTR.

  - On an average, **farmers see either an increase in income or <1% reduction in income**. The average **decrease in yield** (7%) is **offset by the reduction in cost of cultivation** in the DSR method

  - Of the 4 regions, only **UP 1 showed an increase in income for DSR** practising farmers. In this region, **74 % small & marginal** farmers experienced a **higher income** with DSR compared to the average income from traditional PTR. The **increase in income was by 36%**

- On an average, farmers experienced an **11 % reduction in cost of cultivation with DSR** compared to the PTR method

  - A significant portion of savings in DSR comes from the **lack of need** of a **nursery**, **transplanting labour, and lesser irrigation rounds**

  - A **20-45% drop in the total labour cost** is seen in the DSR method as compared to the PTR method

  - DSR method has **higher costs** associated with **land levelling, sowing machinery, pre-emergence herbicides** and **labour for weed removal**

- Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers
- MP data not included for aggregation since it was found to be an outlier

Executive Summary (4/5)

Click on the key findings for supporting slides

- **68 %** farmers cite that the **low labour requirement** and the associated **cost savings** due to the **lack of need of nursery preparation** is the most important **benefit of DSR** method of paddy cultivation

- **Weed management** was stated as the **biggest challenge while following the DSR method**. **89 % of the farmers who faced yield loss** said it was due to **weed growth** in the farmland

- **68 %** of farmers **transitioned from PTR to DSR largely because of the support of partner organizations**. Additionally, farmer peer networks also had some degree of influence on the adoption of DSR

- **79%** of the farmers said they would **continue with the DSR practice of paddy cultivation in the following year**
  - **91 %** of these farmers said they would **continue even without support from partner organisations**
  - Even in cases where the **yield in DSR is lower than PTR, farmers wish to continue** DSR because of lower labour requirement and overall cost savings

- Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers
- MP data not included for aggregation since it was found to be an outlier

Executive Summary (5/5)

Inference drawn from the study analysis helped us arrive at the following conclusions. Our recommendations suggest practical ways to move forward, using our findings to make decisions and achieve successful outcomes.

- **Yield -** DSR **yields aren't always lower** than PTR. Yield depends on factors like environment, soil, and adherence to PoP. **In favorable conditions, DSR yields may be higher than PTR**, all else being equal. Our study does not include carbon credits and govt subsidies, which could be additional income to farmer.

- **Success & Propagation -** Choosing the **right region and soil type, comparatively lesser weed growth, along with access to controlled irrigation** is crucial for the success and propagation of DSR. A **Digital Public Infrastructure (DPI)**, that uses remote sensing and geospatial data, can be created, to **rank regions based on their suitability for DSR.**

- **CSO Playbook -** Farmers need good guidance for successful DSR adoption, as **lack of knowledge** and **not following recommended PoP's** can **cause huge yield losses** and make farmers hesitant about DSR. On-ground **organizations can use the CSO playbook** complied in this report, to handhold farmers and support them in adopting DSR effectively.

- **Weed Control - Affordable weed control technology and machinery** could drive DSR adoption, offering opportunities for startups and tech institutions to innovate in this area

- **DSR Premium -** Studies have consistently shown that DSR significantly **saves water** (12% to 35%) and **reduces greenhouse gas emissions** (60% to 80%). In today's environmentally conscious world, collaboration between **private and government procurers** can **offer a premium** to farmers for paddy cultivated using DSR.

Background

Overview: Paddy Cultivation In India

Rice is one of the **chief grains of India**, which is one of the leading producers of the crop in the world. Rice is mainly grown in areas that receive heavy rainfall due to its high water requirements for growth, and thus mostly it is a kharif crop (monsoon crop).

In India, the net sown area in the period 2020-2021 was **350 million acres**[3], where over **113 million acres**[1] (*or 46 million hectares*) of land was used to grow paddy across all states, with a total production volume of **124 million tonnes**[2]. **86% of the production** is during the **Kharif season**, and remaining 14% during the Rabi season. **Top 5 states** that produce rice are - West Bengal, UP, Punjab, Telangana, and Odisha.

	Sown Area (thousand acres)	**State-wide Production** (thousand tonnes)	**Yield** (quintal/acre)
UP	14,092	15,271	10.83
HR	3,165	4,618	14.59
MP	5,211	4,815	9.24

The table to the left displays the **total sown area**, **state-wise production**, and the **yield** for paddy in the states under our study (Madhya Pradesh, Uttar Pradesh, and Haryana) in the period **2021 - 2022**[1,2,3].

1- RBI: State wise area of foodgrains, 2- RBI: State wise production of foodgrains
3- RBI- State wise net sown area, 4- RBI: State wise estimates of yield

Direct Seeded Rice - Overview

Direct Seeded Rice (DSR) is a practice of growing paddy where the seeds are directly sown in the field. In comparison, **Puddled Transplanted Rice (PTR)**, which is the traditional method, is a practice where the seedlings are first grown in a **nursery** before being transferred onto the field.

Unlike PTR that requires a lot of water for growth via flooding, **DSR does not require standing water**. Instead, the field being moist is the only requirement for DSR. Apart from lower water requirements, DSR also has lower labour requirements.

One of the main challenges with DSR is the **growth of weeds**. In PTR, weed growth is naturally suppressed due to standing water through puddling. However, with the **right steps taken at the appropriate time** by following the package of practices, weed growth can be addressed.

Types of Direct Seeded Rice (DSR) Methods[1,2]

Dry Seeding (Dry-DSR)

- Dry-DSR consists of sowing **dry seeds** on **dry aerobic soil**. (*In some cases, fields are first irrigated to allow existing weeds to grow, which are then ploughed within few weeks.)*
- The dry seeds are sown either by **broadcasting**, **drilling**, or **dibbling**.
- Dry-DSR is done in mostly **rainfed areas** and some in irrigated areas.
- In our study regions, Dry-DSR was done in **Haryana** and **Madhya Pradesh**.

Wet Seeding (Wet-DSR)

- Wet-DSR consists of sowing **pre-germinated seeds** on **wet puddled soil**.
- The pre-germinated seeds are sown either by **broadcasting**, **drilling**, or **line sowing**.
- Wet-DSR is done mostly in **irrigated areas**.
- In our study regions, Wet-DSR was done in **Uttar Pradesh**.

Water Seeding (Water-DSR)

- Water-DSR consists of sowing **pre-germinated seeds** on **standing water**.
- The pre-germinated seeds are sown mostly through **broadcasting** on standing water.
- Water-DSR is done mostly in **irrigated areas** with good land levelling.
- Water-DSR was **not done** in any of our study regions.

1- Virender Kumar, et. al Direct Seeding of Rice: Recent Developments and Future Research Need (2011)
2- M. Farooq et. al. Rice direct seeding: Experiences, challenges and opportunities (2010)

Difference between Transplanting (PTR) and Direct Seeded Rice (DSR) cultivation

	PTR	DSR
Land Preparation	**cultivator** and **rotavator** are used in both nursery as well as main farmland preparation, however, land levelling is not required	apart from cultivator and rotavator use, **land levellor** use is extremely important in DSR to ensure a levelled field
Seed Germination	seeds are **first germinated in a nursery/seedbed** before being transplanted into the main farmland	seeds are **sown directly into the main land** using a seed drill machine
Water Requirement	requires **continuous flooding** of the fields, especially during early stages	has **reduced water requirement** once land levelling is done to ensure uniform distribution of water
Weed Control	has a very **low chance of weed growth** because of flooding which prevents the required conditions for weed growth	has a **high incidence of weed growth**, and therefore, **timely application** of pre-emergence and post-emergence **weedicides** is needed
Labour Requirement	has a **high labour requirement** because of the need for nursery preparation, seedling uprooting, and transplanting of the seedling into the main land	has a **low labour requirement** because steps such as nursery preparation, seedling uprooting and transplanting are avoided; seeds are sown by a seed drill machine

Benefits of the Direct Seeded Rice method of paddy cultivation

Rice is the staple food of more than **50% of the world's population**. Manual **puddled transplanted rice (PTR)** is the the predominant method of rice cultivation. However, due to water table declines, water, energy and labor intensive nature of PTR, adverse effects of puddling on soil health and subsequent crops and high methane emission, **PTR is becoming less profitable**.

Below are ways DSR can be a better alternative to PTR:

Benefit to Environment

- **Methane** emissions are one of the biggest contributors to global warming, and **DSR leads to a 46% reduction** in these emissions[1].
- DSR **saves 25 to 30% of water** because flooding of fields is not required[2].
- Up to 27% of energy (diesel) is saved in DSR because pumping requirements for field preparation, nursery raising, puddling, and continuous irrigation are avoided[1].

Benefit to Farmers

- DSR helps reduce water consumption, and thus cost to farmers. In a study, DSR **reduced water requirement by upto 30%**[3].
- According to a study[4], DSR saved Rs. 2,400 per acre over PTR in overall cultivation costs and overall returns with DSR ranged from Rs. 2070 - 2750 per acre depending on seed variety.

1- Sharma, S et al. (2019). A compendium of technologies, practices, services and policies for scaling climate smart agriculture in Odisha (India).
2- Lather, V.S. (2022). TAR VATTAR DSR: An eco-friendly weed-control and water-conservation technology for direct-seeded rice.
3- Ekta Joshi, et al. (2013) Management of direct seeded rice for enhanced resource - use efficiency
4- Romana G.S.. (2014) Productivity and economics of direct seeded rice (Oryza sativa L.)

DSR suitability and factors impacting yield

DSR is not suitable everywhere. Biophysical characteristics of croplands and climate drive the system's suitability for DSR at any given location. Further the package of practices followed have a huge impact on the yield.

- In a meta-analysis[1], **unbalanced climate stress** resulted in a **25% drop** in DSR relative yield compared to PTR, whereas a DSR relative yield **drop of 7%** occurred **without climate stress**. This suggests that when rice cultivation shifts from PTR to DSR in a particular region, the **seeding time of DSR** must be determined with adequate consideration of climate patterns to avoid substantial yield losses.

- The same meta-analysis also quantified and ranked management and environmental factors that contributed most to the difference in yield in DSR compared to PTR. **Weed management** explained **~35%** of the variation, **climatic stress** explained **~18%** of the variation and **water management** explained **~15%** of the variation in DSR yield. Other factors include soil texture, soil pH, and soil organic carbon.

- **Crop Establishment** (*which includes soil type, seedbed preparation, sowing date, seed rate, and seed preparation, planting machinery, and depth of seeding*) is another major factor that impacts DSR yield. The soil type recommended for the direct-seeded crop is **medium to heavy textured soils** because **light soils suffer from iron deficiency** which can cause significant yield losses[2]. The seedbed should be **free of weeds** and **precisely leveled** at sowing. The optimum time for sowing DSR is about **10–15 days** before the onset of monsoon[3]. Based on trials[4] conducted in the Indo Gangetic Plain, the optimum seed rate of **20–25 kg/ha** for medium-fine-grain rice cultivars with 20 cm spacing between the rows and 5 cm spacing within rows were concluded.

1- Longfei Xu, et. al, Comparing the Grain Yields of Direct-Seeded and Transplanted Rice: A Meta-Analysis (2019)
2- Kaur J, Singh A (2017) Direct seeded rice: prospects, problems/constraints and researchable issues in India. Curr Agri Res J 5(1):13–32
3- Kumar V, Ladha JK (2011) Direct seeding of rice: recent developments and future research needs. Adv Agron 111:297–413
4- Gopal R, et. al. (2010) Direct dry seeded rice production technology and weed management in rice based systems. Technical Bulletin. International Maize and Wheat Improvement Center(CIMMYT), New Delhi, India, 28pp

Challenges in adoption/scaling DSR: Observations from the ground

While DSR could help in challenges such as declining agricultural labor availability, aging farmers, erratic seasonal rainfall, soil degradation, and poor irrigation, there are still challenges that can hinder its adoption.

- **Weed Issues -** DSR is prone to excessive **weed growth**, which is a major pain point for farmers adopting DSR.. Having a **reliable solution** to address this issue of weed growth is necessary for large scale adoption of DSR.

- **Lack of Machine Access -** machine access for **land levelling**, as well as **seed drill** for direct seed sowing is required in DSR. Availability of these machines on a rental basis at an **affordable price** is needed for farmers to adopt DSR.

- **Inertia of existing practice -** farmers tend to follow practices that have been done for generations because of the **familiarity** of practices and the **expected outcomes from those practices**. Adopting a new method whose outcomes are **not proven in their farming conditions** is a major risk that farmers are hesitant to take, especially given the initial investment needed to make the transition.

- **Lack of Knowledge -** many farmers are **not aware** of the DSR method of paddy cultivation and its benefits. Our study reveals that once farmers understand the benefits, and have a peer farmer group that has adopted DSR, they are **more likely to adopt DSR themselves**.

- **Lack of adherence to Package of Practice (PoP) -** when DSR is adopted, following of the **management practices**, and **timing** of critical steps (especially in weed management), are necessary to see expected benefits. However, farmers do not follow the steps and timing accurately, which negatively impacts the yield. Poor adherence to PoP results in poor outcomes, which in turn results in farmers' negative view of DSR method, thus impacting the adoption.

DSR Landscape overview in India

In India, about **46 million (460 lakhs) hectares** is under paddy cultivation, and with a production level of 130 million tonnes of rice. 65% of the area is under irrigation[1].

As per estimate by **Bayer**, **DSR** has the potential to be transformational with **75 percent** of **total rice fields** in **India** which could switch to this cultivation method by **2040**, in comparison to **roughly 11 percent today**[2].

We see increased activity among private sector, and government ecosystem for DSR adoption, especially given the water use efficiency improvement need of the sector.

- Govt of Punjab and Haryana have schemes that give **Rs 4000 subsidy per acre** to farmers who adopt DSR.
- ITC CSR group has a climate smart villages program, under which about **33,000+ farmers** are practicing DSR.
- Bayer has announced **DSR at the center of its sustainability initiative**, and plans to increase the area under coverage to **1 million hectares** by **2030**.
- DSR Consortium led by IRRI **promotes private public partnerships** to increase the adoption of DSR.

1- Agriculture Statistics at a Glance 2022
2. Bayer DSR Press release - Oct 2023

Global Adoption of DSR

- The **largest producer** of rice in the world is **China** followed by India, Indonesia, Bangladesh and Vietnam. The production share of **Asia** is the largest i.e. **90.2%**, followed by the America (5%) and Africa (4.2%)[1].

- In the United States, Malaysia, and Sri Lanka, more than **90%** of the rice has been **direct seeded** for the past few decades[2].

- Precise **land leveling**, suitable **cultivars**, good **crop establishment**, precise **water management**, and effective and efficient **weed and nutrient management** are keys to the success of DSR.

- The establishment of a **strong herbicide industry** resulting in the availability of affordable and appropriate herbicides has also played an important role in these countries.

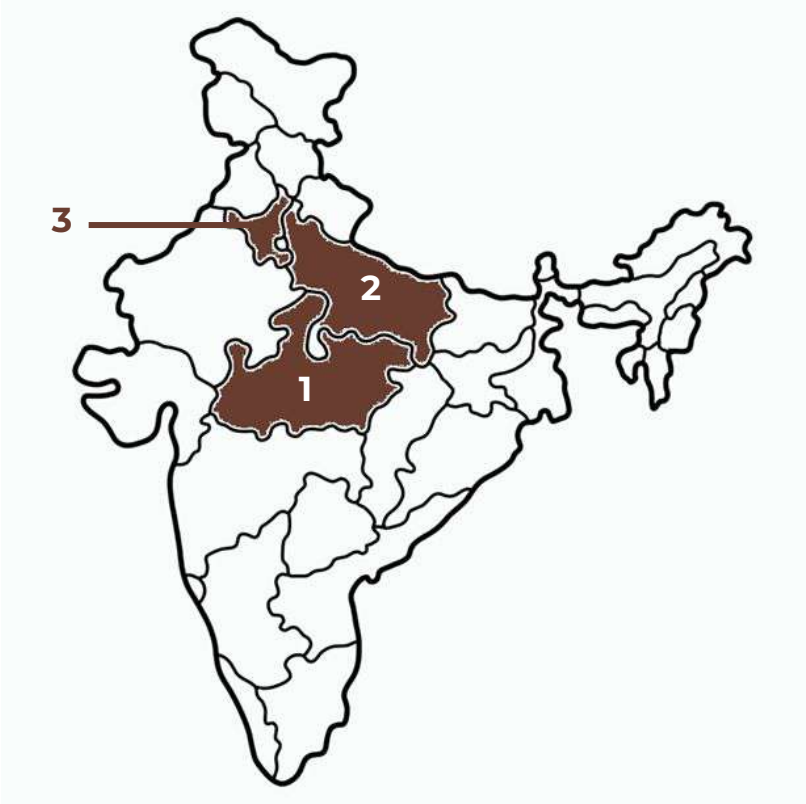
- Experiences have also shown that a shift to DSR resulted in (1) weed flora changes toward more **difficult-to-control** and competitive grasses and sedges, (2) the development of **resistance** in weeds against commonly used herbicides, and (3) the appearance of **weedy rice**.

- Therefore, **anticipatory research** and **development strategies** need to be developed for areas where direct seeding is likely to be adopted. This is important for direct seeding to be sustainable on a long term basis

1- FAOSTAT, 2018
2- Advances in Agronomy, CSISA

Overview of Our Research

Regions covered under the study and target population



1 - Madhya Pradesh

2 - Uttar Pradesh

3 - Haryana

3 States | **9** Districts

79 Villages | **367** Unique farmers[1]

Target population status

- Number of Farmers

	DSR	PTR
	325	161

- Land Under Cultivation (acres)

	DSR	PTR
	3,038	1,656

- Irrigation Status (% of farmers)

	DSR	PTR
Completely irrigated	68 %	75 %
Partially irrigated	19 %	24 %
Rainfed	12 %	1 %

1- The word 'unique farmers' mean overall no. of individual farmers interviewed. Same farmer may be practising both DSR and PTR in different farmlands in the same year. So, the no. of unique individual farmers will be lesser than the sum of farmers interviewed for DSR and PTR.

Districts covered in our study

Our study includes **9 districts** across **3 states**

Madhya Pradesh (MP)

- Vidisha
- Raisen

# of farmers interviewed in MP: **137**

Uttar Pradesh (UP)

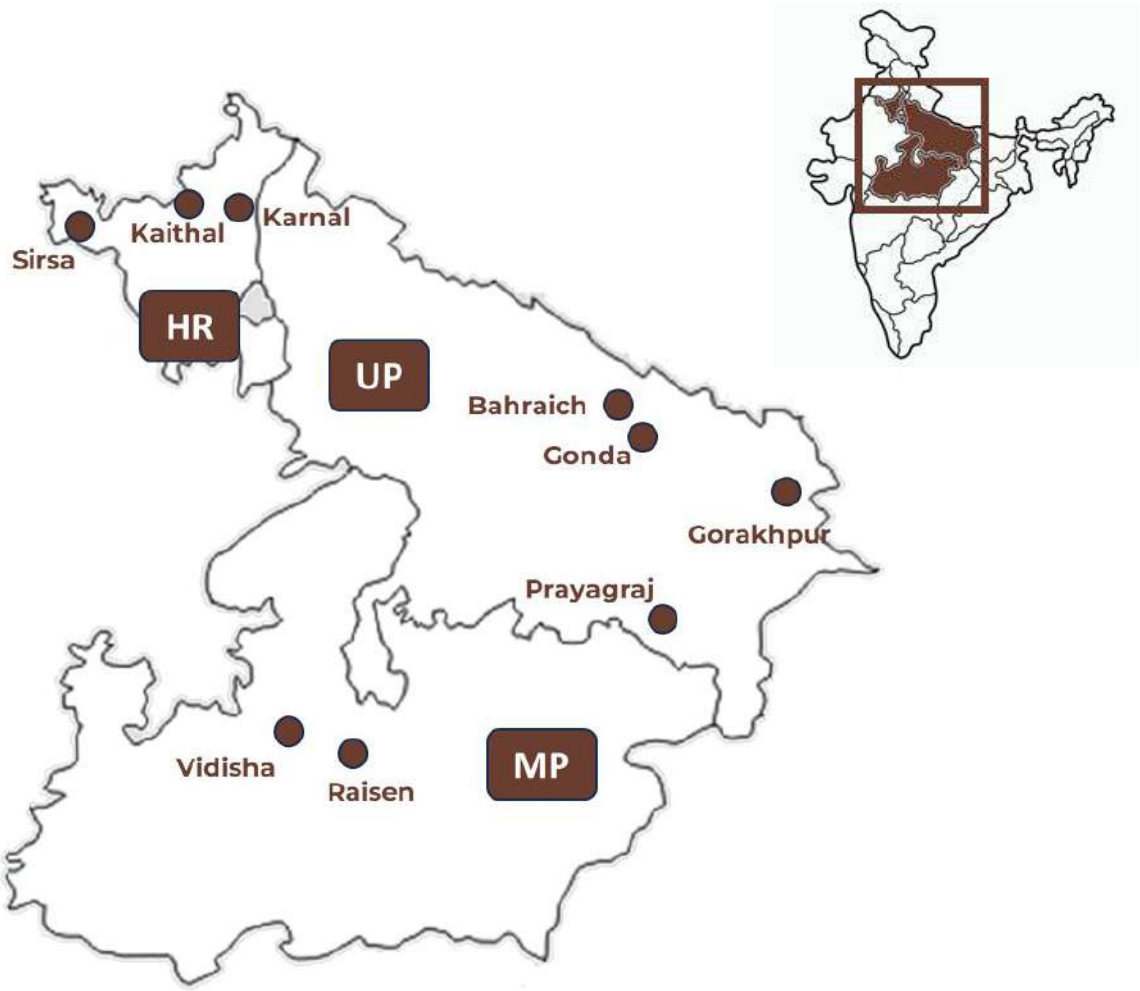
- Bahraich
- Gonda
- Gorakhpur
- Prayagraj

# of farmers interviewed in UP: **174**

Haryana (HR)

- Karnal
- Kaithal
- Sirsa

# of farmers interviewed in HR: **56**



Agro Climatic Zones covered: Based on NARP standard[1]

Districts in our study cover **6 agro-climatic zones**.

Agro climatic zones are **land area units** that are categorized based on the various **agro-climatic conditions** that make certain range of crops suitable for growth in certain regions. The factors that are considered include **soil type**, **rainfall**, **temperature**, and **water availability** which affect the type of vegetation.

Madhya Pradesh

- Vidisha
- Raisen

Vindhya Plateau (MP 5)

Uttar Pradesh

- Bahraich

Central Plain Zone (UP 6)

- Gonda
- Gorakhpur

North Eastern Plain Zone (UP 8)

- Prayagraj

Vindhyan Zone (UP 8) & Central Plain Zone (UP 4)

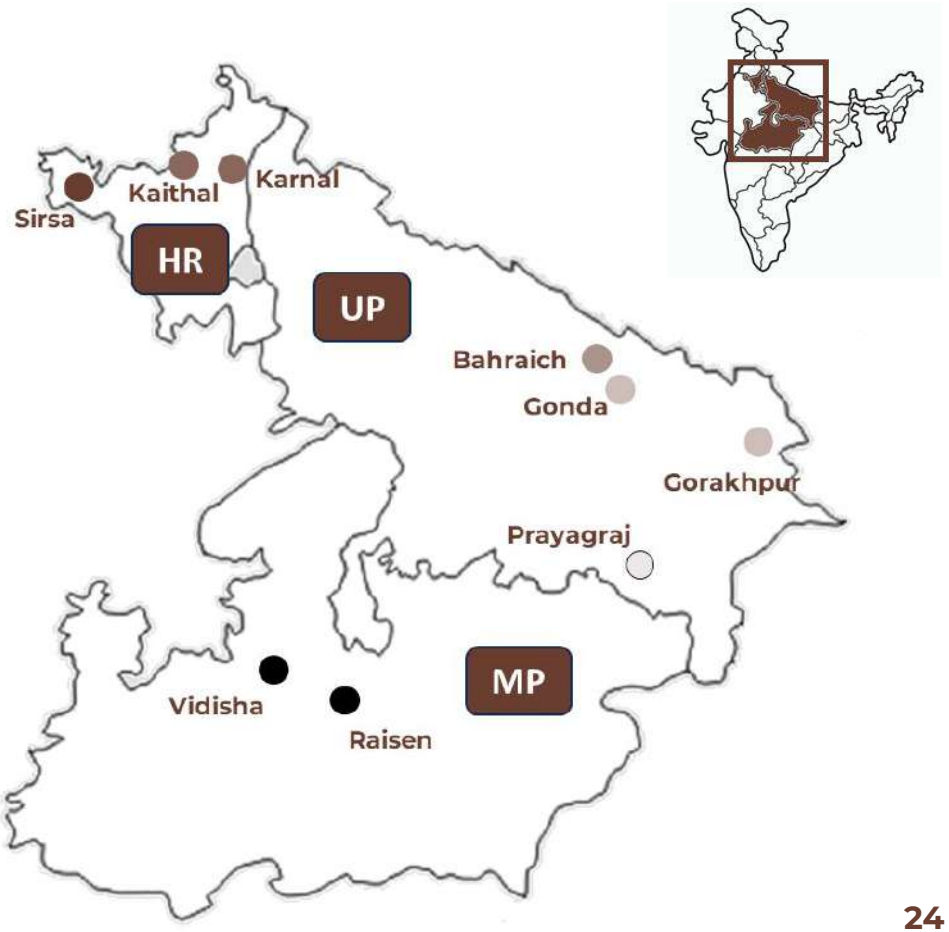
Haryana

- Karnal
- Kaithal

Eastern Zone (HR 1)

- Sirsa

Western Zone (HR 2)



1- NARP: National Agriculture Research Project, ICAR Research Data Repository for Knowledge Management

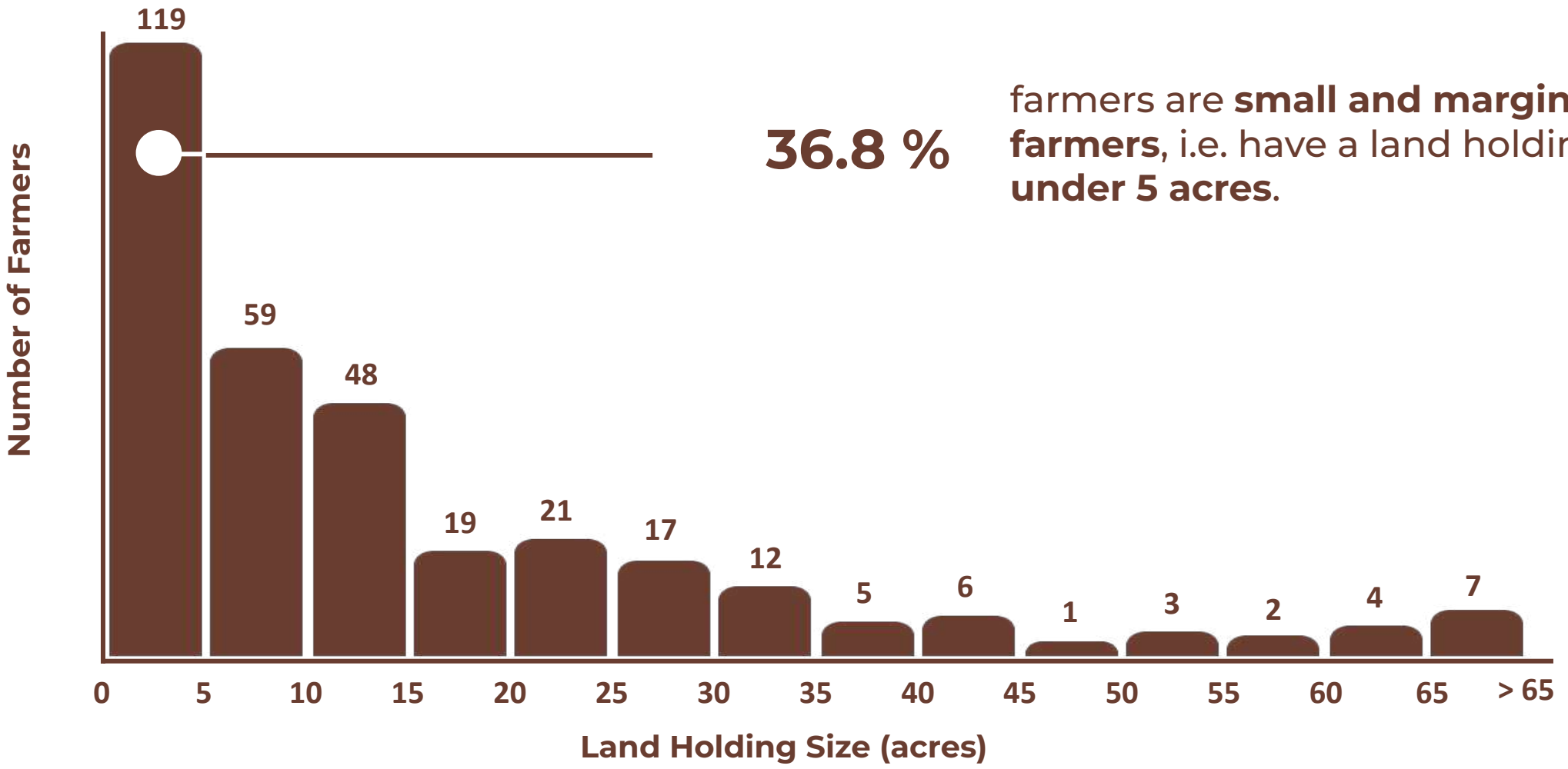
Characteristics of Agro Climatic Zones covered in the study

The table below displays the **soil type** and **annual rainfall** of the agro climatic zones based on the NARP standard[1] covered in our study.

State	District/Area	Agro Climatic Zone	Soil Type	Annual Rainfall (mm)[2]
MP	Vidisha	Vindhya Plateau (MP 5)	Medium black & Deep Black	1200-1400
MP	Raisen	Vindhya Plateau (MP 5)	Medium black & Deep Black	1200-1400
UP	Bahraich	Central Plain Zone(UP 6)	Deep Clay loam Soil	1148
UP	Gonda	North Eastern Plain Zone (UP 8)	Sandy loam Soil & Sandy Soil	1166.8
UP	Gorakhpur	North Eastern Plain Zone (UP-8)	Sandy loam Soil & Sandy Soil, Clay	1364
UP	Prayagraj	Vindhyan Zone (UP-8) & Central Plain Zone (UP-4)	Red sandy loam soil	975
HR	Karnal	Eastern Zone (HR1)	Loamy soil & sandy loam	780
HR	Kaithal	Eastern Zone (HR1)	Loamy soil & sandy loam	551
HR	Sirsa	Western Zone (HR2)	Sandy Loam	391

1 - Classification of Agro-climatic zones is based on the National Agricultural Research Project (NARP) standard which was launched by The Indian Council of Agricultural Research (ICAR).
2- Indian Council of Agricultural Research (ICAR)

Target population by landholding size



36.8 % farmers are **small and marginal farmers**, i.e. have a land holding **under 5 acres**.

One-third of the farmers interviewed across the 3 states in our study are **small** and **marginal** farmers.

Sampling Method and Approach

1 State and district

Selected 3 states based on 4 organisations who we could partner with, and were either piloting DSR with paddy farmers or had access to a pool of DSR practising farmers.
Selected all districts where they had presence in the 3 states; Org 1 - UP (Bahraich, Gonda, Gorakhpur), Org 2 - UP (Prayagraj), Org 3 - Haryana (Karnal, Kaithal, Sirsa), Org 4 - MP(Vidisha, Raisen)

2 Village

Selected 8-9 villages per district based on the following criteria:

- Villages must be as far apart as possible
- Preferably have different intervention initiation time (started this year, 1 yr ago, 2 yrs ago, etc.)

3 Farmer

From the selected villages, 5-6 farmers/village were randomly picked based on the landholding size criteria.
Selected farmers follow either only DSR method, or, only PTR method, or both

3 states

4 regions (partner org.-state combinations)

9 districts

79 villages

367 farmers

States were selected using convenience sampling, where partner organizations had presence
Districts were not sampled, entire population (all districts) where partners had presence selected
Villages were selected based on purposive sampling
Farmers were selected based on purposive random sampling

Study Design: Methodology and Tools

Expected Study Outcomes

- Calculate the difference in **yield, input costs,** and **income** between target farmers employing the DSR method and those using the traditional PTR method for paddy cultivation
- Understand challenges in the cultivation method in the DSR and PTR method
- Understand barriers to adoption of the DSR method of paddy cultivation

Research approach

- Sample baseline vs endline study
- Quasi-experimental treatment vs control

Research method

- Mixed method using both, qualitative and quantitative data

Quantitative data collection tools

- Survey method using Interview schedules

Qualitative data collection tools

- survey method and in-depth interviews using Interview guide

Study Design: Key Metrics and Indicators

Matrices (DSR & PTR method)	Indicators (Influencing factors captured in the study)
Paddy yield	seed variety, cultivation process
Input cost	seed quantity & cost, fertilizers and pesticides quantity & cost, implements used, labour, cultivation process
Income	Selling price of paddy, yield, input cost
Challenges in cultivation	weed and pest management, adherence to PoP, availability of inputs and labour
DSR - Barriers to adoption	awareness, knowledge and assistance by partner organisation, availability of inputs

Most treatment and control farmers are the same set of farmers, but have certain portions of their land under DSR method of cultivation and a certain other portion has paddy grown using the traditional method. The former is considered for treatment and the latter for control. Comparing DSR and non-DSR practice of the same farmer takes away variabilities such as soil type, farmer behavior, water availability, etc. A baseline and endline accounts for variabilities in weather conditions, input cost, etc. between the two consecutive kharif seasons

TASF Action Research Study Timelines and Milestones

May - Aug ‘23 — Partner and Farmer Selection

Sep - Oct ‘23 — Baseline Survey

Nov - Dec ‘23 — Endline Survey

Dec’23 to - Mar‘24 — Analysis of data, reporting findings, and report writing

Mar ‘24 — Report launch and dissemination

Apr ‘24, and Beyond — Scale the adoption of DSR practice by influencing the ecosystem

Observations and Findings

Handholding level by Partner Organizations in study regions

We partnered with **4 on-ground partner organizations** to conduct the study, where each partner provided a **varying degree of support/hand-holding** to farmers. Hand-holding refers to the attention, support, and interaction a partner organization provides to the farmers during the phase of introducing a new intervention or farming technique. Below is a description of what handholding means in this context.

High hand holding level:

- **Interactions** with farmers and village visits
- Support in the form of **resource management**, **knowledge sharing** of PoPs, **problem resolution**, etc.
- Regular **farmer meetings** for educational and training purposes at village or block level
- **Timely reminders** on crucial steps in the intervention PoP
- **Year-round** support to farmers, not just in a specific season

Medium hand holding level: All of the above support at a **medium** or **decreasing frequency**

Low hand holding level: Farmers receive **none or negligible support**

Grouping of data for analysis: 4 distinct regions

Grouping of data for analysis has been done based on **partner organisations** and **states**.

This is so that, while comparing DSR and PTR paddy yield, we can keep parameters such as weather conditions, soil type, farmer-practices and partner support constant.

In this study, we have **4 distinct regions**:

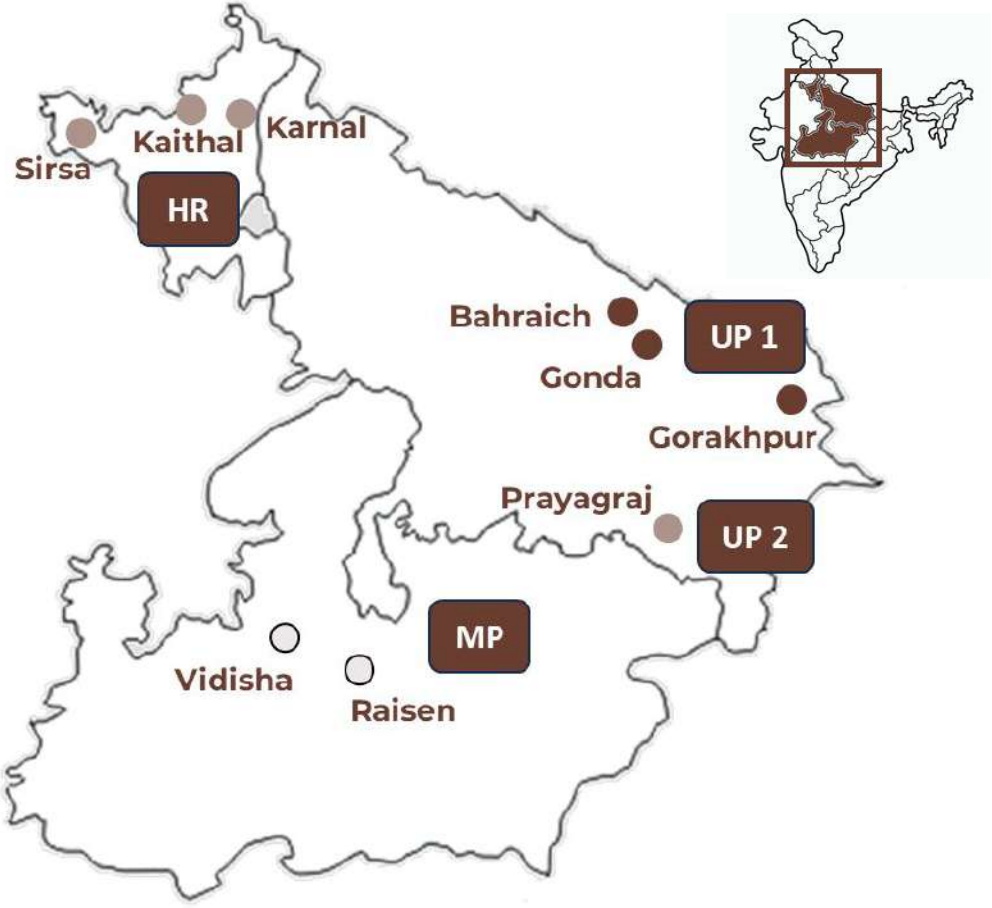
1. **UP 1 - Bahraich, Gonda and Gorakhpur**
Supported by *Org. 1*, providing **high** level of support

2. **UP 2 - Prayagraj**
Supported by *Org. 2*, providing **medium** level of support

3. **Haryana (HR) - Sirsa, Kaithal, Karnal**
Supported by *Org. 3*, providing **medium** level of support

4. **Madhya Pradesh (MP) - Vidisha, Raisen**
Supported by *Org.4*, **low** level of support, no ongoing initiatives on DSR

Regions based on partner organisation and hand-holding



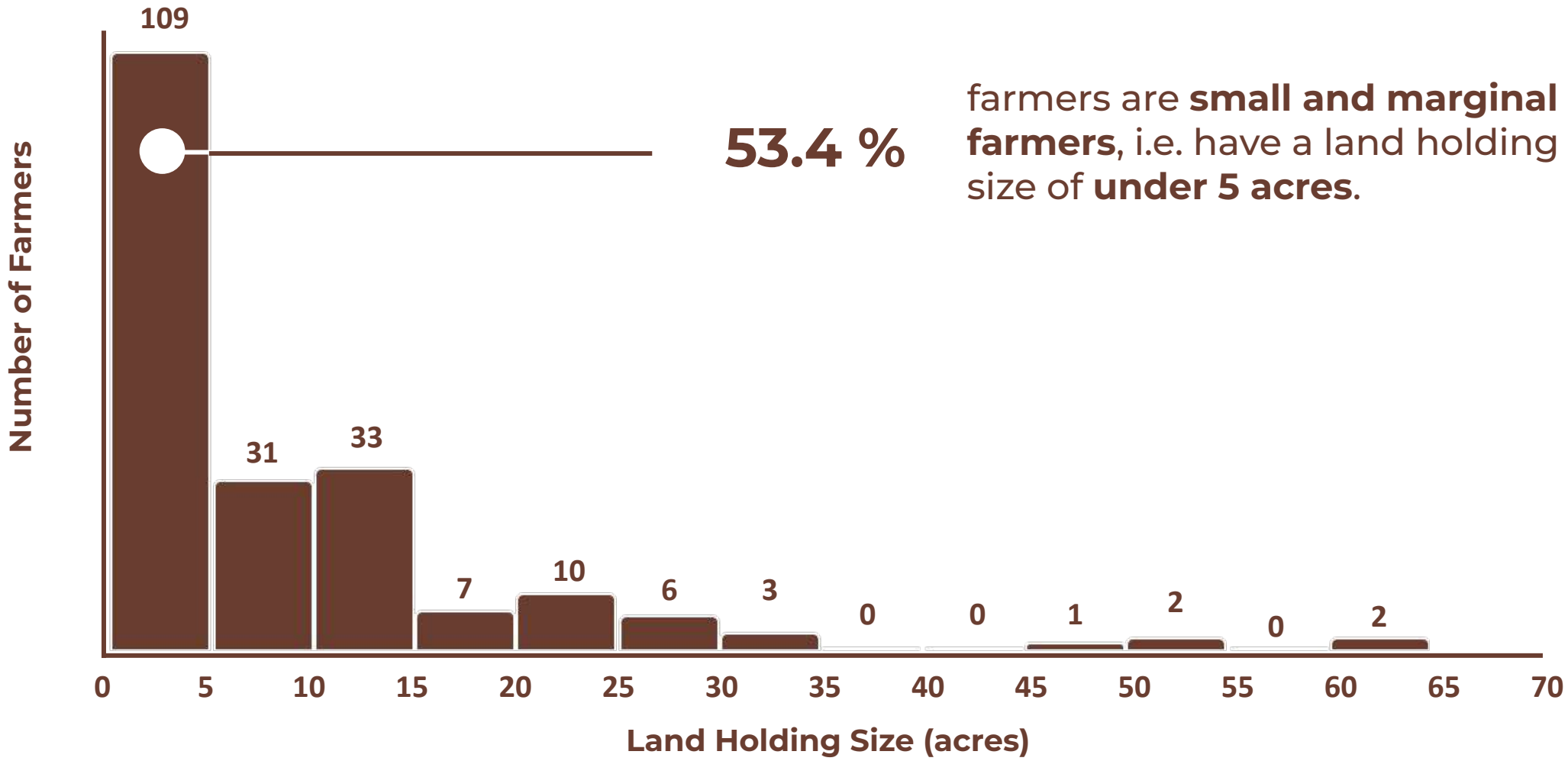
Aggregation of findings: Region-wise and Overall

- ***Region-wise Analysis*:** Analysis on yield, income, i/p cost and cultivation practices is done for each of the 4 region. Analysis within each region ensures factors such as partner support, weather conditions, farmer practices and irrigation status remain constant. The controllable externalities acting upon the parameters measured can be kept minimal.

- ***Aggregated Analysis*:** For the overall analysis, regions **UP 1**, **UP 2**, and **Haryana** data has been aggregated. This is done so that we get a picture the performance of DSR technique across variable soil types, weather conditions, and when support to farmers is variable.

Region 4, **Madhya Pradesh** has **NOT been chosen while aggregating the overall data** because it was an outlier, in comparison with the other 3 regions. Many farmers had extremely poor yield using DSR technique. Water availability, soil fertility, weed issues, coupled with very low handholding levels were some of the reasons for the yield loss. Details on this is discussed further in MP, region-wise analysis in the report.

Target population in UP 1, UP 2 and Haryana based on landholding size



53.4 % farmers are **small and marginal farmers**, i.e. have a land holding size of **under 5 acres**.

Half of the farmers interviewed across 3 regions (UP 1, UP 2 and Haryana) are small and marginal farmers.

- MP data is not included for aggregation because it was found to be an outlier

Aggregated Analysis:
Observations and Findings

Aggregated Yield Analysis

Aggregated Yield Analysis | Steps followed to analyse and compare DSR and PTR yield

1 Common seed varieties

From DSR and PTR yield data of 2023, selected farmers with **similar seed varieties for yield comparison**.

Ensured that the chosen group constitute **at least 50% of the overall farmers** in both DSR and PTR analysis

2 IQR method to remove outliers

Removed yield **outliers** from both data sets using the **Inter Quartile Range (IQR) method**, for each seed variety

Calculated average yield for each seed variety

3 DSR and PTR yield comparison: farmer wise

For each of the **common seed varieties**, calculated the

- no. and % of farmers whose **DSR yield is in the range >=100 %, 100-80%, 80-60%, or <60% of average PTR yield of that variety**

Repeated this for **small & marginal farmers**, and **semi-medium farmers**

4 % Increase/decrease in DSR yield

Compared average of yield for **all farmers**, DSR 2023 and PTR 2023 **across seed varieties**

Compared **PTR yield of 2022** and **DSR yield of 2023** for **same farmer, same farmland**

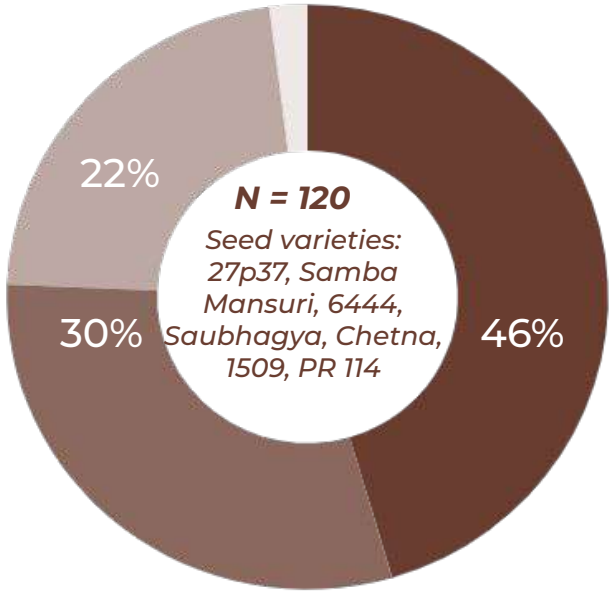
Compared **PTR yield of 2023** and **DSR yield of 2023** for **same farmer**

Compared **DSR** and **PTR yield** in different **agro-climatic zones**

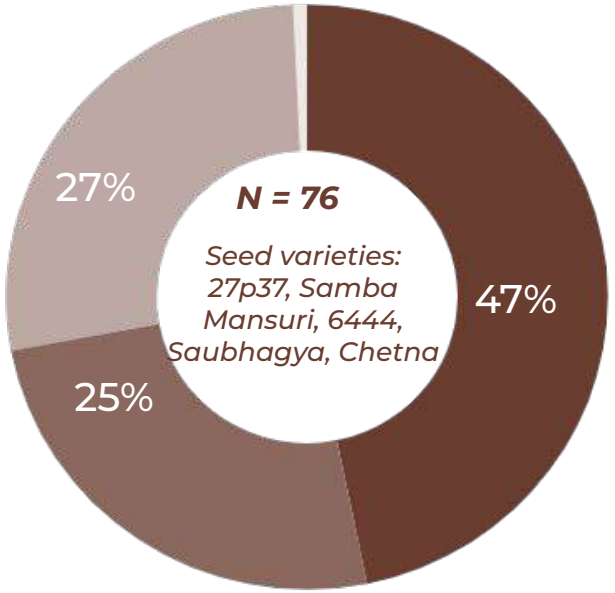
Aggregated % change in yield from each of the 3 regions, for each category of farmers to get average % change across regions

Aggregated Yield Analysis - Comparing similar seed varieties | Over 47% of small and marginal farmers experienced a higher yield with DSR compared to the average yield from PTR

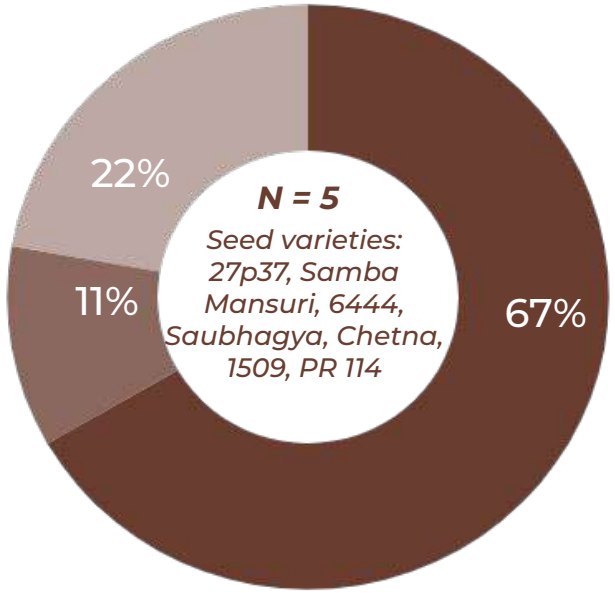
- % farmers with DSR yield >= 100% avg. PTR yield
- % farmers with DSR yield between 80-100% of the avg. PTR yield
- % farmers with DSR yield between 60-80% of the avg. PTR yield
- % farmers with DSR yield <60% of the avg. PTR yield



All farmers using similar seed varieties for DSR and PTR from UP 1, UP 2 & HR



Small and marginal farmers using similar seed varieties for DSR and PTR from UP 1, UP 2[1] (0-5 acres).



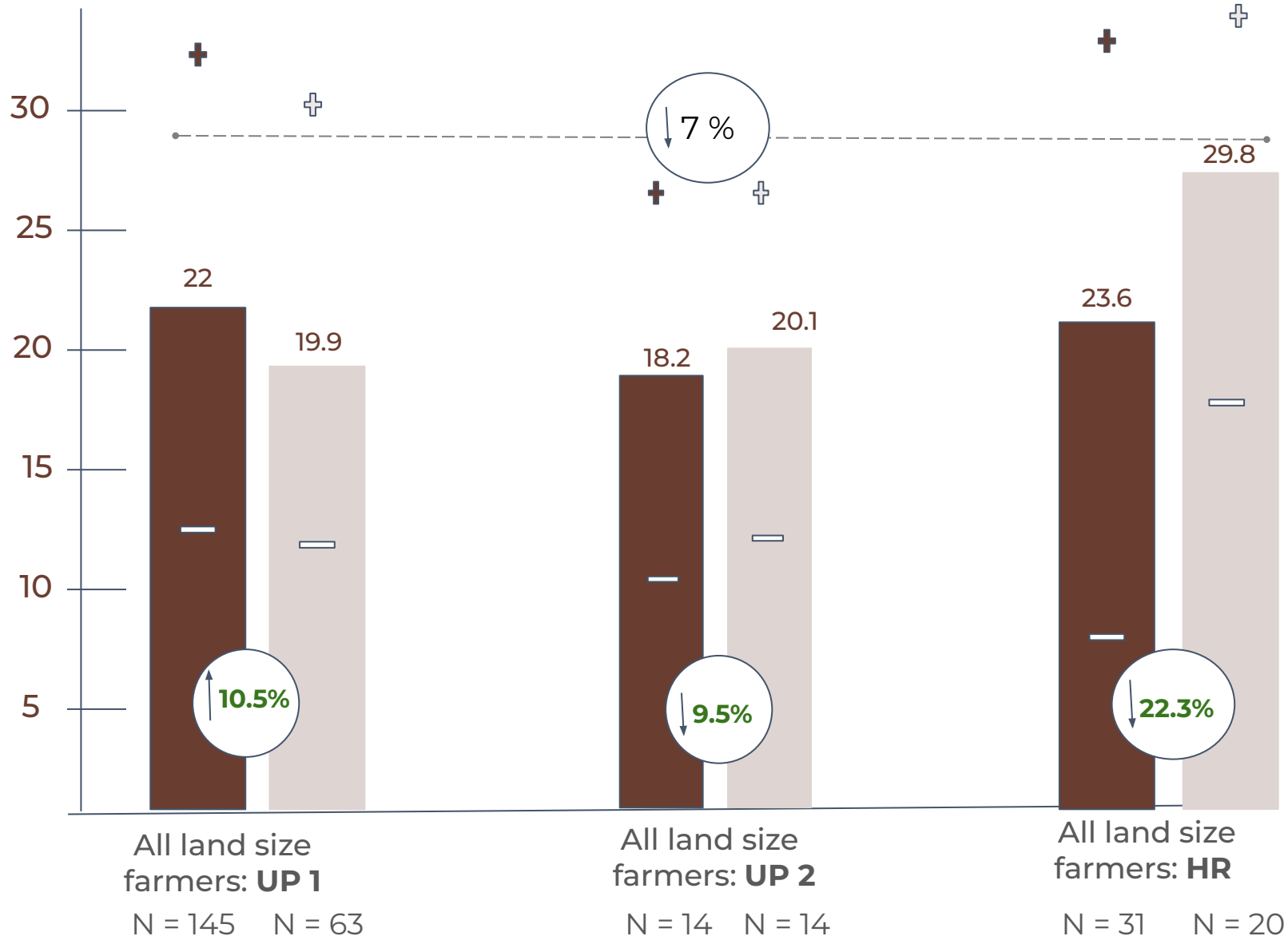
Semi-medium farmers using similar seed varieties for DSR and PTR from UP1, UP 2 & HR (5-10 acres)

Irrespective of the landholding size, **at least 70% of the farmers** following the **DSR technique** have recorded a **yield >=80% of the average PTR yield** for **similar seed varieties**, in regions UP 1, UP 2, and Haryana.

Farmers tell us that, when the variability of yield is within this range, they feel confident in making the switch because the ease of farming and problems with labour availability is managed better with DSR technique.

1- Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers
MP data not included for aggregation since it was found to be an outlier

Aggregated Yield Analysis | Across 3 regions, farmers experienced an average 7 % decrease in yield using the DSR method as opposed to the PTR method



Average DSR yield in quintals/acre

Average PTR yield in quintals/acre

Maximum value

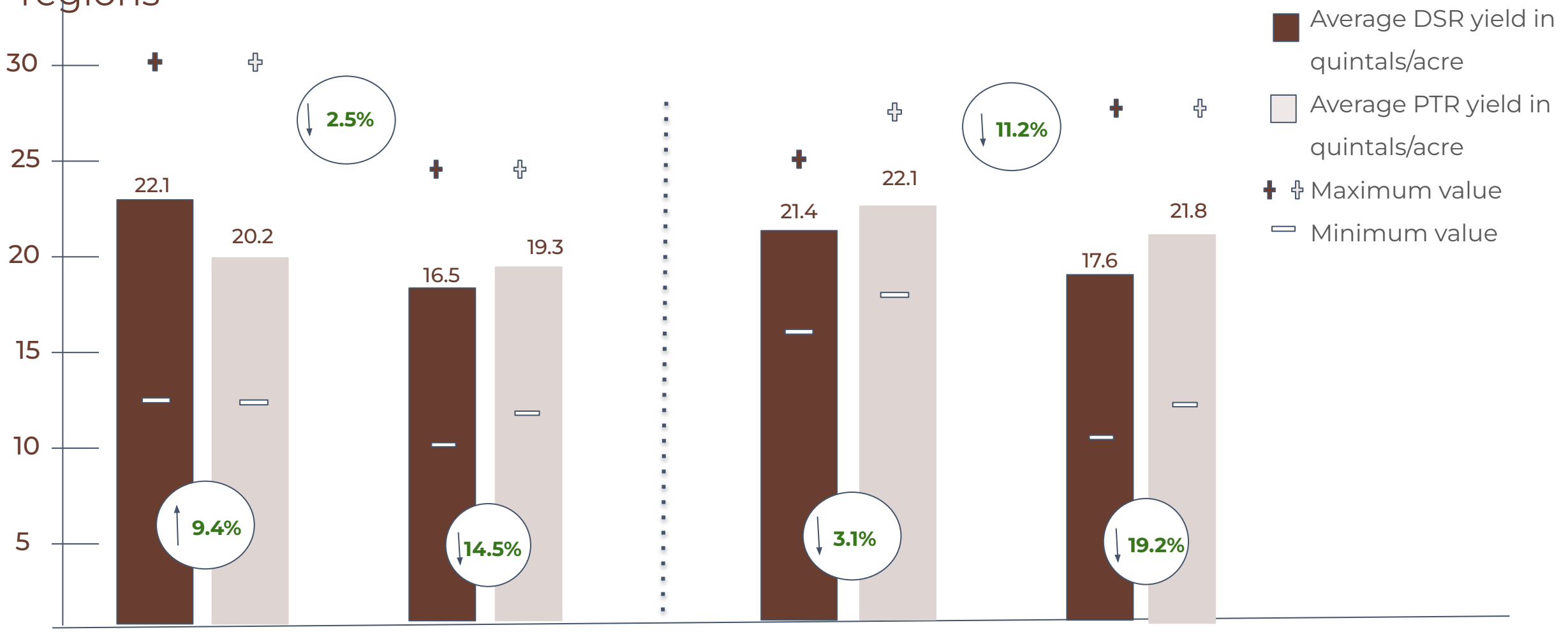
Minimum value

>

- The three regions UP 1, UP 2 and Haryana are different in terms of soil type, weather conditions, farming practices, support they received from partner org. for doing DSR
- UP 1 received high level of support, while UP 2 and HR received medium level of support

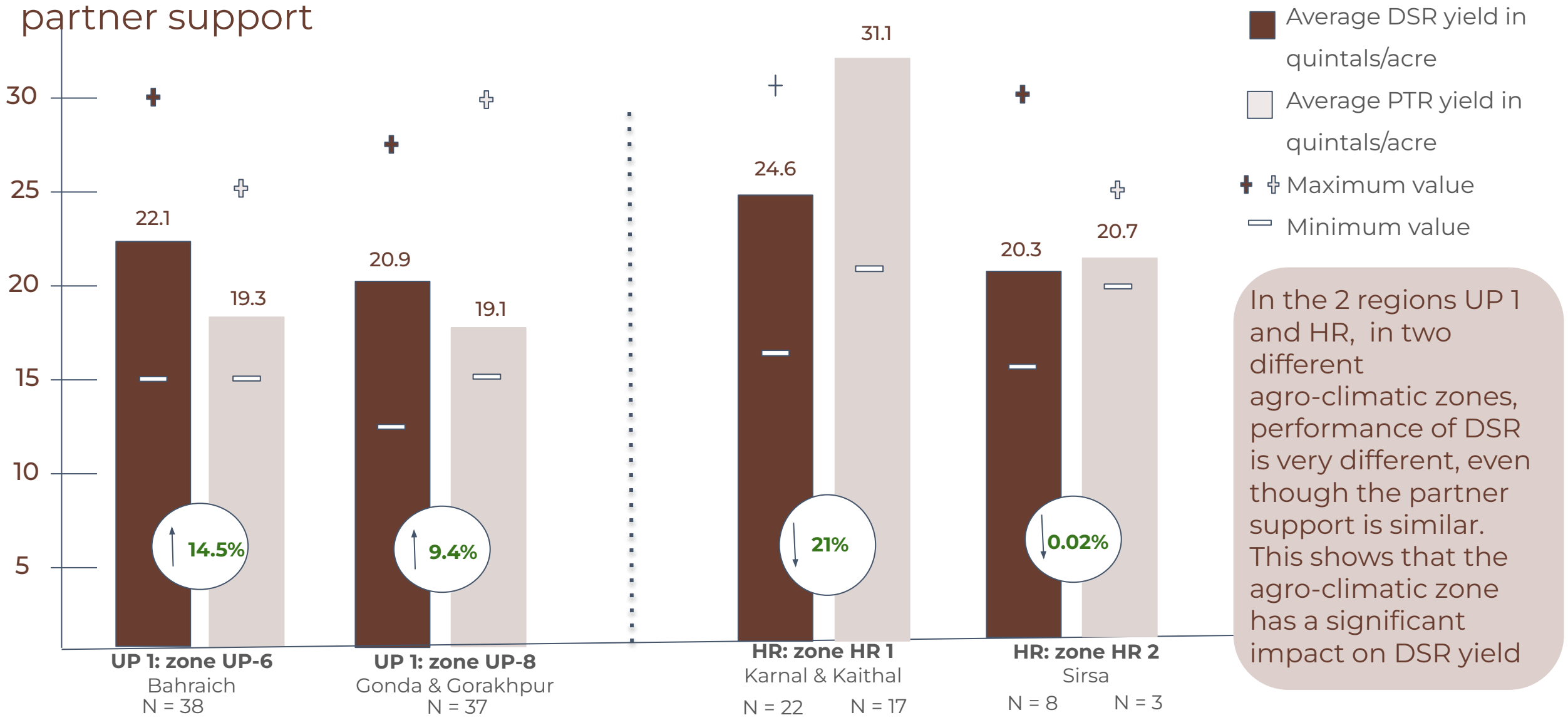
- Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers
- MP data not included for aggregation since it was found to be an outlier

Aggregated Yield Analysis | Small & marginal farmers experienced an average 2.5 % decrease in yield using the DSR method as opposed to the PTR method, across 2 regions



- Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers
- MP data not included for aggregation since it was found to be an outlier

Agro-climatic zone wise yield analysis | Significant difference in change in yield between DSR and PRT under different agro-climatic zones, but with similar level of partner support



In the 2 regions UP 1 and HR, in two different agro-climatic zones, performance of DSR is very different, even though the partner support is similar. This shows that the agro-climatic zone has a significant impact on DSR yield

- Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers
- MP data not included for aggregation since it was found to be an outlier

Impact of Handholding on Yield in our Study Locations

- When transitioning from PTR to DSR, having a ~**10 - 15% decrease** in yield is **acceptable** to farmers due to savings in time, energy and overall cost of cultivation in DSR.
- According to a study[1] done in Haryana in 2015-2016, DSR resulted in a **9.4% drop** in yield when compared to PTR. According to another study[2] in 2015, **PTR had a 10-12% higher yield** than DSR in both years under study.

Region	Handholding level	Yield
UP 1	High	↑ 10.5 %
UP 2	Medium	↓ 9.5 %
HR	Medium	↓ 22.3 %
MP	Low	↓ 86 %

- Handholding levels can impact not only the **adoption** of DSR, but also the **yield** through DSR. Proper handholding by making sure PoPs are followed correctly by farmers, timely application of inputs at the right stages, ensuring knowledge is disseminated, and overall support to farmers during the transition to DSR can have significant impact on yield.

1- A Comparative Analysis of DSR Technology Vs. Transplanted Method in Haryana (2017)
2- Anil Kumar, et al. Productivity and economics of direct seeded rice (Oryza sativa L.) (2015)

Aggregated Income Analysis

Aggregated Income Analysis | Steps followed to analyse and compare net income from DSR and PTR cultivation

1 Steps involved in cultivation

Curated all steps involved in the cultivation process in DSR method and PTR method of paddy cultivation after analysing the survey data

2 Average input cost

Calculated **input cost per acre of cultivation** for both methods using cost provided by the farmers for inputs used at various stages of cultivation

Used the IQR method to **remove outliers** of cost and quantity for each stage of input cost calculation

Calculated **average input cost** for both methods

3 Revenue and income per farmer

Derived **revenue** per farmer for 1 acre of land:

- Used the recorded value of selling price/quintal of each paddy variety, region wise
- Multiplied the value with yield/acre for each farmer
-

Calculated **net income** per farmer

- (Selling price/acre - I/p cost per acre)

4 % Increase/decrease in income

Calculated no. and % of farmers whose **DSR income is in the range >=100 %, 100-80%, 80-60%, or <60% of average PTR yield**

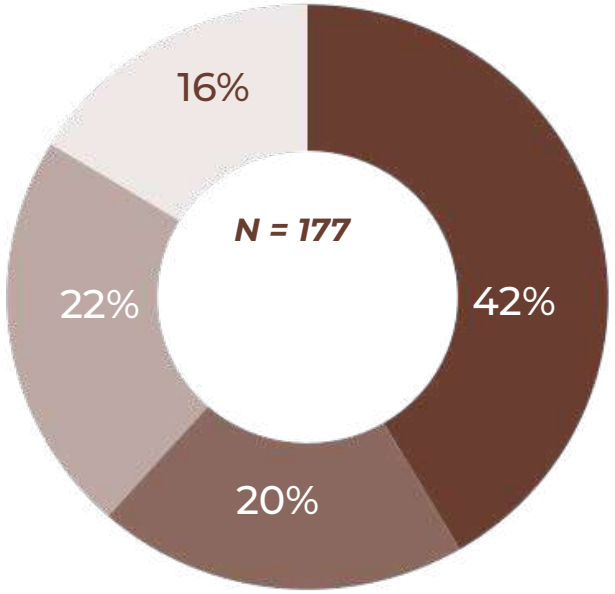
Calculated the **% difference** in income between DSR and PTR method of cultivation

Repeated this for **small & marginal farmers**, and **semi-medium farmers**

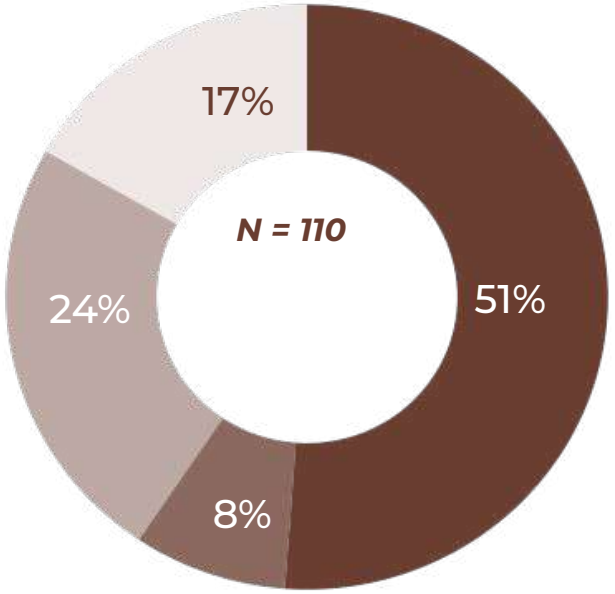
Aggregated % change in net income from each of the 3 regions, for each category of farmers to get average % change across regions

Aggregated Income Analysis | Over 51% of small and marginal farmers experienced a higher net income with DSR compared to the average income from PTR

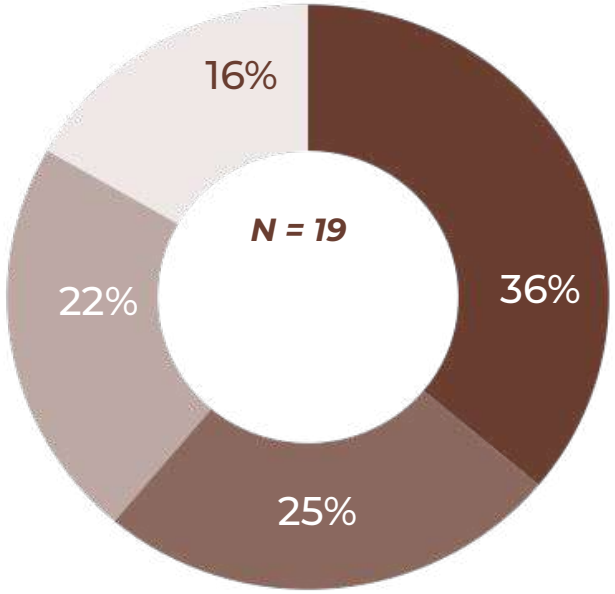
- % farmers with DSR yield >= 100% avg. PTR yield
- % farmers with DSR yield between 80-100% of the avg. PTR yield
- % farmers with DSR yield between 60-80% of the avg. PTR yield
- % farmers with DSR yield <60% of the avg. PTR yield



All land side farmers from UP 1, UP 2 & HR



Small and marginal farmers UP 1, UP 2 [1] (0-5 acres).

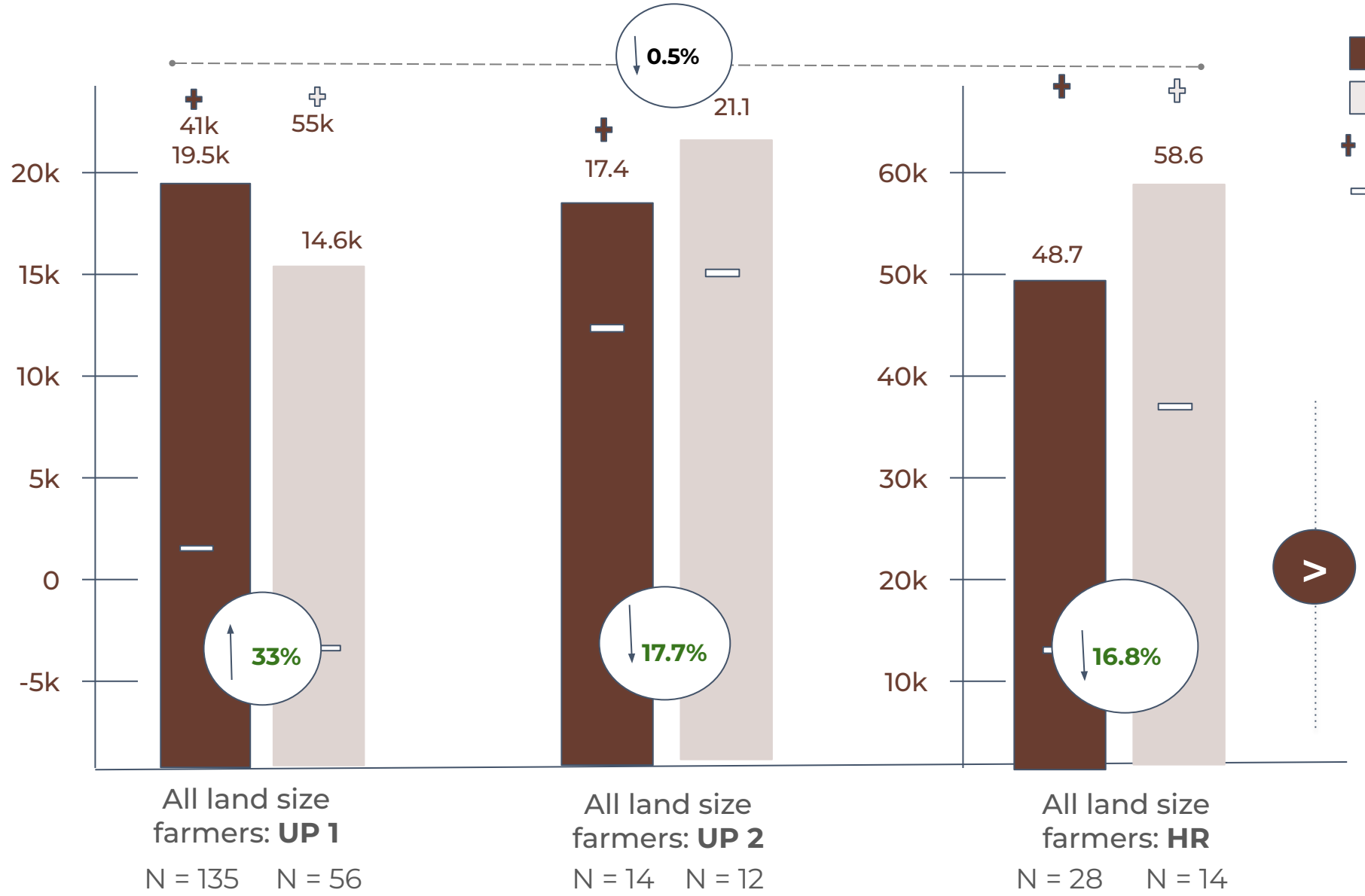


Semi-medium farmers UP1, UP 2 & HR (5-10 acres)

Irrespective of the landholding size, **at least ~36% of the farmers** following the **DSR technique** have recorded an **income higher than the average PTR income** in regions UP 1, UP 2, and Haryana.

- Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers
- MP data not included for aggregation since it was found to be an outlier

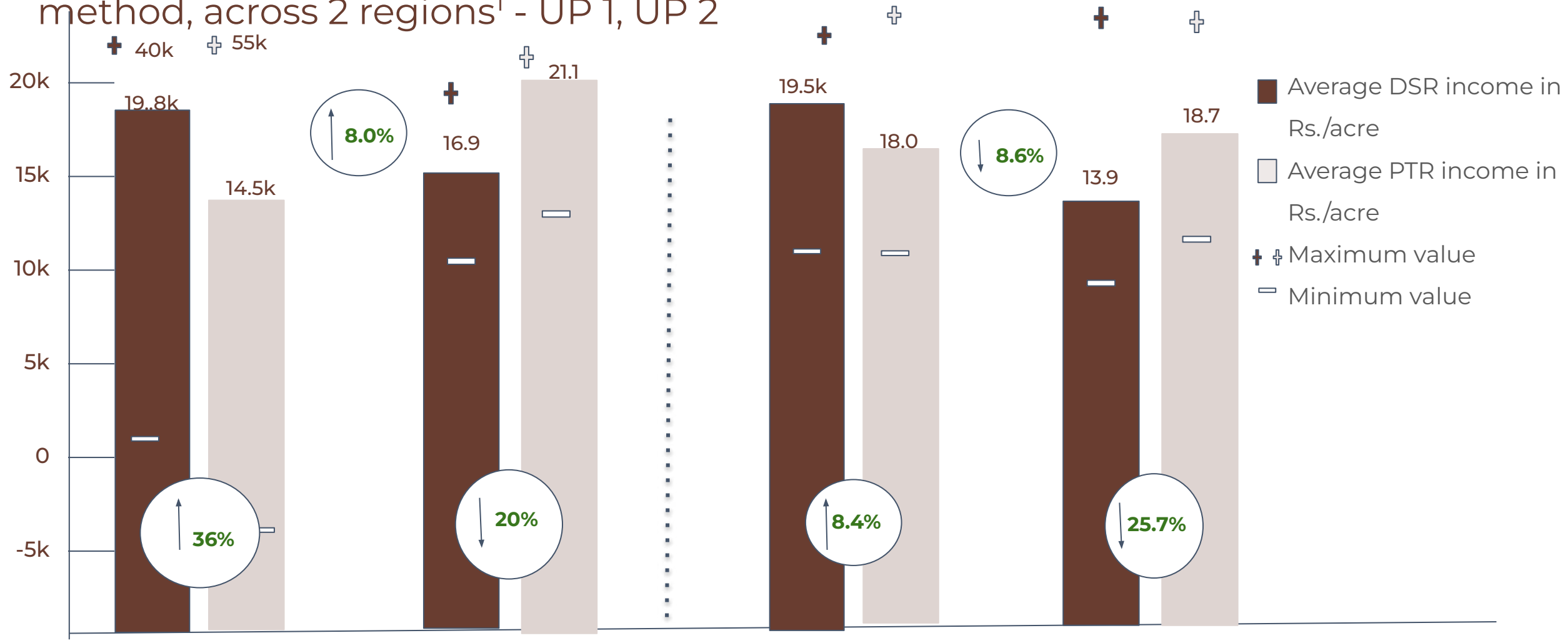
Aggregated Income Analysis | Farmers experienced an average 0.5 % decrease in net income using the DSR method as opposed to the PTR method, across 3 regions



- Though there is an average 7% reduction in yield, the decrease in income on an average is only 0.5%. This is because of the reduction in cost of cultivation.
- We observed that in some regions, farmers were able to sell their PTR produce at 2-5% higher value than the DSR produce. Even with this, the net income change is significant.
- When we tried normalising the selling price across DSR and PTR, for UP 1, the income increase was found to be 47 %

- Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers
- MP data not included for aggregation since it was found to be an outlier

Aggregated Income Analysis | Small & marginal farmers experienced an average 8 % increase in net income using the DSR method as opposed to the PTR method, across 2 regions[1] - UP 1, UP 2



UP 1: **Small and marginal** farmers (0-5 acres) N = 103 N = 39

UP 2: **Small and marginal** farmers (0-5 acres) N = 7 N = 10

UP 1: **Semi-medium** farmers (5-10 acres) N = 12 N = 5

UP 2: **Semi-medium** farmers (5-10 acres) N = 4 N = 5

1 Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers - MP data not included for aggregation since it was found to be an outlier

Overall Cultivation process and Cost calculation

Key Cultivation Steps in PTR and DSR

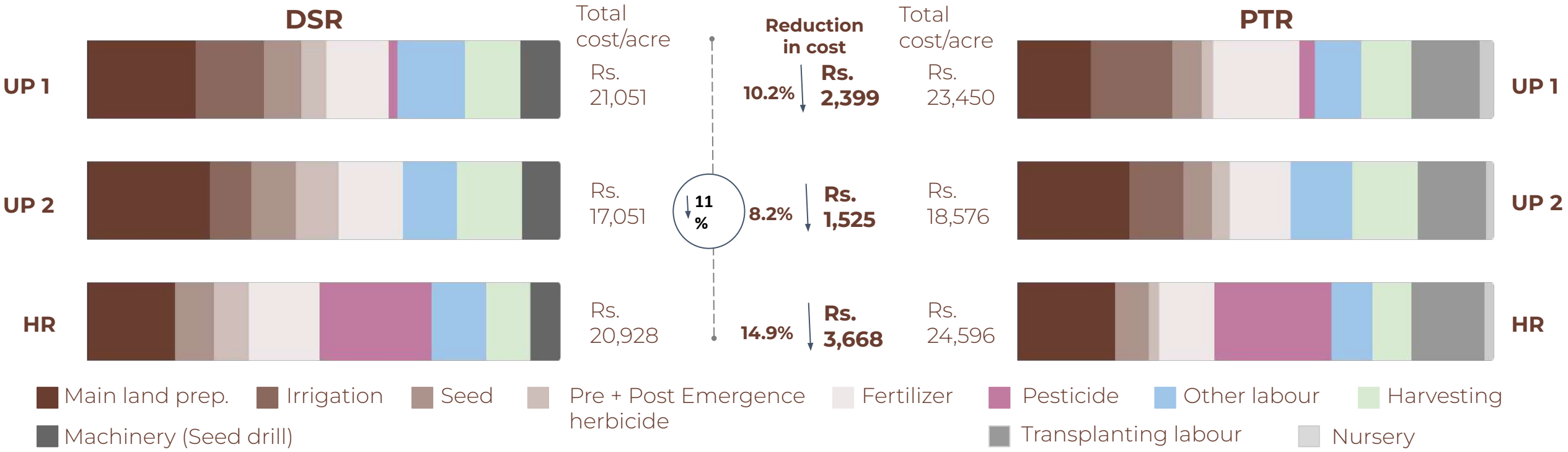
PTR

1. **Nursery Land Preparation:** nursery bed is prepared to cultivate paddy sapling
2. **Seed Germination:** seeds are sown in the nursery soil bed and appropriate inputs such as fertilizers and pesticides are added
3. **Main Land Preparation:** cultivators and rotavators are used to break up and aerate the main land soil
4. **Main Land Irrigation:** irrigation is continuously done to maintain sufficient water depth
5. **Transplanting:** seedlings from nursery, once a certain height is reached, are uprooted and transplanted into the main farmland
6. **Fertilizer Application:** fertilizers such as urea and DAP are applied to the main farmland to improve soil fertility
7. **Pesticide Application:** few rounds of pesticides are sprayed to prevent pest attacks
8. **Post-emergence Herbicide:** are applied to kill weeds

DSR

1. **Main Land Preparation:** apart from the use of cultivators and rotavators, laser land levelling is critical
2. **Irrigation before Sowing:** irrigation is done either before or after sowing depending on the specific methodology, or when hairline cracks emerge in soil
3. **Seed Sowing:** seeds are sown directly into the mainland via a seed drill machine
4. **Pre-emergence herbicide:** is applied to the field within 24-48 hours of sowing
5. **Fertilizer Application:** fertilizers such as urea and DAP are applied to farmland
6. **Pesticide Application:** few rounds of pesticides are sprayed to prevent pest attacks
7. **Post-emergence Herbicide:** another round of herbicides are applied after seedlings emerge
8. **Weed removal:** weeds, which have a high chance of occurance in DSR, are removed manually

Overall Input Cost Analysis | On an average, farmers experienced a 11% reduction in input cost with DSR compared to the PTR method



Major contributors to input cost in DSR include **mainland preparation** and **fertilizer** cost. Costs specific to DSR include **machinery** (seed drill), **pre- emergence herbicides**, and **higher cost of seeds.**.

Major contributors to input cost in PTR include **mainland preparation**, **transplant labour**, **fertilizer**, and **irrigation**. Costs specific to PTR include **nursery preparation** and **transplanting labour**.

DSR has savings in cost due to lack of **nursery preparation** and lack of **transplant labour** which are both present in PTR. PTR, which even though has a higher overall cost than DSR, has reduced cost with **main land preparation**, **herbicides**, relatively **lower cost of seeds**, and lack of need of **seed sowing machinery**. .

- Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers
- MP data not included for aggregation since it was found to be an outlier

DSR cultivation and adoption challenges: voices from the ground

(Aggregated from regions UP 1, UP 2 and Haryana)

- MP data not included for aggregation since it was found to be an outlier

Understanding Farmer Transition to DSR: Aggregated from regions UP 1, UP 2 and Haryana

Challenges with PTR

81 %

of farmers cite that the **low availability of labour**, and thus its higher cost, as their biggest challenge given the labour intensive requirement of PTR method of paddy cultivation

Benefits of DSR

68 %

of farmers cite that the **low labour requirement** and the **associated cost savings** is a major benefit of DSR method of paddy cultivation due to the lack of need of nursery preparation

Challenges with DSR

89 %

of farmers cite that the excess **growth of weeds** is a major concern with DSR method of paddy cultivation

How to improve DSR adoption?

77 %

of farmers cite that if there is a solution to address the issue of weed growth through **effective weed management**, adoption of DSR can be significantly improved

- Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers
- MP data not included for aggregation since it was found to be an outlier

Influence and Support by Partner Organization: Aggregated from regions UP 1, UP 2 and Haryana

Influence by Partner Organization to Adopt DSR

68 %

of farmers transitioned from PTR to DSR because of the **influence of Partner Organizations**. Additionally, farmer peer networks have also had some degree of influence on the adoption of DSR

Partner Organization

Support provided by Partner Organization to farmers

92 %

of farmers, who transitioned to DSR due to the influence of Partner Organizations, received support in the form of **PoP knowledge**, **guidance**, **access to DSR machinery**, and **monitoring** via on-field visits. Majority of the farmers were **not provided any free or subsidised**[1] inputs by partners

1 - Only Org 2 provided support in the form of free or subsidised inputs, in UP 2
- Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers
- MP data not included for aggregation since it was found to be an outlier

Farmers' Perspective on Future Adoption of DSR: Aggregated from regions UP 1, UP 2 and Haryana

DSR adoption by Smallholder farmers

80 %

of farmers cite that **small** and **marginal farmers can adopt DSR** because of the cost saving benefits, however, having an effective **weed management solution** would be critical

Continued Adoption of DSR

79 %

of farmers cite that they **will continue with DSR the following year**. Even in cases where the yield in DSR is lower than PTR, farmers are still continuing DSR because of lower labour requirement and overall cost savings

Continued Adoption of DSR without Support

91 %

of farmers who plan to continue with DSR the following year cite that they would **continue with DSR even without support from partner organizations**

- Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers
- MP data not included for aggregation since it was found to be an outlier

Region Wise Analysis:
Observations and Findings

Region 1: Uttar Pradesh (UP 1) - Bahraich, Gonda, Gorakhpur

Observations and Findings

Program supported by

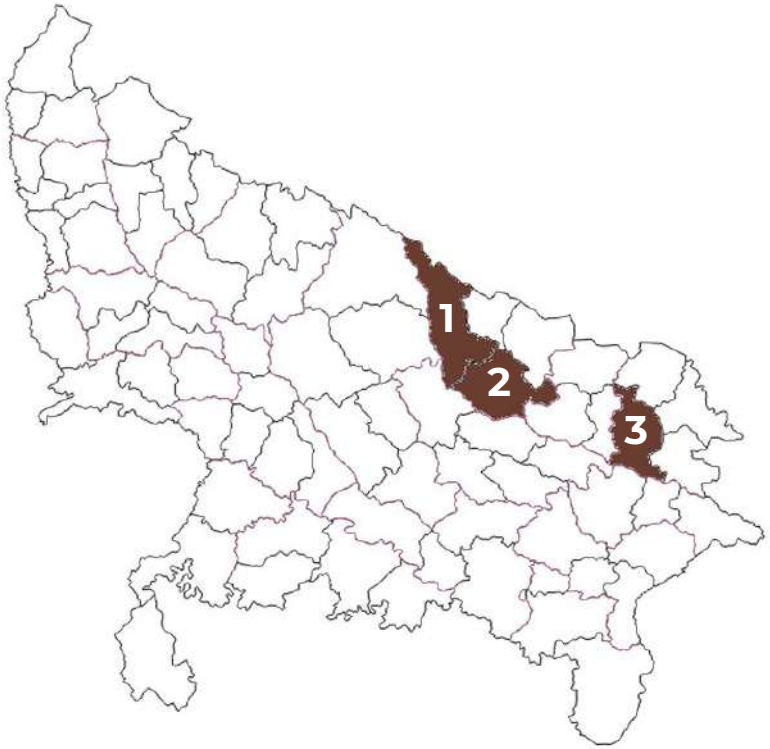
Background: Uttar Pradesh 1

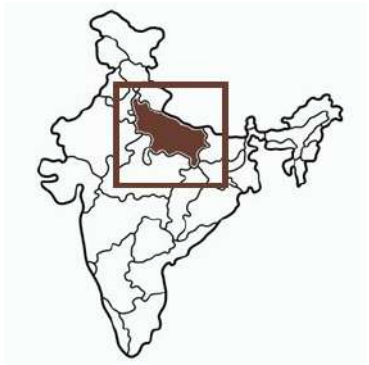
Districts covered	Bahraich, Gonda, and Gorakhpur
Agro Climatic Zones (NARP)	Central Plain Zone (UP 6) and North Eastern Plain Zone (UP 8)
Partner Support Level	High *(interactions with farmers, PoP knowledge dissemination, resource management support, problem resolution, etc.)*
Most grown crops in UP	Sugarcane, Rice, Wheat
Common Soil Type	Deep Clay loam Soil, Sandy loam Soil, Sandy Soil, Sandy loam Soil
Paddy Sown Area in UP	14,092.42 thousand acres (2021 - 2022)[1]
Paddy Yield in UP	10.83 quintal per acre (2021 - 2022)[2]

1- RBI: State wise area of foodgrains
2- RBI: State wise estimates of yield

“ I am very happy that the partner organization introduced me to DSR. Because of their support, I am getting a higher yield than PTR with savings in overall cost. ”

Uttar Pradesh 1 : Regions under Study and Target Population





1 - Bahraich

2 - Gonda

3 - Gorakhpur

3 Districts | **33** Villages | **157** Unique farmers[1]

Target population status

- Number of Farmers

	DSR	PTR
	152	67

- Land Under Cultivation (acres)

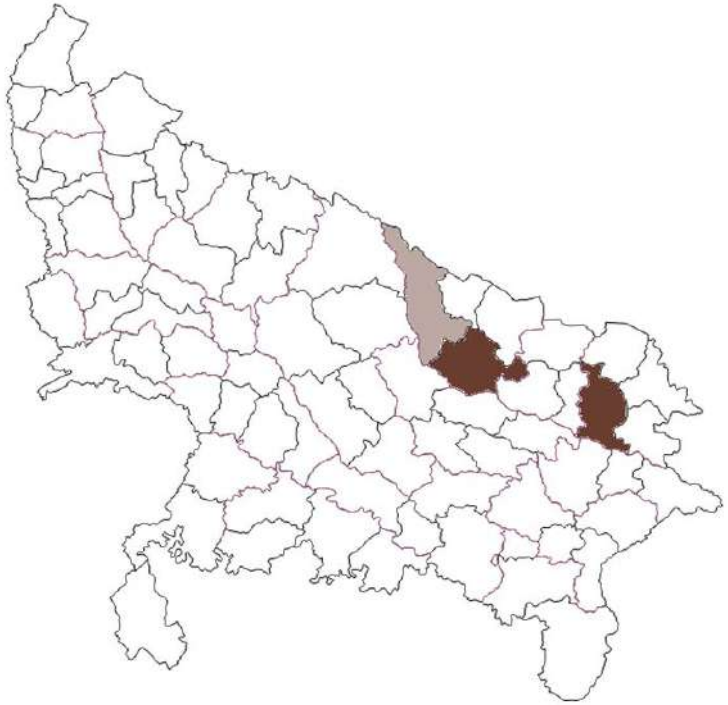
	DSR	PTR
	1007	491

- Irrigation Status (% of farmers)

	DSR	PTR
Completely irrigated	99 %	100 %
Partially irrigated	1 %	0%
Rainfed	0 %	0%

1- The word 'unique farmers' means overall no. of individual farmers interviewed. Same farmer may be practising both DSR and PTR in different farmlands in the same year. So, the no. of unique individual farmers will be lesser than the sum of farmers interviewed for DSR and PTR.

Uttar Pradesh 1 : Agro-climatic zones



Central Plain Zone (UP 6)

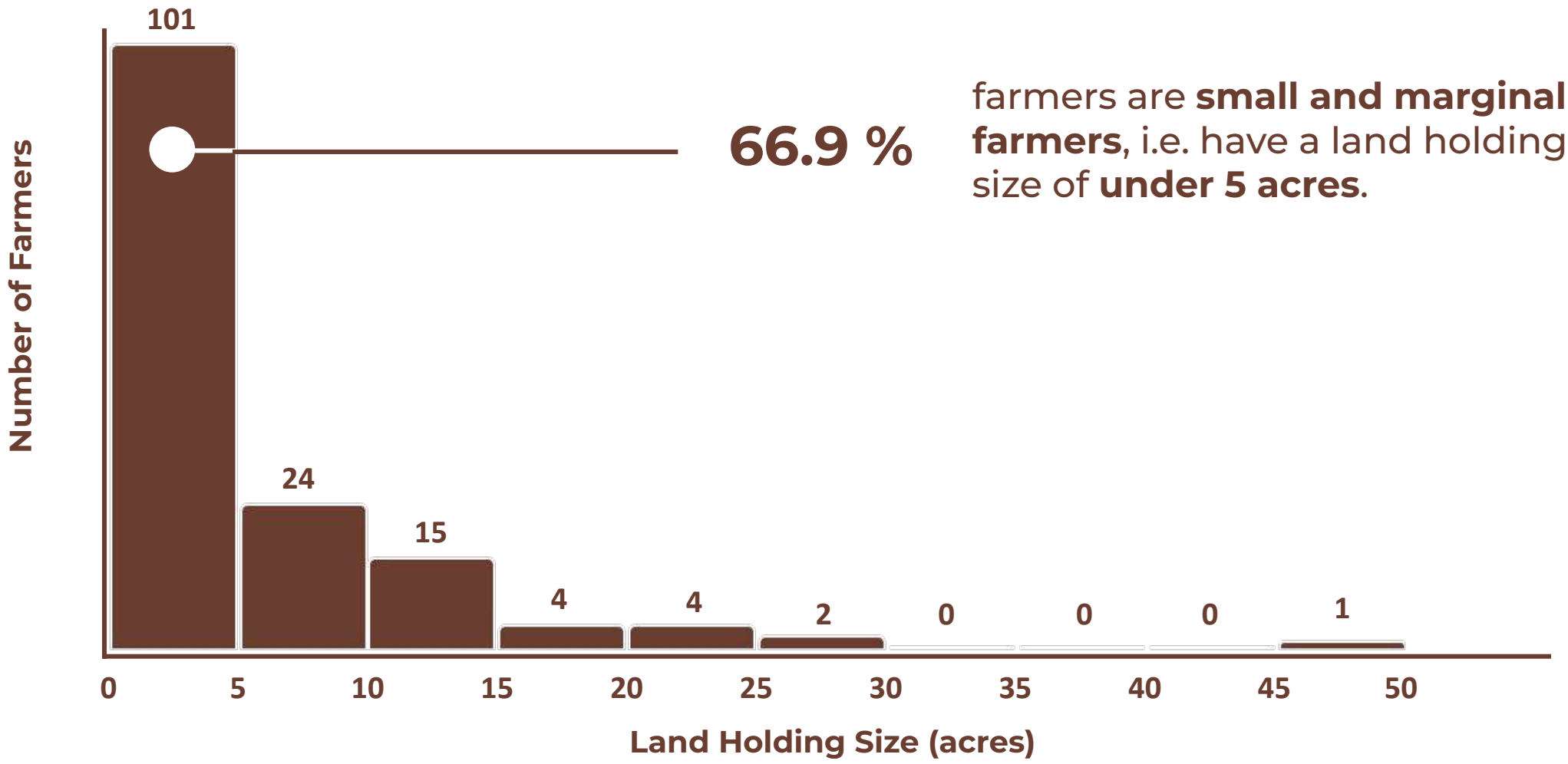
North Eastern Plain Zone (UP 8)

Parameters

District/Area	Agro Climatic Zone (NARP) [1]	Soil Type	Annual Rainfall (mm) [2]
Bahraich	Central Plain Zone (UP 6)	Deep Clay loam Soil	1148
Gonda	North Eastern Plain Zone (UP 8)	Sandy loam Soil & Sandy Soil	1166.8
Gorakhpur	North Eastern Plain Zone (UP-8)	Sandy loam Soil & Sandy Soil, Clay	1364

1 - Classification of Agro-climatic zones is based on the National Agricultural Research Project (NARP) standard which was launched by The Indian Council of Agricultural Research (ICAR).
2 - Agriculture Department Uttar Pradesh, The Indian Council of Agricultural Research (ICAR).

Uttar Pradesh 1 : Target population by landholding size



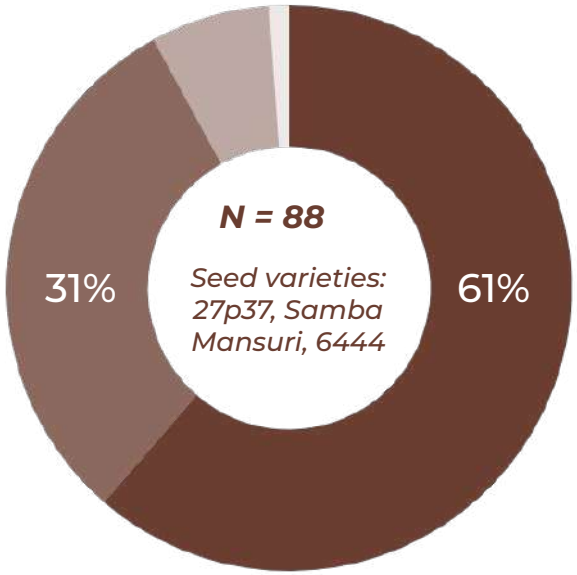
66.9 % farmers are **small and marginal farmers**, i.e. have a land holding size of **under 5 acres**.

Two-thirds of the farmers interviewed were small and marginal. We were able to achieve this because the partner organisation in this region has focused the intervention for these farmers

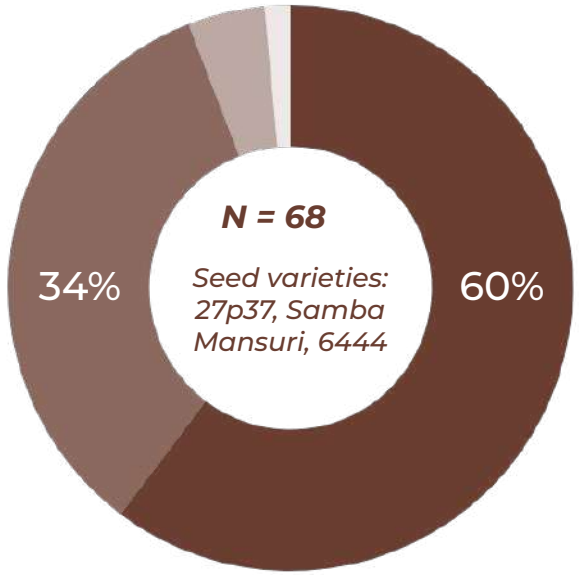
Yield Analysis

UP 1 - Yield Analysis - Comparing similar seed varieties | Over 60% of small and marginal farmers experienced a higher yield with DSR compared to the average yield from traditional PTR

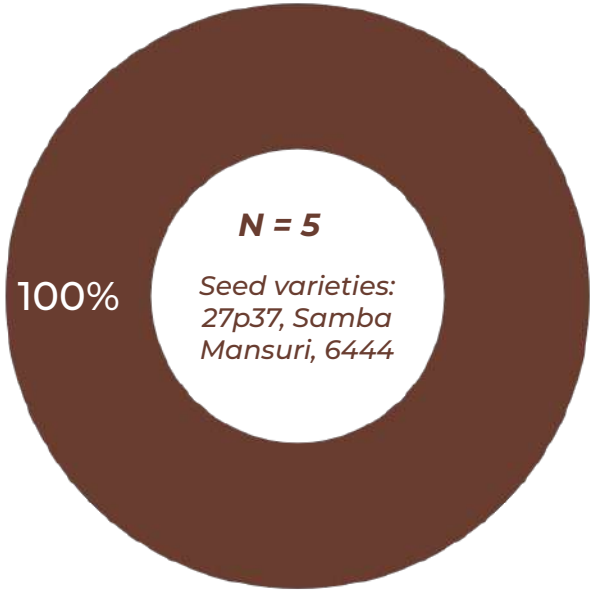
- % farmers with DSR yield >= 100% avg. PTR yield
- % farmers with DSR yield between 80-100% of the avg. PTR yield
- % farmers with DSR yield between 60-80% of the avg. PTR yield
- % farmers with DSR yield <60% of the avg. PTR yield



All farmers using similar seed varieties for DSR and PTR



Small and marginal farmers (0-5 acres) using similar seed varieties for DSR and PTR

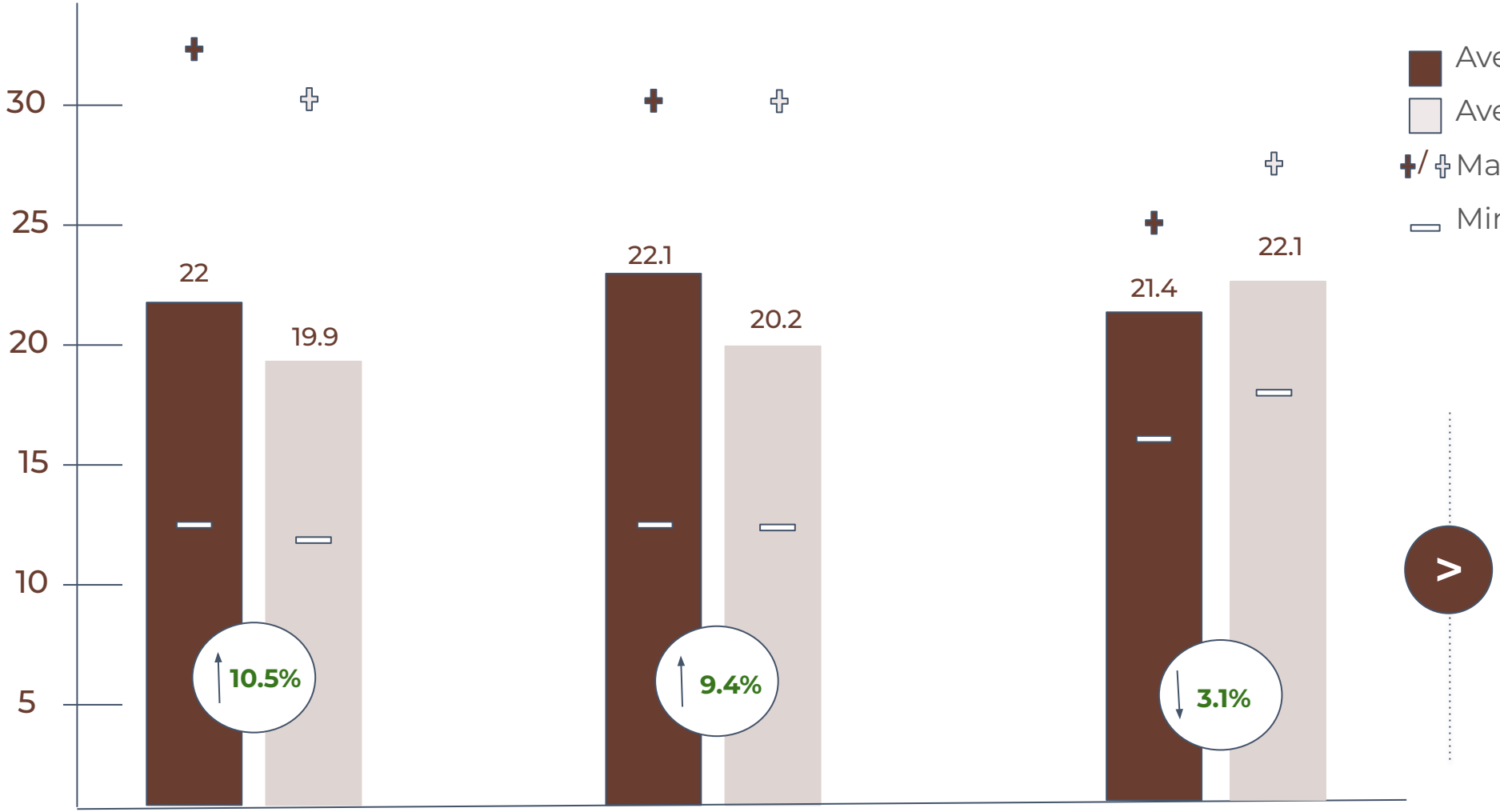


Semi-medium farmers (5-10 acres using similar seed varieties for DSR and PTR)

Irrespective of the landholding size, **at least 90% of the farmers** following the **DSR technique** have recorded a **yield >=80% of the average PTR yield** for the **similar seed varieties**.

Farmers tell us that, when the variability of yield is within this range, they feel confident in making the switch because the ease of farming and problems with labour availability is managed better with DSR technique.

UP 1 - Yield Analysis | On an average small and marginal farmers witnessed ~9% increase in yield while using the DSR method, as opposed to the traditional PTR



All land size farmers

N = 145 N = 63

Small and marginal farmers (0-5 acres)

N = 114 N = 46

Semi-medium farmers (5-10 acres)

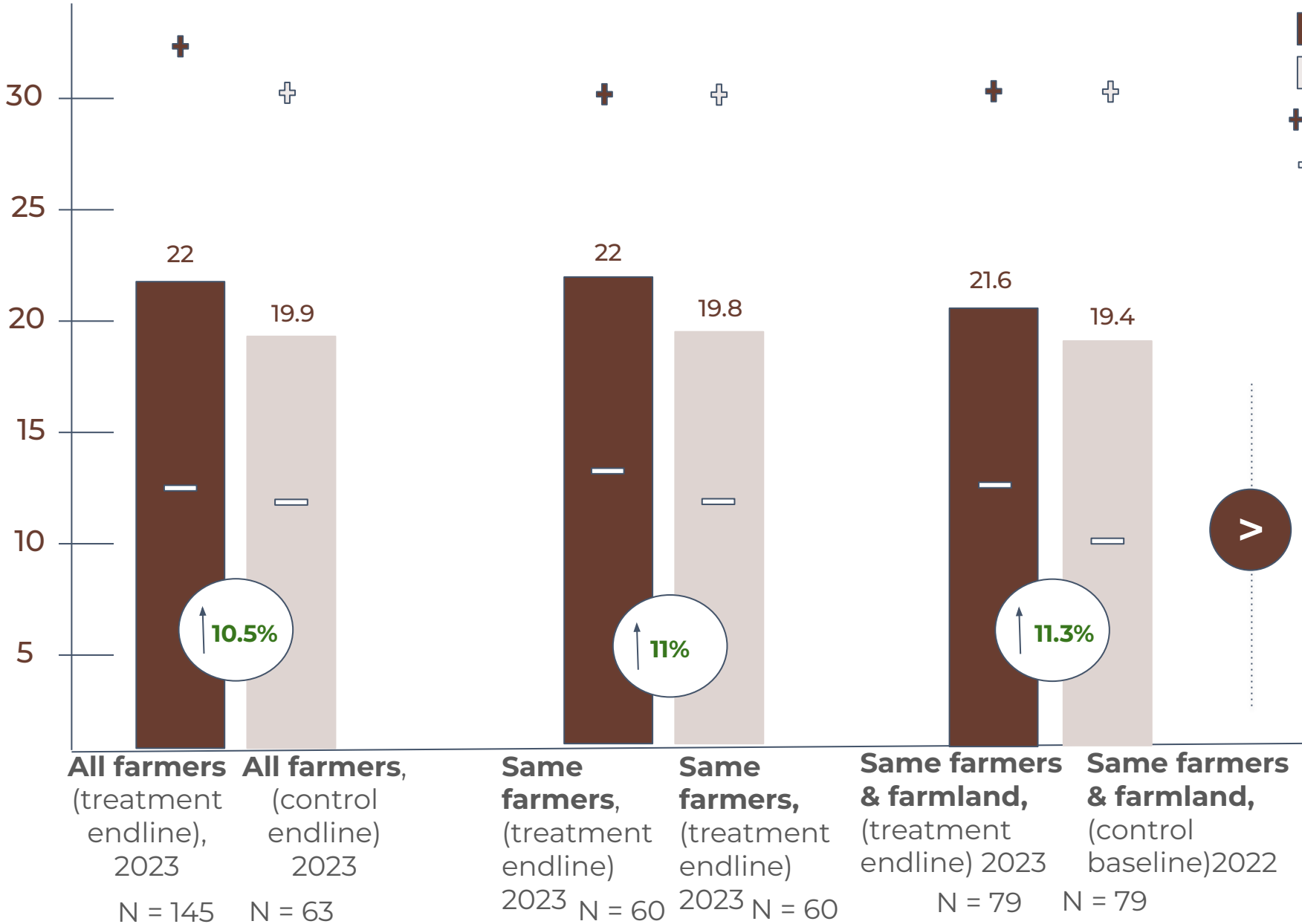
N = 16 N = 5

>

Small and marginal farmers in this region did not face any particular challenges in yield while following the DSR technique

In addition to high level of hand-holding by the partner org., it was observed that the soil and weather conditions were suitable for non-weed paddy growth even when farmers did not use pre and post emergence herbicides

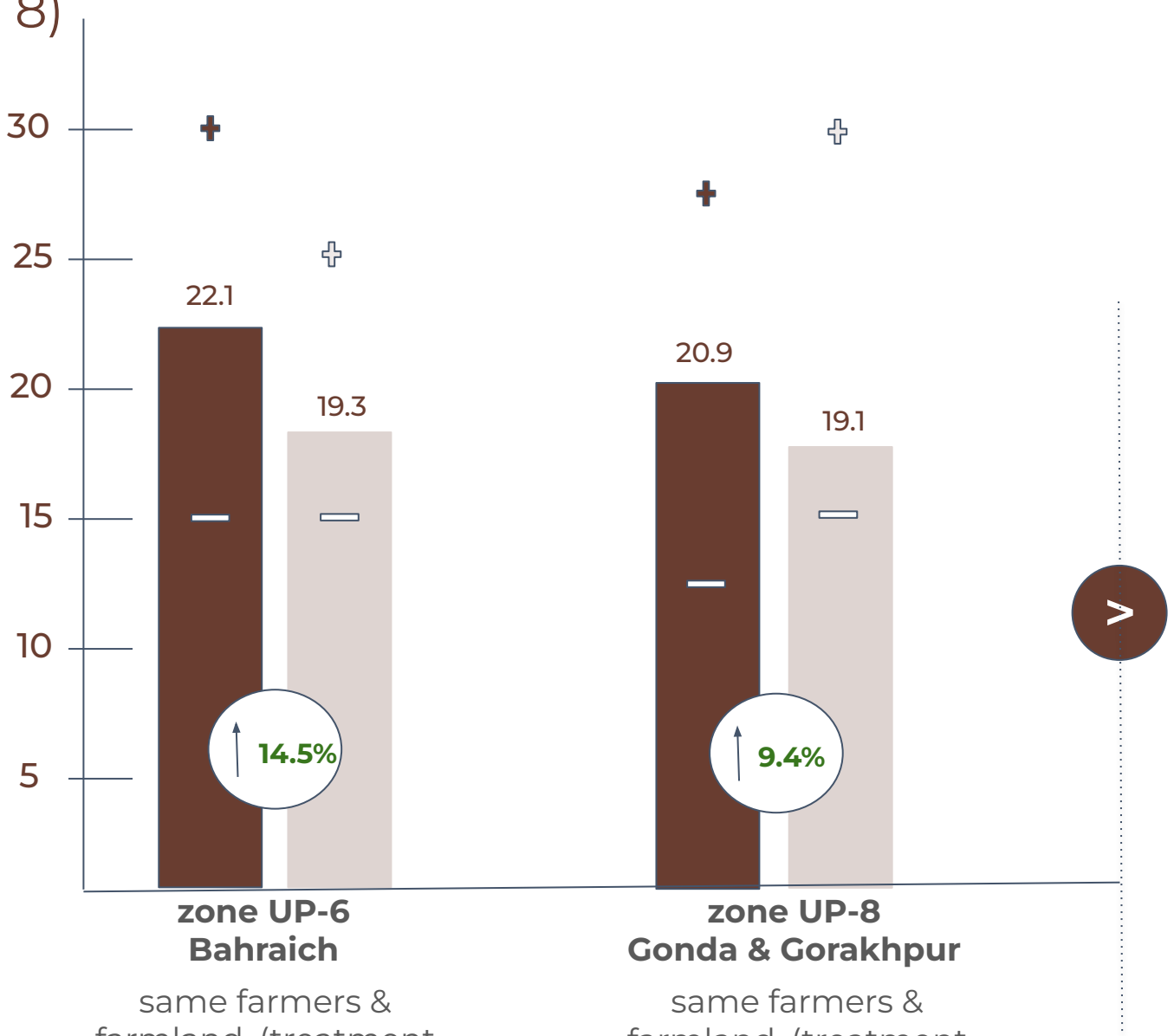
UP 1 - Yield Analysis | On an average same farmers witnessed ~11% increase in yield while using the DSR method, as opposed to the traditional PTR method



Various sub-groups chosen for analysis **takes into account variability of: Time/weather, farmer skill, farmland fertility**

- The 1st pair of graphs is a comparison between DSR and PTR in 2023, accounting for any variabilities in weather during that year
- The 2nd pair of graphs takes into account the 1st consideration + variability of farmer skill
- The 3rd pair of graphs is a comparison of same farmers doing PTR in 2022, and then DSR in 2023 on the same farmland - takes into account farmland fertility + farmer skill

UP 1 - Agro-climatic zone wise yield analysis | Central-plain zone (UP 6) recorded better increase in yield using DSR method compared to North-eastern plain zone (UP 8)



- % increase in DSR yield as compared to PTR yield is higher in UP 6 than in UP 8 zone
- The change in % yield increase is because of an increase in DSR yield
- Additionally, we also recorded that no. of legacy DSR farmers were in fact lesser in zone 6, where the average no. of years a farmers has done DSR was 1.38 yrs., while in zone 8 it was 2.84
- Though there could be several other factors such as irrigation type, etc. that may have resulted in this variation, thai result shows that, even when conditions such as support by partner organisation is constant, the agro-climatic zone has an effect on DSR yield

Income Analysis

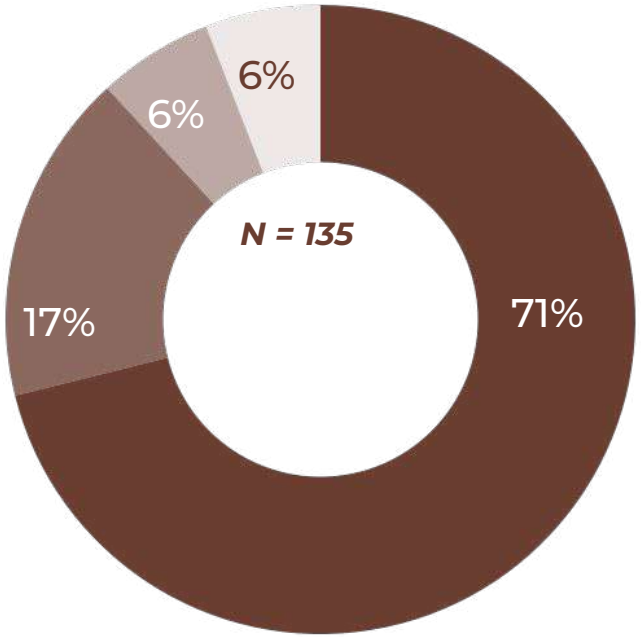
UP 1 - Income Analysis | Over 74% of small and marginal farmers experienced a higher net income with DSR compared to the average income from traditional PTR

% farmers with DSR income >= 100% avg. PTR income

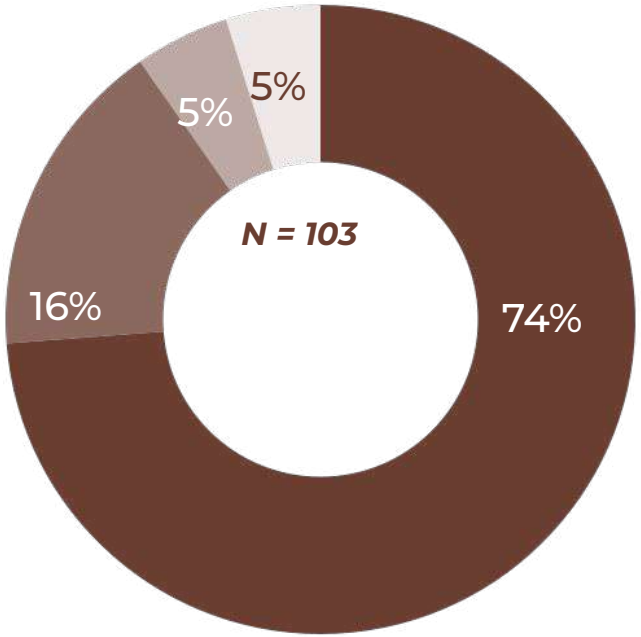
% farmers with DSR income between 80-100% of the avg. PTR income

% farmers with DSR income between 60-80% of the avg. PTR income

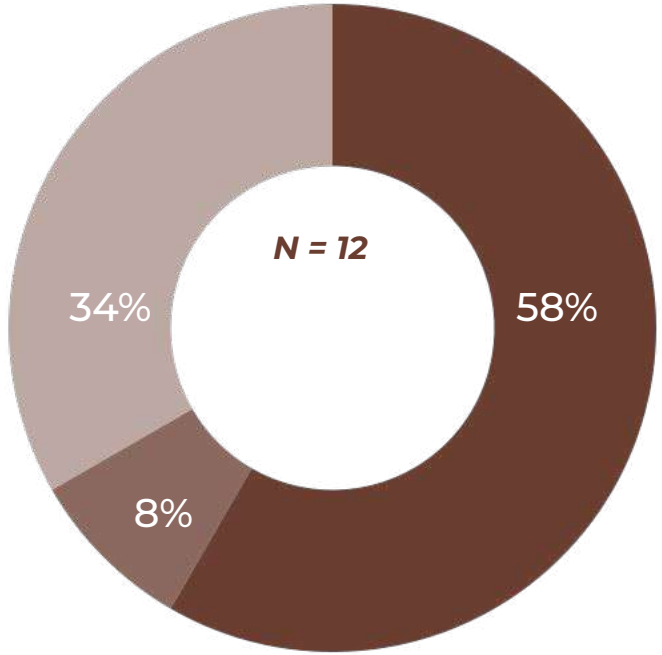
% farmers with DSR income <60% of the avg. PTR income



All land size farmers



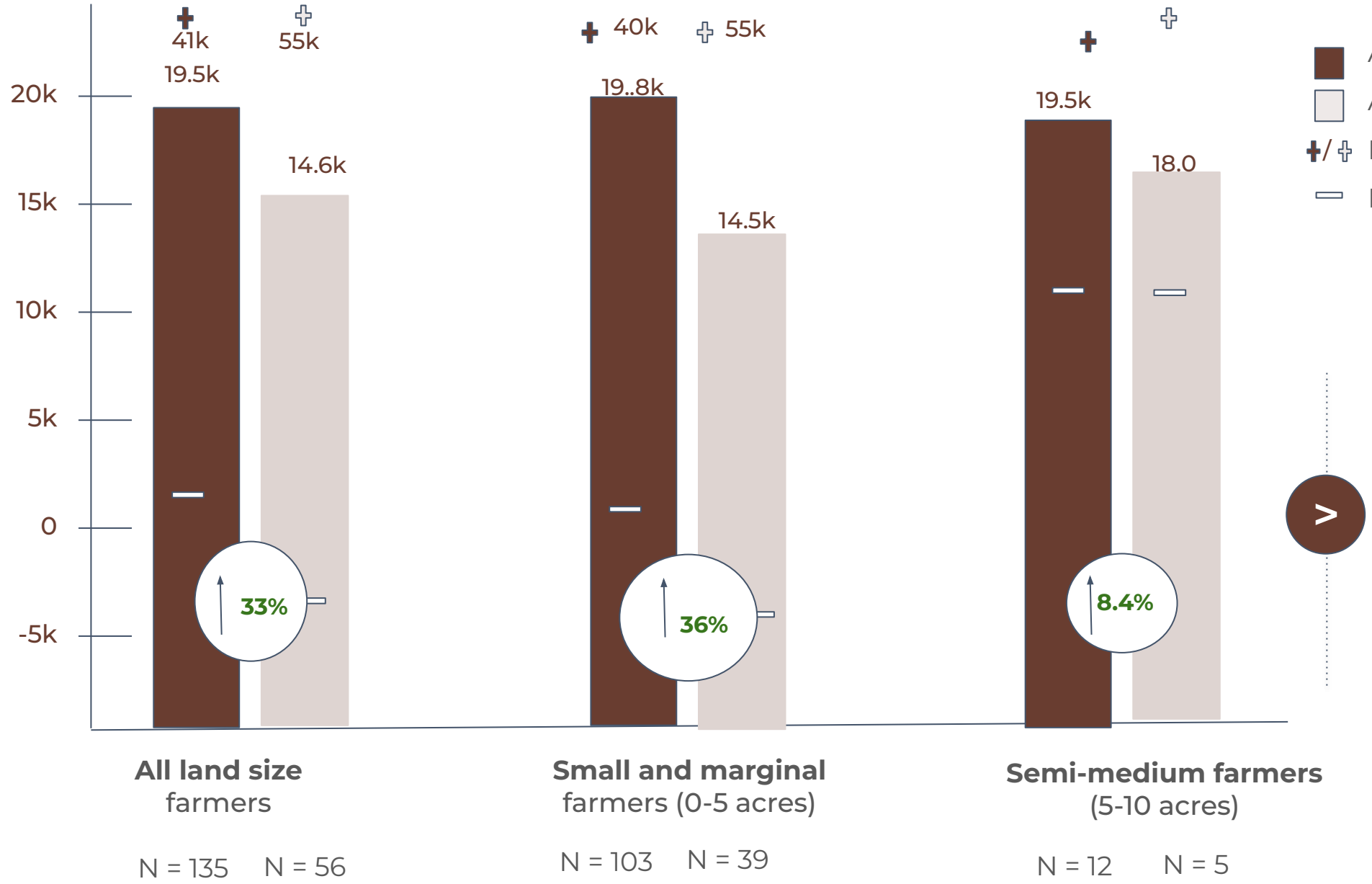
Small and marginal farmers (0-5 acres)



Semi-medium farmers (5-10 acres)

Irrespective of the landholding size, **at least ~58% of the farmers** following the **DSR technique** have recorded an income **higher than the average PTR income**

UP 1 - Income Analysis | On an average small and marginal farmers witnessed ~36 % increase in net income by following the DSR method as compared to PTR method



>

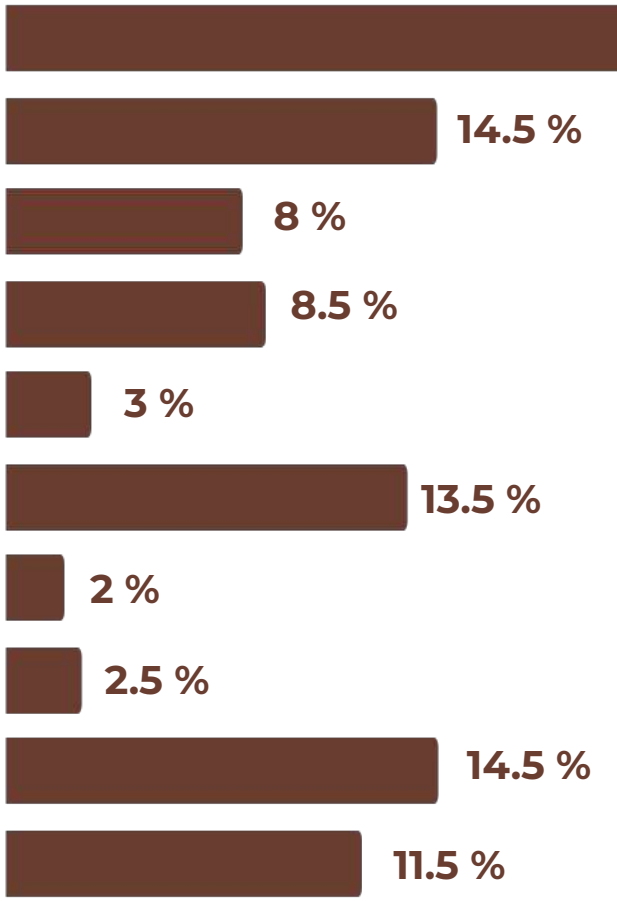
- DSR was observed to be a viable method of paddy cultivation for small and marginal farmers
- The no. of farmers in the semi-medium range are very few. Data may have been skewed due to the inadequate no. of farmers

Cultivation process and Cost calculation

UP 1 - Total Costs by Stages | DSR method of paddy cultivation

Stages	Cost/Acre - DSR
1. **Main Land Preparation**	₹ 4,840
2. **Irrigation**	₹ 3,000
3. **Seed**	₹ 1,645
4. **Machinery (Seed drill)**	₹ 1,795
5. **Pre Emergence Herbicide**	₹ 587
6. **Fertilizer**	₹ 2,791
7. **Pesticide**	₹ 399
8. **Post Emergence Herbicide**	₹ 522
9. **Other Labour**	₹ 3,003
10. **Harvesting**	₹ 2,469
	₹ 21,051

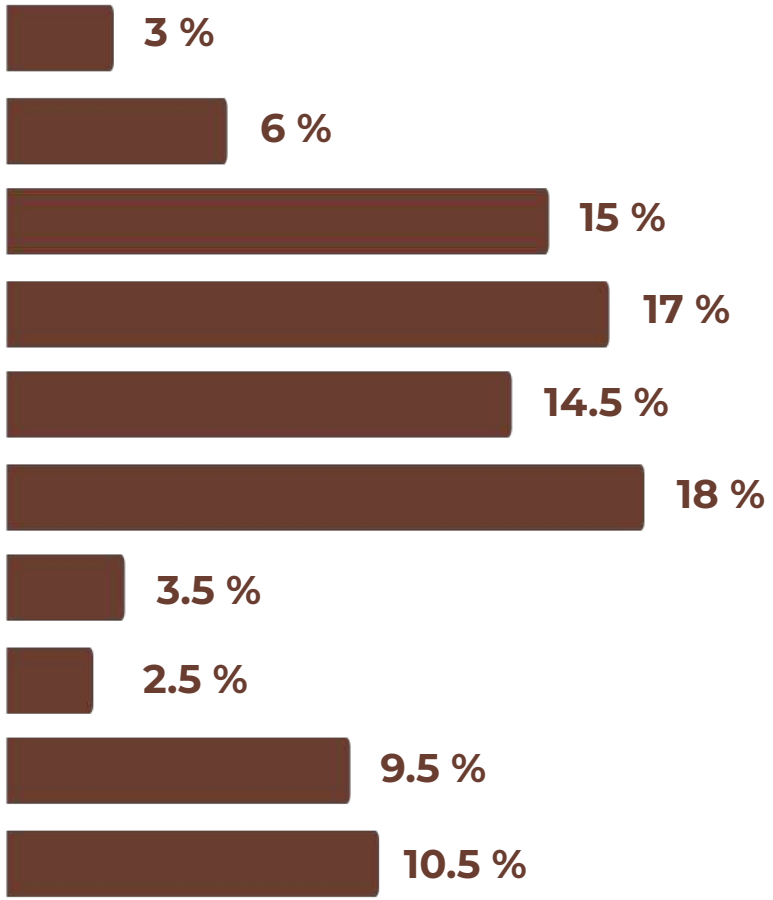
% contribution to total cost



- **23%** of the total cost is contributed by **main land preparation**, within which **land levelling** and **rotavator** carry significant costs.
- **Labour** and **irrigation** costs carry the next highest contribution to the overall cost at **14.5% each**. In labour costs, cost for weed removal carries a major contribution.

UP 1 - Total Costs by Stages | PTR method of paddy cultivation

Stages	Cost/Acre - PTR	% contribution to total cost
1. Nursery[1]	₹ 700	3 %
2. Seed	₹ 1,464	6 %
3. Main Land Preparation	₹ 3,601	15 %
4. Irrigation	₹ 4,000	17 %
5. Transplanting Labour	₹ 3,354	14.5 %
6. Fertilizer	₹ 4,237	18 %
7. Pesticide	₹ 775	3.5 %
8. Post Emergence Herbicide	₹ 573	2.5 %
9. Other Labour	₹ 2,276	9.5 %
10. Harvesting	₹ 2,470	10.5 %
	₹ 23,450	



- The highest contribution to the overall cost is from **fertilizer** costs at **18%**. This includes costs associated with **DAP** and **urea**, where DAP carries the maximum contribution.
- **Irrigation, main land preparation** (rotavator and cultivator) and **transplanting labour** costs account for the other major contributors to the overall cost at **17%**, **15%**, and **14.5%** respectively.

1 - 'Nursery' stage cost includes cost of land preparation as well as cost of fertilizers need for nursery preparation.

UP 1 - Cost Comparison | Farmers recorded ~10.2 % decrease in input cost using the DSR method as compared to the PTR method of cultivation

Stages	Cost/Acre - DSR		Cost/Acre - PTR	
1. Main Land Preparation	₹ 4,840		₹ 3,601	
2. Nursery[1]	₹ 0		₹ 700	
3. Irrigation	₹ 3,000		₹ 4,000	
4. Seed	₹ 1,645		₹ 1,464	
5. Machinery (Seed drill)	₹ 1,795		₹ 0	
6. Pre Emergence Herbicide	₹ 587		₹ 0	
7. Transplanting Labour	₹ 0	Total Labour ₹ 3,003	₹ 3,354	Total Labour ₹ 5,630
8. Other Labour[2]	₹ 3,003		₹ 2,276	
9. Fertilizer	₹ 2,791		₹ 4,237	
10. Pesticide	₹ 399		₹ 775	
11. Post Emergence Herbicide	₹ 522		₹ 573	
12. Harvesting	₹ 2,469		₹ 2,470	
	₹ 21,051		**₹ 23,450**	

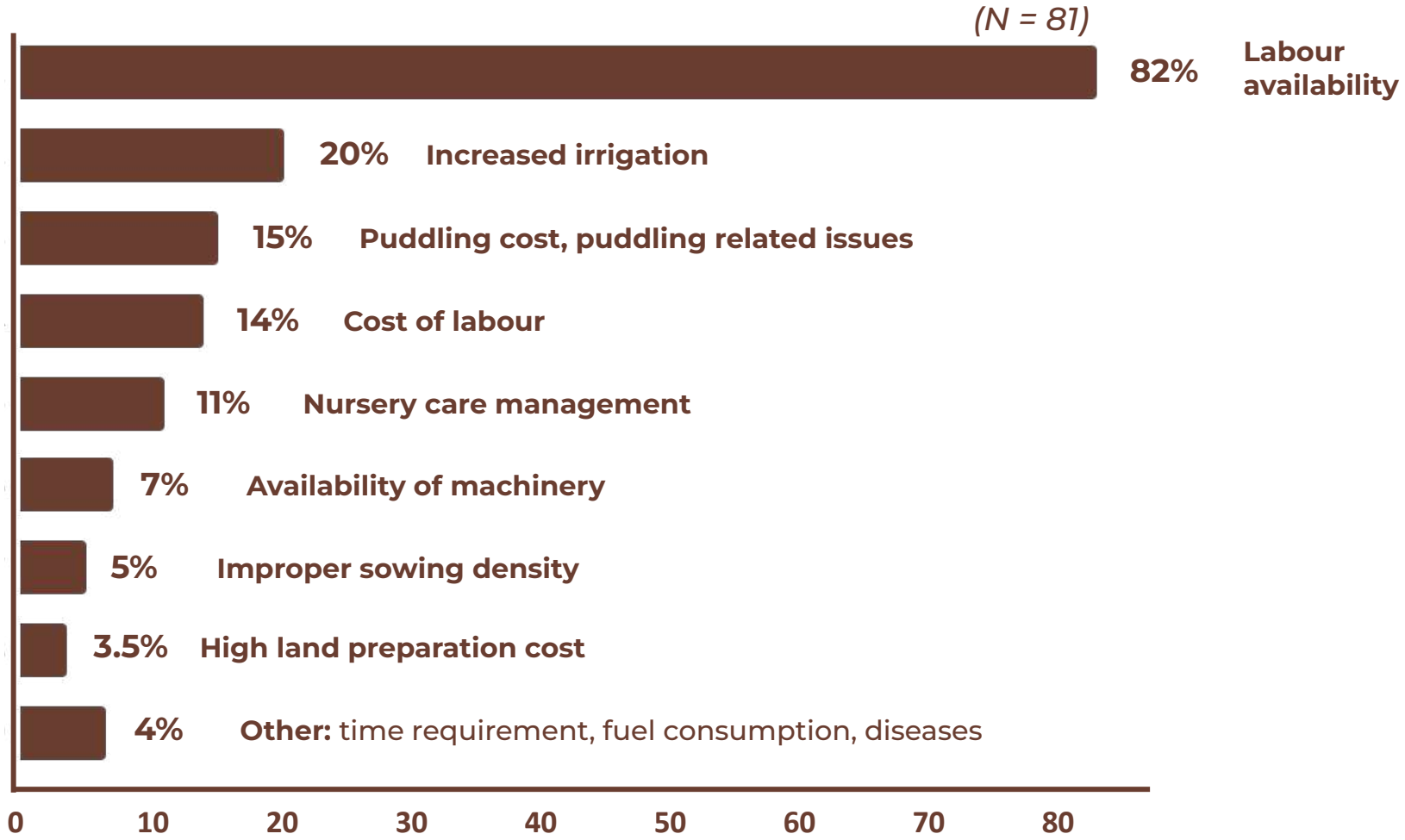
- Major savings in DSR come from reduced **total labour** costs, **fertilizer** usage, and **irrigation** cost. Additionally, lack of need for nursery is a cost saving benefit.
- A **~47% drop** in **total labour cost** is seen in DSR compared to PTR.
- However, DSR has added costs associated with **land levelling**, **machinery** (seed sowing) and **pre-emergence herbicide**.
- The labour cost (**Other Labour**) **in DSR is higher than that of PTR** because of the labour needed to **remove weeds** that is an area of concern in DSR.

1 - 'Nursery' stage cost includes cost of land preparation as well as cost of fertilizers needed for nursery preparation.
2 - 'Other Labour' includes labour excluding labour for transplanting. This would include labour for pesticides and herbicide spray, weed removal, machinery operation, etc.

DSR cultivation and adoption challenges: voices from the ground

UP 1 - Challenges with PTR | Labour availability is the biggest challenge in PTR as quoted by 82% of farmers

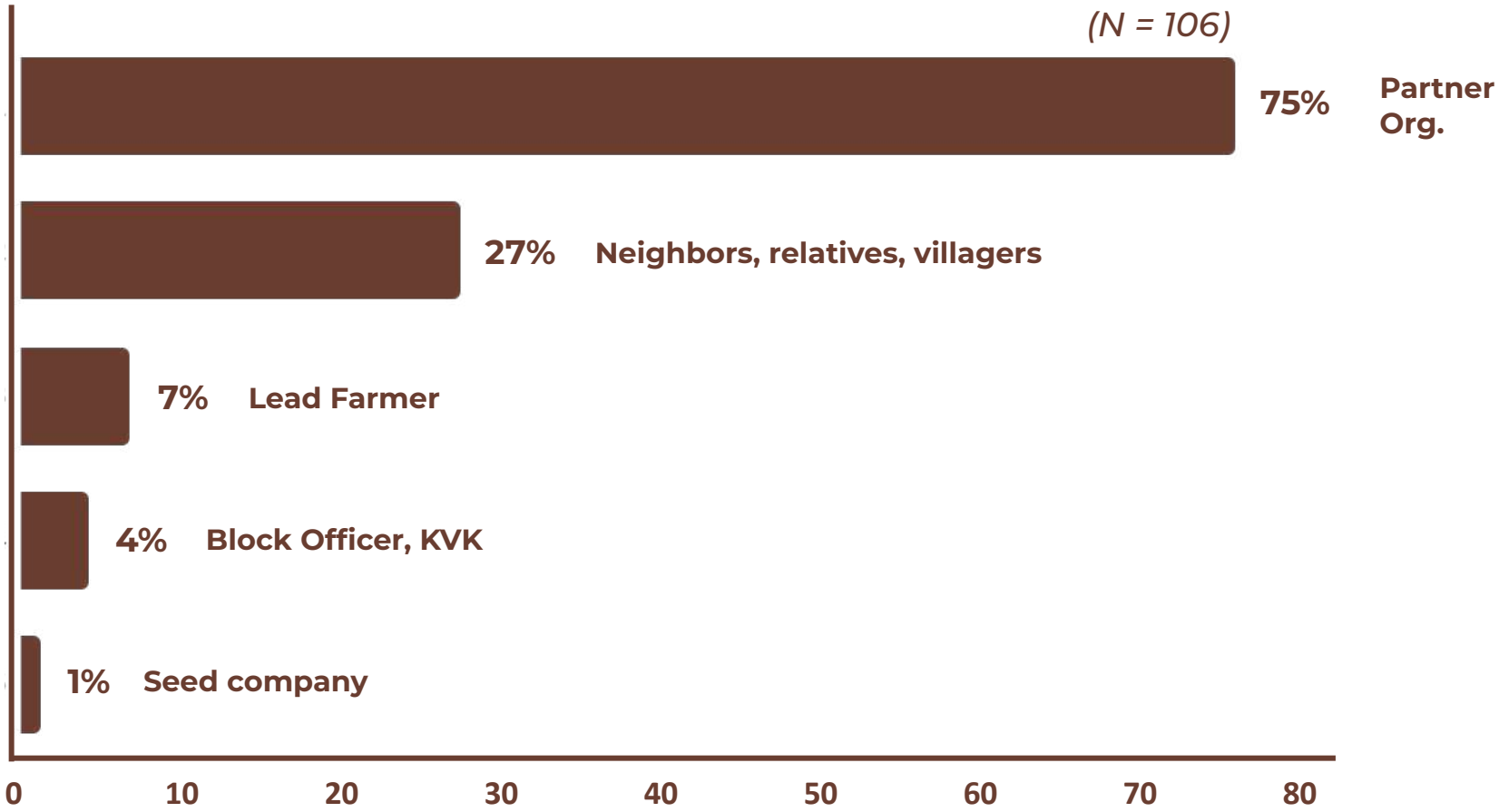
- Challenges faced by Farmers with PTR Technique



- The biggest challenge faced by farmers with PTR is **labour scarcity**, and thus the additional **increase in cost of labour**.
- The next biggest challenge is the **large water requirement** for PTR due to the need for puddling.

UP 1 - Push for Adoption | Partner Org had the largest influence on farmers to adopt DSR, accounting for 75% of the adoption

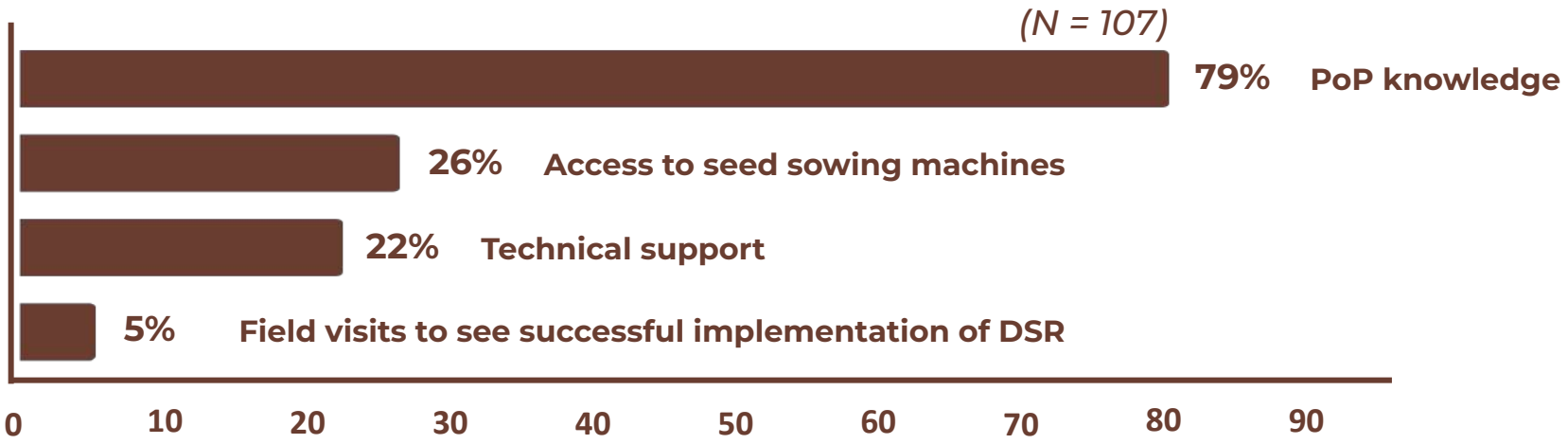
- Organizations or persons that convinced farmers to adopt DSR



- **Partner org.** accounts for the **largest influence** on farmers to adopt DSR
- Lead Farmers and KVKs were influenced by the Partner Org.
- Apart from the above organizations, the **peer network** (neighbors, relatives, and villagers) have the **next largest influence** on DSR adoption, thus highlighting the importance of the **community effect**.

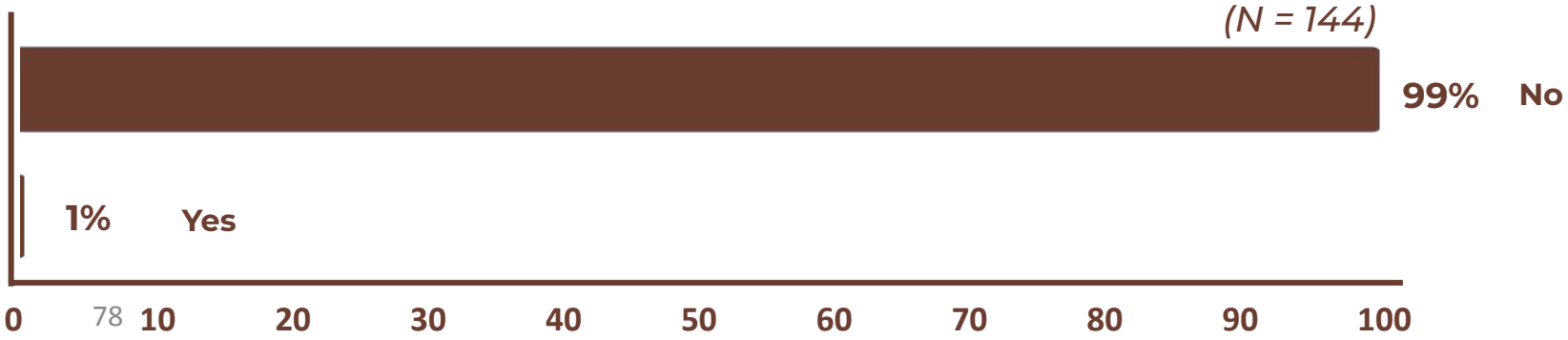
UP 1 - Partner Support | ~80% of farmers cited getting PoP knowledge support, while none of the farmers received subsidized or free inputs

- Types of Support provided to farmers by Organizations and Peers



- **Knowledge dissemination on the practice of DSR and its benefits** was the most commonly cited support provided to farmers.
- **Access to seed sowing machines** was the next commonly cited support. This is beneficial because **affordable access** to machinery is important for adoption.

- Were the farmers provided with free or subsidized inputs?

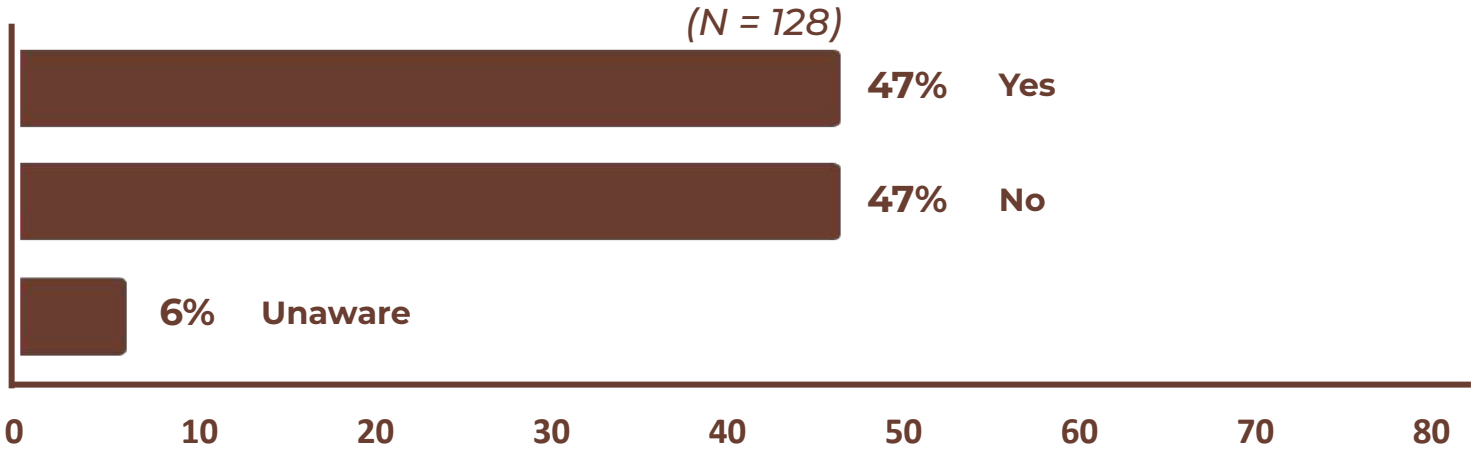


- **99%** of farmers were **not given free or subsidized inputs** by supporting organizations (such as seeds, pesticides, fertilizers, etc).

78

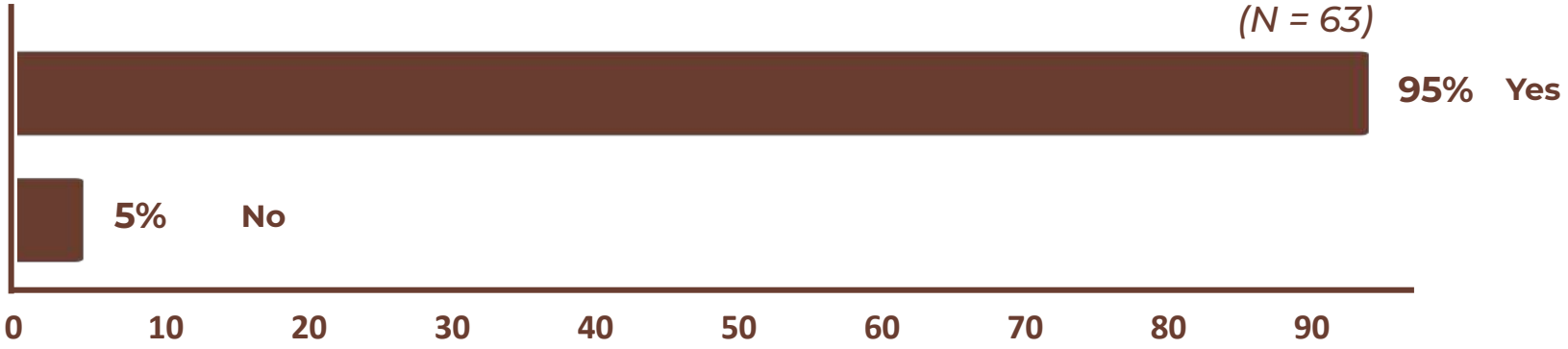
UP 1 - Peer Effect | Almost all farmers whose peers had adopted DSR successfully were motivated to try DSR themselves

- Before a farmer adopted DSR, did his peers adopted DSR successfully?



- This highlights that **close to 50%** of farmers who adopted DSR **had at least one peer** who adopted DSR.

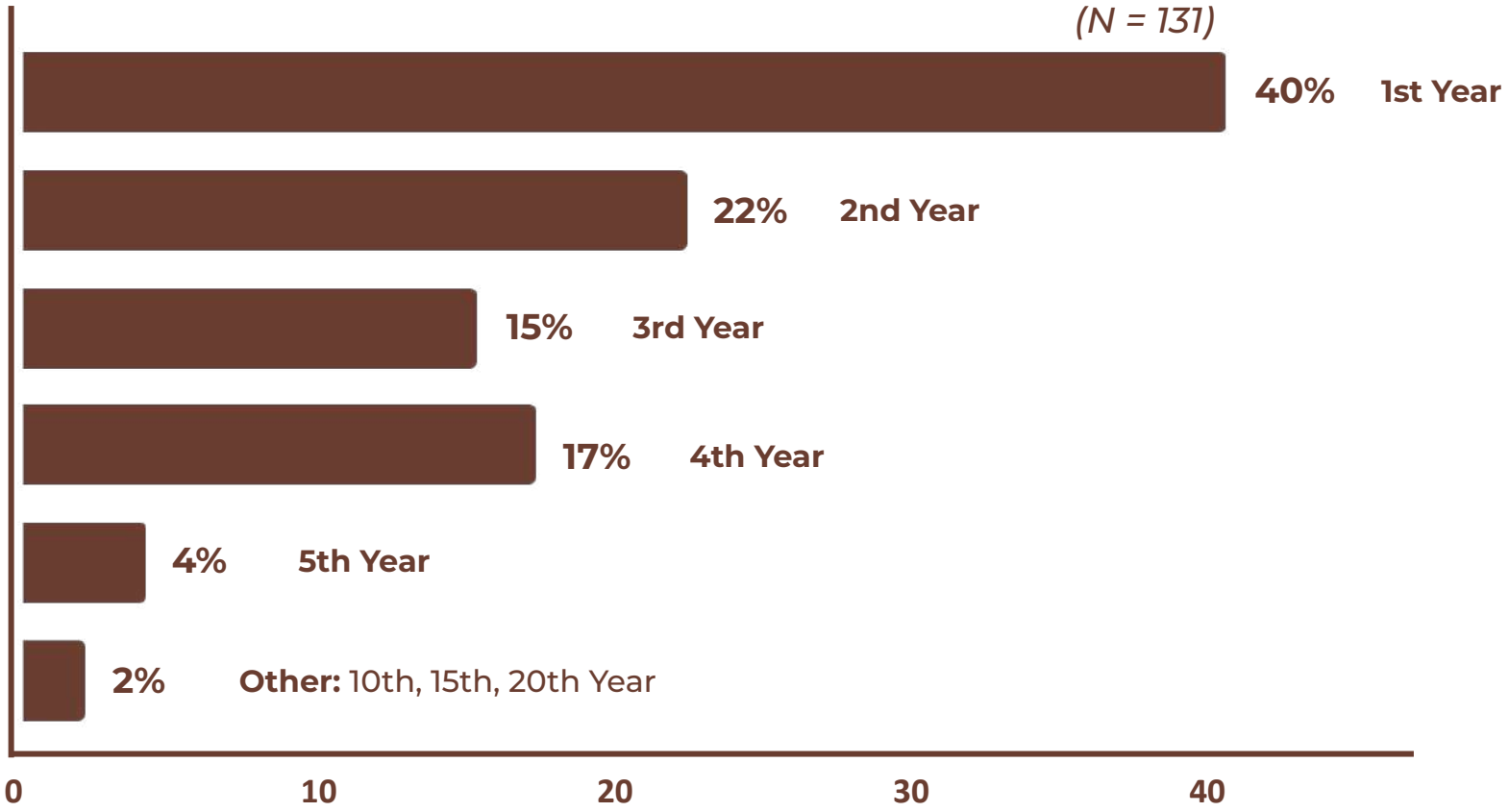
- Was a farmer motivated to adopt DSR if his peers adopted DSR successfully?



- **95%** of farmers were **motivated to adopt DSR** if their peers adopted DSR successfully, emphasizing the impact of **peer network**.

UP 1 - DSR Legacy Farmers | ~60% of the farmers in this region have practised DSR technique for more than one season

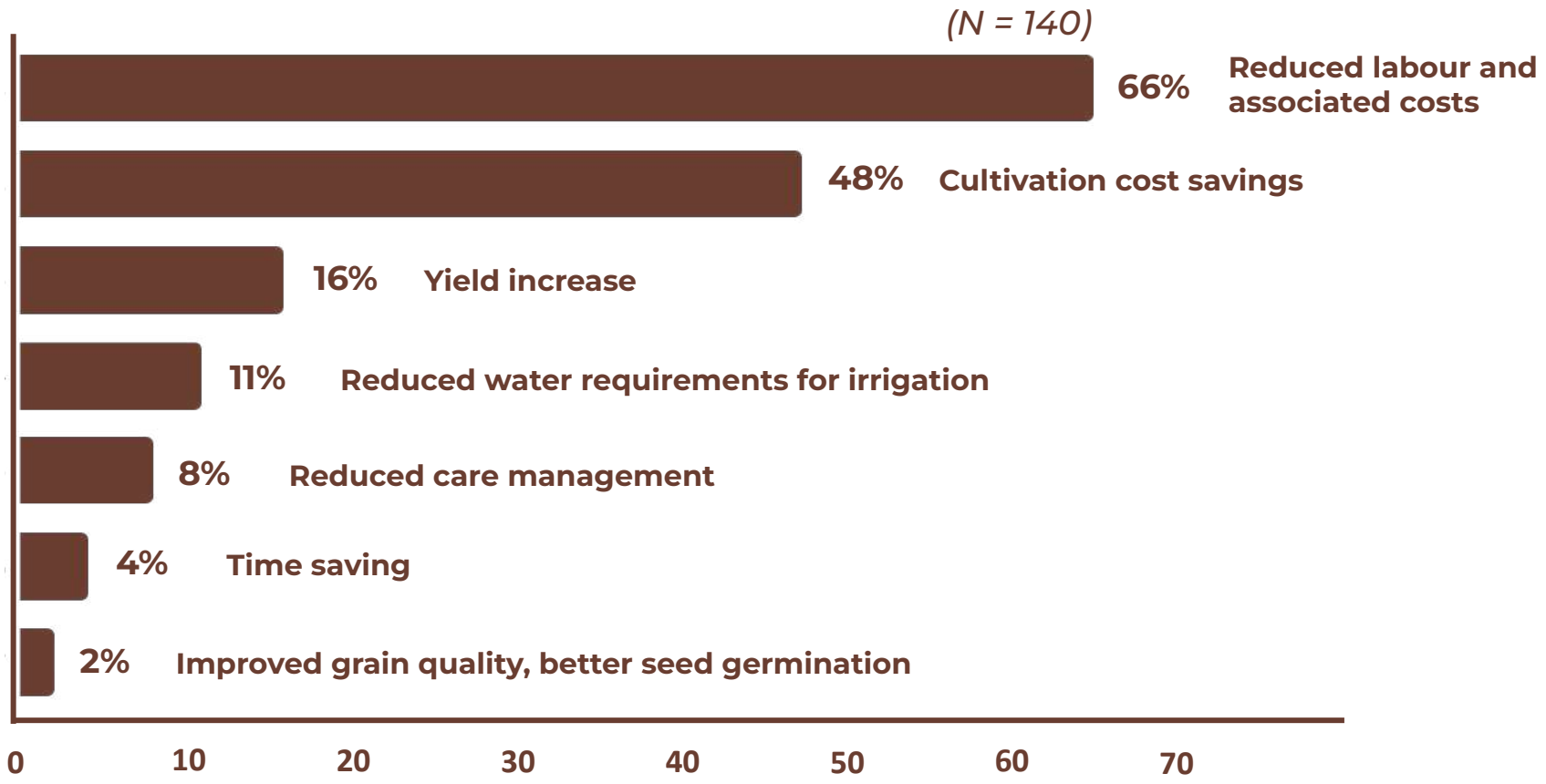
- Number of Years the farmers have been practicing DSR



- **94%** of farmers started DSR within the **past 4 years** while little over **75%** of farmers started just **3 years ago**.
- This highlights that **DSR adoption has seen a rise** in adoption over the past **5 years**.
- **60%** of the farmers are **repeat farmers**, i.e. who have done DSR at least once before.

UP 1 - DSR Method Benefits | 66% of farmers cite reduced labour requirement and cost savings as a major benefit in DSR

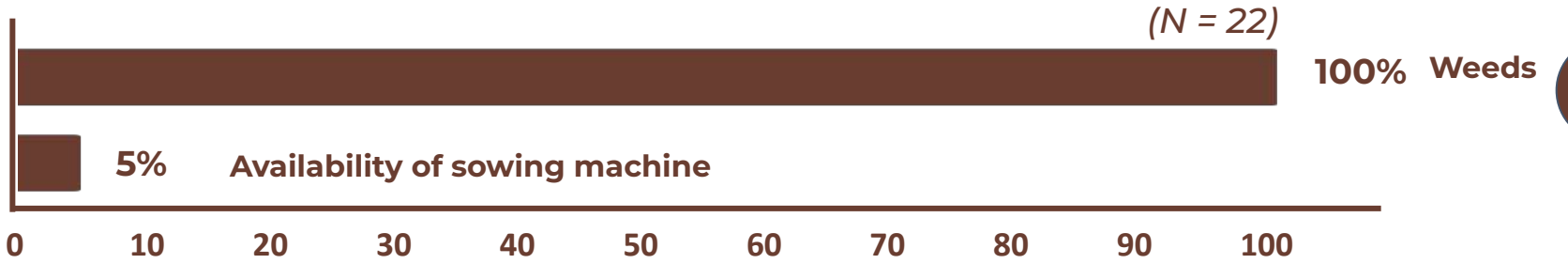
- Major Benefits of DSR according to farmers



- The greatest benefit of DSR according to farmers is the **reduced need for labour and the associated costs**.
- **16%** of farmers cite a **yield increase** through DSR method
- Other cost savings come from the **lack of need for puddling** which has a high water requirement.

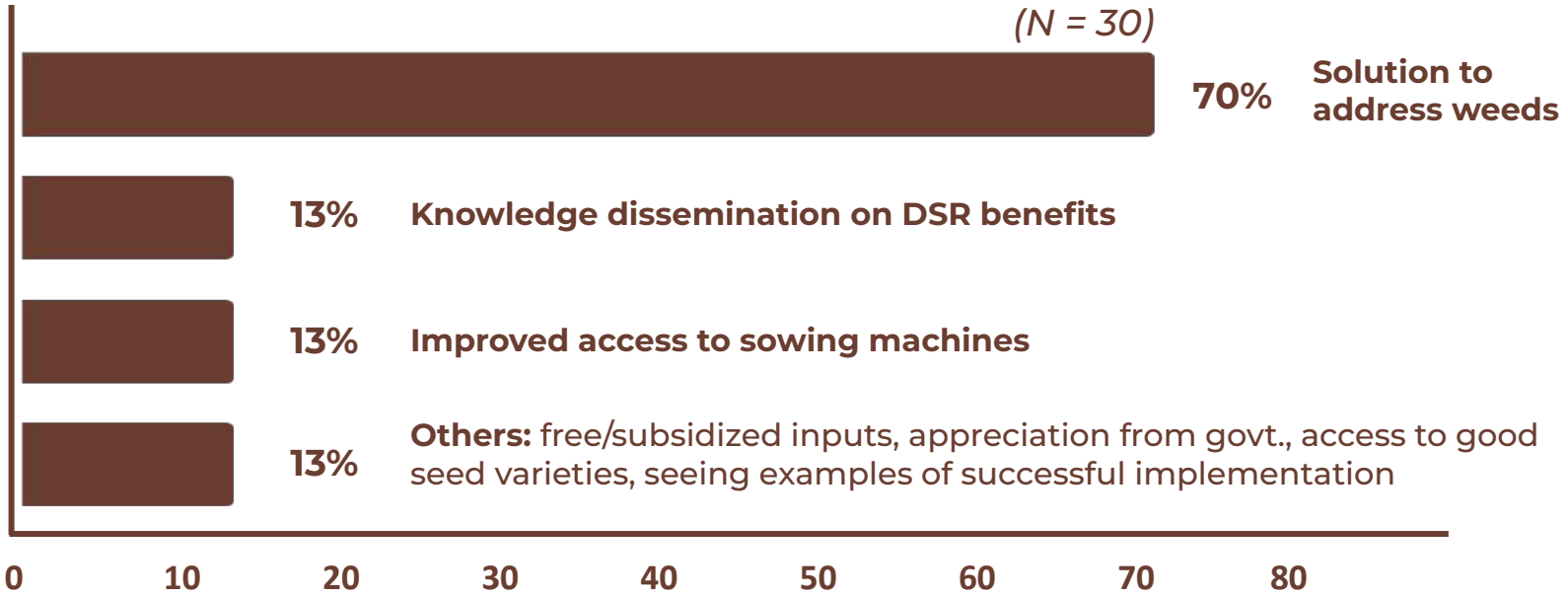
UP 1 - Challenges in DSR Method | Almost all farmers who faced issues with the DSR method stated management of weeds as a problem, and suggested that solving for this can improve adoption

- Major Issues with DSR according to farmers



- Among the farmers that cited issues with DSR, **100%** of them shared that **weed growth is their top concern**.

- What can be done to improve DSR adoption?



- Having a **reliable solution** to address the **problem of weed growth** can be a tipping point to accelerate DSR adoption.

- Additionally, **increasing the reach of the dissemination** of the benefits of DSR can also improve its adoption.

UP 1 - Understanding DSR Adoption Status and Continuity

- **100%** of farmers believe that DSR can be **adopted by smallholder farmers** *(N = 150)*
- **100%** of farmers will **continue with DSR** in the following year *(N = 149)*
- **98%** of farmers will continue with DSR even if **supporting organizations or personnel leave the area** *(N = 148)*
- **76%** of farmers have **influenced peers** to adopt DSR after adopting DSR themselves *(N = 113)*

Region 2: Uttar Pradesh (UP 2) - Prayagraj

Observations and Findings

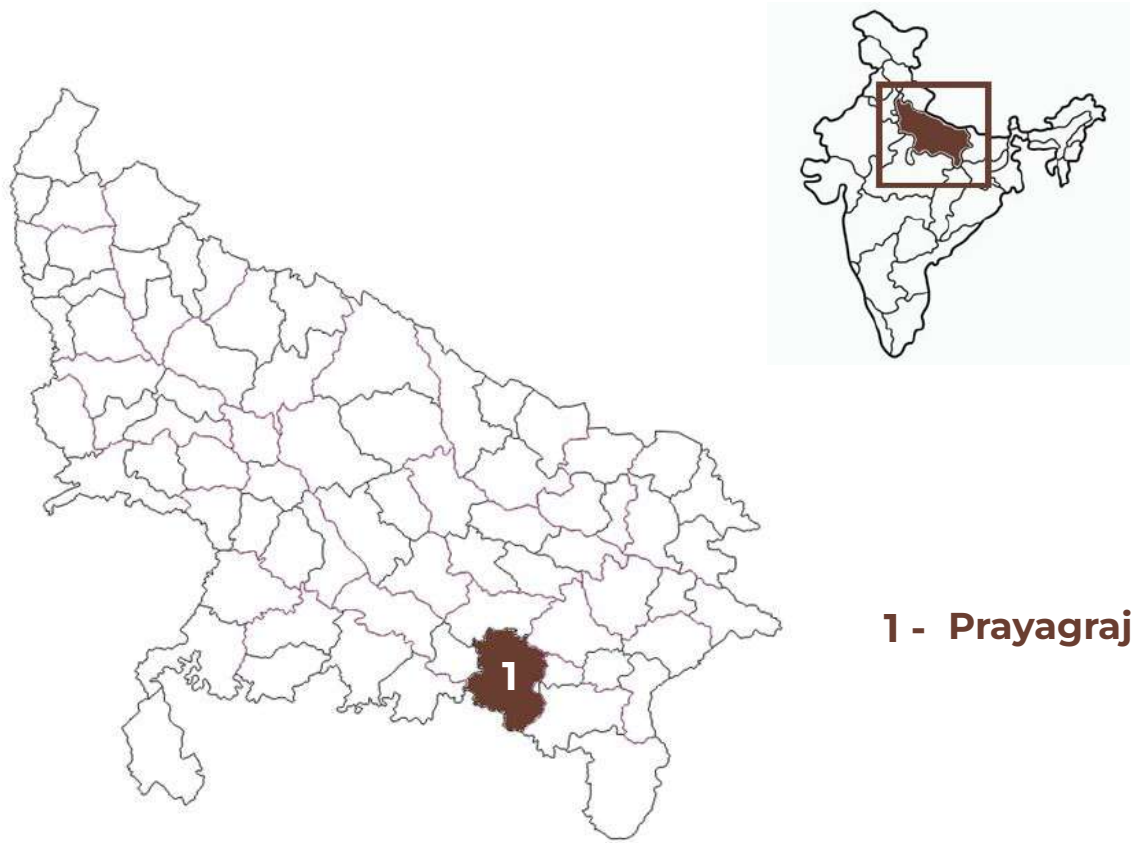
Background: Uttar Pradesh 2

Districts covered	Prayagraj
Agro Climatic Zones (NARP)	Vindhyan Zone (UP 8) & Central Plain Zone (UP 4)
Partner Support Level	Medium *(interactions with farmers, PoP knowledge dissemination, resource management support, problem resolution, etc.)*
Most grown crops in UP	Sugarcane, Rice, Wheat
Common Soil Type	Red sandy loam soil
Paddy Sown Area in UP	14,092.42 thousand acres (2021 - 2022)[1]
Paddy Yield in UP	10.83 quintal per acre (2021 - 2022)[2]

1- RBI: State wise area of foodgrains
2- RBI: State wise estimates of yield

“Even though I am doing DSR for the first time, it was easy to adopt it because I received free seeds and other inputs, while also getting knowledge about DSR PoP from the partner organization. However, I am facing issues with excessive weed growth.”

Uttar Pradesh 2: Regions under Study and Target Population



1 - Prayagraj

1 District | **10** Villages | **17** Unique farmers[1]

Target population status

	DSR	PTR
Number of Farmers	18	17
Land Under Cultivation (acres)	44	96

Irrigation Status (% of farmers)

	DSR	PTR
Completely irrigated	100 %	88 %
Partially irrigated	0 %	12 %
Rainfed	0 %	0 %

1- The word 'unique farmers' mean overall no. of individual farmers interviewed. Same farmer may be practising both DSR and PTR in different farmlands in the same year. So, the no. of unique individual farmers will be lesser than the sum of farmers interviewed for DSR and PTR.

Uttar Pradesh 2: Agro-climatic zones

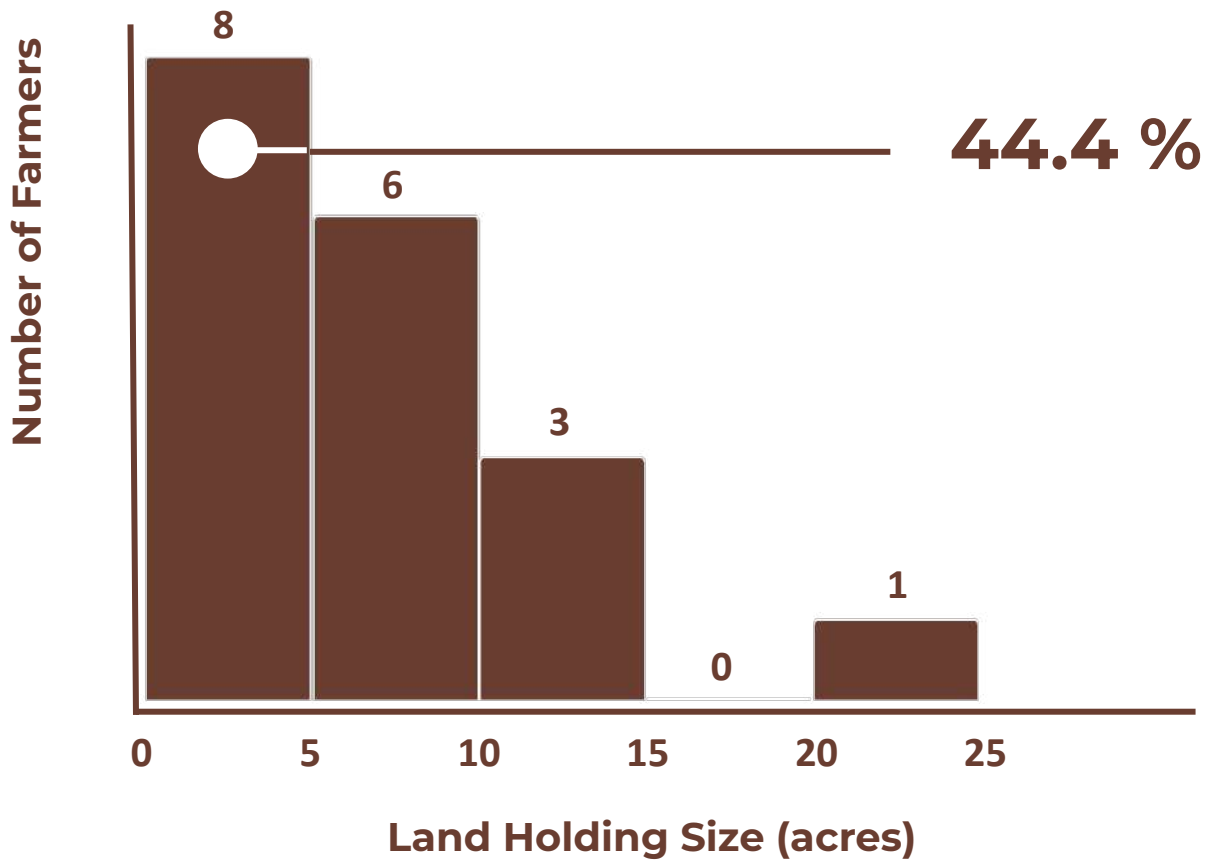
Vindhyan Zone (UP-8) & Central Plain Zone (UP-4)

Parameters

District/Area	Agro Climatic Zone (NARP) [1]	Soil Type	Annual Rainfall (mm) [2]
Prayagraj	Vindhyan Zone (UP-8) & Central Plain Zone (UP-4)	Red sandy loam soil	975

1 - Classification of Agro-climatic zones is based on the National Agricultural Research Project (NARP) standard which was launched by The Indian Council of Agricultural Research (ICAR).
2 - Agriculture Department Uttar Pradesh, The Indian Council of Agricultural Research (ICAR).

Uttar Pradesh 2: Target population by landholding size



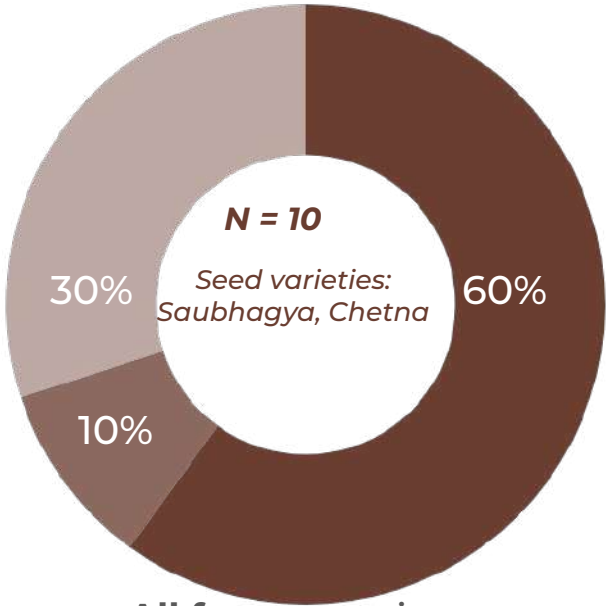
farmers are **small and marginal farmers**, i.e. have a land holding size of **under 5 acres**.

~ 45 % of the interviewed farmers were small and medium farmers

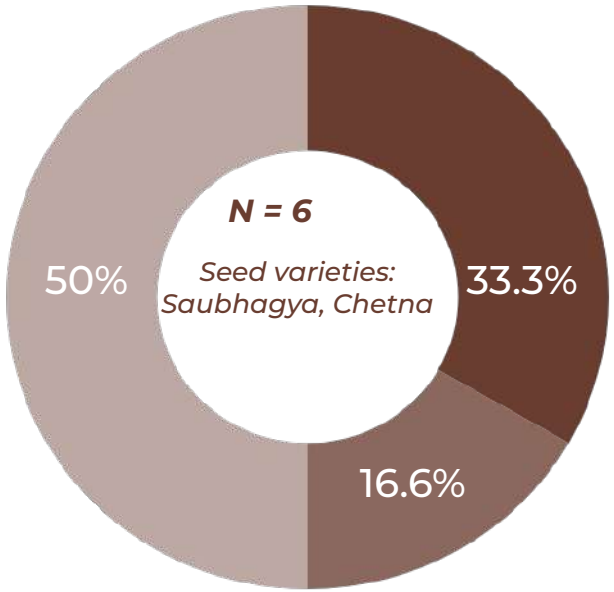
Yield Analysis

UP 2 - Yield Analysis - Comparing similar seed varieties | One-third of small and marginal farmers experienced a higher yield with DSR compared to the average yield from traditional PTR

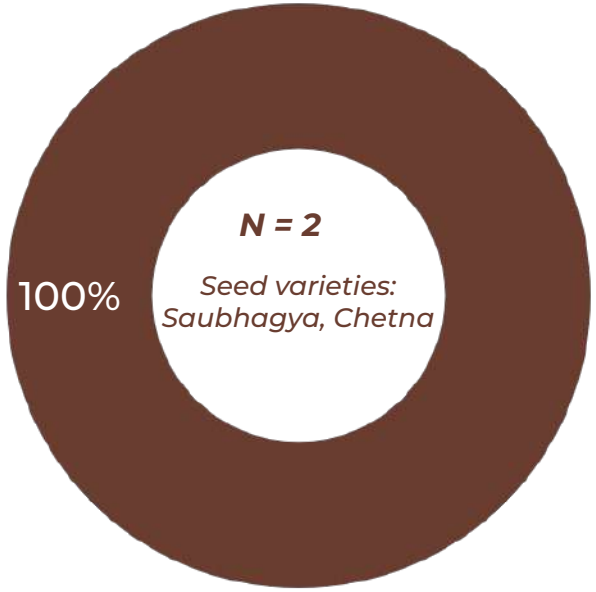
- % farmers with DSR yield >= 100% avg. PTR yield
- % farmers with DSR yield between 80-100% of the avg. PTR yield
- % farmers with DSR yield between 60-80% of the avg. PTR yield
- % farmers with DSR yield <60% of the avg. PTR yield



All farmers using similar seed varieties for DSR and PTR



Small and marginal farmers (0-5 acres) using same varieties for DSR and PTR

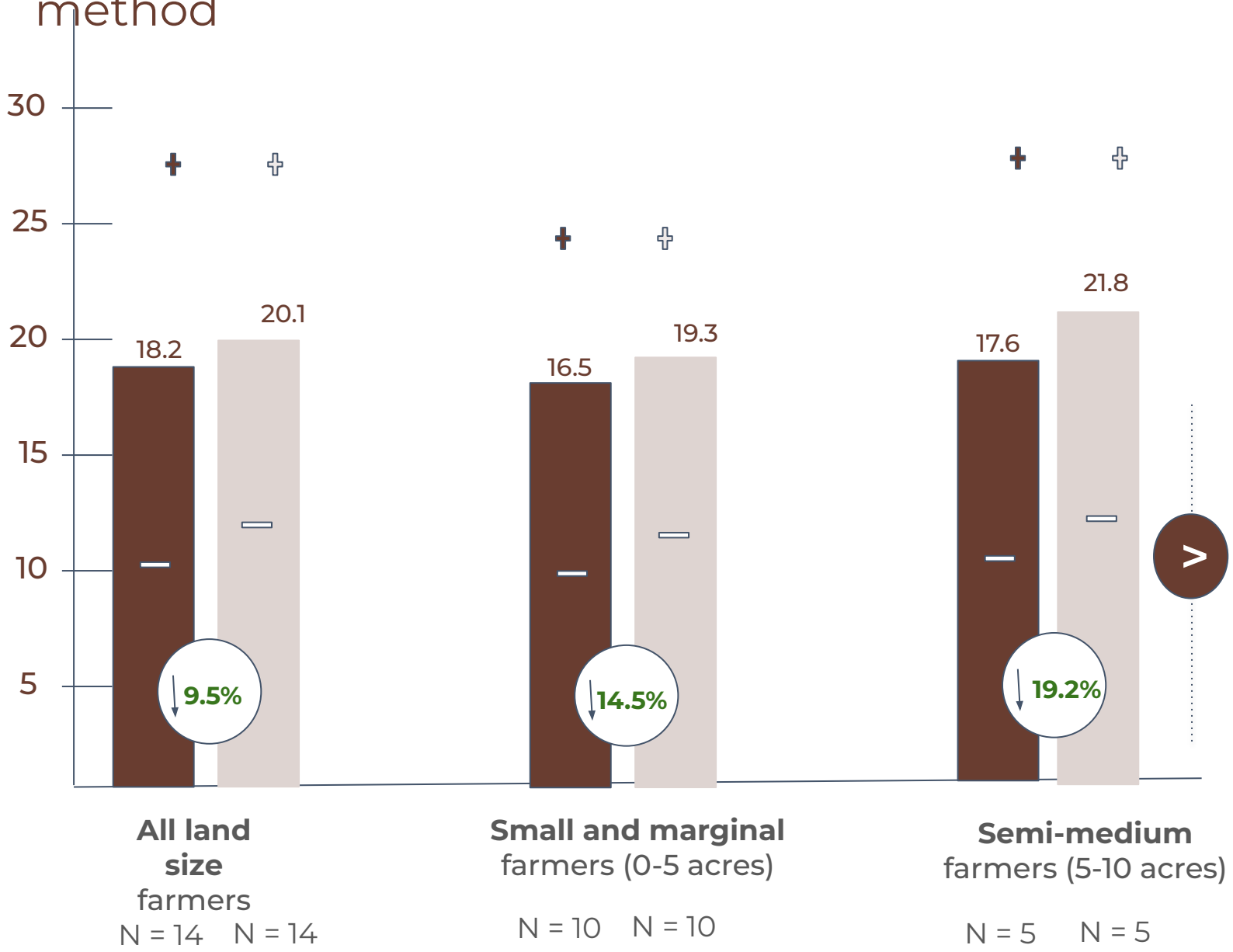


Semi-medium farmers (5-10 acres using similar seed varieties for DSR and PTR)

Irrespective of the landholding size, **at least 50% of the farmers** following the **DSR technique** have recorded a **yield >=80% of the average PTR yield** for the **similar seed varieties**.

Farmers tell us that, when the variability of yield is within this range, they feel confident in making the switch because the ease of farming and problems with labour availability is managed better with DSR technique.

UP 2 - Yield Analysis | On an average small and marginal farmers witnessed 14% decrease in yield while using the DSR method, as opposed to the traditional PTR method



Some reasons that may have contributed to low yield are:

1) Savanah full page seed was shared by the company as a research DSR seed, but the corresponding herbicide was not shared in time which led to weeds and yield loss

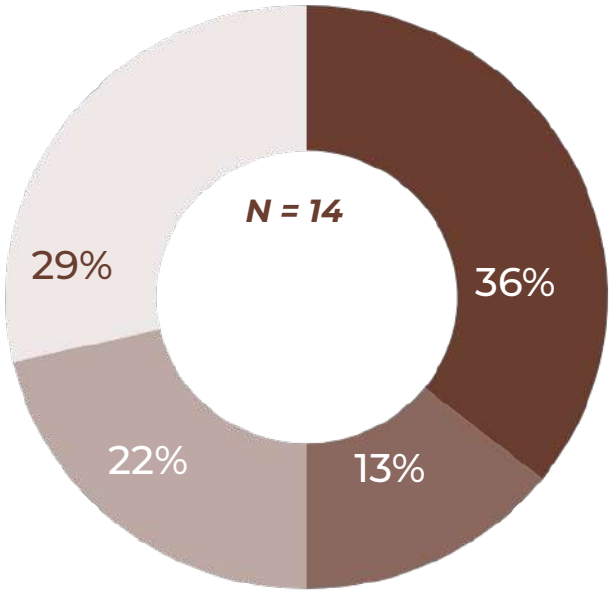
2) Late sowing due to untimely rains led to poor germination, leading to yield loss

3) Level of handholding not enough to help farmer decide what inputs to use and when to use them

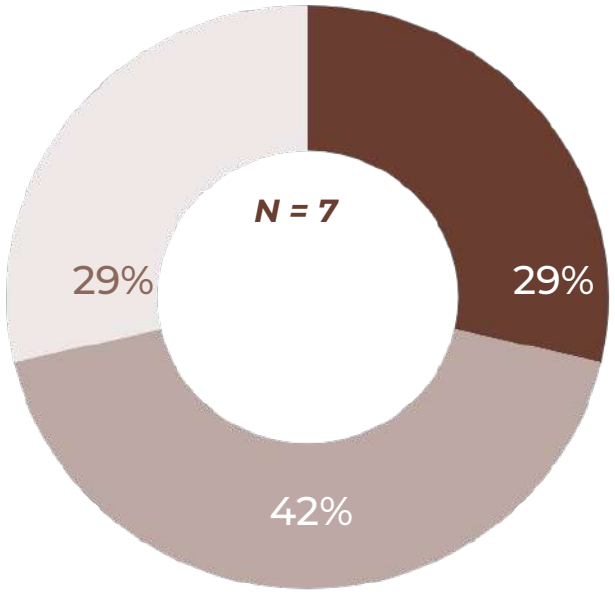
Income Analysis

UP 2 - Income Analysis | Over 30% of small and marginal farmers experienced a higher income with DSR compared to the average net income from traditional PTR

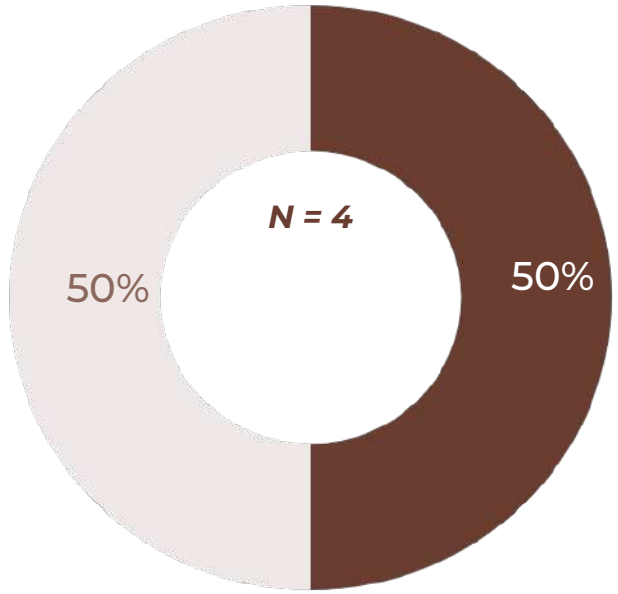
- % farmers with DSR income >= 100% avg. PTR income
- % farmers with DSR income between 80-100% of the avg. PTR income
- % farmers with DSR income between 60-80% of the avg. PTR income
- % farmers with DSR income <60% of the avg. PTR income



All land size
farmers



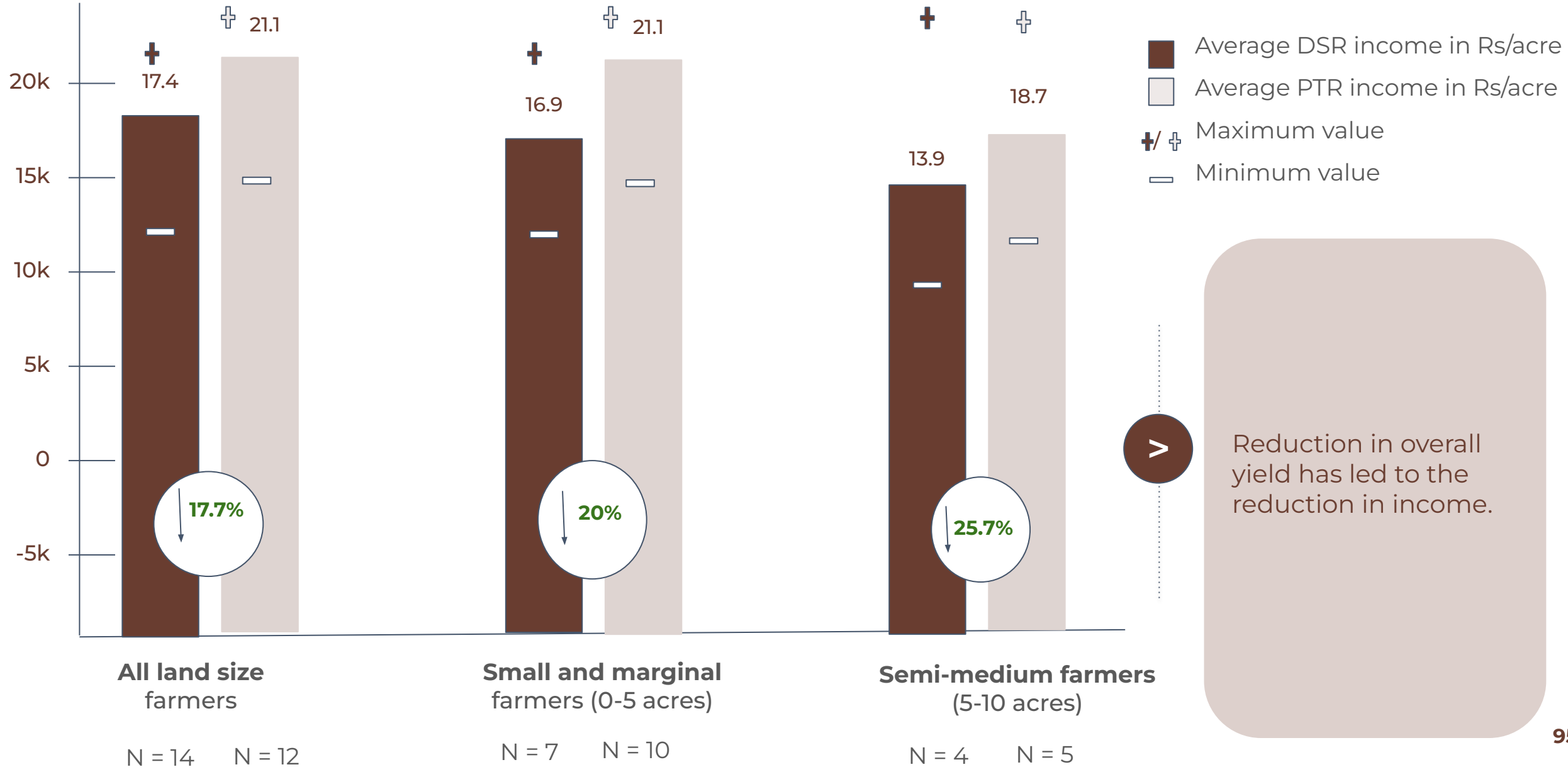
Small and marginal
farmers (0-5 acres)



Semi-medium farmers
(5-10 acres)

Irrespective of the landholding size, **at least ~30% of the farmers** following the **DSR technique** have recorded an income **higher than the average PTR income**

UP 2 - Income Analysis | On an average small and marginal farmers witnessed ~20 % decrease in net income by following the DSR method as compared to PTR method



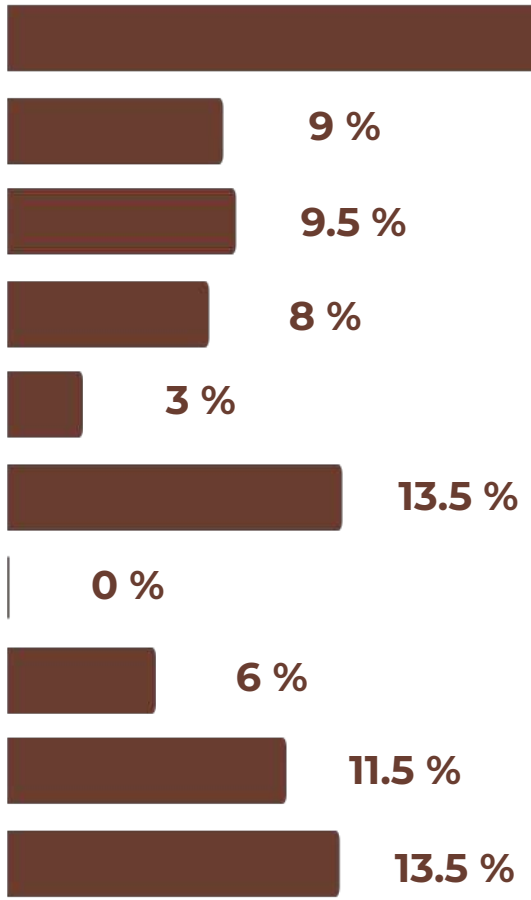
>

Reduction in overall yield has led to the reduction in income.

Cultivation process and Cost calculation

UP 2 - Total Costs by Stages | DSR method of paddy cultivation

Stages	Cost/Acre - DSR	% contribution to total cost
1. Main Land Preparation	₹ 4,389	26 %
2. Irrigation	₹ 1,500	9 %
3. Seed	₹ 1,597	9.5 %
4. Machinery (Seed drill)	₹ 1,404	8 %
5. Pre Emergence Herbicide	₹ 522	3 %
6. Fertilizer	₹ 2,337	13.5 %
7. Pesticide	₹ 0	0 %
8. Post Emergence Herbicide	₹ 1,027	6 %
9. Other Labour	₹ 1,950	11.5 %
10. Harvesting	₹ 2,325	13.5 %
	₹ 17,051	



- **Main land preparation** has the largest contribution to the overall cost of cultivation at **26%**, where **land levelling** and **cultivators** contribute the major cost.
- An **added cost** that is specific to DSR is the cost associated with the use of **land leveller** for levelling the land and **sowing machines** needed to sow the seeds.

UP 2 - Total Costs by Stages | PTR method of paddy cultivation

Stages	Cost/Acre - PTR	% contribution to total cost
1. Nursery[1]	₹ 283	1.5 %
2. Seed	₹ 1,080	6 %
3. Main Land Preparation	₹ 4,391	23.5 %
4. Irrigation	₹ 2,100	11.5 %
5. Transplanting Labour	₹ 2,684	14.5 %
6. Fertilizer	₹ 2,405	13 %
7. Pesticide	₹ 0	0 %
8. Post Emergence Herbicide	₹ 695	4 %
9. Other Labour	₹ 2,400	13 %
10. Harvesting	₹ 2,538	13.5 %
	₹ 18,576	

- **Land Preparation** carries the **largest contribution** to the overall cost in PTR at **~24%**, which includes the cost associated with **cultivator** use.
- **Irrigation cost** is higher in PTR (Rs. 2,100) compared to DSR (Rs. 1,500) due to the high water requirement needed for puddling.
- **labour requirement** (for uprooting and transplanting seedlings from nursery to mainland) **is high**, and thus high associated cost.

1 - 'Nursery' stage cost includes cost of land preparation as well as cost of fertilizers need for nursery preparation.

UP 2 - Cost Comparison | Farmers recorded ~8.2 % decrease in input cost using the DSR method as compared to the PTR method of cultivation

Stages	Cost/Acre - DSR		Cost/Acre - PTR	
1. Main Land Preparation	₹ 4,389		₹ 4,391	
2. Nursery[1]	₹ 0		₹ 283	
3. Irrigation	₹ 1,500		₹ 2,100	
4. Seed	₹ 1,597		₹ 1,080	
5. Machinery (Seed drill)	₹ 1,404		₹ 0	
6. Pre Emergence Herbicide	₹ 522		₹ 0	
7. Transplanting Labour	₹ 0	Total Labour ₹ 1,950	₹ 2,684	Total Labour ₹ 5,084
8. Other Labour[2]	₹ 1,950		₹ 2,400	
9. Fertilizer	₹ 2,337		₹ 2,405	
10. Pesticide	₹ 0		₹ 0	
11. Post Emergence Herbicide	₹ 1,027		₹ 695	
12. Harvesting	₹ 2,325		₹ 2,538	
	₹ 17,051		**₹ 18,576**	

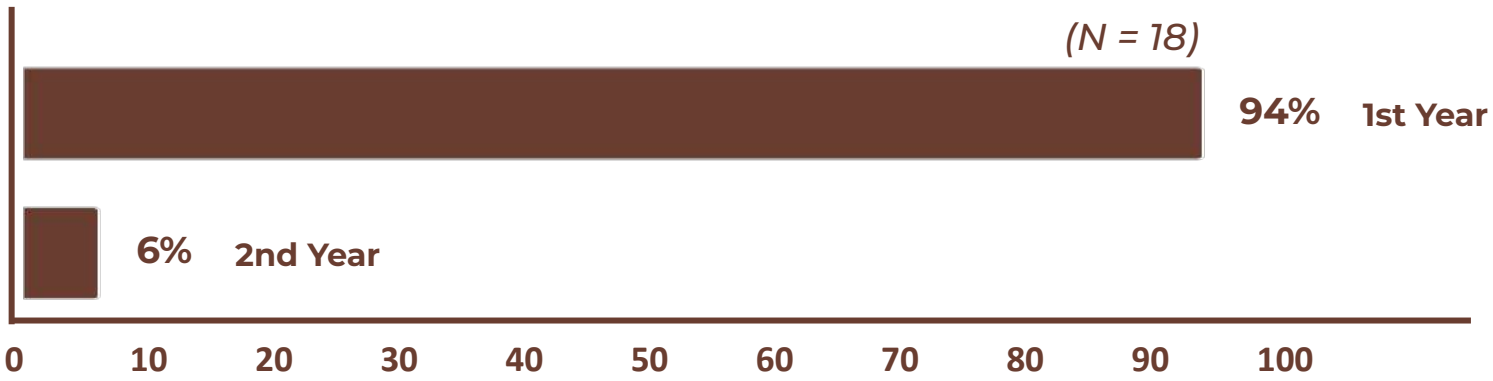
- Major saving in DSR come from **lower labour requirement** as well as **lower water requirement** for irrigation.
- A **61%** drop in **total labour cost** is seen in DSR compared to PTR.
- However, **DSR has increased costs** mainly from the need for **machinery** for seed sowing.
- The labour cost (**Other Labour**) in DSR accounts for the need for labour to manually remove weeds, among others.

1 - 'Nursery' stage cost includes cost of land preparation as well as cost of fertilizers needed for nursery preparation.
2 - 'Other Labour' includes labour excluding labour for transplanting. This would include labour for pesticides and herbicide spray, weed removal, machinery operation, etc.

DSR cultivation and adoption challenges: voices from the ground

UP 2 - DSR Legacy Farmers | 94% of farmers have adopted DSR for the first time in the past year even though none of their peers have adopted DSR before

- Number of Years the farmers have been practicing DSR



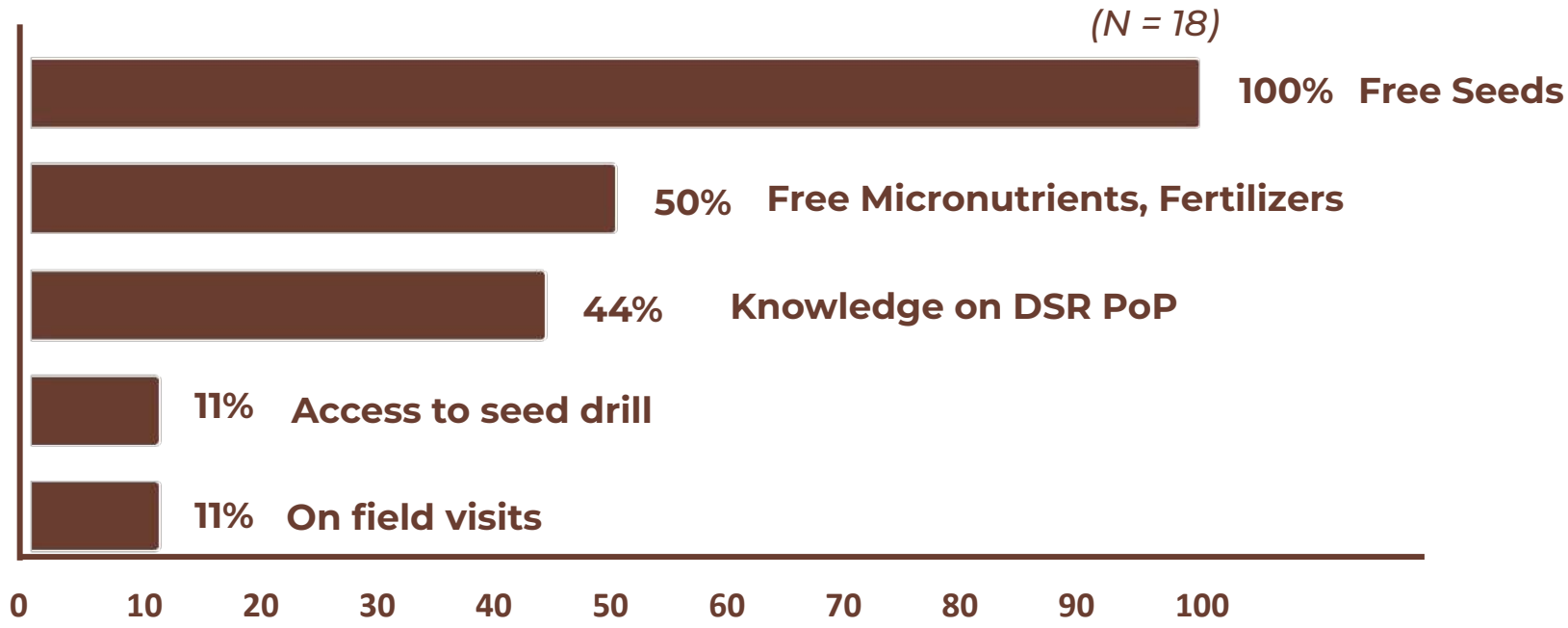
- **94%** of farmers have adopted DSR for the **first time** while only **6%** of them are doing it for the **second year**.

- **0%** of farmers had **at least one peer** (neighbor, relative) who adopted DSR *(N = 7)*

- DSR adoption among all farmers in Prayagraj was due to the **influence** of the **partner organization**.

UP 2 - Partner Support | 100% of farmers received free inputs (seeds, micronutrients, fertilizers) as an incentive to adopt DSR

- Types of Support provided to farmers by Organizations and Peers

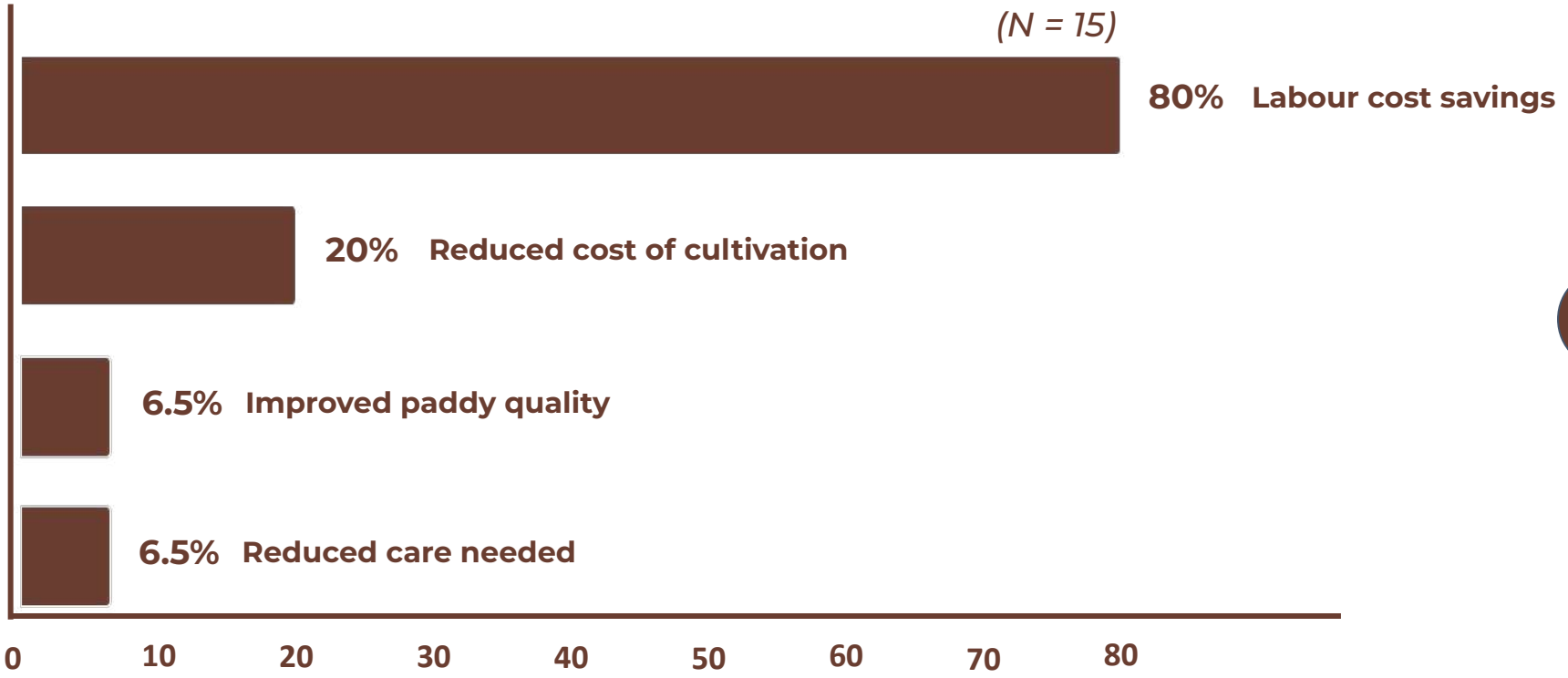


- **All farmers** received **free seeds** from the partner organization, which was an incentive for farmers to adopt DSR.
- **50%** of farmers received **free micronutrients and fertilizers**.

- **100%** of farmers received **free or subsidized inputs** *(N = 18)*

UP 2 - DSR Method Benefits | 80% of farmers cite labour cost savings as a major benefit of DSR

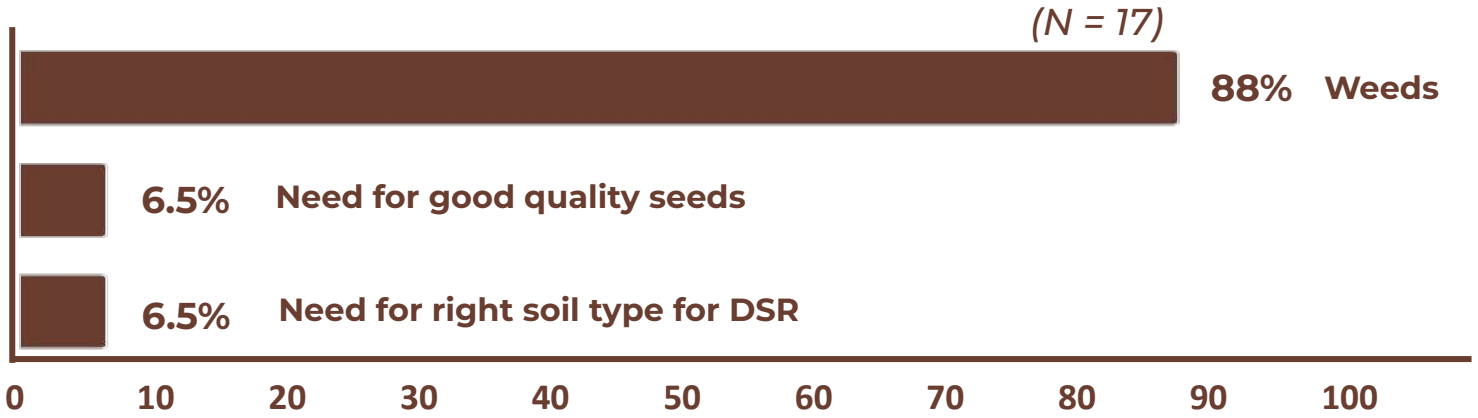
- Major Benefits of DSR according to farmers



- Since DSR method requires less labour, **80%** of farmers quote **cost savings from reduced labour requirements** as a major benefit in DSR.

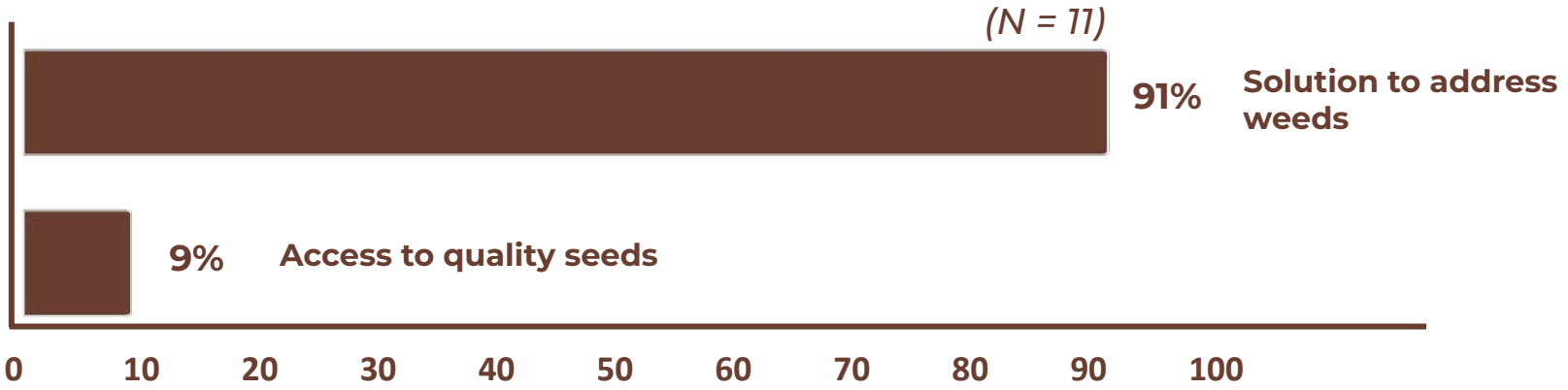
UP 2 - Challenges in DSR | 88% of farmers cite weeds are a major concern in DSR; 91% of farmers quote that having a solution to address weeds would help improve DSR adoption

- Major Issues with DSR according to farmers



- **Growth of weeds** is a major challenge, as quoted by **88%** of farmers.
- Additionally, having the right **quality of seeds** for DSR is important too, which is also a challenge for some farmers.

- What can be done to improve DSR adoption?



- **91%** of farmers quote that having a **solution to address weed growth** would help improve the adoption of DSR among other farmers.

UP 2 - Understanding DSR Adoption Status and Continuity

- **100%** of farmers have been **influenced** by the **partner organization** to adopt DSR *(N = 18)*
- **67%** of farmers will **continue with DSR in the following year** *(N = 18)*
- **88%** of farmers who will continue with DSR will do so even if **supporting organizations or personnel leave the area** *(N = 8)*
- **67%** of farmers believe that DSR can be **adopted by smallholder farmers** *(N = 18)*

Region 3: Haryana
Observations and Findings

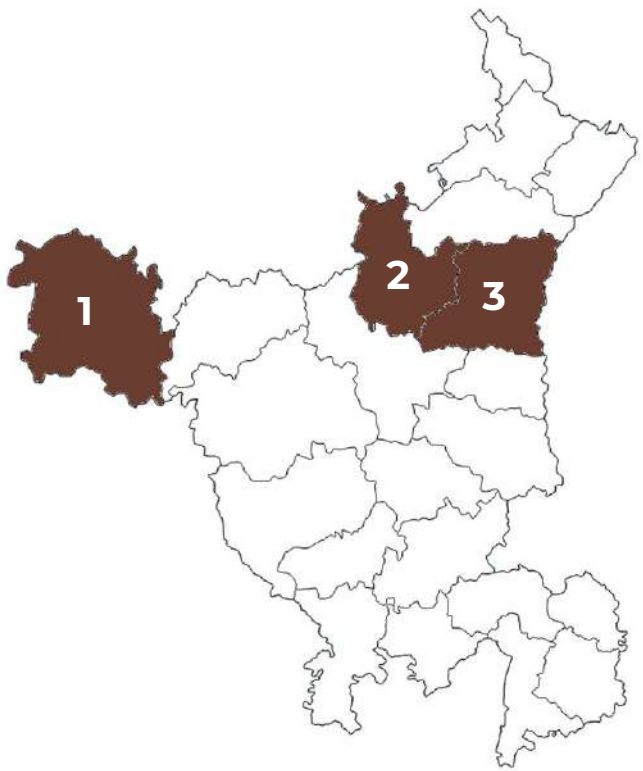
Background: Haryana

Districts covered	Sirsa, Kaithal, Karnal
Agro Climatic Zones (NARP)	Eastern Zone (HR 1), Western Zone (HR 2)
Partner Support Level	Medium *(interactions with farmers, PoP knowledge dissemination, resource management support, problem resolution, etc.)*
Most grown crops in HR	Wheat, Rice, Sugarcane
Common Soil Type	Loamy soil, sandy loam
Paddy Sown Area in HR	3,165.42 thousand acres (2021 - 2022)[1]
Paddy Yield in HR	14.59 quintal per acre (2021 - 2022)[2]

1- RBI: State wise area of foodgrains
2- RBI: State wise estimates of yield

“I started DSR this year, and it was good to see that the partner organization visited my field once a week to monitor my field to see if conditions were optimal for successful DSR growth. Because of their support, I will be continuing with DSR the following year also. However, weed growth is a pain point, and access to land leveller and seed drill is not easy and can be improved.”

Haryana: Regions under Study and Target Population



1 - Sirsa

2 - Kaithal

3 - Karnal

3 Districts | **19** Villages | **56** Unique farmers[1]

Target population status

- Number of Farmers

	DSR	PTR
	35	23

- Land Under Cultivation (acres)

	DSR	PTR
	258	303

- Irrigation Status (% of farmers)

	DSR	PTR
Completely irrigated	97 %	100 %
Partially irrigated	0 %	0 %
Rainfed	0 %	0 %

1- The word 'unique farmers' means overall no. of individual farmers interviewed. Same farmer may be practising both DSR and PTR in different farmlands in the same year. So, the no. of unique individual farmers will be lesser than the sum of farmers interviewed for DSR and PTR.

Haryana: Agro Climatic Zones

Eastern Zone (HR1)

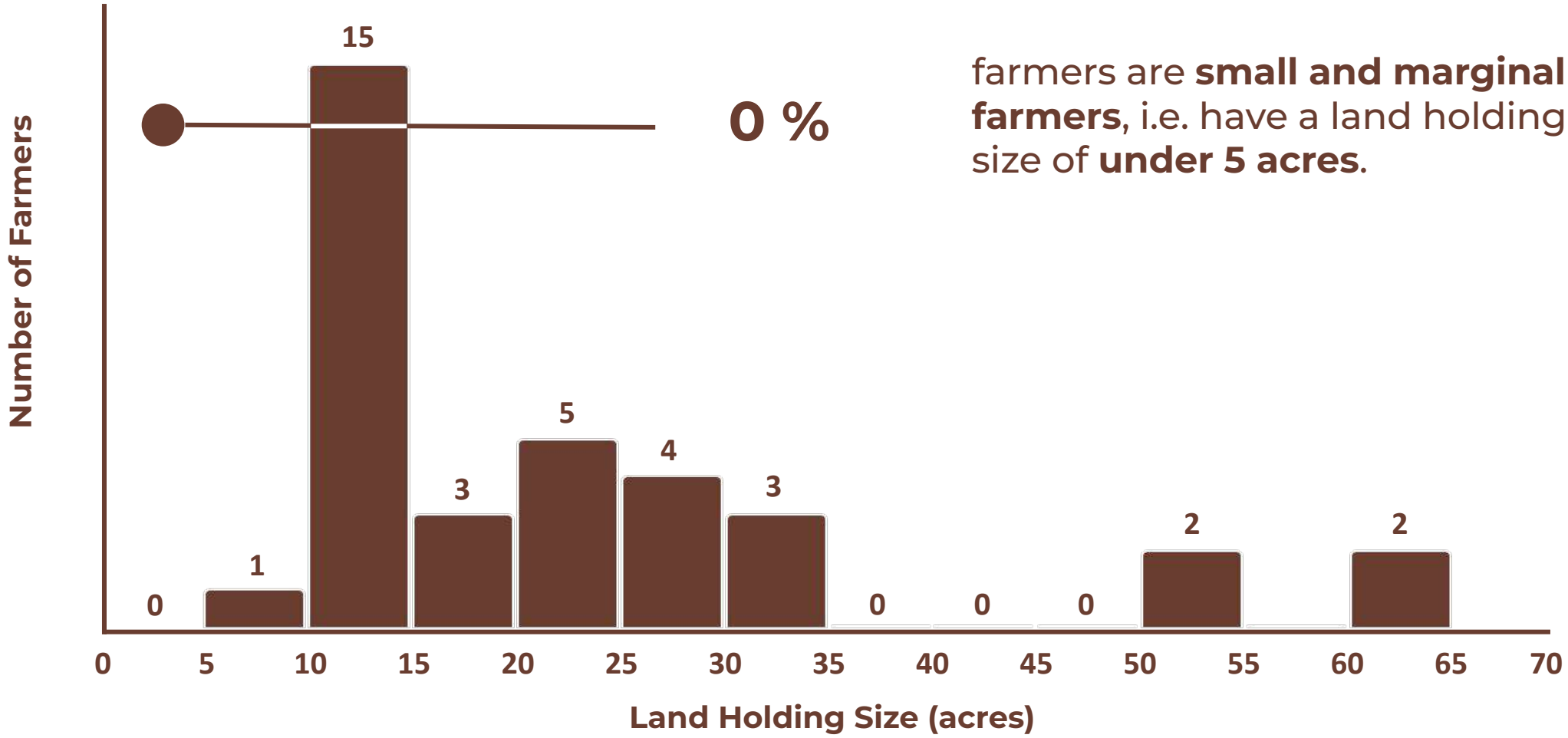
Western Zone (HR2)

Parameters

District/Area	Agro Climatic Zone (NARP) [1]	Soil Type	Annual Rainfall (mm) [2]
Karnal	Eastern Zone (HR1)	Loamy soil & sandy loam	780
Kaithal	Eastern Zone (HR1)	Loamy soil & sandy loam	551
Sirsa	Western Zone (HR2)	Sandy Loam	391

1 - Classification of Agro-climatic zones is based on the National Agricultural Research Project (NARP) standard which was launched by The Indian Council of Agricultural Research (ICAR).
2 - Agriculture Department Uttar Pradesh, The Indian Council of Agricultural Research (ICAR).

Haryana: Target population by landholding size



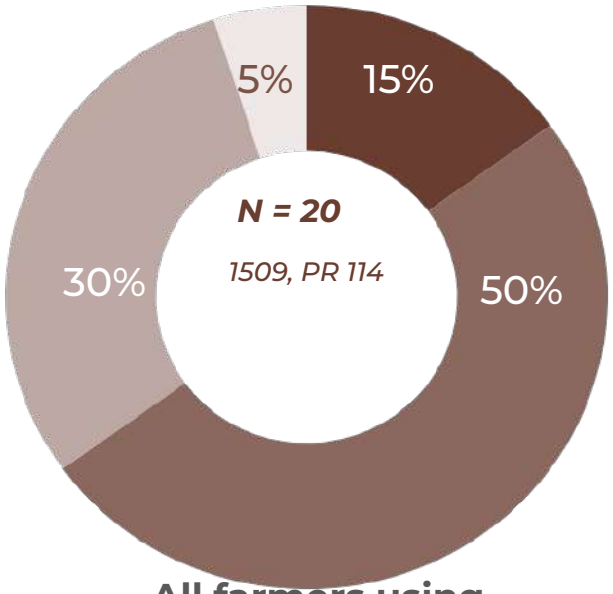
farmers are **small and marginal farmers**, i.e. have a land holding size of **under 5 acres**.

Most of the farmers interviewed in Haryana were either medium or large farmers. We were not able to interview any small or marginal farmers because, on an average the landholding size is high in this region.

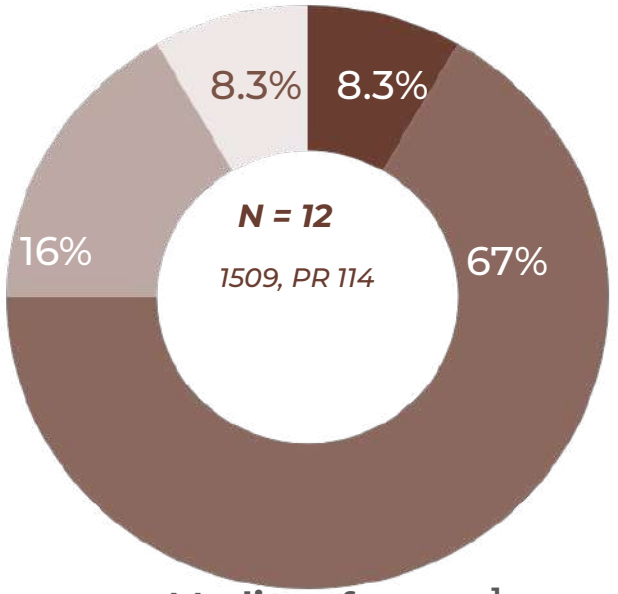
Yield Analysis

Haryana - Yield Analysis - Comparing similar seed varieties | ~15% of farmers experienced a higher yield with DSR compared to the average yield from traditional PTR

- % farmers with DSR yield >= 100% avg. PTR yield
- % farmers with DSR yield between 80-100% of the avg. PTR yield
- % farmers with DSR yield between 60-80% of the avg. PTR yield
- % farmers with DSR yield <60% of the avg. PTR yield



All farmers using similar seed varieties for DSR and PTR



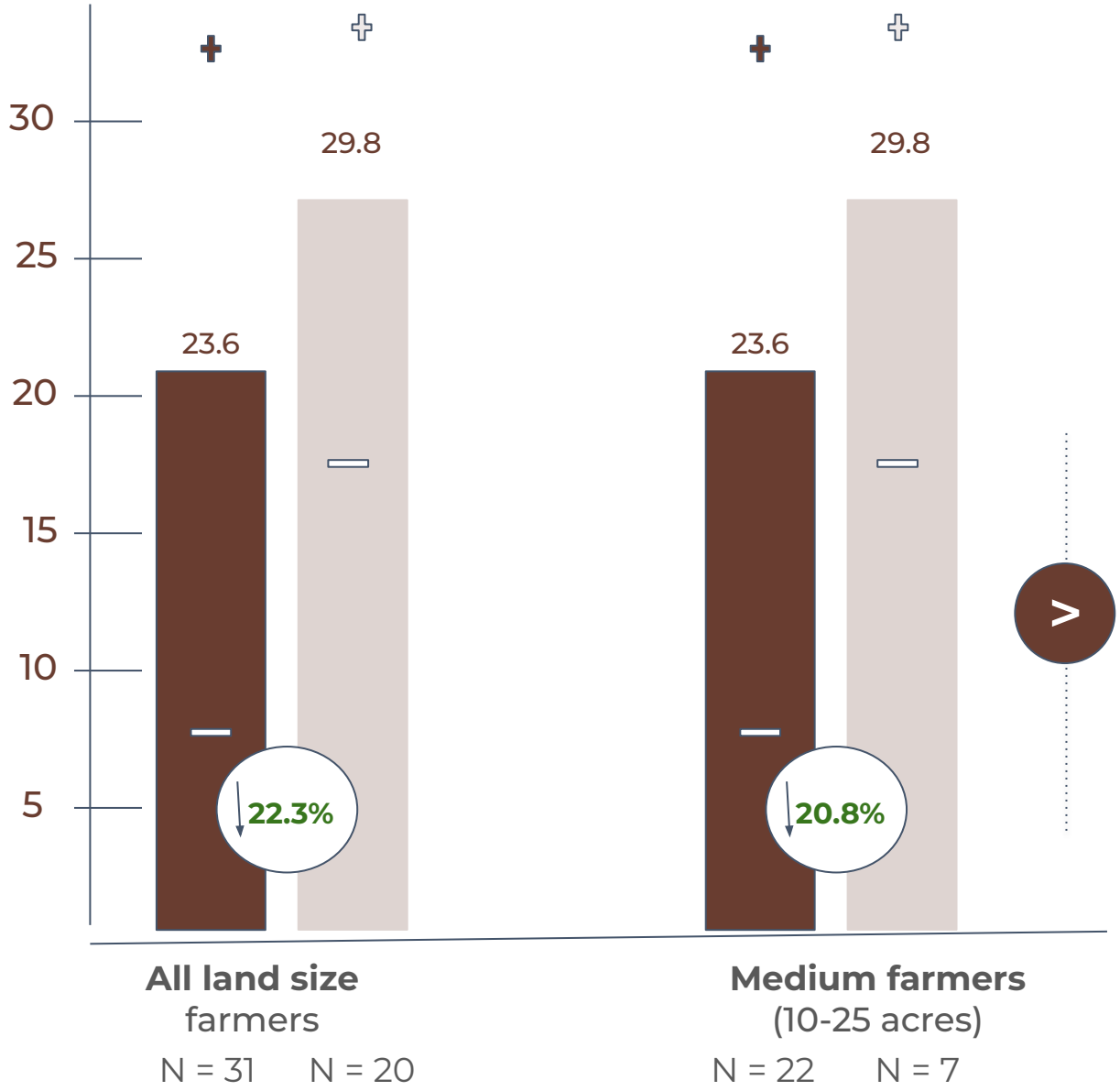
Medium farmers[1] (10-25 acres) using similar seed varieties for DSR and PTR

Irrespective of the landholding size, **at least 65% of the farmers** following the **DSR technique** have recorded a **yield >=80% of the average PTR yield** for the **similar seed varieties**.

Farmers tell us that, when the variability of yield is within this range, they feel confident in making the switch because the ease of farming and problems with labour availability is managed better with DSR technique.

1– Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers

Haryana - Yield Analysis | On an average farmers witnessed ~22% decrease in yield while using the DSR method, as opposed to the traditional PTR



Average DSR yield in quintals/acre

Average PTR yield in quintals/acre

Maximum value

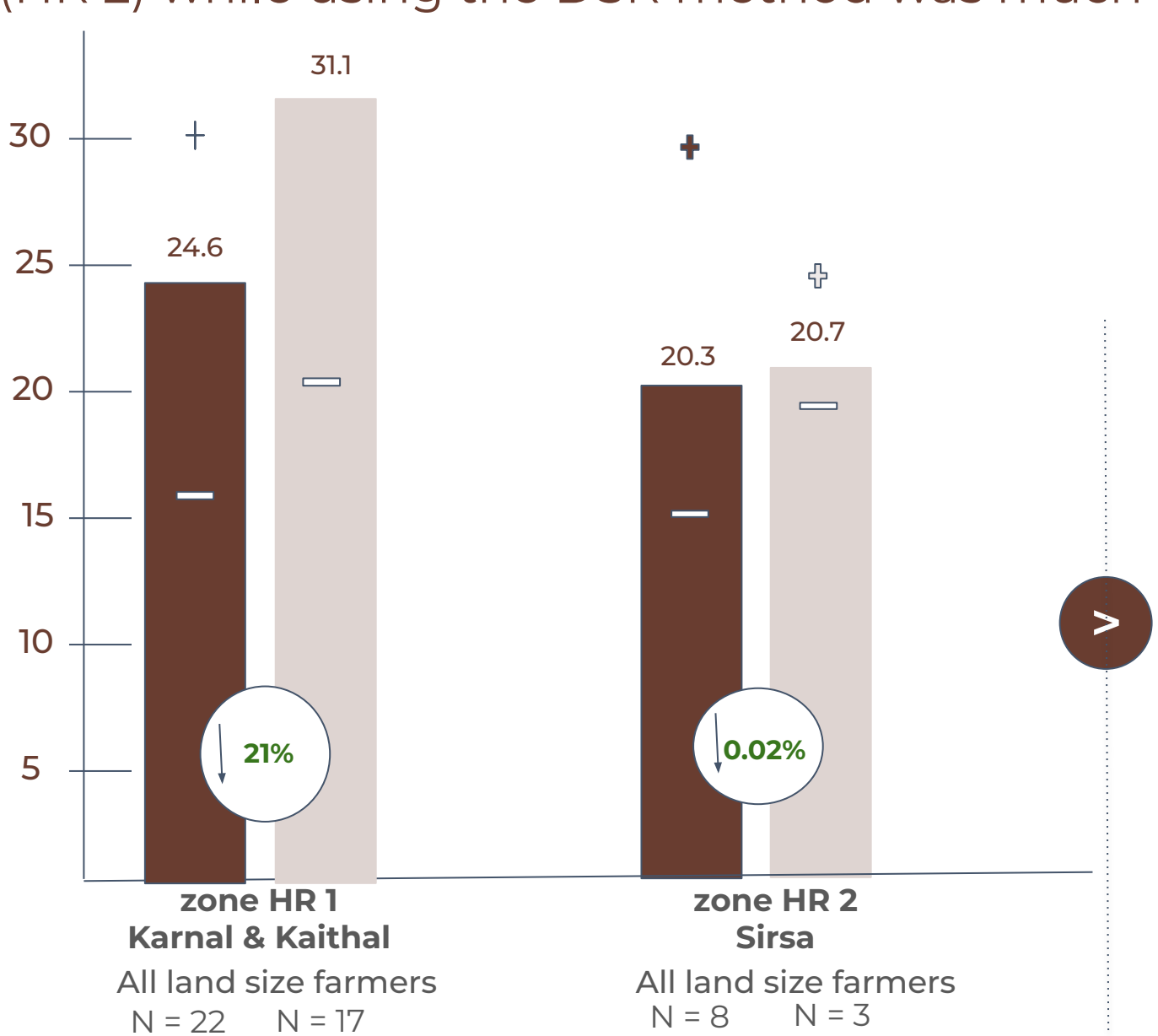
Minimum value

Reasons that may have contributed to the yield loss are:

- Level of handholding not enough to help farmer decide what inputs to use and when to use them. Timely use of inputs is almost as important as the usage itself
- Same farmers practising DSR and PTR maybe deploying a portion of his land with lesser irrigation facility or soil fertility to use the DSR method, since it is experimental. The yield is very susceptible to the level and time of irrigation

- Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers

Haryana - Agro-climatic zone wise yield analysis | Reduction in yield in Western zone (HR 2) while using the DSR method was much lesser than in the Eastern zone (HR 1)



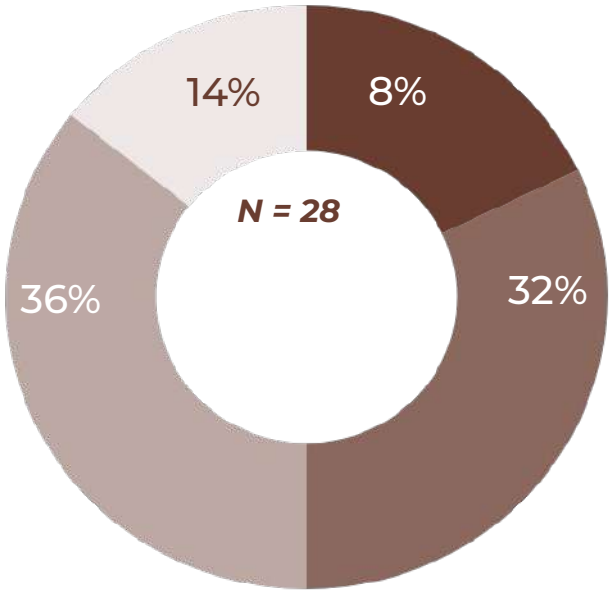
- Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers

- In Hr 2 zone, the yields from PTR and DSR are almost the same, while in HR 1, the reduction of yield in DSR is by 21%
- On an average, HR 1 zone provides better yield for paddy
- This shows that even with low support from partner organisation, zone HR 2 is more conducive for a shift to DSR with almost no yield loss
- Additionally, we also recorded that no. of legacy DSR farmers were in fact lesser in zone 2, compared to zone 1 where the average no. of years a farmers had done DSR was 3, while in zone 2 it was 2.25

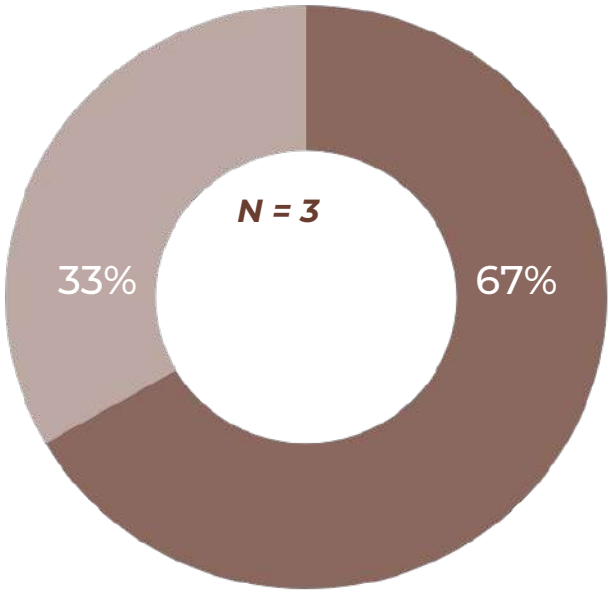
Income Analysis

Haryana - Income Analysis | Only over 8% of farmers experienced a higher net income with DSR compared to the average income from traditional PTR

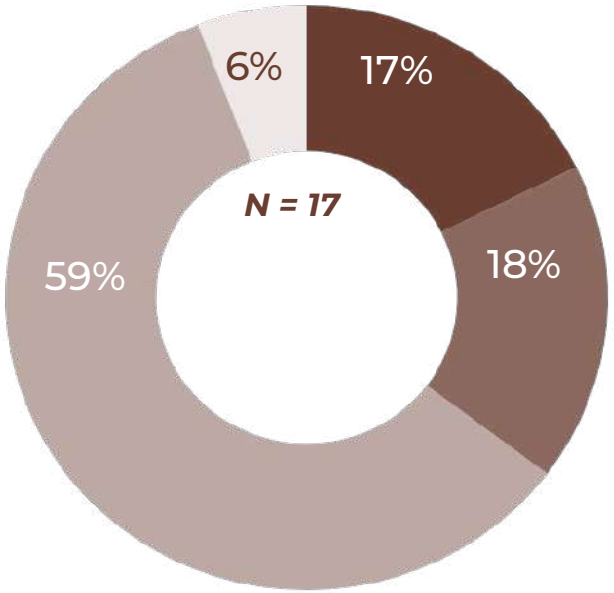
- % farmers with DSR income >= 100% avg. PTR income
- % farmers with DSR income between 80-100% of the avg. PTR income
- % farmers with DSR income between 60-80% of the avg. PTR income
- % farmers with DSR income <60% of the avg. PTR income



All land size
farmers



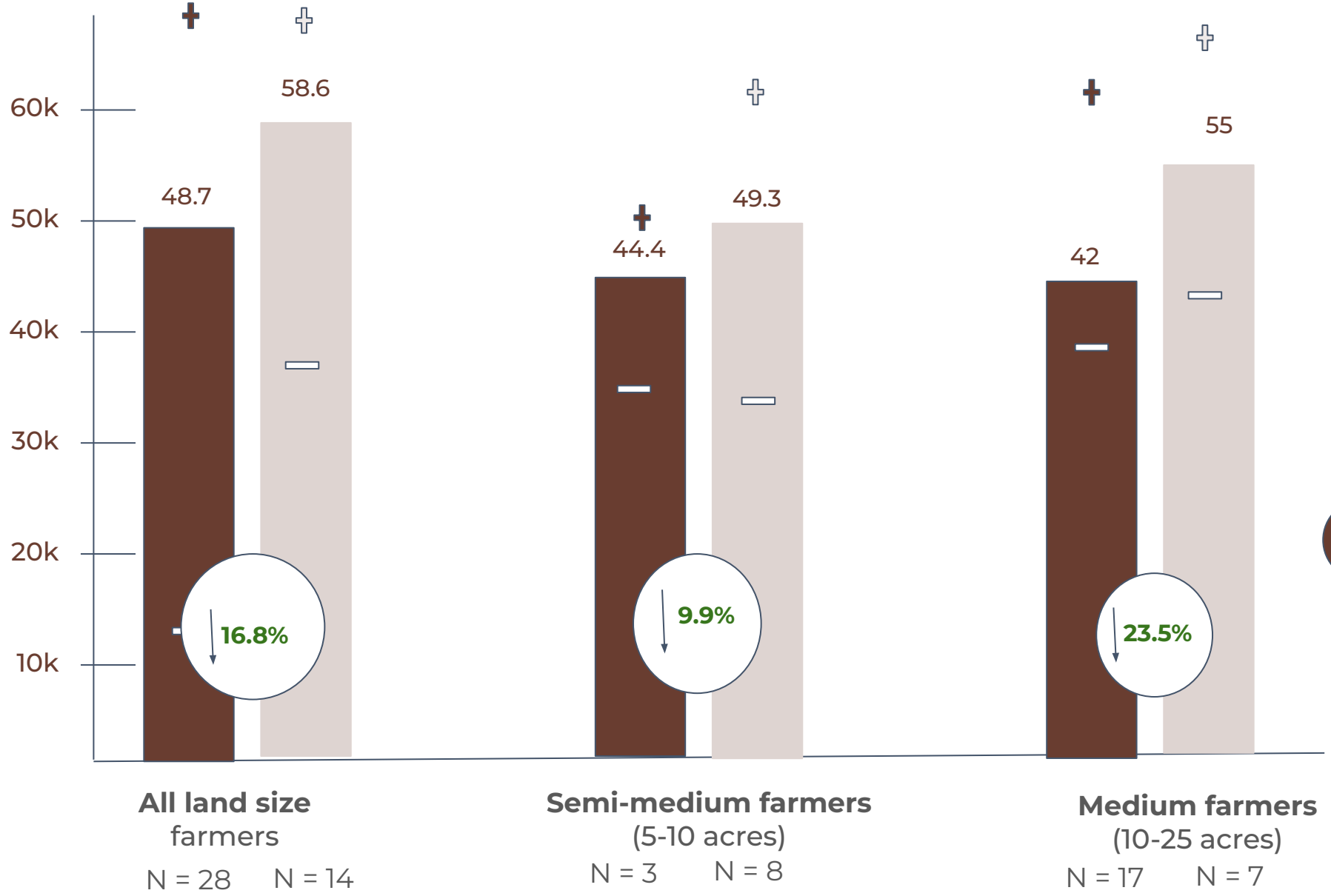
Semi-medium farmers
(5-10 acres)



Medium farmers
(10-25 acres)

- Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers

Haryana - Income Analysis | On an average farmers witnessed 17 % decrease in net income by following the DSR method as compared to PTR method



> Reduction in overall yield has led to the reduction in income.

- Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers

Cultivation process and Cost calculation

Haryana - Total Costs by Stages | DSR method of paddy cultivation

	Stages	Cost/Acre - DSR	% contribution to total cost
1.	Main Land Preparation	₹ 3,846	18.5 %
2.	Irrigation	₹ 0	0 %
3.	Seed	₹ 1,722	8 %
4.	Machinery (Seed drill)	₹ 1,349	6.5 %
5.	Pre Emergence Herbicide	₹ 590	3 %
6.	Fertilizer	₹ 3,120	15 %
7.	Pesticide	₹ 5,017	24 %
8.	Post Emergence Herbicide	₹ 946	4.5 %
9.	Other Labour	₹ 2,369	11.5 %
10.	Harvesting	₹ 1,969	9.5 %
		₹ 20,928	

- **Pesticide** cost has the major contribution to the overall cost of cultivation in DSR in this region at **24%**. This includes three rounds of sprays of an average cost of Rs. 1670 per round.
- **Main land preparation** carries the next major contribution to overall cost at **18.5%**. This includes the use of land leveller, harrow, and cultivator.

- Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers

Haryana - Total Costs by Stages | PTR method of paddy cultivation

Stages	Cost/Acre - PTR	% contribution to total cost
1. Nursery[1]	₹ 493	2 %
2. Seed	₹ 1,736	7 %
3. Main Land Preparation	₹ 5,077	20.5 %
4. Irrigation	₹ 0	0 %
5. Transplanting Labour	₹ 3,783	15.5 %
6. Fertilizer	₹ 2,808	11.5 %
7. Pesticide	₹ 6,085	25 %
8. Post Emergence Herbicide	₹ 524	2 %
9. Other Labour	₹ 2,090	8.5 %
10. Harvesting	₹ 2,000	8 %
	₹ 24,596	

- **Pesticide** cost is the major contributor to the overall cost of cultivation at **25%**. This includes three rounds of sprays at an average cost of ~Rs. 2,030 per round.
- **Main land preparation** carries the next major contribution to overall cost at **20.5%**. This includes the use of harrow and cultivator.
- The next major contributor to overall cost is the **transplanting labour** cost at **15.5%**.

1- 'Nursery' stage cost includes cost of land preparation as well as cost of fertilizers need for nursery preparation.
- Haryana data sets do not have any small and marginal farmers and only 3 semi-medium farmers

Haryana - Cost Comparison | Farmers recorded ~15 % decrease in input cost using the DSR method as compared to the PTR method of cultivation

Stages	Cost/Acre - DSR		Cost/Acre - PTR	
1. **Main Land Preparation**	₹ 3,846		₹ 5,077	
2. **Nursery**[1]	₹ 0		₹ 493	
3. **Irrigation**	₹ 0		₹ 0	
4. **Seed**	₹ 1,722		₹ 1,736	
5. **Machinery (Seed drill)**	₹ 1,349		₹ 0	
6. **Pre Emergence Herbicide**	₹ 590		₹ 0	
7. **Transplanting Labour**	₹ 0	**Total Labour** ₹ 2,369	₹ 3,783	**Total Labour** ₹ 5,873
8. **Other Labour**[2]	₹ 2,369		₹ 2,090	
9. **Fertilizer**	₹ 3,120		₹ 2,808	
10. **Pesticide**	₹ 5,017		₹ 6,085	
11. **Post Emergence Herbicide**	₹ 946		₹ 524	
12. **Harvesting**	₹ 1,969		₹ 2,000	
	₹ 20,928		**₹ 24,596**	

>

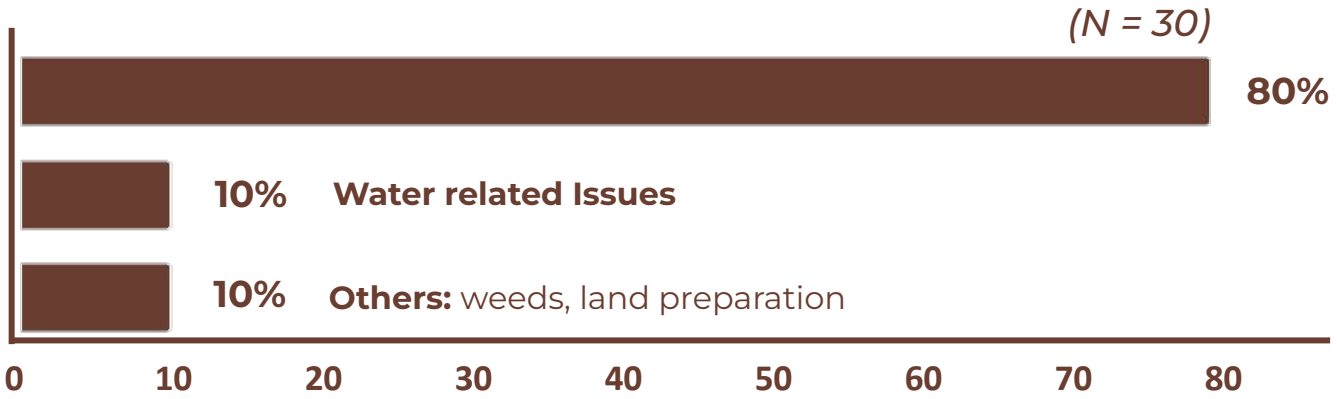
- An **~60% savings** in **total labour costs** is seen in DSR when compared to PTR.
- However, added costs specific to DSR include **machinery** (for seed sowing) and use of **pre- and post-emergence herbicides**.
- **Irrigation cost** in this region is **Rs. 0** because of **free electricity** given by the government to farmers.

1 - 'Nursery' stage cost includes cost of land preparation as well as cost of fertilizers needed for nursery preparation.
2 - 'Other Labour' includes labour excluding labour for transplanting. This would include labour for pesticides and herbicide spray, weed removal, machinery operation, etc.

DSR cultivation and adoption challenges: voices from the ground

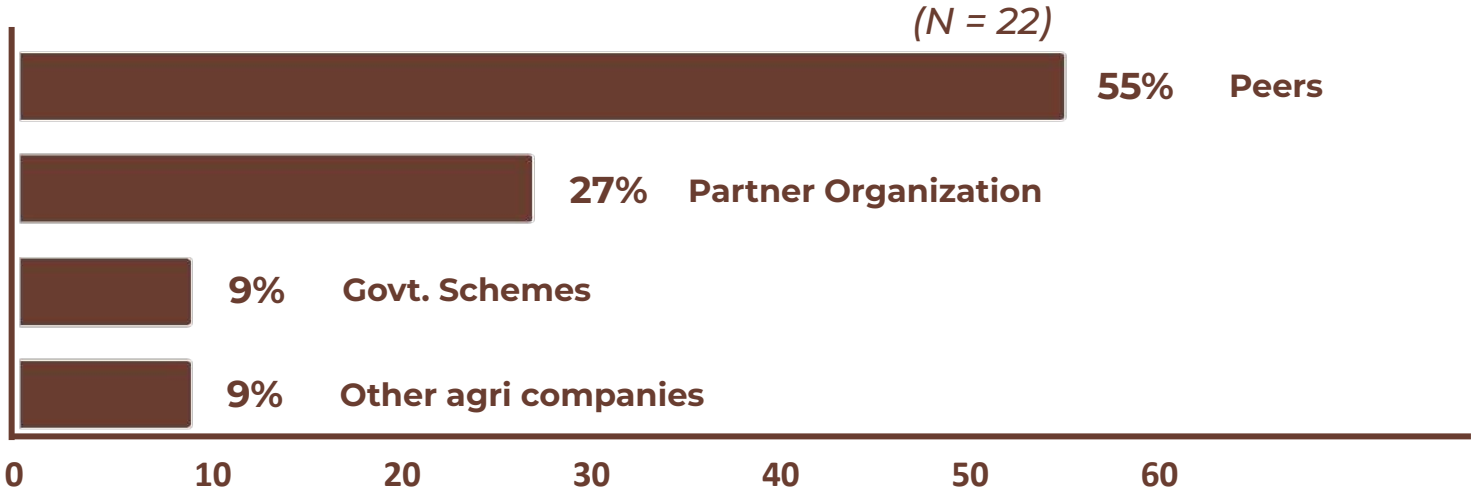
Haryana - Challenges with PTR and Push for Adoption | 80% of farmers quote shortage of labour as a challenge in PTR; 55% of farmers transitioned to DSR due to the influence of their peers

- Challenges faced by Farmers with PTR Technique



- **80%** of the farmers interviewed cited that the **availability of labour** is the biggest challenge they face with PTR.

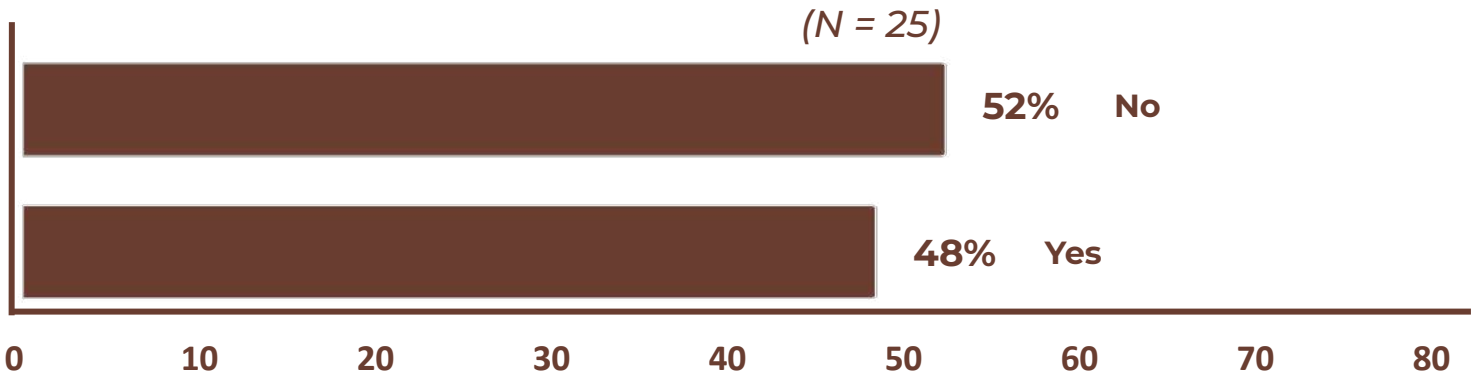
- Organizations or persons that convinced farmers to adopt DSR



- **55%** of farmers who adopted DSR have done so due to the **influence of their peers** (neighbors, relatives, etc), while **27%** of farmers adopted DSR due to **influence of the partner organization**, highlighting the impact a peer network can have on adoption.

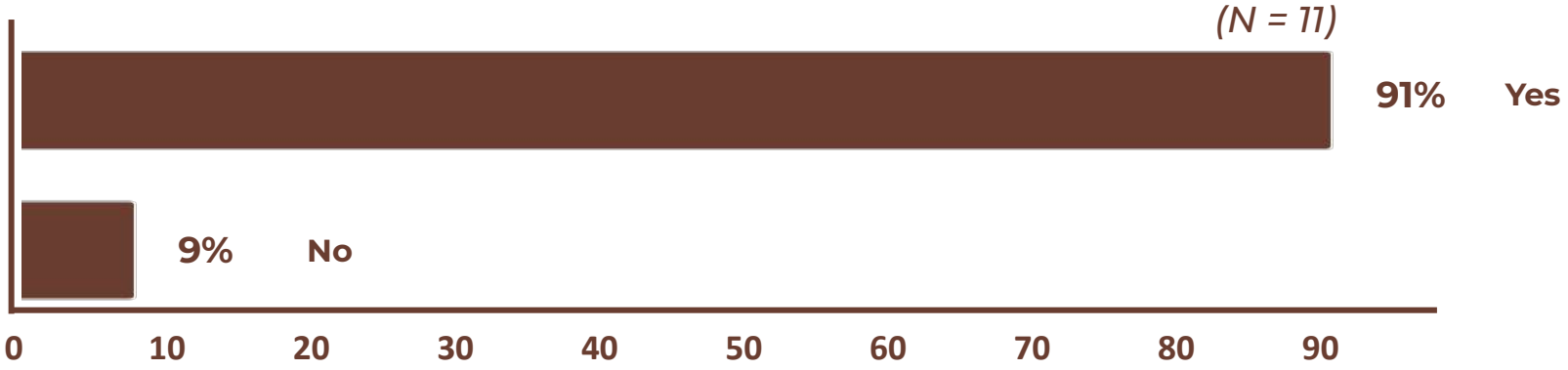
Haryana - Peer Effect | 48% of farmers had peers who did DSR, and in such cases, the farmer was 91% more likely to adopt DSR

- Before a farmer adopted DSR, did his peers adopted DSR successfully?



- Among the farmers interviewed, **48% had at least one peer who did DSR**, highlighting the DSR adoption level in the region.

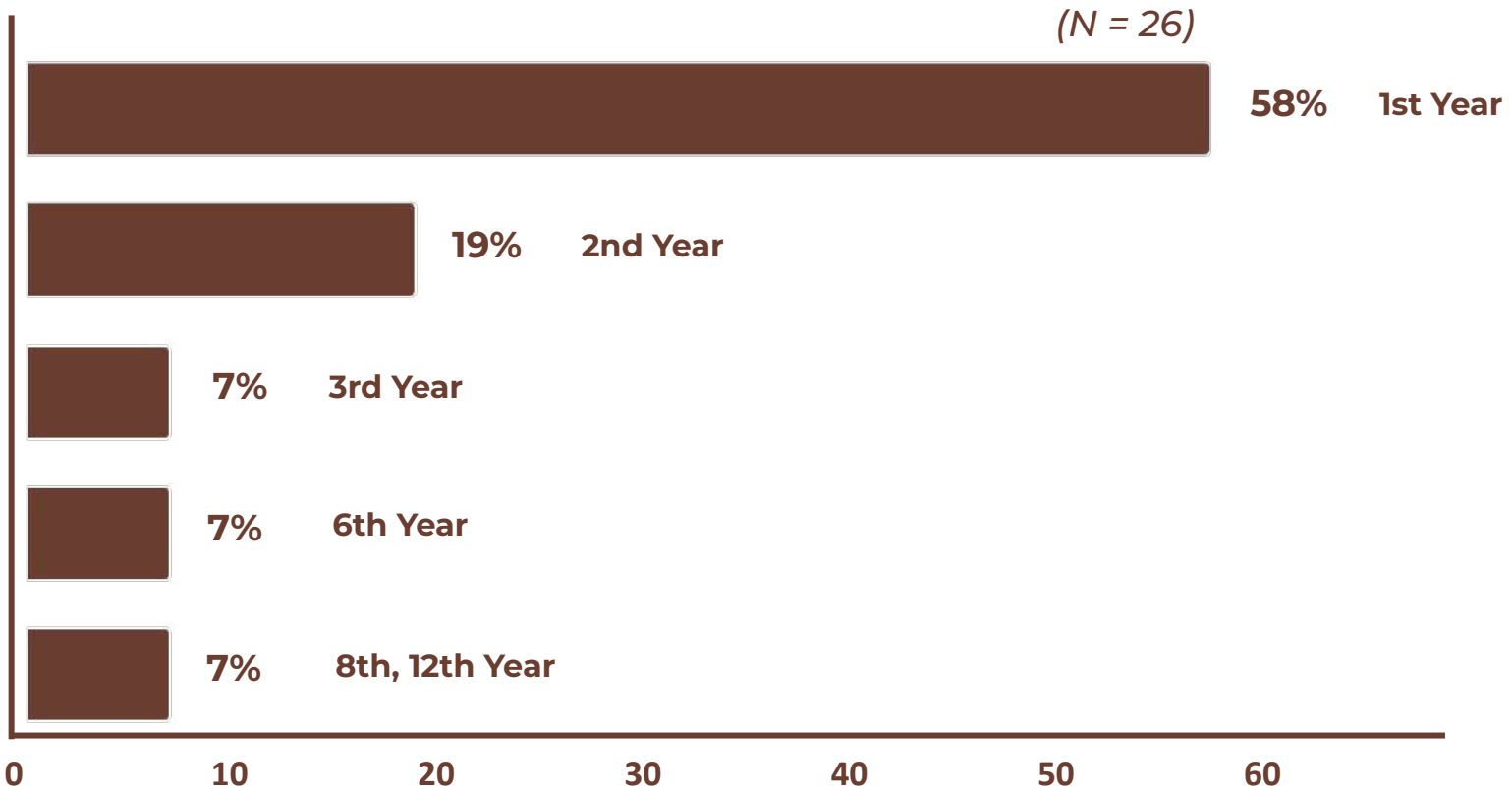
- Was a farmer motivated to adopt DSR if his peers adopted DSR successfully?



- In cases where a farmer had a peer doing DSR, he/she was **91% more likely to adopt DSR**. This shows the influence peers can have on the adoption practices.

Haryana - DSR Legacy Farmers | 58% of farmers have adopted DSR for the first time, while about 77% have been doing DSR for 2 years

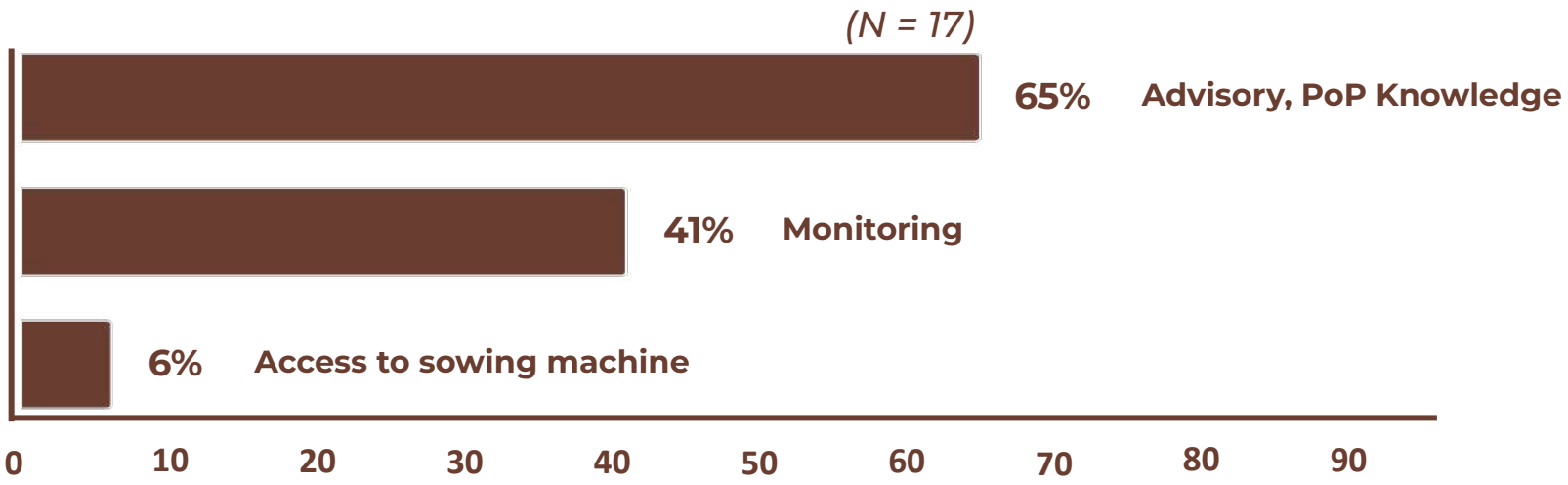
- Number of Years the farmers have been practicing DSR



- In Haryana, a majority (**58%**) of farmers interviewed have been doing **DSR for the first time**.
- a combined **77%** of farmers have been doing **DSR for the past 2 years**.
- **40%** of farmers are **repeat farmers**, i.e they have done DSR at least once before.

Haryana - Partner Support | 65% of farmers received support from organizations or peers in the form of advisory and PoP Knowledge, however none of the farmers received support in the form of subsidized or free inputs

- Types of Support provided to farmers by Organizations and Peers

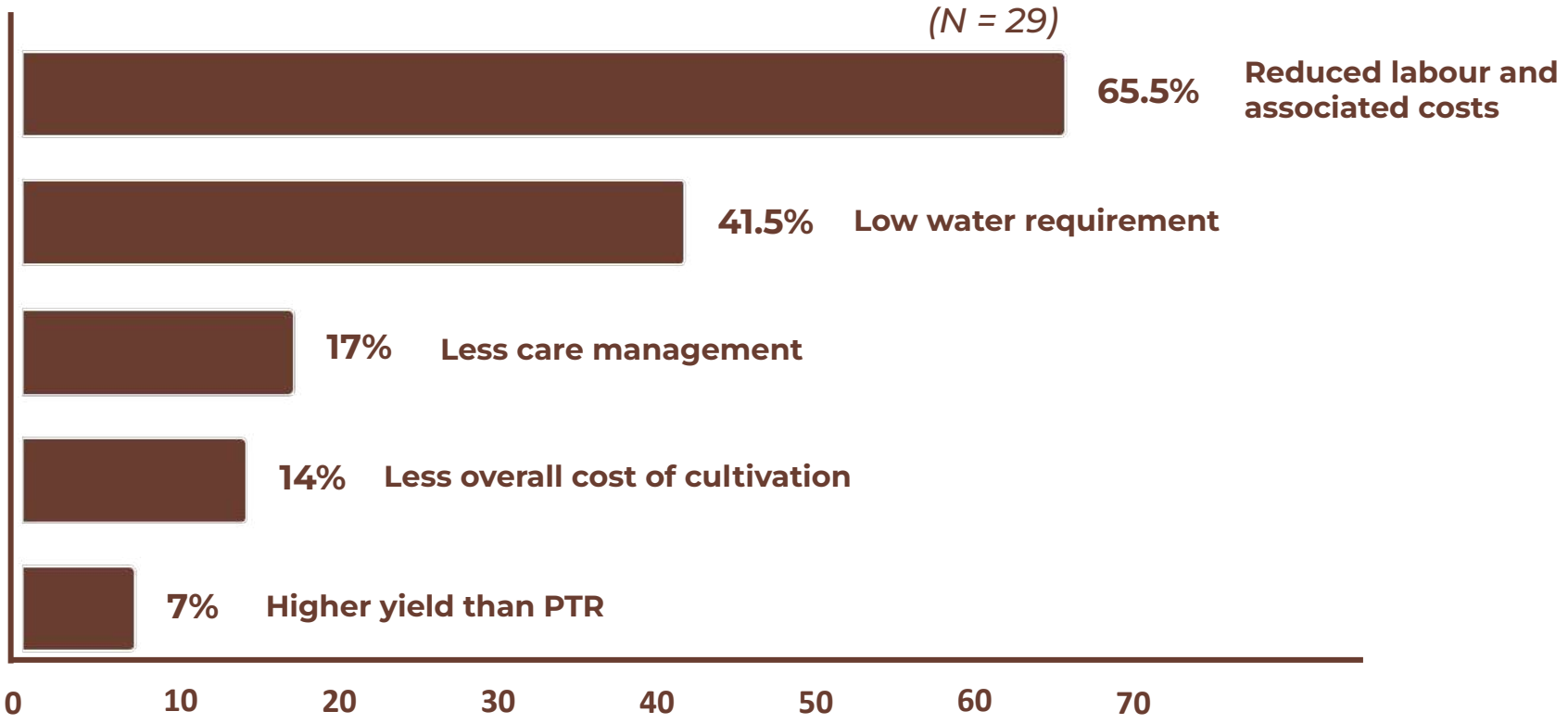


- **65%** of farmers received support through **advisory and knowledge on DSR PoP**.
- **41%** of farmers cited getting **monitoring support**, where the partner organization visits farmers' fields approximately **once a week** to ensure stable field conditions for good yield

- **0%** of farmers received **free or subsidized inputs** from organizations *(N = 19)*

Haryana - DSR Method Benefits | ~66% of farmers quote reduced labour requirements as a major benefit in DSR

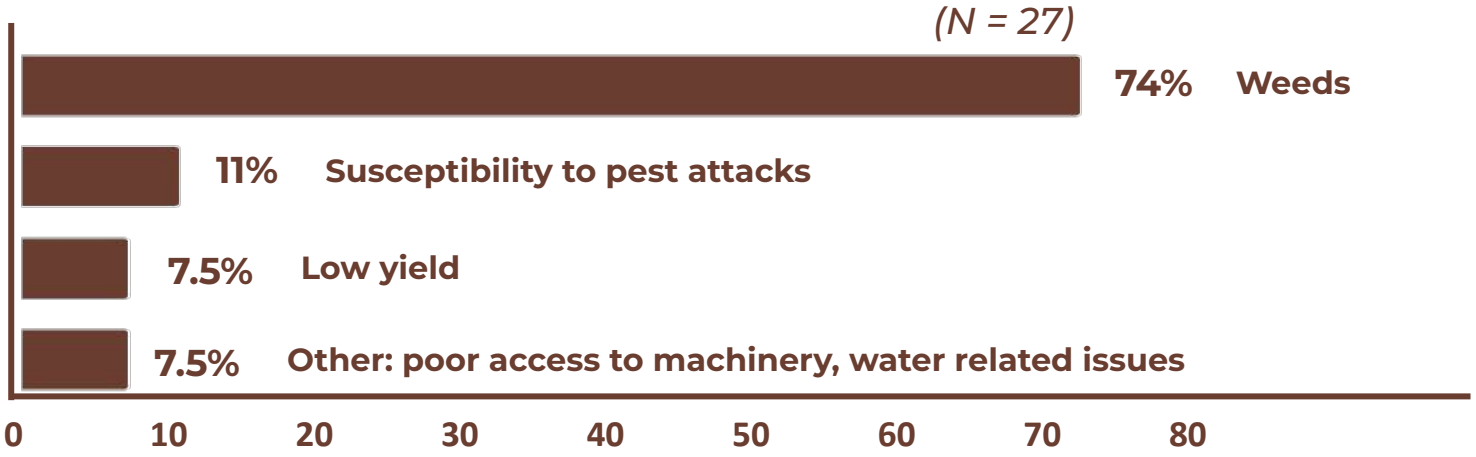
- Major Benefits of DSR according to farmers



- Since DSR technique requires less labour, **~66%** of farmers share that **cost savings due to reduced labour** requirements is a major **benefit** in DSR
- Additionally, **~42%** of farmers cite **low water requirement** as its associated savings as another major benefit in DSR.

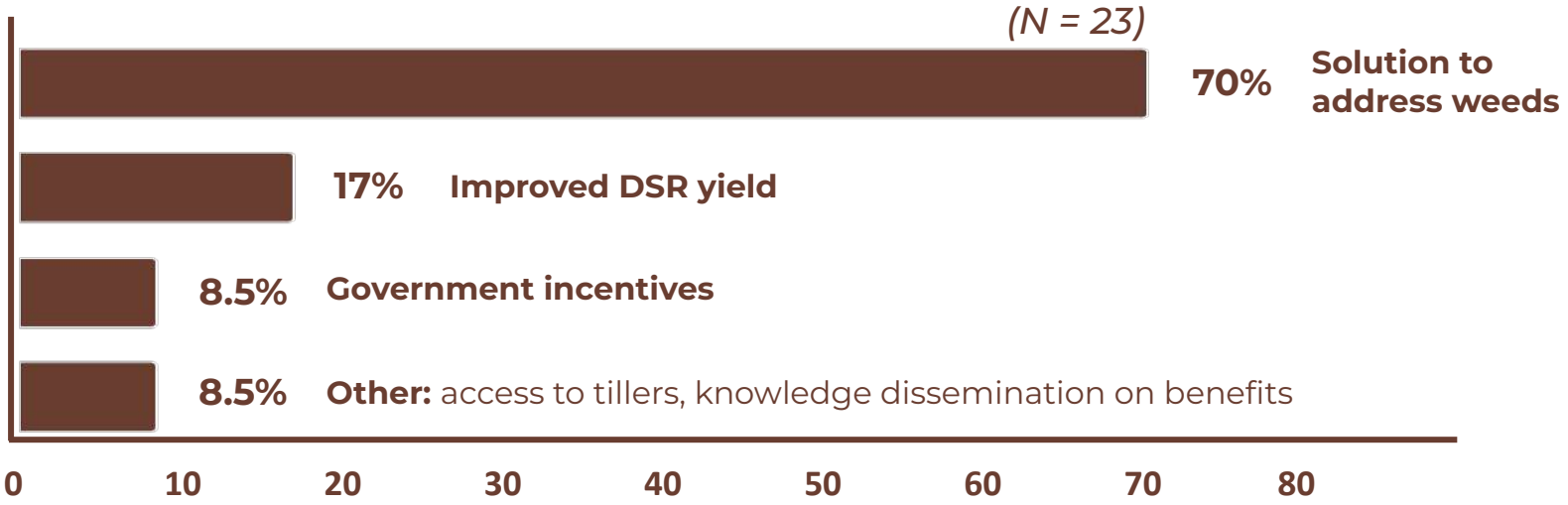
Haryana - Challenges in DSR | 74% of farmers cite weeds as a major concern in DSR; 70% of farmers feel that having a solution to address weeds can improve DSR adoption

- Major Issues with DSR according to farmers



- **Weed growth** is common in DSR technique and is a major concern as cited by **74%** of farmers.

- What can be done to improve DSR adoption?



- **70%** of farmers feel having a **solution to address weeds** can positively impact DSR adoption.
- Additionally, if **paddy yield via DSR can be increased**, potentially by using **appropriate seed varieties**, this too can improve adoption of DSR.

Haryana - Understanding DSR Adoption Status and Continuity

- **74%** of farmers believe that DSR can be **adopted by smallholder farmers** *(N = 31)*
- **69%** of farmers will **continue with DSR in the following year** *(N = 35)*
- **88%** of farmers will continue with DSR even if **supporting organizations or personnel leave the area** *(N = 24)*
- **65%** of farmers have **influenced peers to adopt DSR** after adopting DSR themselves *(N = 26)*

Region 4: Madhya Pradesh
Observations and Findings

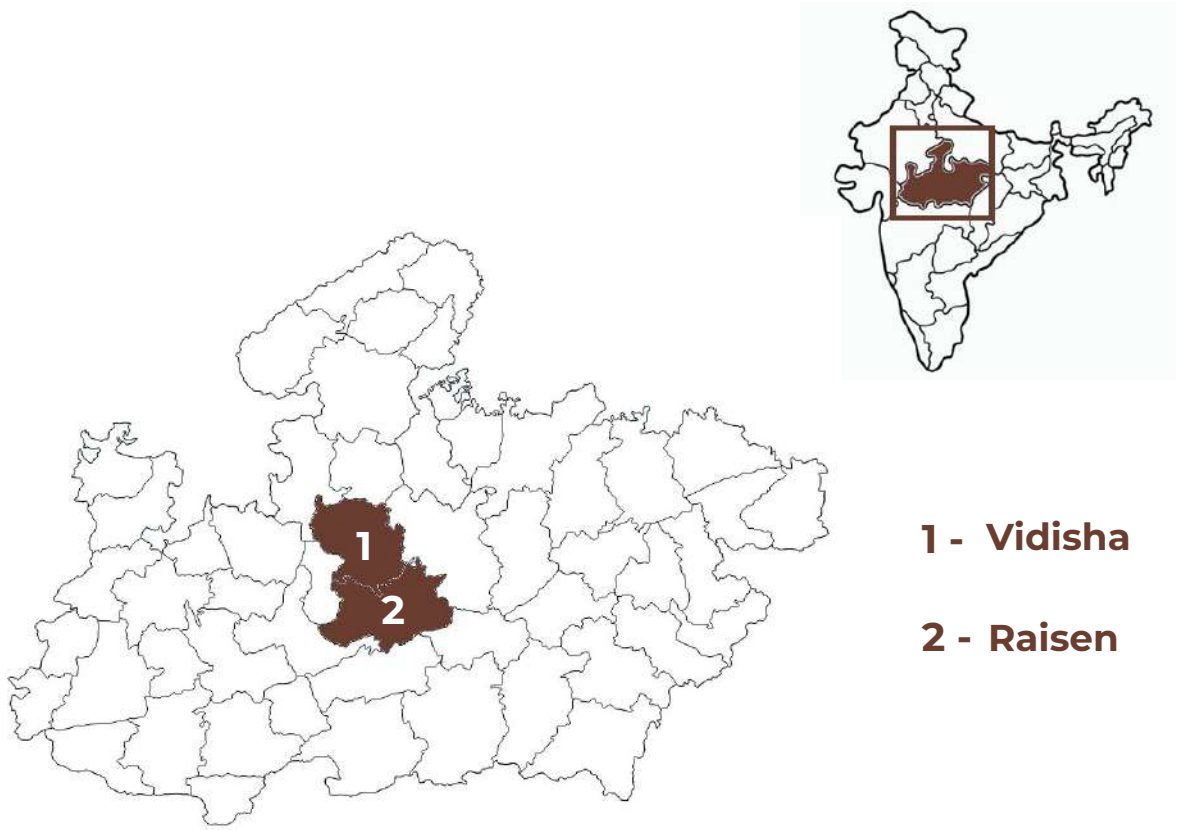
Background: Madhya Pradesh

Districts covered	Vidisha, Raisen
Agro Climatic Zones (NARP)	Vindhya Plateau (MP 5)
Partner Support Level	Low *(interactions with farmers, PoP knowledge dissemination, resource management support, problem resolution, etc.)*
Most grown crops in MP	Wheat, Rice, Soybean, Pulses
Common Soil Type	Medium black & Deep Black
Paddy Sown Area in MP	5,211.45 thousand acres (2021 - 2022)[1]
Paddy Yield in MP	9.24 quintal per acre (2021 - 2022)[2]

1- RBI: State wise area of foodgrains
2- RBI: State wise estimates of yield

“I shifted to DSR because I was unable to get affordable labour for PTR. But in DSR, I am facing issues with weed growth, and the spray I use for weeds is not effective. Also, irrigation facility is poor.”

Madhya Pradesh: Regions under Study and Target Population



1 - Vidisha

2 - Raisen

2 Districts | **17** Villages | **137** Unique farmers[1]

Target population status

- Number of Farmers

	DSR	PTR
	120	54

- Land Under Cultivation (acres)

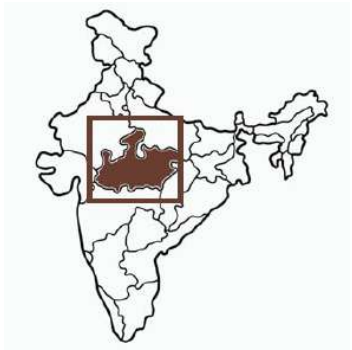
	DSR	PTR
	1,729	766

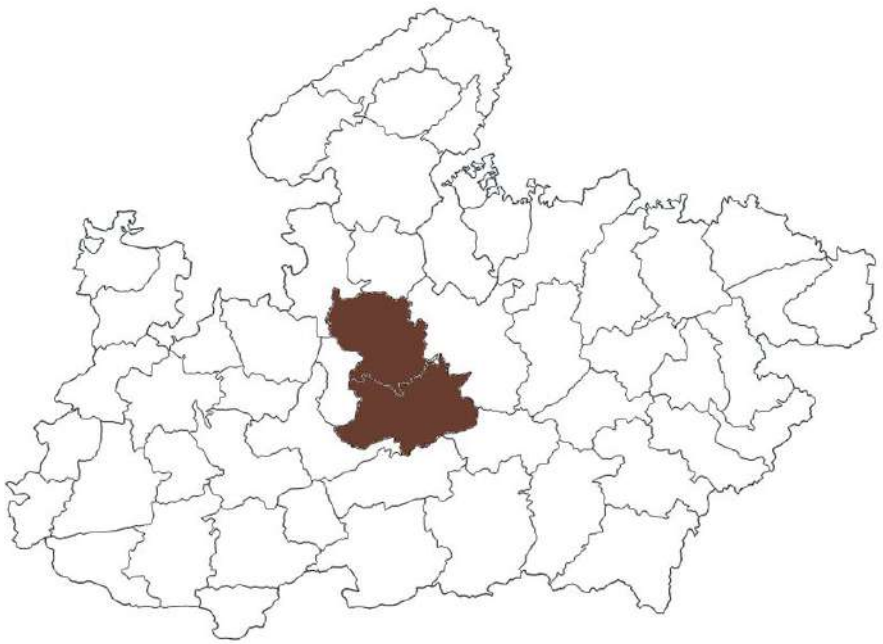
- Irrigation Status (% of farmers)

	DSR	PTR
Completely irrigated	15 %	28 %
Partially irrigated	52 %	67 %
Rainfed	33 %	4 %

1- The word 'unique farmers' mean overall no. of individual farmers interviewed. Same farmer may be practising both DSR and PTR in different farmlands in the same year. So, the no. of unique individual farmers will be lesser than the sum of farmers interviewed for DSR and PTR.

Madhya Pradesh: Agro Climatic Zones





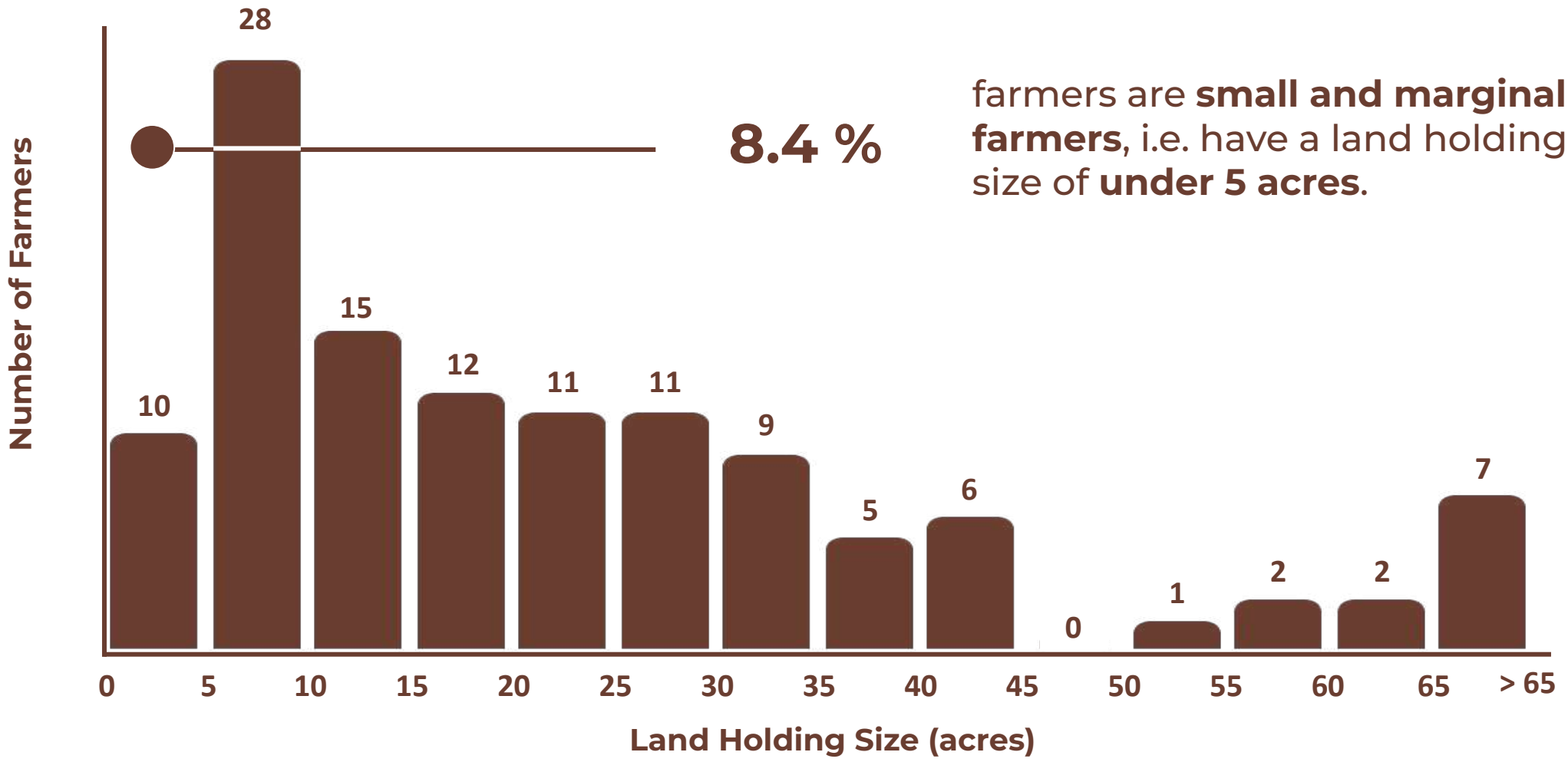
Vindhya Plateau (MP 5)

Parameters

District/Area	Agro Climatic Zone (NARP) [1]	Soil Type	Annual Rainfall (mm) [2]
Vidisha	Vindhya Plateau (MP 5)	Medium black & Deep Black	1200-1400
Raisen	Vindhya Plateau (MP 5)	Medium black & Deep Black	1200-1400

1 - Classification of Agro-climatic zones is based on the National Agricultural Research Project (NARP) standard which was launched by The Indian Council of Agricultural Research (ICAR).
2 - Agriculture Department Uttar Pradesh, The Indian Council of Agricultural Research (ICAR).

Madhya Pradesh: Target population by landholding size



8.4 %

farmers are **small and marginal farmers**, i.e. have a land holding size of **under 5 acres**.

Only 8 % of the farmers who were interviewed were small and marginal. Most of them were either semi-medium or medium farmers.

Yield Analysis

MP - Yield Analysis | Possible reason for failure of DSR in the MP region

Various factors may have contributed to the very low DSR yields in MP:

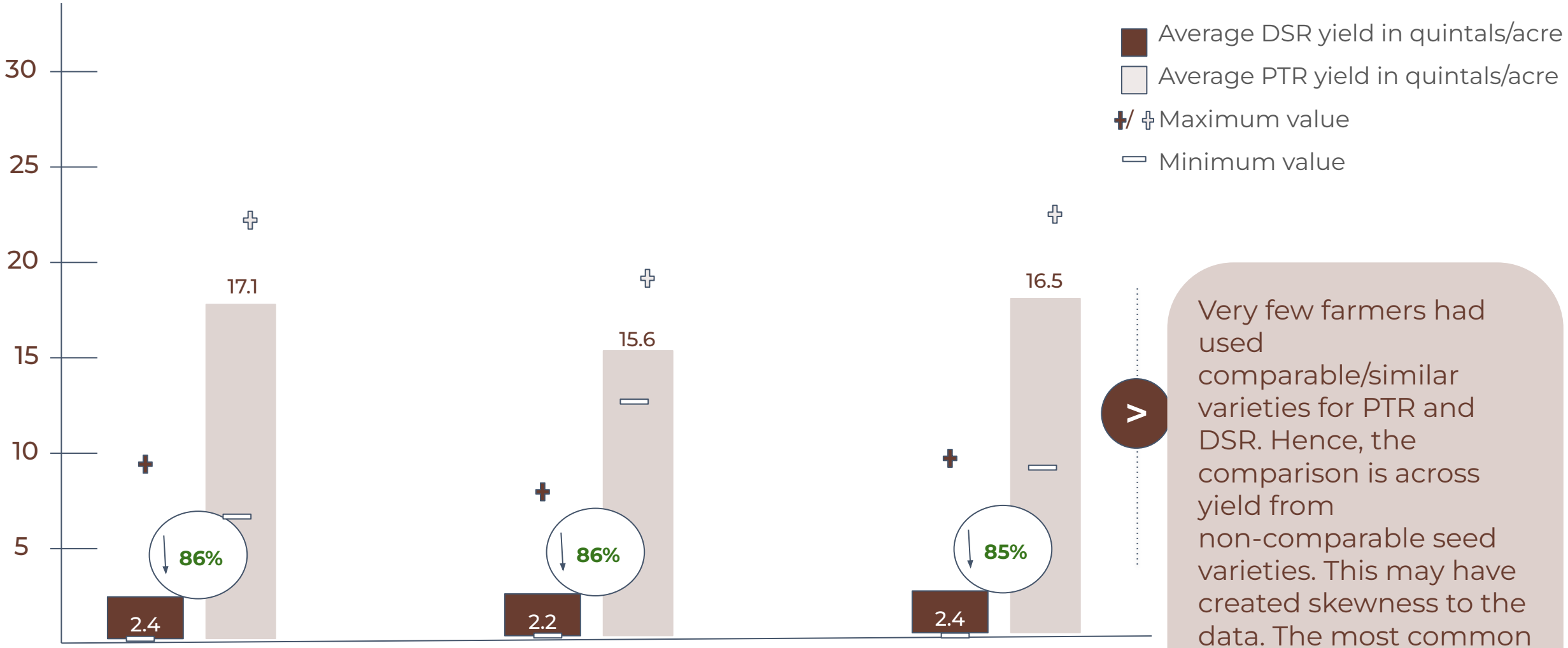
Soil: As quoted by farmers, soil fertility is less in the surveyed region than in the surrounding areas. Even though the soil type in the region is medium to deep black soil, less fertility in the region is not conducive to yield maximization.
Additionally, the region is steep and the soil structure has less water retention capacity. This has a bearing on water-intensive crops such as paddy.

Irrigation: The region is prone to dry spells and had a long dry season of almost ~25 days in 2023 during the Kharif season after sowing; directly leading to poor paddy germination levels

Weed Management: It was observed that farmers did not apply pre-emergence herbicide, resulting in heavy weed growth from the sowing stage itself, leading to yield loss and suppressed growth of paddy crops. Post-emergence herbicide was also not used at the right time (when weeds have 3 to 4 leaves) . The absence of knowledge, support, and low hand-holding prevents the farmers in this region from practicing DSR viably

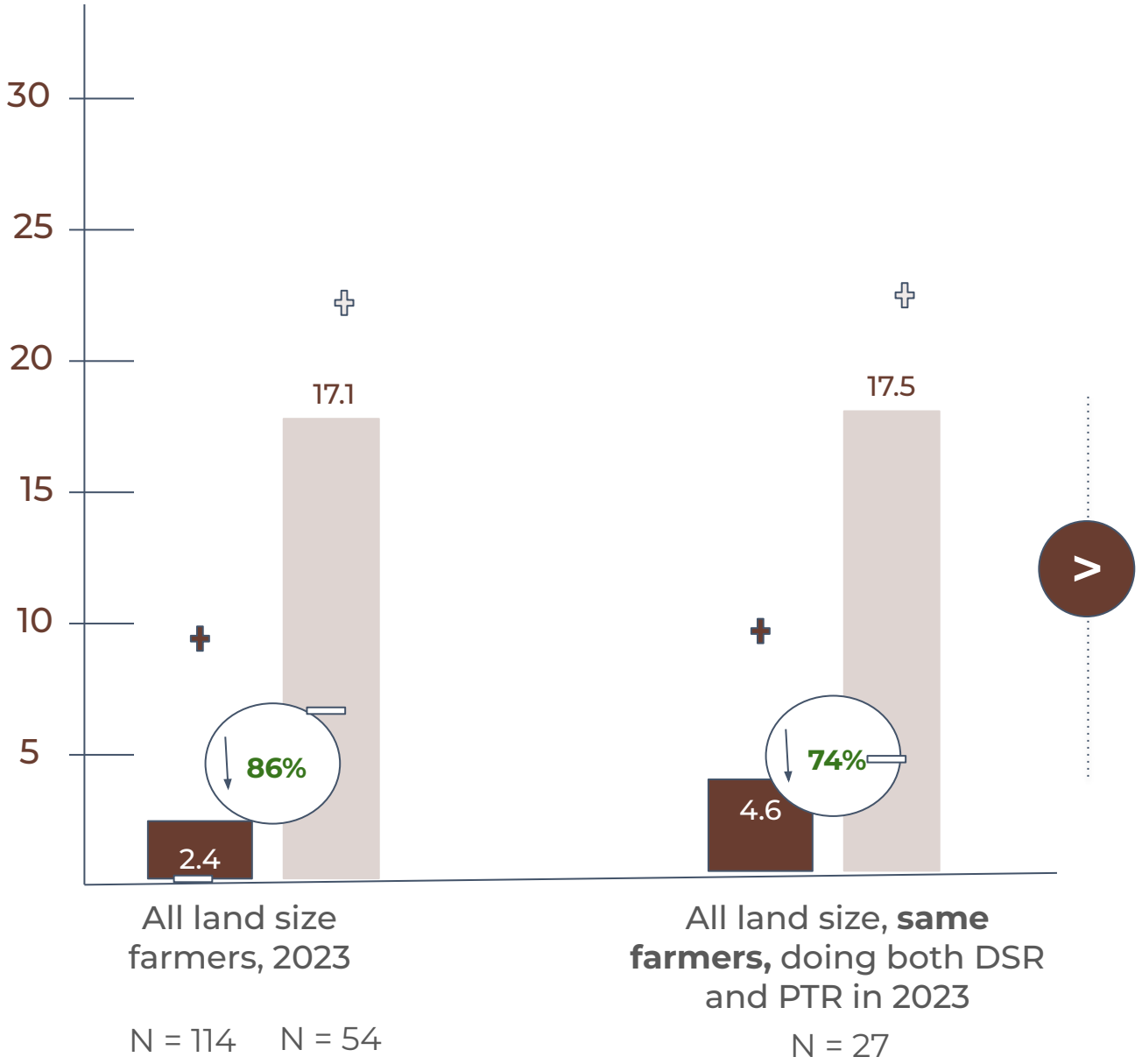
High seed usage per acre: It was observed that the region has one of the highest seed-sowing densities in the country, ~30kg/acre. The standard advised seed rate for DSR is ~12kg/acre which may be extended up to ~15-20kg/acre depending on the zone. However, such a massive seed rate in this region directly affects the tillering stage of the crop, leading to poor yields

MP - Yield Analysis | On an average small and marginal farmers witnessed ~85% decrease in yield while using the DSR method, as opposed to the traditional PTR



Very few farmers had used comparable/similar varieties for PTR and DSR. Hence, the comparison is across yield from non-comparable seed varieties. This may have created skewness to the data. The most common seed variety for DSR was 1509, while it was PB 1 for PTR

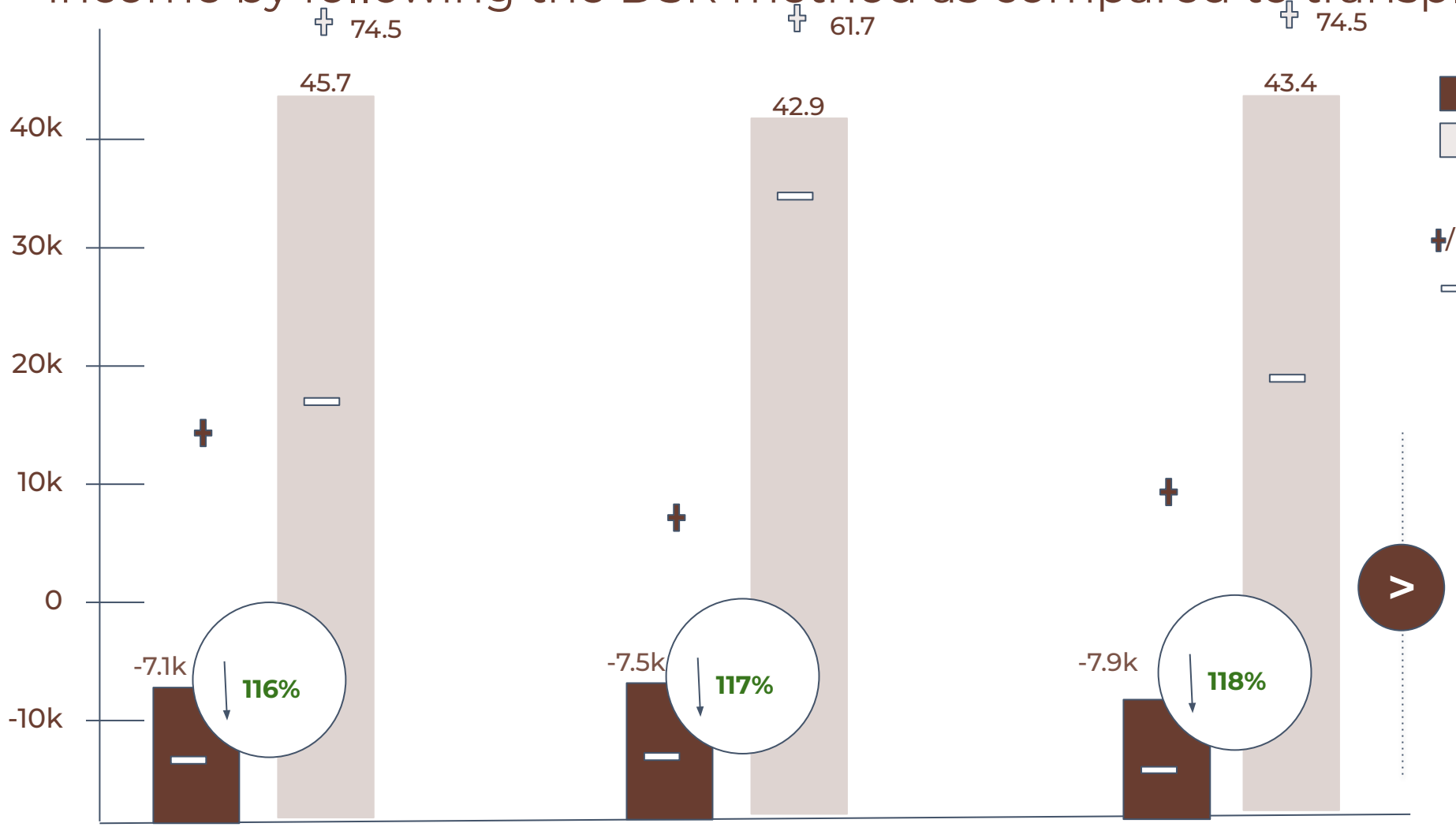
MP - Yield Analysis | On an average same farmers witnessed ~74% decrease in yield while using the DSR method, as opposed to the traditional transplant method



- Same farmers practicing DSR and PTR in the data set, have used seed varieties such as PB 1, 1847, 1121, 1637 which have provided an yield much greater than the average DSR yield in the region(7.7, 7,4,3 quintals/acre). This is the reason for the reduction in yield loss among same farmers in the region.
- It is possible that these seed varieties are better suited for DSR in this region, but we don't have sufficient data sets to establish the same.

Income Analysis

MP - Income Analysis | On an average farmers witnessed 117 % decrease in net income by following the DSR method as compared to transplant method



All land size farmers
N = 90 N = 52

Small and marginal farmers (0-5 acres)
N = 15 N = 7

Semi-medium farmers (5-10 acres)
N = 21 N = 8

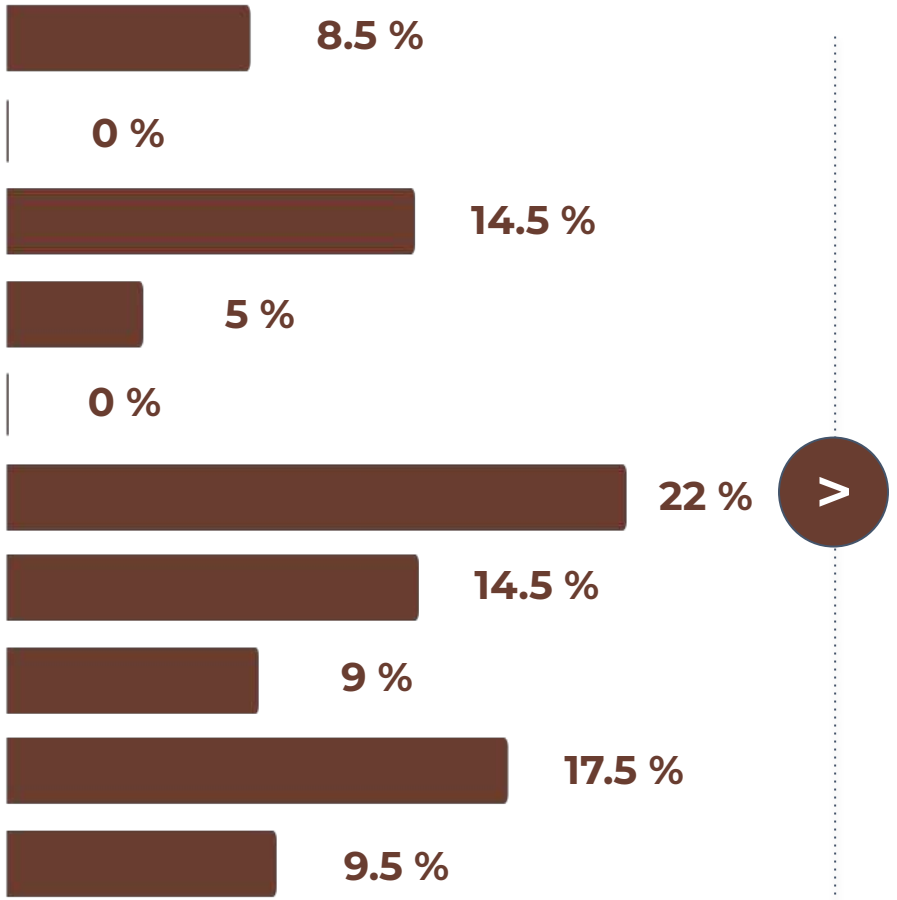
Reduction in overall yield has led to the reduction in income.

In addition to this, the selling price of paddy yield from seed varieties used in PTR is double the selling price per quintal of the seed varieties used in DSR. This had a significant impact on the revenue for farmers in thai region

Cultivation process and Cost calculation

MP - Total Costs by Stages | DSR method of paddy cultivation

Stages	Cost/Acre - DSR	% contribution to total cost
1. **Main Land Preparation**	₹ 1,322	8.5 %
2. **Irrigation**	₹ 0	0 %
3. **Seed**	₹ 2,225	14.5 %
4. **Machinery (Seed drill)**	₹ 737	5 %
5. **Pre Emergence Herbicide**	₹ 0	0 %
6. **Fertilizer**	₹ 3,381	22 %
7. **Pesticide**	₹ 2,247	14.5 %
8. **Post Emergence Herbicide**	₹ 1,370	9 %
9. **Other Labour**	₹ 2,735	17.5 %
10. **Harvesting**	₹ 1,470	9.5 %
	₹ 15,487	



- **Fertilizer** cost accounts for the largest contribution to the overall cost of cultivation at **22%**. This includes the use of **DAP** and **urea** as the main fertilizers.
- Other major contributions to overall cost are from **labour** (for weed removal), **pesticides** (two rounds at an average cost of Rs. 1,123 per round), and **seed variety cost**.

MP - Total Costs by Stages | PTR method of paddy cultivation

Stages	Cost/Acre - Transplant	% contribution to total cost
1. Nursery[1]	₹ 435	2 %
2. Seed	₹ 577	2.5 %
3. Main Land Preparation	₹ 2,742	12 %
4. Irrigation	₹ 0	0 %
5. Transplanting Labour	₹ 3,762	16 %
6. Fertilizer	₹ 4,724	20.5 %
7. Pesticide	₹ 2,277	10 %
8. Post Emergence Herbicide	₹ 496	2 %
9. Other Labour	₹ 4,917	21 %
10. Harvesting	₹ 3,369	14.5 %
	₹ 23,299	

- **Labour** and **fertilizer** costs accounts for the largest contribution to the overall cost of cultivation at **21%** and **20.5%** respectively.
- Other labour costs include labour for **spraying** of pesticides and fertilizer, **threshing** and one round of **weed removal**.
- The next major contributor to overall cost is the cost associated with **transplanting labour** at **16%**. This includes labour to uproot and transplant seedlings from nursery to main land.

1- 'Nursery' stage cost includes cost of land preparation as well as cost of fertilizers need for nursery preparation.

MP - Cost Comparison | Farmers recorded ~33.5 % decrease in input cost using the DSR method as compared to the transplant method of cultivation

Stages	Cost/Acre - DSR		Cost/Acre - Transplant	
1. **Main Land Preparation**	₹ 1,322		₹ 2,742	
2. **Nursery**[1]	₹ 0		₹ 435	
3. **Irrigation**	₹ 0		₹ 0	
4. **Seed**	₹ 2,225		₹ 577	
5. **Machinery (Seed drill)**	₹ 737		₹ 0	
6. **Pre Emergence Herbicide**	₹ 0		₹ 0	
7. **Transplanting Labour**	₹ 0	**Total Labour** ₹ 2,735	₹ 3,762	**Total Labour** ₹ 8,679
8. **Other Labour**[2]	₹ 2,735		₹ 4,917	
9. **Fertilizer**	₹ 3,381		₹ 4,724	
10. **Pesticide**	₹ 2,247		₹ 2,277	
11. **Post Emergence Herbicide**	₹ 1,370		₹ 496	
12. **Harvesting**	₹ 1,470		₹ 3,369	
	₹ 15,487		**₹ 23,299**	

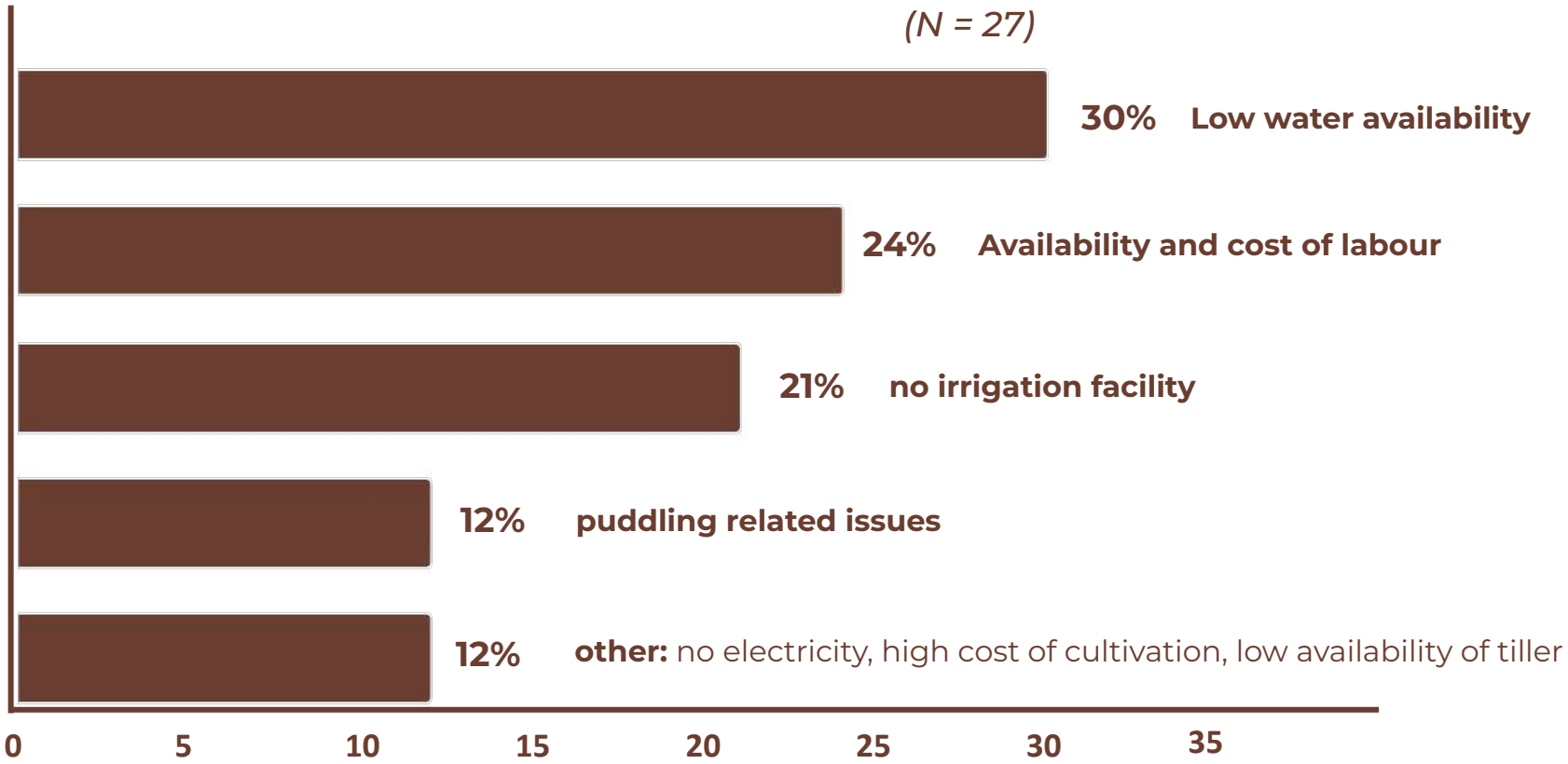
- A **37% reduction** in total labour costs is seen in DSR in comparison to PTR.
- Other major savings come from **main land preparation**, **fertilizer**, and **harvesting**.
- However, **added costs** specific to DSR include **special seed variety**, **machinery** (seed drill machine), and **post emergence herbicide**
- **Irrigation cost** is **Rs. 0** due to **free electricity** provided by the government, eliminating pumping costs for irrigation..

1 - 'Nursery' stage cost includes cost of land preparation as well as cost of fertilizers needed for nursery preparation.
2 - 'Other Labour' includes labour excluding labour for transplanting. This would include labour for pesticides and herbicide spray, weed removal, machinery operation, etc.

DSR cultivation and adoption challenges: voices from the ground

MP - Challenges with PTR | 30% of farmers cite poor availability of water as their major concern with PTR, while 24% cite low availability of labour

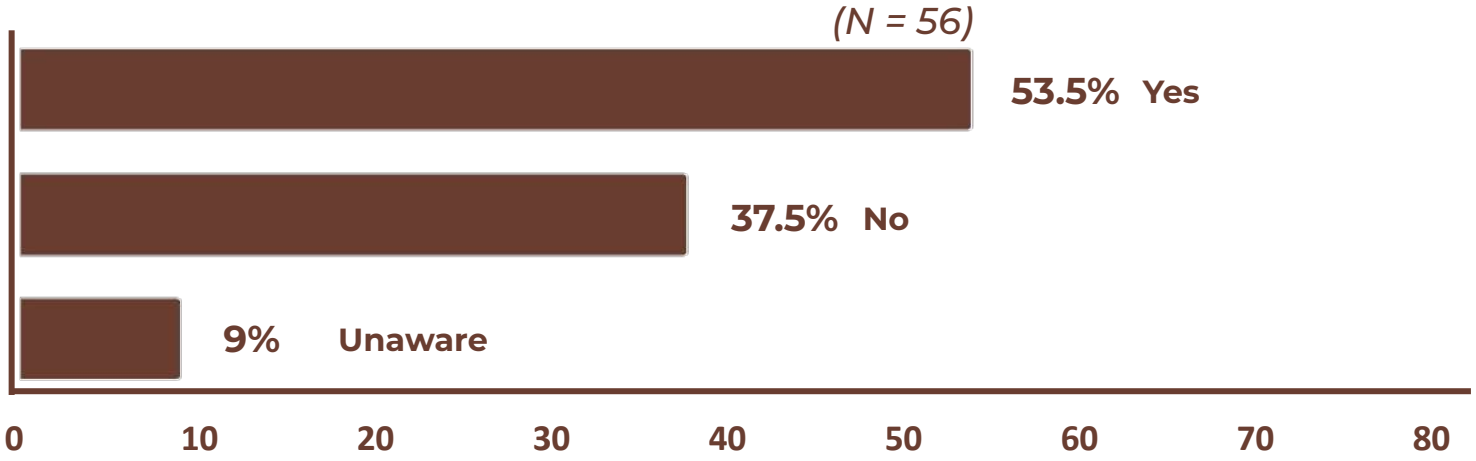
- Challenges faced by Farmers with PTR Technique



- In MP, the biggest challenge faced by farmers with PTR is **poor access to water**, as cited by **30%** of farmers interviewed.
- The next common challenge is **labour scarcity**, which thus **increases the cost of available labour**.

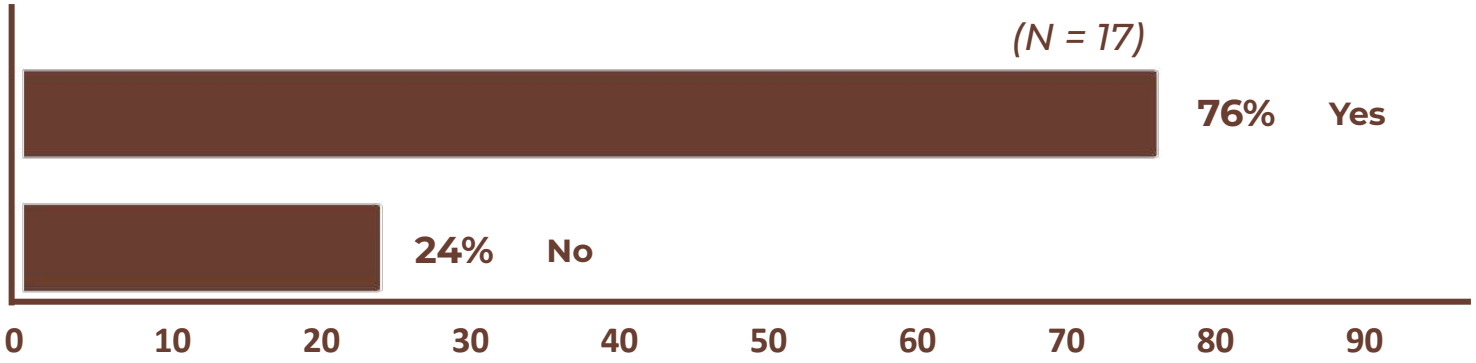
MP - Peer Effect | ~ 54% of farmers had peers who did DSR, and in such cases, the farmer was 76% more likely to adopt DSR

- Before a farmer adopted DSR, did his peers adopted DSR successfully?



- Among the farmers interviewed, **53.5% had at least peer who did DSR**, highlighting the DSR adoption level in the region.

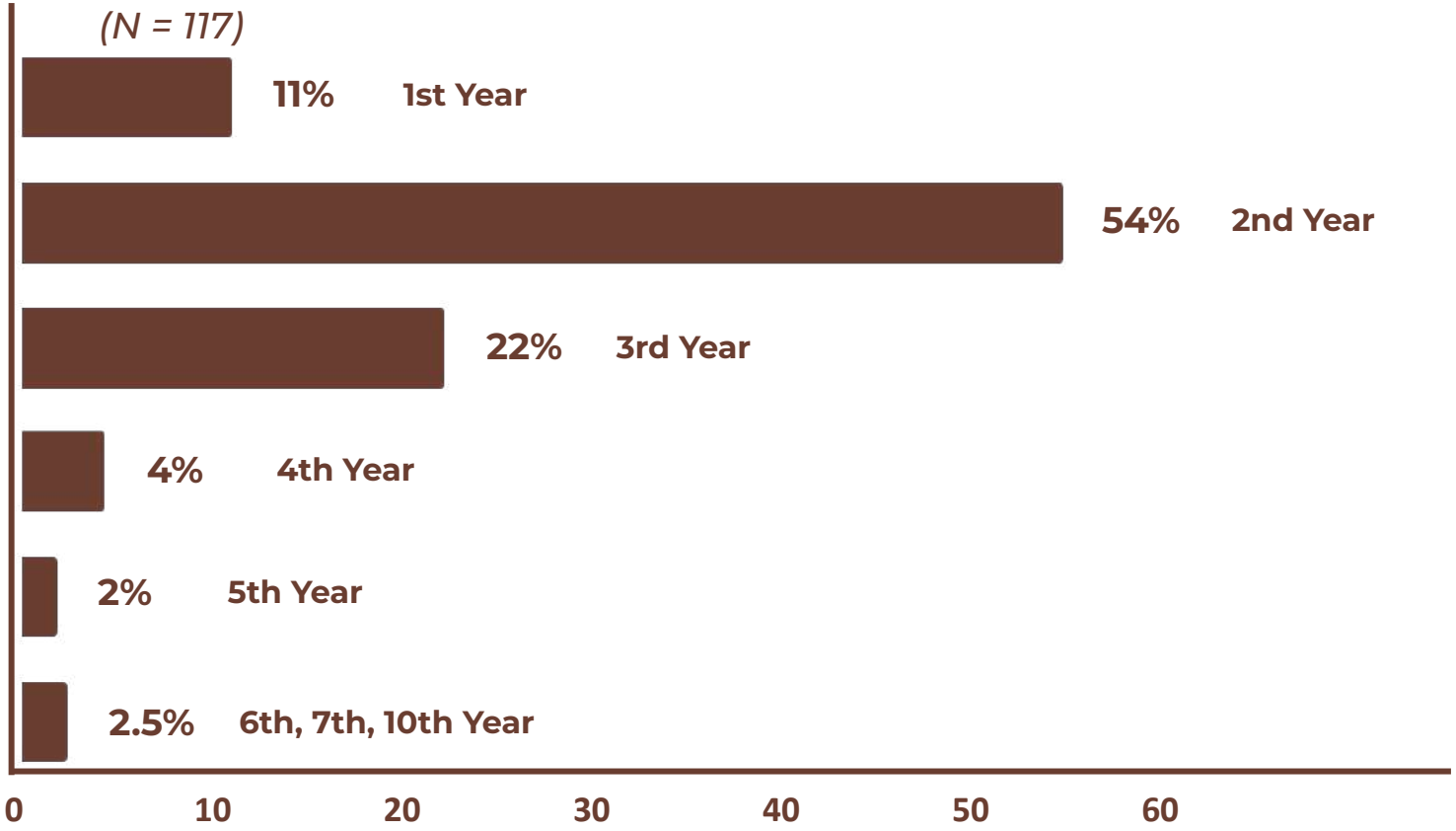
- Was a farmer motivated to adopt DSR if his peers adopted DSR successfully?



- In cases where a farmer had a peer doing DSR, he/she was **76% more likely to adopt DSR**. This shows the influence peers can have on the adoption practices.

MP - DSR Legacy Farmers | A combined 76% of farmers have been doing DSR for 2-3 years, while only 11% of them have been doing DSR for the first time

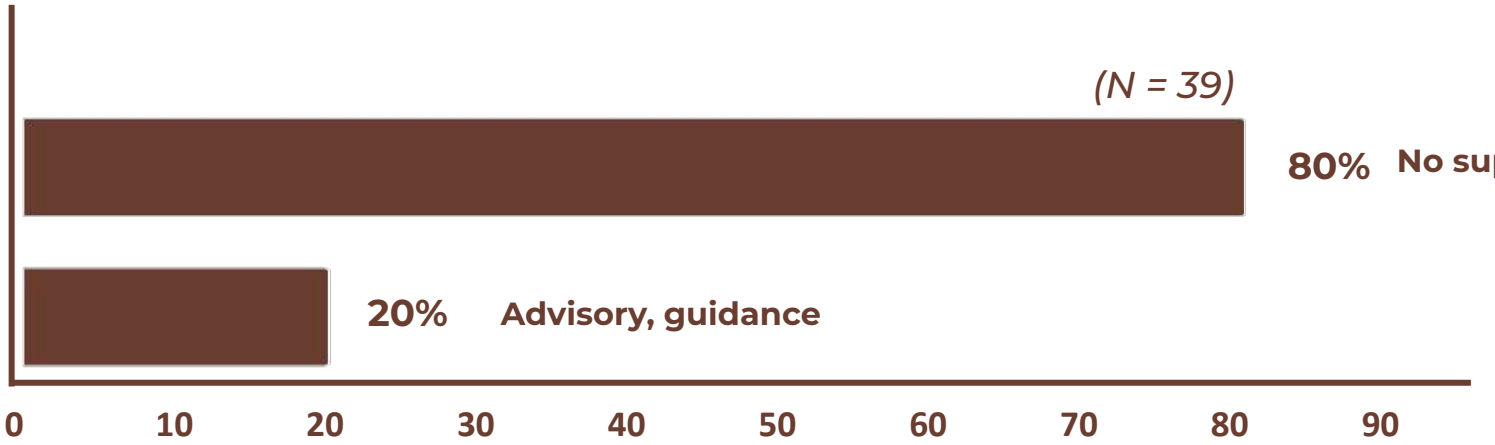
- Number of Years the farmers have been practicing DSR



- In MP, a majority (**54%**) of farmers interviewed have been doing **DSR for 2 years**.
- A combined **87%** of farmers have been doing **DSR within the past 3 years**.
- A combined **8.5%** of farmers have been doing DSR for **4 years or more**.

MP - Partner Support | Only 20% of farmers received support from organizations or peers and no farmers received subsidized or free inputs

- Types of Support provided to farmers by Organizations and Peers

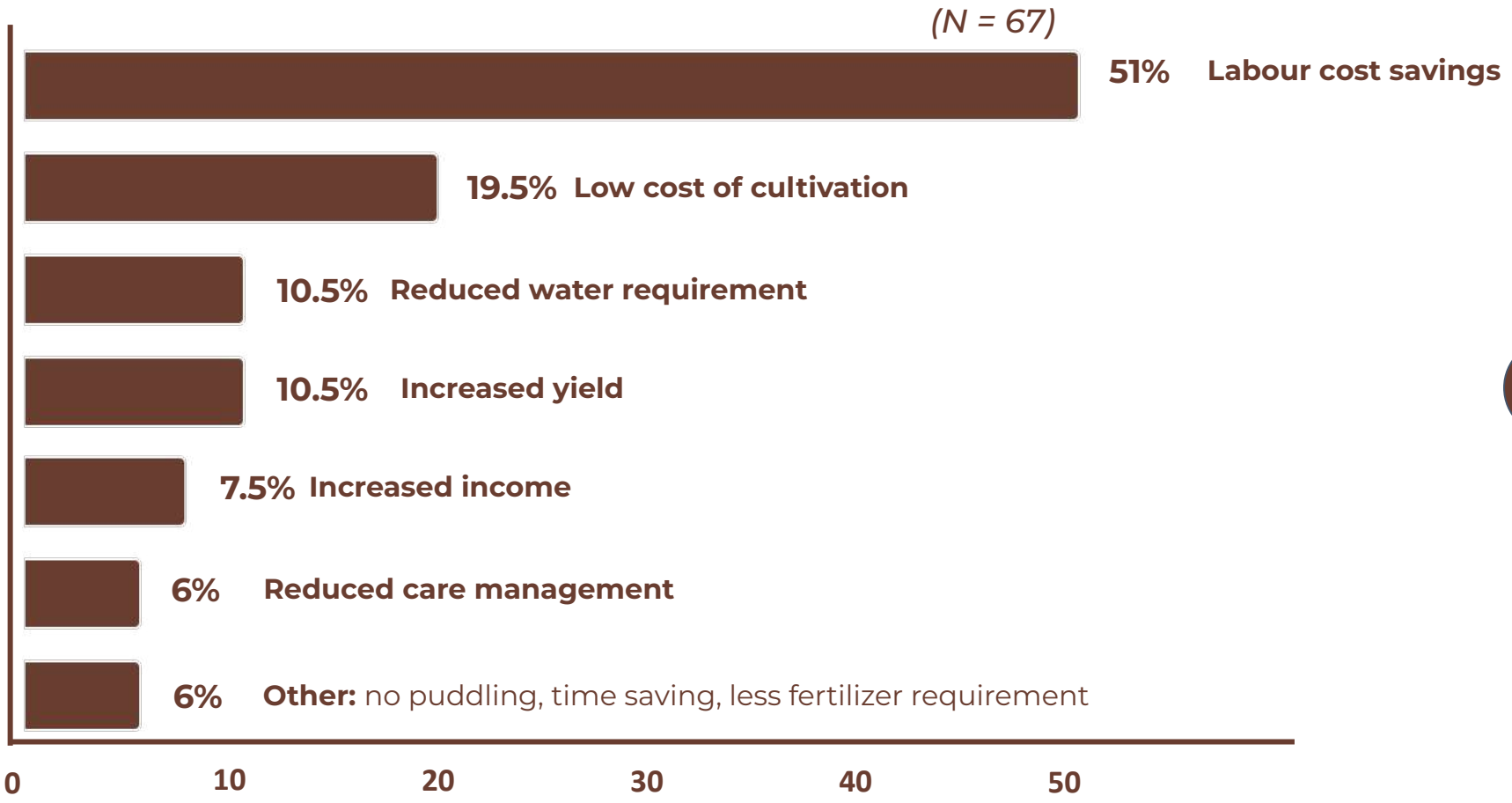


- Among the farmers interviewed, **80% received no support,** while only **20%** received **advisory and guidance** support.

- **0%** of farmers received **free or subsidized inputs** from organizations *(N =26)*

MP - DSR Method Benefits | 51% of farmers cite labour cost savings as the most significant benefit of DSR

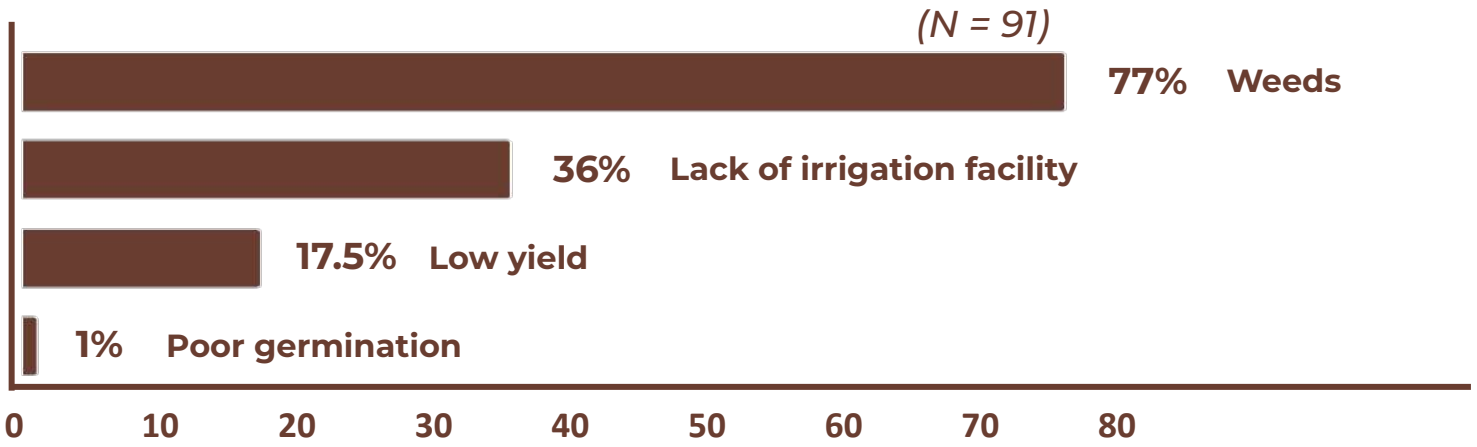
- Major Benefits of DSR according to farmers



- **Labour cost savings** is a major benefit of DSR according to **51% of farmers** in this region. This is due to the low labour requirement
- **~20%** of farmers cite an overall **low cost of cultivation** in DSR as compared to PTR. Costs associated with the nursery preparation, transplanting of seedlings to main ground, and reduced water requirement are saved.

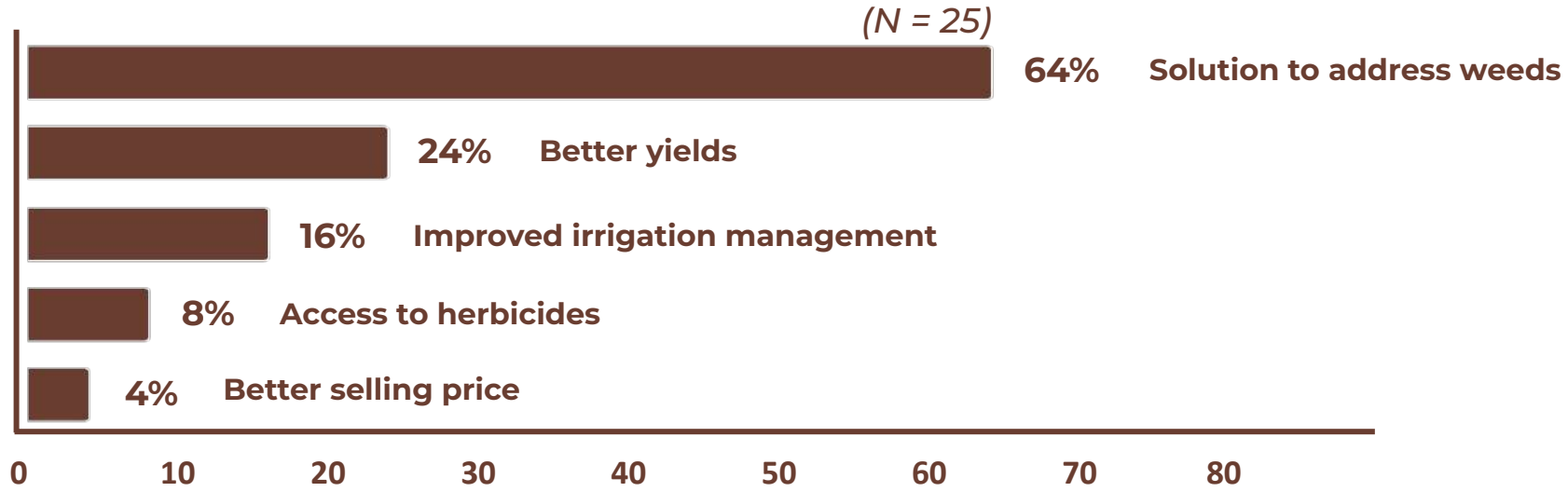
MP - Challenges in DSR | 77% of farmer cite weed growth as a major issue; 67% of farmers cite having a solution to address weeds would improve DSR adoption

- Major Issues with DSR according to farmers



- **Weed growth** is the most common problem with DSR, as quoted by **77%** of farmers.
- **36%** of farmers cite having **poor irrigation facility** as another major challenge.

- What can be done to improve DSR adoption?



- Having a **solution to address the issue of weeds** would help improve DSR adoption, as cited by **64% of farmers**.
- Additionally, **24%** of farmers stated that **improving the paddy yield** by DSR method could also improve the adoption of DSR.

MP - Understanding DSR Adoption Status and Continuity

- **87%** of farmers cited starting DSR **on their own** without motivation from external entities such as organizations or peers *(N =106)*
- **33%** of farmers believe that DSR **can be adopted by smallholder farmers** *(N = 93)*
- **71%** of farmers will **continue with DSR in the following year** *(N = 74)*
- **92%** of farmers will continue with DSR even if **supporting organizations or personnel leave the area** *(N = 12)*

Conclusion and Recommendations

Conclusion & Recommendations

1. DSR paddy cultivation technique, **can be adopted by small and marginal farmers**, if the **region is suitable for DSR**, and there is **adequate hand holding** in first few years. In our survey,
   a. 79% of the farmers said they will continue with DSR practice next year.
   b. 65% of the small and marginal farmers experienced higher income over transplantation method of paddy.

2. As **groundwater levels** become a **bigger challenge** in the nation, DSR technique will become more important, for paddy cultivation over time, and will the area under cultivation increase. Secondary research show upto 35% water saving in DSR.

3. Need for **labor** during the short window for transplantation and **reduction in cultivation** cost is the other drivers for adoption

4. Global warming and need to reduce GHG emissions will also likely drive DSR adoption, where secondary research indicates a decrease in 85% of GHG emissions.

5. **Weed management** emerged as the biggest cause of concern, among farmers.

Conclusion & Recommendations

6. **Availability of machinery** is a **barrier** in scaling of the practice. **Laser levelling** machinery and **direct sowing** machinery is needed to be available on rent in that region for this practice to be adopted.

7. **Hand holding** of farmers to make them familiar with package of practice for DSR is a key factor in scaling. Specifically, the awareness around the **right time to spray pre-emergence weedicide** is crucial for weed management among other things.

8. Suitability of the right region, right soil type, and availability of controlled irrigation and other factors are important in ensuring that technique is being propagated in the right areas. DSR can be grown on soil with good water holding capacity which range from sandy loan to heavy clay, but not on light textured soils such as loamy sands and sands.

A DPI (Digital Public Infrastructure), using remote sensing geospatial data for a region can be created, which can rank a region's suitability for DSR.

9. As we study the landscape, we are seeing several large organizations like ITC, and Bayer in India, are participating in propagating this practice. Further, the emerging carbon credits market for such practice adoption could be an additional catalyst.

Conclusion & Recommendations

10. Contrary to popular belief, **DSR doesn't always result in lower yields compared to PTR**. Yield depends on various factors including environmental conditions, soil types, and adherence to practices like PoP. Our data demonstrates that **under favorable conditions, DSR can actually yield higher than PTR**, all else being equal.

11. A **cost-effective technological solution for weed control** could significantly boost the adoption of Direct Seeded Rice (DSR). It presents an **opportunity for startups and technological institutions** to delve into this issue and explore potential solutions.

12. DSR demands a significant amount of knowledge, and **failure to adhere to the PoP often leads to substantial yield losses**. Rather than offering incentives solely for transitioning to DSR, government could consider providing a **Minimum Support Price (MSP) premium for paddy cultivated through DSR**. Such an incentive would encourage farmers to meticulously follow the PoP guidelines for DSR, thereby improving overall yields.

Limitations of the study

Limitations of the Study(1/2)

- Two-thirds of the farmers interviewed were small and marginal, the rest had larger land holdings. In regions like Haryana, none of the farmers interviewed were small & marginal, and in MP, only 8% were small & marginal. Most of the data on small and marginal farmers is only from the Uttar Pradesh region (UP 1 and UP 2 regions in the study)

- Input costs were not recorded at the point of purchase, or even at the point of use. All numbers were recorded based on interviews with farmers, memory based, hence the reliability is between, medium and low.

- Inputs used while farming are all purchased in certain quantities and farmers use these items over years/several seasons in the same year. In this event, they are unable to tie up the cost of cultivation for each acre or for each season. Additionally, when farmers are growing in different sets of land, following different practices (DSR and PTR), they do not attribute the exact amount of inputs used separately in these two practices.

- Baseline data (2022 cultivation data) was collected from farmers in 2023, so all the numbers were collected based on farmer's memory, and in retrospect. Most farmers do not maintain a written record of input costs, income, etc. Hence the reliability is between medium to low. However, for calculations, the study used most (~90%) of the data from the endline data, collected in 2023, for the year 2023. (Recall bias).

Limitations of the Study(2/2)

- We were unable to isolate the exact impact of hand-holding because we did not have partner organisations providing exactly same level of handholding in the same agro-climatic zone. We did however see that both hand-holding and agro-climatic conditions have an impact on the yield

- We were not able to account for village level variations while sampling. We noticed that in certain villages within the same district, availability of water for irrigation, level of land fertility, and even undulations in the land may have played a role in DSR yield

- We did not have a ‘lab-like environment’ set-up, hence many externalities that could have had an impact on yield may have been missed

- At the farmer level, in some regions, we learnt during our interviews that the the land used for the purpose of DSR isn’t as fertile as the land used for PTR, or water does not flow in easily in that part of the land. They were doing the DSR method more as an experiment, in portions of their land that weren’t very fertile or did not receive sufficient water. Factors such as these could not be added as this was not quantifiable

Playbook for CSOs: Based on on-ground success of DSR implementation by partner organisation, ITC

ITC's program to enable farmers to adopt the DSR method of paddy cultivation in Uttar Pradesh (Bahraich, Gonda and Gorakhpur) is a success story. Our study in this region, noted an increase in yield (by ~10%), and a subsequent increase in the net income (by 36%) for small and marginal farmers following this practice.

This playbook is a compilation of interventions at various stages that helped achieve these results. It is created in the hope that other organisations looking to work with farmers for the same cause can benefit from the knowledge base and observations.

Steps followed by ITC can broadly be divided into the following sections:

Stage 1

Objective finalization and village identification

Stage 2

Gaining trust and credibility of the community and moving from proof of concept to scale-up

Stage 3

Scaling up and Amplification

ITC Playbook - Objective finalization and village identification (1/2)

1. ITC has a two Horizon strategy with *Horizon 1* focusing on strengthening livelihoods for today and *Horizon II* building capabilities for tomorrow. Horizon I essentially has interventions related to Climate Smart Agriculture, Natural Resources Management and On-farm / Off-farm livelihoods, predominantly addressing the challenges of small and marginal farmers in rural India. Horizon I interventions tend to be the rural catchment areas of ITC's agri value chains or manufacturing locations. These subsequently do get expanded to other locations also through partnerships. DSR is part of ITC's strategy to strengthen livelihoods for today.

2. ITC and its implementation partners conduct ground-level assessments for climate-smart agriculture to understand existing challenges related to farming/cultivation. While doing so, some progressive farmers with trust and credibility in the village are also identified beforehand as lead farmers and included in the assessment process.

3. Post the farmer-level baseline assessment, the catchment-specific Climate Smart Agriculture (CSA) plan is prepared through a technically rigorous process. While the entire catchment is planned to be saturated in a phased manner with the Tool kit, the specific villages in the catchment where to initiate the intervention are decided based on the acuteness of the need, availability of process enablers, and in consultation with local stakeholders like the KVKs.

ITC Playbook - Objective finalization and village identification (2/2)

The CSA plan typically involves the following steps:

a. Scientific data and assessments of their impact on major crops in the region are used to evaluate current and projected climate change patterns. An understanding of these crops and the existing level of access to nature-based resources like water, knowledge-based resources, technologies, etc., is also developed.

b. The CSA Adaptation Tool kit is finalized after discussions with farmers, scientists from agriculture universities, local KVKs, Government departments, experts, etc. The Adaptation Tool kit comprises practices to be adopted by farmers to cope with climate change episodes whilst reducing costs and improving yields and incomes. In the case of the three districts of Uttar Pradesh, which are covered in the study, a CSA Tool kit was prepared to address paddy and wheat, which were identified as the major crops in these districts. Direct Seeding of Rice and Zero Tillage sowing of wheat were planned for both crops, along with a varietal recommendation, seed treatment, irrigation scheduling, fertilizer dosages, and other packages of practices.

c. Methodology of promotion and communication of CSA adaptation Tool kit by engaging with agricultural institutions like KVKs and the implementation partner.

d. Design of training and communication material in local languages which are user-friendly.

ITC Playbook - Gaining trust and credibility of the community and moving from proof of concept to scale-up (1/4)

1. ITC leverages its existing equity with the farmers. This is further supplemented by round-the-year connections with them directly and through the implementation partner. Also, the lead farmers are farmers from the same village, and hence, they command a level of trust from other farmers from the same or nearby villages.

2. To promote the CSA Tool kit with farmers, ITC has adopted the Farmer Field School (FFS) model, as recommended by the UN FAO. An FFS consists of a principal farmer and 20-24 student farmers. In most cases, the lead farmer identified at the initial baseline assessment stage is considered the principal farmer.

3. ITC complements the FFS module by including farmer exposure visits to Choupal Pradarshan Khets and demonstration plots, the use of physical and digital training modules, and the onboarding of farmers to ITC's ITCMAARS platform that provides localized weather forecasts, crop-specific advisories, as well as solutions to farmers' specific queries.

4. During the season, demonstration plots are set up in the principal farmer's field or strategically located Choupal Pradarshan Khets (to ensure maximum visibility). The identified lead farmers are expected to adopt the new interventions so that, thereafter, the successful results can be used as demonstration (demo) plots to convince the other farmers in the village to adopt such practices.

ITC Playbook - Gaining trust and credibility of the community and moving from proof of concept to scale-up (2/4)

5 All FFS members (principal & students) gather at these demonstration plots at each stage of cultivation, starting from land preparation & seed sowing onwards. The recommended practices as per the CSA Adaptation Tool kit are implemented in the field in their presence, and they are trained on how to do it. Scientists from KVKs, agri institutions, etc., participate in these training sessions to provide expert advice and clear farmers' doubts. Interaction with external experts and managers from ITC's Agri-Business also infuses confidence among farmers, in addition to the student farmers reaching out to the principal farmer as and when needed.

6 Several other outreach programs are also held throughout the cultivation period to support and aid the farmers in adopting new practices. During the first year, the main focus of these outreach programs is to enable the lead farmers to adopt new cultivation practices successfully. There are group meetings where the entire village(s) can participate. This helps the implementation partner and the farmers build familiarity with each other since it is the first year of their participation in the program in that village. Training and communications are also reinforced through simple-to-use WhatsApp groups, anchored with the help of KVKs.

7 Through continuous outreach meetings and programs, ITC and the implementation partner can also train the lead farmers to become successful trainers on the Tool kit.

ITC Playbook - Gaining trust and credibility of the community and moving from proof of concept to scale-up (3/4)

8 The demo plot provides material evidence to convince the farmer about the actual benefits of the new practices. After each field training, farmers return to their field and implement the practice in their field under the supervision of the program team. The farmers may choose to adopt one or more of these practices as per their comfort. All FFS farmers record the practices, costs, and other details in farmer diaries. These detailed diaries provide material evidence to convince other farmers about the real benefits of the new practices, besides serving as useful references to reflect on what was done in the past.

9 It is important to note that no specific financial assistance is provided to the principal or student farmers for adopting the practices. The philosophy is to convince the farmers to adopt the new practices based on their merit rather than under the guise or influence of any hidden incentives or short-term monetary gains.

10 However, ITC and the implementation partner team do try to provide help with resources that are unavailable in the village. For example, in the case of the Gorakhpur region, ITC provided a DSR machine to a local women-run Custom Hiring Center (the CHC was set up by ITC as well). The CHC thereafter rented out these DSR sowing machines to the farmers at minimal prices.

ITC Playbook - Gaining trust and credibility of the community and moving from proof of concept to scale-up (4/4)

11 After the first season of adoption, challenges and benefits are reviewed along with FFS members, and necessary changes are made in consultation with scientists and experts.

12 In this way, a locally proven CSA Adaptation Tool kit is finalized. After the revisit and improvements, the Tool kit is replicated for other village farmers.

ITC Playbook - Scaling Up and Amplification (1/2)

1. Specific training sessions and workshops are added to the outreach programs to enable the farmers to transition completely to sustainable practices.

2. With these sessions and continuous engagements, the team can identify specific agricultural risks and opportunities pertaining to different regions, such as areas with low-lying or high-lying lands, different kinds of soils in the different regions favoring different crops, etc. For example, if flooding is a problem, then flood-resistant varieties are identified with the help of the local KVK so that the yield is not affected.

3. The tool kit undergoes dynamic changes based on the experiences of each season or expansion to other villages in the region, which is done with the help of the local KVK, the agricultural department, and local agricultural universities.

3. The team also tries to support the farmers against any localized problem that may suddenly affect the region in a big way. For example, in the previous year, abnormally high winter temperatures affected the flowering stage of the wheat crop. An advisory on sprays that can mitigate the effect of high temperatures was prepared and shared with all the farmers through numerous WhatsApp groups and other forms of engagement.

ITC Playbook - Scaling Up and Amplification (2/2)

5. The program also starts to take a formal structure to scale the practice among lakhs of farmers

   a. The lead farmers are categorized into VRPs (Village Resource Persons), who have fully understood the new practices and are paid for their services till the time training is required in those villages

   b. One VRP manages five nearby villages and helps farmers adopt new practices. The VRP also coordinates the outreach programs.

   c. A supervisor manages 5 to 10 VRPs and is an employee of the implementation partner.

   d. The district Coordinator from the implementation partner manages supervisors, and the latter is also responsible for all MIS work, such as daily reports.

   e. An identified team member of ITC engages with the implementation partner daily to take stock of the progress and make changes as may be required. There is a formal governance and review structure for this team member till it reaches the leadership team overseeing the intervention.

   f. The targets for farmer coverage are increased every year in consultation with ITC.

6. In addition to direct implementation, ITC also focuses on replicating the programs at scale through Government machinery and resources in different states and regions.

Annexure

Generic Playbook for CSOs (1/2)

1. **Shortlist the region or the villages** one wants to work in based on the constraints and resources
2. **Form a field team** or **partner with a local NGO** for on-ground work
3. **Identify the main issues** plaguing the farmers in these regions by conducting baseline surveys
4. **Finalize the intervention** to be implemented on farmland in the above villages based on the issues faced
5. **Devise a PoP** for the aforementioned intervention with the help of Agri experts
6. **Decide the villages** where the intervention will be implemented
7. **Identify lead farmers in these villages** - can be identified during baseline surveys or through village visits etc.
8. **Train and support the lead farmers** in successfully implementing the intervention

Generic Playbook for CSOs (2/2)

9. **Conduct outreach programs and training sessions** in the selected villages to build trust and bond with the farmers

10. **Utilize demo plots** from the lead farmers and group sessions to convince more farmers to adopt sustainable practices

11. **Handhold the farmer** throughout the cultivation season to guide him in adopting the new practice - **Conduct training sessions, provide advisory, interaction with lead farmers** etc.

12. Be specifically attentive to **critical steps in the new cultivation process**. Risk mitigation measures should be timely propagated in order to have a successful yield

13. **Always be there for the farmer** - help him with the problems he is facing, as elicited in training sessions

14. **Support the farmer in this journey for at least 2-3 years**, as these processes are knowledge-intensive and it takes time for the farmer to get comfortable with it

15. **Scale up** the adoption

16. **Assign lead farmers as Village Resource Persons** responsible for propagating shortlisted sustainable cultivation practices and coordinating regular training sessions and workshops at the village level